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"LET KNOWLEDGE GROW FROM MORE TO MORE
AND THUS BE HUMAN LIFE ENRICHED."

ENCYCLOPÆDIA BRITANNICA

A New Survey of Universal Knowledge

Volume 23

VASE to ZYGOTE

THE UNIVERSITY OF CHICAGO

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Volume 23
VASE to ZYGOTE

VASE, a vessel, particularly one of ornamental form or decoration; the term is often confined to such vessels which are uncovered and with two handles, and whose height is greater in proportion to their width. (*See* POTTERY AND PORCELAIN.)

VASELINE, trade mark of Chesebrough Manufacturing Company, Cons'd, used upon its line of products, the best known of which is petroleum jelly (also called petrolatum and, in Great Britain, *paraffinum molle*), a commercial product of petroleum. It is largely employed in pharmacy, alone and as a vehicle for external application of medicinal agents, especially when local action rather than absorption is desired.

It is also used as a protective coating for metallic surfaces, and for other purposes. "Vaseline" petroleum jelly consists of a semi-solid mixture of hydrocarbons, having a melting-point usually ranging from a little below to a few degrees above 100°. It is colourless, or of a pale yellow colour, translucent, fluorescent and amorphous. It does not readily oxidize on exposure to the air, and is not readily acted on by chemical reagents. It is soluble in chloroform, benzene, carbon bisulphide and oil of turpentine. It also dissolves in warm ether and is slightly soluble in hot alcohol, but separates from the latter in flakes on cooling.

VASILKOV, a town of the Ukrainian S.S.R., in 50° 12′ N., 30° 18′ E., lying south of Kiev. Pop. (1926) 20,743. It is an agricultural centre. Founded in the 10th century, it was laid waste by the Mongols 1239–42, captured by Lithuania in 1320, and later by the Poles. In 1686 it was annexed to Russia.

VASSAL, the tenant and follower of a feudal lord (*see* FEUDALISM). The etymology of the word after much discussion remains obscure. Under the Frankish empire the *vassi dominici,* essentially servants of the royal household, were great officers of state, sent on extraordinary missions into the provinces, to supervise local administration in the interests of the central power. Sometimes they were sent to organize and govern a march, sometimes they were rewarded with benefices, and as, with the growth of feudalism, these developed into hereditary fiefs, the word *vassus* or *vassallus* was naturally retained as implying the relation to the king as overlord, and was extended to the holders of all fiefs whether capital or mediate. In course of time the word came to acquire a military sense, and in mediaeval French poetry *vasselage* is commonly used in the sense of "prowess in arms," or generally of any knightly qualities. In this sense it became acclimatized in England, but in countries which were not feudally organized—in Castile, for instance—vassal meant simply subject, and during the revolutionary period acquired a distinctly offensive significance as being equivalent to slave.

VASSAR COLLEGE, a nonsectarian institution for the higher education of women, two miles east of Poughkeepsie, N.Y., and 75 mi. from New York city. In 1861 it was incorporated as Vassar Female college, a name which was changed in 1867 to Vassar college. Immediately after the incorporation, the founder, Matthew Vassar, transferred to a board of trustees of his own selection about $400,000, increased by his will to almost twice that amount, and 200 ac. of land on which the college was to be built. Three buildings were erected and the college was opened on Sept. 20, 1865, but before that time Milo P. Jewett, selected by Mr. Vassar as the first president, had resigned, and John Howard Raymond, one of the trustees, was chosen by the board as his successor. To Dr. Raymond fell the task of creating the curriculum, selecting the entire faculty and planning the organization of the first adequately endowed and equipped college for women. After his death in 1878 Samuel L. Caldwell was called to the presidency. He resigned in 1885 and after one year, during which James Ryland Kendrick served as provisional president, James Monroe Taylor began a long and successful administration (1886–1914).

The number of students increased until in 1906 it was decided to limit them to 1,000; new chairs were established, and many important policies adopted; the preparatory department was abolished and the department of wardens created. Henry Noble MacCracken, president 1915–1946, was succeeded by Sarah Gibson Blanding. While maintaining the early high standards and preserving the spirit and ideals of the founder, he accepted the changed conditions of the times and adopted modern educational policies. Increasing powers of self-government were granted to the students. They share with the faculty the responsibility of maintaining the good name of the college, and, through the student curriculum committee, they participate in the discussion of educational problems. Voluntary chapel was substituted for compulsory attendance at religious services and a Community Church was established. The curriculum was revised so

that more freedom is given each student in choosing her course of study and more guidance is given by faculty advisers in making her choice. A new department is that of euthenics, a word that has been defined as the science of efficient living. Its purpose is to apply the arts and sciences to the improvement of living conditions of the individual and the race, and since 1926 there has been held on the college campus a summer institute of euthenics for graduates of Vassar and other colleges, both men and women.

The college opened with a faculty of eight professors and 20 instructors and an enrolment of 353 students. The first graduating class was that of 1867, and comprised four members, to whom were given temporary certificates stating that they were "entitled to be admitted to the *first degree of liberal arts*," the propriety of awarding the degree of *bachelor* to women being questioned at that time; in 1868 these certificates were replaced by diplomas bestowing the degree of A.B. At present (1936) the college has a faculty of instruction numbering 171, 109 of whom are of professorial rank, besides 21 other officers of academic administration. The first lady principal was Hannah W. Lyman (1865–1871); in 1913 the office was abolished and in its place was organized the department of wardens, consisting of the warden, who has a house on the campus, and an associate warden in each residence hall. The wardens are responsible for material living conditions and the social life of the college. In 1923 the trustees voted to continue the policy adopted in 1905 of limiting the number of students but to increase the enrolment to 1,150.

The college confers the baccalaureate degree in arts (A.B.) upon the completion of the regular courses of four years, and a second degree in arts (A.M.) upon bachelors of arts of Vassar or any approved college who have completed by examination and thesis a course of advanced non-professional study. In 1936, the endowment was more than $9,100,000 and the funds available for scholarships about $1,063,000.

The present equipment includes about 40 buildings exclusive of faculty houses, and the total area of the college grounds is 1,000 acres, inclusive of a farm of 600 acres. The library contains over 200,000 volumes.

There is an open air theatre, capable of seating three thousand people; a Shakespeare garden, and also an outdoor botanical laboratory designed to contain specimens of all plants growing in Dutchess county. (C. RA.)

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VÄSTERÅS (VESTERÅS or WESTERÅS), a town and bishop's see of Sweden, capital of the district (*län*) of Västmanland, on a northern bay of Lake Mälar, 60 mi. N.W. by W. of Stockholm by rail. Pop. (1943) 40,812. The original name of the town was Västra Aros ("western mouth"), in distinction from Östra Aros, the former name of Uppsala. Several national diets were held in Västerås, the most notable being those of 1527, when Gustavus Vasa formally introduced the Reformation into Sweden, and 1544, when he had the Swedish throne declared hereditary in his family. Its Gothic cathedral, rebuilt by Birger Jarl on an earlier site, and consecrated in 1271, was restored in 1850–60, and again in 1896–98. The episcopal library contains the valuable collection of books which Oxenstjerna, the chancellor of Gustavus Adolphus, brought away from Mainz near the end of the Thirty Years' War. A castle overlooking the town was captured by Gustavus Vasa and rebuilt by him, and then was rebuilt in the 17th century, and remains the seat of the provincial government.

VASTO (anc. *Histonium*), a fortified town of the Abruzzi, Italy, in the province of Chieti, about a mile from the Adriatic, 32 m. direct S.E. by E. of Chieti and 131 m. by rail from Ancona, 525 ft. above sea-level. Pop. (1936) 10,964 (town); (commune) 18,401. It is surrounded by mediaeval walls, and commands views extending to the Tremiti islands and Monte Gargano.

The ancient *Histonium* was a town of the Frentani, and an Oscan inscription of the period of its independence speaks of censors there, probably officers of the community of the Frentani. It appears to have flourished in Roman times and also lay on the line of the ancient road which prolonged the Via Flaminia to the south-east, and reached the coast here after having passed through Anxanum (Lanciano). It is subject to severe earthquakes.

VATICAN, THE, the official residence of the pope, situated upon the Vatican hill in the city of Rome. The article which follows contains sections on history, religious services, organization, Vatican court, Holy See vacancy and Lateran treaty. *See* also ROME, PAPACY, etc.

HISTORY

The Vatican hill, a low eminence on the right bank of the Tiber at the north-west end of Rome, first began to occupy a place in world history at the death of the Apostle Peter. In Roman times it was a district occupied by villas and gardens. It probably took its name from the *vaticinia* which were pronounced there in the neighbourhood of a famous temple of Apollo. The principal building in the *ager vaticanus* at the time of St. Peter was the circus constructed by Caius Caligula and therefore called *Caianum*. It was here that in A.D 64 and 65 the "great multitude" of Christians mentioned by Tacitus (*Annals* XV., 44), who were accused by Nero of having caused the burning of Rome, were martyred with cruel tortures, which the Roman historian describes in detail.

Tradition.—According to the most wide-spread and authoritative tradition, the martyrdom of St. Peter took place in A.D. 67. The disciples obtained possession of his body, as Roman law allowed them to do, and buried it in a tomb near the Via Cornelia, which ran past the Circus not far from the place of martyrdom. The fact of St. Peter's coming to Rome and his martyrdom there, which is attested by strong historical evidence, is strikingly confirmed by a discovery made in 1912 during the excavations which were made under the Basilica of St. Sebastian on the Appian Way. A number of incised inscriptions (*graffiti*) were discovered on the walls containing invocations to St. Peter and St. Paul in Greek and Latin. This entirely corresponds to the tradition that the bodies of the two Apostles were transported to that spot and remained there some time, possibly for concealment, during the period when the persecutions were at their height. The tradition which places the martyrdom of St. Peter on the Vatican hill is also the oldest and the best established; another view, according to which it took place on the Janiculum near to where the Church of St. Peter-in-Montorio now stands, is now to a large extent discredited amongst scholars. An inscription was placed in 1923 on the site of Caligula's Circus on the small piazza south of the Vatican basilica beside the sacristy. The inscription, which was engraved by order of the *Collegium Cultorum Martyrum*, indicates that the first Roman martyrs suffered death at that spot "under the leadership of the Apostle Peter."

Constantine's Basilica.—The first successors of St. Peter desired to be buried near his tomb; for this reason his third successor, St. Anaclete, was obliged towards the end of the first century A.D. to construct, around the *cella* which contained the body of the Apostle, a *memoria* large enough to contain not only St. Peter's tomb but those of his successors. It was only in the third century that it began to be the custom for the popes to be buried in the catacombs. The Emperor Constantine I. gave freedom to the Church in 313, and showed it all possible marks of favour. He presented the pope with the palace of the senator Plautius Lateranus as a residence. This palace had become imperial property as a result of its confiscation by Nero. Constantine also built the Basilica of the Saviour, now St. John Lateran, which became "the cathedral of the pope" and "the Mother Church and the head of all churches of the city and of the world" (*Urbis et Orbis*). According to tradition it was in 324 that he began the construction of a splendid basilica on the Vatican hill over St. Peter's tomb. This church was enriched with valuable ornaments, including a great golden cross. The tomb

itself remained untouched. Constantine's basilica was not completed until 349, in the reign of Constantius. In order to build it, it was necessary to demolish what remained of Caligula's Circus. Nothing was left of the Circus except the central obelisk, which was moved to the centre of the piazza of St. Peter's in 1586 by order of Sixtus V.

Nothing unfortunately remains of Constantine's basilica or of the splendid monuments with which it was adorned in the course of nearly twelve centuries, with the exception of a few remains preserved in the crypts (*grotte*) of the present basilica. The *Museum Petrianum* was built next the basilica during the pontificate of Benedict XV., and was opened in 1925 under Pius XI. All the monuments relating to the history of St. Peter which existed in various places have been collected in this museum.

Although the history of the present basilica can easily be traced, that of the ancient basilica is extremely difficult to discover. Constantine's basilica had five naves; its walls were adorned with paintings and mosaics, which were much admired by pilgrims; its five doors opened on a great square atrium called Paradisus, which was surrounded by a colonnade and in which there gradually accumulated the tombs of all the popes, emperors, kings and princes who expressed a wish to be buried near St. Peter's tomb.

The most notable of the buildings erected after the Basilica are the Mausoleum, constructed early in the 5th century for the burial of Honorius and Theodosius II., in which other members of the imperial family were also buried, the oratory of St. Andrew, which was dedicated by Pope Symmachus (498–514) and destroyed by Pius VI. in 1776 to make room for the present sacristy, the Campanile built by Stephen II. (752–757), the oratory of Sta. Maria Antiqua whose image is preserved in the crypt of the present basilica, and the oratory of John VII. (705–707), which was built to contain the *Veronica* or Portrait of Our Lord. The remnants of the decorations of this oratory are preserved in the *Museum Petrianum*.

One of the ornaments of Constantine's basilica was the fountain which was placed in the middle of the atrium for the refreshment of pilgrims. It dated from the end of the 4th century, but was repeatedly improved and restored. Nothing remains of it to-day except two bronze peacocks and the central pine-apple, also of gilded bronze, from which the water sprang. This pine-apple is mentioned by Dante in the 31st canto of the "Inferno." The basilica was decorated with mosaics of various periods. Among the most important were that placed on the façade of the oratory of St. Mary-in-Turri under Paul I., that situated near the entrance of the basilica, which represented Our Lord between St. Peter and St. Paul, and which is at present in the crypt, and that representing St. Peter walking on the water, which was executed by Giotto early in the XIVth century by order of Cardinal Stefaneschi. The latter mosaic, which is known as the *Navicella*, was destroyed when the ancient basilica was demolished.

Emperors and Kings.—Of the historical events of which the Vatican Basilica was the scene during the Middle Ages, the most famous, and that which had the most influence on the history of the world, was the constitution of the Holy Roman Empire, which was founded when Leo III., on Christmas Day 800, crowned Charlemagne as emperor of the West with solemn rites. After that time some of the emperors came to Rome to receive their crown from the pope in St. Peter's. The last to do so was Frederick III., who was crowned by Nicholas V. on March 19, 1452. Perhaps the most solemn coronation was that of the Emperor Conrad, who came to Rome accompanied by Canute, king of England, Denmark and Norway, and Rudolph, king of Burgundy, and was anointed by John XIX. on Easter Day 1027. Napoleon I. intended to be crowned in St. Peter's after having been anointed by Pius VII. at Notre Dame in Paris, but his intention was not carried out owing to his dispute with the pope.

Many kings and princes have made pilgrimages to St. Peter's tomb in the Vatican Basilica. In particular, a number of Anglo-Saxon sovereigns made this pilgrimage, for not far from the Vatican basilica was the *Schola Saxonum* or hospice for English pilgrims. The hospice no longer exists, but it has given its name to the Church of the Holy Spirit in Sassia, which stands near St. Peter's. The first king of the West Saxons to visit Rome was Caedwalla, who was only a catechumen when he arrived at Rome under the pontificate of Sergius I. (689–701). He was baptised in St. Peter's, but died a few days later and was buried in the atrium of the cathedral near the tomb of the Emperor Otho II. King Ina came to Rome in 720 and visited St. Peter's. It was he who founded the hospice for Saxons. Queen Frothogitha came in 787, Ceolwulf, king of Northumberland, in 758, Ethelwulf in 855—he restored and enlarged the Saxon hospice—and Alfred, Ethelwulf's son, was sent as a child by his father to be anointed by Leo IV. and later, in token of his devotion to the Vatican basilica, required each family in his kingdom to pay a silver coin to the pope every year. This was the origin of "Peter's Pence."

The basilica of St. Peter has several times been sacked and devastated. At the time of the barbarian invasions Alaric and Genseric gave orders that it should be respected, but it was not always spared during the civil wars. On some occasions it was occupied by anti-popes, who endeavoured to resist the legitimate pope. The most terrible devastation suffered by the basilica was, however, that of 846, during the Saracen invasion. It was as a result of this event that Pope Leo IV. (847–855) built round the basilica and the Vatican hill a wall called the Leonine Wall after him. The same name has been given to the part of Rome enclosed by the wall. Terrible damage was again done in 1527 by the Lutheran soldiers of Charles V., commanded by the Constable of Bourbon, at the time of the famous sack of Rome.

The New Basilica.—When Nicholas V. became pope, Constantine's basilica was falling into ruin. Vain attempts had been made during the preceding centuries to restore the edifice, more particularly by the popes who reigned after the return to Rome following the Western Schism. The basilica leaned so much to one side that the famous architect Leo Baptista Alberti ascertained that the southern wall was 1·75 metres out of the perpendicular. Drastic action was clearly necessary. Nicholas V., on the advice of Alberti, decided that the best, or indeed the only remedy, was to demolish Constantine's basilica, and to build a new one on the same site. The demolition of the apse was begun, but was suspended by the death of this humanist pope.

On April 11, 1506, Julius II. laid the first stone of the new basilica, which according to Bramante's original design, was to have been in the form of a Greek cross. Work was carried on with great activity until the end of the pontificate of Leo X. (1521) under the direction of Raphael, who succeeded Bramante in 1514, and that of Giuliano da Sangallo, Fra Giocondo da Verona, Baldassare Peruzzi and Antonio da Sangallo. After the death of Leo X. the work was carried on with less energy until in 1546 Paul III. entrusted its direction to Michelangelo. Michelangelo returned to Bramante's plan, which had been modified by the intervening architects, and added the famous dome, which he himself designed. The work again slackened after the death of Michelangelo (1564), when it was carried on by Vignola, Pirro Ligorio and Giacomo della Porta. Sixtus V., however, took the matter up with his usual energy, and appointed his favourite architect, Domenico Fontana, to act with Giacomo della Porta. In 1590, Michelangelo's great cupola, slightly modified by Giacomo della Porta, was completed after only 22 months' work. In 1603, during the reign of Clement VIII., the new basilica was completed, according to the original plan, in the form of a Greek cross. Some remains of the ancient basilica were still left standing. Paul V. decided in 1605 to demolish them. He adopted Carlo Maderno's plan of giving the basilica the form of a Latin cross by extending the eastern arm. The façade, which was designed by Maderno, was completed in 1612. The new basilica was solemnly consecrated by Urban VIII. on Nov. 18, 1626.

The majestic beauty of the basilica is completed by the splendid piazza which gives access to it. In the centre is an obelisk, and on the two sides are two beautiful fountains constructed by Maderno in the reign of Paul V. The piazza is surrounded by the two marvellous semi-circular colonnades erected by Bernini in 1667 under Alexander VII. They consist of 284 columns of Travertine marble placed in four rows and surmounted

by a balustrade on which are 140 statues. The general effect produced by the piazza is unequalled throughout the world.

The Papal Palaces.—On the left of the basilica (to the spectator's right) is the imposing group of the papal palaces. Symmachus was the first pope to reside in the Vatican, on account of the occupation of the Lateran by the anti-pope Laurentius. He built two episcopal residences, one to the left and the other to the right of the basilica. At the end of the schism, however, he returned to the Lateran. Leo III. improved the left-hand residence for the reception of Charlemagne in 800. Gregory IV. (827–844) built a new residence to be used by the pope when he desired to spend several days near St. Peter's in order to officiate in the cathedral. Eugenius III. (1145–53) began another palace, which was continued by Celestinus III. (1191–98) and completed by Innocent III. (1198–1216). Other buildings were constructed by Innocent IV. (1243–54) and Nicholas III. (1277–80). The latter pope undertook a great deal of building, and may be regarded as the real founder of the Vatican as the residence of the popes. He laid out the Vatican gardens, which were surrounded with walls and towers. When the Holy See was transferred from Rome to Avignon, the Vatican and the Lateran were abandoned and fell into dilapidation. Urban V. resided in the Vatican during his temporary return from Avignon in 1367, and Gregory XI. established himself there when the papacy was finally transferred back to Rome. The Lateran was then abandoned, and the Vatican became the official residence of the popes; from the time of Paul V. to that of Pius IX. they also resided in the Quirinal.

From the 15th to the 17th centuries.—During the Renaissance period the Vatican became a centre of art and culture. The celebrated humanist, Nicholas V. (1447–55), included all the buildings on the left of the basilica in a single palace surrounded with walls and towers, one of the latter of which is still intact. On the ground floor he placed the library, which he enriched with manuscripts collected from all countries. The library was enlarged by Sixtus IV. (1471–84) and was transported to the premises which it now occupies by Sixtus V. in 1588. Nicholas V. commissioned Fra Angelico in 1449 to paint frescoes in a chapel in his apartment. Pius II. (1458–64) and Sixtus IV. (1471–84) enlarged and completed the buildings begun by Nicholas V. Sixtus IV. built the Sistine chapel, which was completed in 1483 and adorned with frescoes by Cosimo Rosselli, Sandro Botticelli, Domenico Ghirlandajo and Pietro Perugino. Half a century later Michelangelo also painted frescoes in the Sistine chapel. Paul II. (1464–71) built colonnades round the court in front of the palace of Nicholas V. and constructed the staircase giving access to the storey on which the library is situated. Innocent VIII. (1484–92) erected a new structure next to the entrance to the papal palace and adjoining the atrium of the basilica. On the side of the Vatican hill which looks towards Monte Mario, he built another palace which was magnificently decorated by Pinturicchio and Mantegna. Little trace now remains of this palace, which was replaced under Pius VI. by new structures intended to be used as museums. Alexander VI. (1492–1503) commissioned Pinturicchio and Mantegna to paint frescoes on the first floor of Nicholas V.'s palace. These frescoes are one of the glories of the Vatican. Julius II. (1503–13) ordered Michelangelo to paint the ceiling of the Sistine chapel, and invited Bramante to come to Rome. This architect, as well as designing the new Vatican basilica as stated above, undertook the systematic arrangement of all the Vatican palaces, reaching from that of Innocent VIII. on the Belvedere to that of Nicholas V. adjoining the basilica. This was the origin of the immense and magnificent rectangular structure which surrounds the court of the Belvedere, and in which in course of time the papal art collections were deposited. This palace was only completed under Pius V. (1559–65). Bramante himself designed the three tiers of galleries or *loggie* which were later extended around the three sides of the court of St. Damasus, formed by the papal palaces. Julius II. also commissioned a number of the most famous artists of the day to decorate the rooms or *stanze* in the Vatican. Raphael was one of the artists so employed at the suggestion of Bramante. Considering him to be superior to all the rest, the pope dismissed the other artists and entrusted Raphael alone with the direction of the work, which was continued under Leo X. (1513–21). Raphael died in 1520, and the decoration of the *stanze* was completed by his pupils under Clement VII. (1523–34). Paul III. (1534–49) recalled Michelangelo and commissioned him to paint the famous "Last Judgment" on the end wall of the Sistine chapel. This painting was completed in 1541. Michelangelo also painted the "Martyrdom of St. Peter" and the "Conversion of St. Paul" in the Pauline chapel which the pope had just had built from the designs of Antonio da Sangallo. The same architect built the *Sala Regia,* which was decorated with frescoes by several painters, including Giorgio Vasari, under Paul III. and Gregory XIII. (1572–85). Next to this hall were two large rooms which were also adorned with frescoes by the order of Paul IV. (1555–59) and Pius V. (1566–72). These rooms were afterwards thrown into one by Bernini and formed the *Sala Ducale.* The decoration of the lower part of the walls was only completed under Benedict XV. (1914–22), who had them covered with coloured marbles. Pius IV. (1559–65) commissioned Pirro Ligorio to build him a summer casino in the Vatican gardens. Pius V. ordered the brothers Antonio and Ignazio Danti to paint maps of the various countries of the world on the walls of the third loggia. These maps throw an interesting light on the history of geographical knowledge. Gregory XIII. ordered the same painters to decorate another large gallery in one of the wings of the Belvedere palace with maps of the various districts of Italy. He constructed the "Tower of the Winds" above the same wing in memory of the reform of the calendar. He extended the three *loggie* which shut in the Court of St. Damasus on the northern side and had them decorated with paintings. He also decorated the *Sale dei Paramenti* which formed a continuation of the *Sala Ducale.*

Sixtus V. had a great palace built from the designs of Domenico Fontana. This is the palace in which the popes reside at the present day. The *loggie,* which look out over the court of St. Damasus, were decorated by Mantovani under Pius IX. (1846–78). Sixtus V. also cut the Belvedere Court in two by building a middle wing connecting the two lateral wings. He transferred the library to this wing, the rooms of which were decorated by Cesare Nebbia, Paride Nogari and other artists. Clement VIII. (1592–1605) completed the great palace which had been begun by Sixtus V., and commissioned Paul Brill and other painters to decorate the Clementine Hall and the Hall of the Consistorium. Paul V. built two other palaces, one adjoining the palace of the Borgia, and the other on the site of the palace of Innocent VIII., which was falling into decay. At this period, however, the popes began to prefer the Quirinal to the Vatican. The Quirinal palace was begun by Gregory XIII., continued by Sixtus V., and completed by Paul V. The popes at first used it for a summer residence on account of its high and healthy situation. They gradually came to occupy it more continuously until 1848, and they only resided in the Vatican from time to time when ceremonies were to be celebrated at St. Peter's or on other specially solemn occasions. Urban VIII. (1628–44) commissioned Bernini to erect the monumental staircase, known as the *Scala Regia,* which gives access to the Vatican palaces. The Scala Regia was recently restored by order of Pius XI.

The 18th and 19th Centuries.—From that period until the end of the 18th century few additions of any importance have been made to the Vatican. As there was not sufficient room for the valuable art collections of the Vatican, Clement XIV. (1769–75) built a new wing parallel to that of Sixtus V. in the Belvedere Court to contain the museum of sculpture. Pius VI. (1775–99) and Pius VII. (1800–23), notwithstanding the difficult conditions which prevailed during their rule as a result of the French Revolution and the reign of Napoleon I., continued and completed the arrangement of the Vatican museums and galleries with a magnificence which may be compared to that of the period of the Medici. Even to-day it is difficult to decide whether to admire most the magnificence of the collections or the beauty of the buildings in which they are housed. The greatest artists of the day—Camporesi, Simonetti, Stern and the immortal Canova—took part in this great work. Later Gregory XVI. (1831–46) founded the

Etruscan Museum, and Pius IX. the Egyptian Museum. The latter pope commissioned Podesti to paint frescoes in the Hall of the Immaculate Conception next to Raphael's *stanze*, built the grand staircase, which gives access to the Court of St. Damasus, and the other which leads from that court to the papal apartments. Leo XIII. (1878–1903) entrusted Seitz and Torti with the decoration of the Gallery of the Candelabra. Pius X. moved the collection of paintings to a new gallery looking over the Belvedere Court.

The Vatican Gardens.—Adjoining the group of palaces on the west are the Vatican gardens (*Giardini Vaticani*), in which the popes were accustomed to take their walks following the decision not to leave the Vatican after the entry of the Italian troops into Rome in 1870. The gardens are traversed by part of the old wall of Leo IV., which includes three great towers. The Vatican Astronomical Observatory (*Specola*) is installed in these towers. In 1893 Leo XIII. commissioned Vespignani to build a small summer palace around the principal tower. He did not, however, occupy it for long, as it was found not sufficiently cool and comfortable in hot weather. It was then used as an extension of the *Specola*. The Vatican Observatory plays an important part in the astronomical world. In 1889 it was entrusted with part of the great work of photographing the heavens, which was divided between the principal observatories of the world. Splendid literary and scientific traditions gather round the Vatican gardens. Leo X. held literary assemblies there; Clement VII. in 1533 was present at a lecture given by the Austrian Chancellor, John Vidmenstadt, on the theory of the movement of the earth round the sun. In token of his satisfaction the pope presented the chancellor with a Greek Codex, now to be seen in the Munich Library. Innocent XII. (1691–1700) was present at the experiments made in the Vatican gardens by the famous doctor and physicist Giorgio Baglivi on barometric pressure. Pius XI. in 1923 installed the Papal Academy of Science, known as the "Nuovi Lincei" in Pius IV.'s casino.

There is little to add to the summary of the artistic history of the Vatican which has been given above. The basilica of St. Peter is full of magnificent works of art. In the centre is the colossal bronze baldachino designed by Bernini to the order of Urban VIII. It surmounts the principal altar, below which is the tomb of St. Peter.

The Tomb of St. Peter.—The tomb is the only thing which was scrupulously respected when the old basilica was demolished and the new one built. Julius II. firmly refused to agree to Bramante's scheme that it should be moved in order that the new edifice might have a different orientation from the old. The tomb still remains buried beneath the earth as it had always been throughout the ages, with the golden cross of Constantine and the bronze slabs with which it had been covered by the popes in order to protect it against injury by the weather or by human agency. Even the Saracens who sacked the basilica in 846 were unable to profane the Apostle's tomb, so well was it protected. The last observation of the tomb was made about 1895 by Hartmann Grisar, who was authorized to explore all of the tomb that remains visible. He was able to see through the only opening which still remains unblocked, nearly 1½ metres below the level of the crypt, the ancient marble slab which covered the tomb at a certain distance. The slab is broken in half, but it is still in its place, and a small heap of débris can be seen at the bottom of the sort of little well which is beneath it. Everything corresponds to the state in which, according to the records of the period, the tomb must have been in the middle ages after the incursions of the Saracens and their attempts to violate it. This shows that in spite of all the vicissitudes through which the basilica has passed, St. Peter's tomb has been scrupulously respected and has remained intact.

At the order of Urban VIII. Bernini also constructed at the far end of the apse the magnificent bronze reliquary containing the *cathedra* which, according to tradition, was the seat used by St. Peter at religious ceremonies. The seat is a simple wooden chair which was adorned with carved ivory plaques during the Carolingian period. Bernini placed four colossal bronze statues to support the reliquary. They represent the four great doctors of the Church, St. Augustine and St. Ambrose for the Roman Church, St. Athanasius and St. John Chrysostom for the Greek Church.

There are four colossal statues at the feet of the four great piers which support the dome; the statue of St. Longinus is by Bernini, that of St. Andrew by Duquesnoy, that of St. Helena by Bolzi, and that of St. Veronica by Mochi. There are four balconies or *loggie* placed halfway up the four columns; they were designed by Bernini, who adorned them with the eight columns known as *vitineae* or *torsi*, which were taken from the principal altar of the old Basilica. In niches cut in the other piers of the Basilica are statues of the founders of the religious orders of the Catholic Church. The statues are of different periods, and of various degrees of artistic value.

The pictures over the altars of the basilica are all mosaics, and are reproductions of the masterpieces in the Vatican or in various Roman churches and museums. In the first chapel to the right on entering the basilica is the famous Pietà, sculptured by Michelangelo to the order of Cardinal de la Grolaye.

Tombs of the Popes.—All along the walls of the basilica are placed the tombs of the popes. These are of incalculable artistic and historical importance; they include the tombs of Paul III. by Guglielmo della Porta, Urban VIII. and Alexander VII. by Bernini, Gregory XIII. by Rusconi, Gregory XIV. by Prospero da Brescia, Leo XI. by Algardi, Clement X. by De Rossi; Innocent XI. by Maratta and Bonnot, Alexander VIII. by San Martino, Innocent XII. by Fuga, Benedict XIV. by Bracci, Clement XIII. and Pius VI. by Canova, Pius VII. by Thorwaldsen, Pius VIII. by Tenerani, Gregory XVI. by Amici, Pius X. by Astorri, and Benedict XV. by Canonica. There are also four tombs commemorating members of ruling families; that of Countess Matilde of Canossa by Bernini and his pupils; that of Queen Christina of Sweden, by Fontana; that of Clementina Sobieski, the wife of James Stuart (the Pretender) by Bracci, and that of the three last Stuarts, James (called the Third), and his two sons Charles (called the Third) and Henry, duke, then the cardinal of York, by Canova. The Crypt contains a number of sarcophagi from the old basilica. One is that of Pope Adrian IV. (Nicholas Breakspeare, the only English pope), on which the Norwegian Government has recently placed an inscription commemorating what he did for Scandinavia. The others include those of Gregory V., Boniface VIII., Nicholas III., Urban V., Nicholas V., Pius II., Paul II., Alexander VI., Pius III., Julius III., Marcel II. and Innocent IX. The Crypt also contains the great porphyry vessel which contained the remains of the Emperor Otho II. Two bronze monuments by the famous sculptor Pollaiuolo also found a place in the new basilica, that of Innocent VIII. and that of Sixtus IV. The latter was recently moved to the *Museum Petrianum*. A marble slab, which was set up in 1928 in the atrium of the sacristy, gives a list of the names of the 142 popes from St. Peter to Benedict XV., who were temporarily or permanently buried in the cathedral. Mention should also be made of the bronze statue of St. Peter which is one of the glories of the basilica. Scholars are not agreed on its period, but there is some ground for assigning it to the pontificate of Symmachus (498–514).

On the pavement of the principal nave of the Vatican Basilica are inscribed in bronze letters the dimensions of the largest Christian churches, all of which are smaller than St. Peter's. Reading downwards from St. Peter's tomb, they are as follows: St. Sophia at Constantinople, Westminster Cathedral, St. Mary-of-the-Angels at Assisi, St. Justina at Padua, Antwerp Cathedral, St. John Lateran, St. Paul-Outside-the-Walls at Rome, Seville Cathedral, St. Petronius at Bologna, Cologne Cathedral, Milan Cathedral, Reims Cathedral, Florence Cathedral, St. Paul's.

It would be impossible to give here even a brief description of the works of art contained in the Vatican. The galleries and museums of the Vatican contain a number of priceless masterpieces in addition to those which were mentioned above in the historical survey. It will be sufficient to mention in the gallery of paintings Raphael's "Transfiguration," and among more recent pictures the splendid portrait of George IV. by Lawrence, sent

by that king as a gift to Pius VII.; in the galleries of sculpture the Hercules in gilt bronze from the Theatre of Pompeii, the Laocoön, the Apollo Belvedere, the Belvedere Torso, which Michelangelo admired, and the Augustus and Doryphore of the "Braccio Nuovo"; in the other galleries, the tapestries designed by Raphael and carried out in the workshops of Van Aelot at Brussels.

RELIGIOUS SERVICES

The religious services carried out in the basilica and in the Vatican palace are of a special character, both by their nature and by the fact that the pope takes part in them.

The basilica of St. Peter does not occupy the first place among Catholic churches from the hierarchical point of view. The first Catholic church is the basilica of St. John Lateran, which is the cathedral of the popes. At the same time, the basilica of St. Peter undoubtedly occupies the first place in the minds of Catholics and in the tradition of Christendom as a whole, both as an object of veneration and as an artistic monument.

The Vatican basilica is served by a chapter of canons and by a large body of clergy, at the head of whom is a cardinal with the title of archpriest. The archpriest has ordinary or episcopal jurisdiction over the clergy attached to the cathedral. The canons of the Vatican basilica are, in virtue of their office, supernumerary apostolic protonotaries, *i.e.*, members of a special category of the highest college of the prelacy. As a general rule, some of them are bishops. Eighteen popes have been elected from among their number: Adrian I. (772–795); Leo III. (795–816); Pascal I. (817–824); Leo IV. (847–855); Benedict III. (855–858); Nicholas I., called the Great (858–867); Stephen VI. (885–891); Innocent III., of the family of the Counts of Segni (1198–1216); Gregory IX., of the family of the Counts of Segni (1227–1241); Nicholas III.-Orsini (1277–1280); Boniface VIII.-Caetani (1294–1303); Paul II.-Barbo (1464–1471); Clement IX.-Albani (1700–1721); Benedict XIV.-Lambertini (1740–1758); Pius VI.-Braschi (1775–1799); Leo XII.-Della Genga (1823–1829); Pius XI.-Ratti (1922–1939); and Pius XII-Pacelli (1939–).

In addition to the usual services carried out in the cathedral, certain specially solemn ceremonies, which can only be carried out by the pope, are sometimes held. These are beatifications, canonizations, and Holy Years.

Beatifications and Canonizations.—Since the time of Alexander III. beatifications and canonizations have been carried out exclusively by the pope. The rite of beatification consists in the reading of a papal brief proclaiming the new Blessed, and the first act of "cultus" towards his image and relics. The brief is read in the presence of the cardinal archpriest and the Vatican chapter, the cardinal prefect and the other cardinals who are members of the Congregation of Rites. In the afternoon of the same day the pope goes to the basilica accompanied by his court and the Sacred College of Cardinals, prays before the statue of the new Blessed, and receives the Benediction of the Holy Sacrament. The rite of canonization is of a much more solemn character. The pope himself proclaims the new saint after three "postulations" made by the "Consistorial Advocates" each of which is followed by special prayers asking for the help of the other saints and for light from the Holy Ghost in the solemn act which the pope is about to carry out. After the proclamation of the new saint the pope celebrates the pontifical Mass.

Holy Years.—The Holy Years or Jubilees take place every 25 years. The special rite which then takes place is the passage of the Faithful through a special door called the Holy Door, which exists in the four great basilicas, St. John Lateran, St. Peter's, St. Paul's-Outside-the-Walls and St. Mary's Major. These doors are always walled up except in the Jubilee Year. The Holy Door of the Vatican basilica is opened at the beginning of the Holy Year and closed at the end of it by the pope in person.

On the eve of the Festival of St. Peter in each year, the pope blesses the palliums in St. Peter's. The palliums are white woollen stoles embroidered with small black crosses which archbishops wear around their necks as a symbol of communion with the Holy See. When the palliums have been blessed by the pope, they are preserved in a coffer near St. Peter's tomb, and are only taken out to be sent to new archbishops on their election.

Relics.—The Vatican basilica also contains certain relics which are specially venerated by Catholics. The most famous of these is the Veronica. This is a veil with which, according to a tradition going back to the first centuries A.D. a pious woman named Veronica wiped the Face of Our Lord as He went up to Calvary carrying His Cross. The Saviour's Image is believed to have remained imprinted on the veil. Another equally famous relic is the lance with which the soldier mentioned in the Gospels pierced the Heart of Christ on the Cross. The point of the lance is said to have been preserved by the early Christians and concealed during the period of the conquest of Palestine by the Mohammedans. It was discovered at Antioch at the period of the first crusade, and fell into the hands of the Mohammedans when they reconquered the Holy Land. The Sultan Bajazet II. presented it to Pope Innocent VIII. in 1492. It was brought by a special messenger and was received by the pope with a magnificent ceremony which is described with admiration by the chroniclers of the day. These relics are preserved in one of the four small chapels cut by Bernini in the great piers supporting the dome. They are shown to the congregation in the basilica from the balcony of this chapel at the great festivals of the Church. In the case of the Veronica, in particular, this "ostension" has taken place from the earliest days. Dante refers to the ceremony in the 31st canto of his "Paradiso."

Another ceremony which takes place exclusively in the Vatican basilica is the washing (*lavanda*) of the principal altar with wine and water. This is done on the evening of Holy Thursday after the singing of the *Tenebrae* by the cardinal archpriest and the chapter.

Papal Coronations.—One of the most characteristic of the coronation rites of a new pontiff is the thrice-repeated burning of a wisp of tow before the pope by a master of ceremonies who chants: "Holy Father, thus passes away the glory of the world." After the papal Mass, the first cardinal deacon places the tiara with the three crowns (*triregnum*) on the head of the new pope, saying "Receive the tiara with the three crowns, and know that thou art the Father of kings and princes, the Pastor of the universe, and the Vicar on earth of Our Lord Jesus Christ, to whom belongs honour and glory, world without end." The coronations of Leo XIII. (1878) and Benedict XV. (1914) took place in the Sistine chapel; those of Pius X. (1903) and Pius XI. (1922) in the basilica, that of Pius XII. (1939) on the basilica balcony.

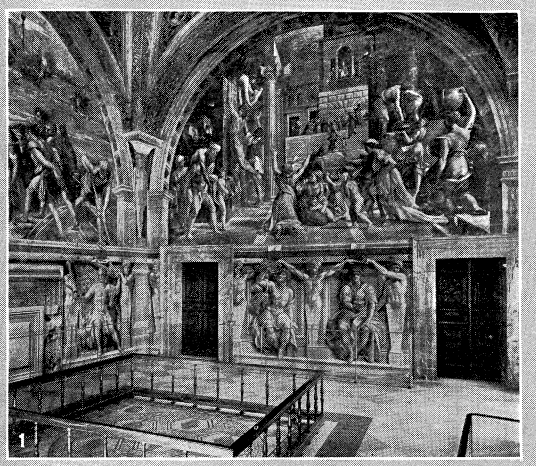
It should also be remembered that all Catholic bishops are obliged to pay periodical visits *ad limina Apostolorum*, that is to say to the threshold of the Apostles' tomb. In order to do this they go to the basilica of St. Peter and obtain from the canon who is responsible for this duty a certificate attesting that the visit has been made. European bishops have to make this visit every five years, and bishops in other parts of the world every ten years.

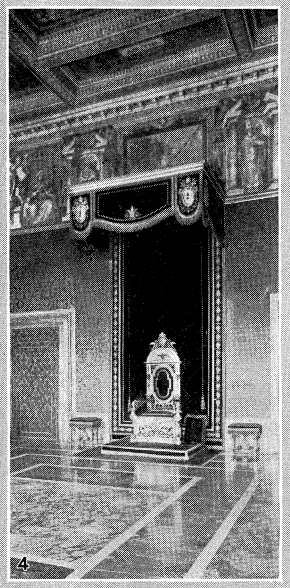
Sistine and Pauline Chapels.—In the interior of the Vatican palace, services are held in the Sistine chapel, the Pauline chapel and the pope's private chapels. The Sistine chapel is reserved exclusively for papal ceremonies, that is to say those carried out by the pope in person or in his presence. When the Holy See falls vacant, the funeral service of the deceased pope is held in the Sistine chapel, and the meetings at which the voting for the election of the new pope takes place are also held there.

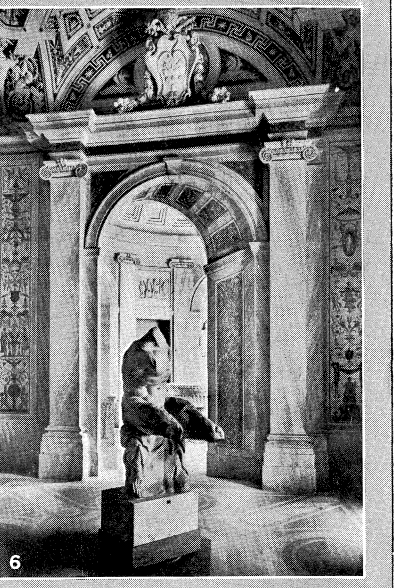
The Pauline chapel is used exclusively as the place of worship of the inhabitants of the Holy Apostolic palaces, and is for this reason the seat of a special internal parish existing to provide for their spiritual needs. This parish is entrusted to the Augustine Friars, and the parish priest, who bears the title of papal sacristan, is always of episcopal rank. Sometimes the pope himself attends specially solemn ceremonies in the Pauline chapel, but in such cases he is not accompanied by his court.

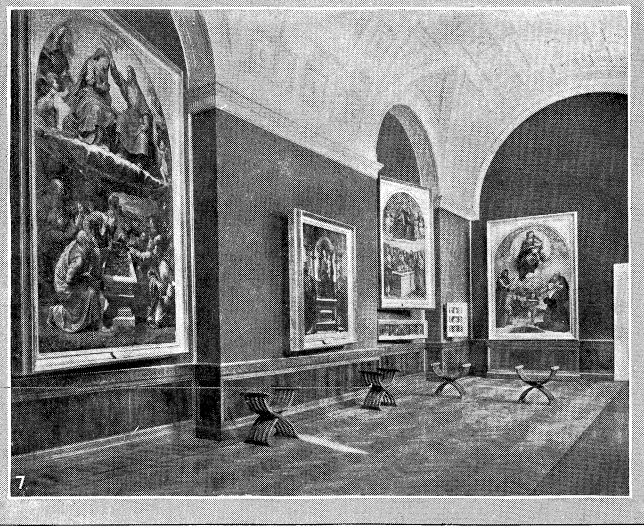
The pope's private chapels are two in number, one in his official apartments and one in his private apartments. Important persons, sovereigns or diplomats, are sometimes allowed to hear Mass in the chapel in the pope's official apartments and to receive the Sacrament from the pope himself. In the same chapel, on the fourth Sunday in Lent, the pope blesses the "Golden Rose." This

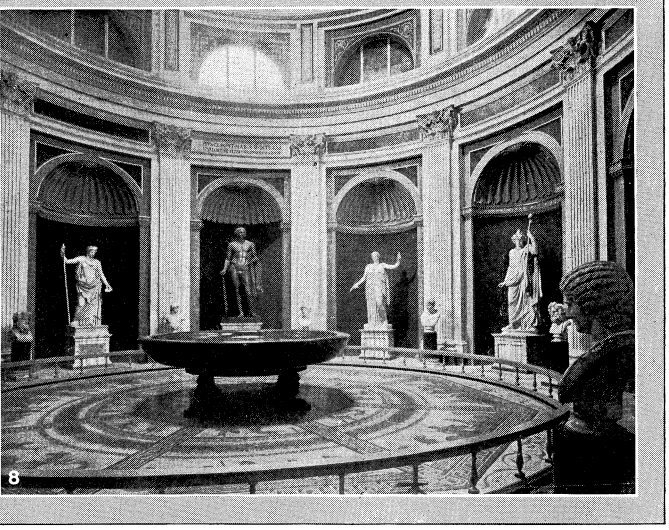
VATICAN











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INTERIORS OF THE VATICAN PALACE

1. View of the Stanza dell' Incendio showing the "Incendio del Borgo" painted by Raphael (1483–1520) and his pupils in 1517
2. Loggia of Gregory XIII., one of the many galleries in the palace
3. Interior of the Sistine chapel built for Sixtus IV. by Giovanni di Dolci (d. 1486) in 1473–81. The ceiling frescoes were executed by Michelangelo (1475–1564) in 1508–10
4. The Throne room in the private apartments of His Holiness
5. The Sala Regia, reception room for ambassadors. Frescoes are by Vasari (1511–74), Salviati (1510–63) and Zuccaro (1529–66)
6. The Torso del Belvedere in the Museo Pio Clementino, a division of the famous Vatican Museums organized by Clement XIV. and Pius VI. The torso was found in the Campo dei Fiori during the pontificate of Julius II. and bears the signature of the Athenian Apollonius
7. "The Salon of Raphael" in the Vatican Pinacoteca constructed by Pius X in 1909. It contains the Madonna di Foligno, The Coronation of the Virgin and the Theological Virtues and Mysteries, all painted by Raphael
8. Sala Rotunda, a circular room of Greek and Roman sculpture in the Museo Pio Clementino designed by Simonetti (1840–92) after the Pantheon. The table in the centre is of porphyry

is a spray of roses carved in gold and supported by a vase, also of gold, which the pope presents to a sovereign or a member of a reigning family. In the centre of the principal rose is a small phial in which the pope places a few drops of musk and balsam; he then blesses the rose with a special ceremonial. In former times this ceremony took place once a year, but it is now performed more rarely. Another special ceremony which the pope performs every five years, or more frequently if necessary, is the blessing of the *Agnus Dei.* These are wax medallions made by the Cistercian monks of the Basilica of the Holy Cross in Jerusalem; they are then blessed by the pope with special rites, and are then distributed to the faithful, who hold them in special veneration as pledges of Divine protection.

ORGANIZATION

In addition to its historical and artistic signification, the word "Vatican" has a metaphorical sense in which it stands for the central authority of the Catholic Church, or in other words the pope, with the hierarchical power vested in his person, the administration of the Church, the papal curia, and all the representatives of the Holy See throughout the world.

The hierarchical power of the Catholic Church, though shared in different degrees among those to whom it is entrusted (the lower clergy and bishops), is centralized in the person of the pope as its source. It is true that the Roman Church includes among its dogmas the divine institution of the priesthood in two different degrees (priests and bishops), and recognises the validity of orders conferred even outside its communion provided that the transmission of the priestly office has not been interrupted; but it only admits the transmission as legitimate if it is made by a bishop subject to the supreme authority of the successor of St. Peter, the prince of Apostles and the vicar of Our Lord. Thus the Vatican, as the place which contains St. Peter's tomb and the seat of his successors, the bishops of Rome, sums up and symbolizes, in the minds of Catholics, all that is connected with the dignity, authority and power of their Church.

Cardinals.—The Vatican, being the actual residence of the pope, is also the legal seat of the Sacred College of Cardinals, since they are the advisers most closely attached to the pope's person and form with him a single moral entity. The cardinals were originally the bishops of the districts immediately surrounding Rome, and the priests and deacons of the churches of the city, who formed as it were the council of the bishop of Rome. Little by little, as the administrative machinery was developed and perfected, the highest dignitaries and the most distinguished ecclesiastics of the Catholic Church, not only of Rome and Italy but of all nations, were summoned by the pope (who has the sole right of appointing cardinals) to form part of the Sacred College.

The cardinals meet at the Vatican whenever they are summoned by the pope to hold a collective council or Consistorium. Formerly all ecclesiastical affairs of any importance were discussed in the Consistorium, where each cardinal had to state his opinion on the subject under consideration. As business accumulated, however, this system gave rise to a number of difficulties, and in 1587 Sixtus V., doing what Paul III. had done for the Holy Office and Pius IV. for the application of the rules laid down by the Council of Trent, classified all business into a certain number of categories and entrusted each category to a group or committee of cardinals selected for their special competence.

Congregations.—This was the origin of the Roman Congregations, which are to this day the usual organs for the administration and discipline of the Catholic Church. Their number and organization have frequently varied. In addition to the Congregations set up by Sixtus V., Urban VIII. created the Congregation *de Propaganda Fide,* which deals with missions, and Pius VII. that of "Extraordinary Ecclesiastical Affairs," which is entrusted with questions of diplomatic relations with States. The most important reform in the constitution of the Roman Congregations was that introduced by Pius X. in 1908. They are now definitely regulated by the code of canon law promulgated by Benedict XV. in 1917. Meetings of the cardinals belonging to the different Congregations are always held at the Vatican, except those of the Congregations of the Holy Office and of the Propagation of the Faith, which have their own palaces. The decisions of the Congregations are always subject to the approval of the sovereign pontiff.

In addition to the Congregations which exercise its administrative power and carry out its decisions, the Vatican has three tribunals which exercise its judicial power: the Poenitentiaria, a special court which judges questions of conscience and has no authority except over the conscience of the individual, the *Sacra Romana Rota* and the *Signatura Apostolica,* which possess external authority.

The Rota and the Signatura.—The Rota, which has an extremely brilliant tradition in the legal world, consists of a College of Prelates Auditors who, grouped in threes according to seniority, form a number of judicial commissions which give judgment on all matters coming under ecclesiastical law.

It is because of its organization in a number of groups that this tribunal is known as the Rota. Most of the cases with which it deals are of a matrimonial character, for although the Roman Church maintains without any exception the indissolubility of a marriage contracted and consummated, it does not refuse to consider cases in which it can be shown that there existed at the origin of the marriage a defect or impediment which made it invalid and null. In such cases the Church, though it cannot declare a marriage dissolved, can declare it null. The Rota meets at the Vatican every year for the opening of its discussions. After the Mass of the Holy Spirit has been celebrated in the Pauline chapel, the Rota is received by the pope, who makes a speech inaugurating the juridical year.

The tribunal of the Signatura is composed of cardinals, who consider appeals lodged against decisions of the Rota. It cannot decide on the merits of the question, but may consider whether there has been any error of procedure sufficiently important for the case to be referred back to the Rota, where it will be considered by other judges than those who dealt with it the first time.

The Secretariat of State.—Other bodies forming part of the administrative machinery of the Church are the offices of the Vatican, the chief of which is the secretariat of State. This office is directly controlled by the cardinal secretary of State, whose position in relation to the pope corresponds to that of a prime minister. The secretariat of State is the most definitely political organ of the Vatican. With the assistance of the Congregation of Extraordinary Ecclesiastical Affairs, which is specially connected with it, it deals with all business connected with relations between the Holy See and the various Governments. The cardinal secretary of State and his office are responsible for everything having to do with the *concordats,* with diplomatic relations, with the nomination of bishops, and all matters in which some measure of agreement with the civil authority is necessary, and with the instructions to be given to the Faithful on questions relating to national political life. Every day, before dealing with other business, the pope receives the cardinal secretary of State or one of the prelates responsible for the various branches of the secretariat of State. It is for this reason that the only cardinal who resides in the Vatican is the secretary of State, and the only ecclesiastical administrative office which has its headquarters at the Vatican is the secretariat of State. When in everyday speech reference is made to the attitude or policy of the Vatican, what is meant is generally the activity of the secretariat of State or the papal diplomacy for which the secretariat is directly responsible.

Representatives of the Vatican.—The Vatican exercises its authority not only through its central organs, but also through permanent or temporary representatives.

The permanent representatives of the Vatican or, more correctly, of the Holy See, are divided into two main categories, those of a diplomatic character and those of a purely ecclesiastical character. The first category includes nuncios and inter-nuncios, and the second the Apostolic delegations.

Nuncios.—The distinction between nuncios and inter-nuncios corresponds to that between ambassadors and ministers-plenipotentiary of lay Governments. Nuncios are of two degrees—the first or the second—according to the actual or historical importance of their post. As a general rule they possess the rank of

archbishop. Nuncios of the first class complete their diplomatic careers by their elevation to the rank of cardinal. According to the decisions of the Congress of Vienna (1815) papal nuncios are regarded as the doyens of the diplomatic corps to which they belong, and therefore have precedence over all other members of the diplomatic corps.

Since the World War there has been a great increase in the number of nuncios and inter-nuncios, and reciprocally in the number of ambassadors and ministers accredited to the Vatican. The important part played by the Vatican during the World War will be remembered. It is for this reason that many of the States which were created or enlarged as a result of the War have shown anxiety to maintain continuous relations with the Head of the Catholic Church, and that certain Powers which had broken off relations have decided to renew them.

At the end of 1928 the Vatican had 27 diplomatic representatives: 21 nuncios (Germany, Argentina, Austria, Bavaria, Belgium, Bolivia, Brazil, Chile, Colombia, Spain, France, Hungary, Peru, Poland, Portugal, Prussia, Rumania, Switzerland, Czechoslovakia, Venezuela, Yugoslavia) and 6 inter-nuncios (Central America [including the republics of Costa Rica, Honduras, Nicaragua, Panama and San Salvador], Haiti, Netherlands, Latvia, Lithuania, Luxembourg). Thirty diplomatic representatives are accredited to the Vatican: 9 ambassadors (Germany, Argentina, Belgium, Brazil, Chile, Spain, France, Peru, Poland) and 21 ministers (Austria, Bavaria, Bolivia, Colombia, Costa Rica, Great Britain, Haiti, Hungary, Latvia, Liberia, Lithuania, Monaco, Nicaragua, Portugal, Prussia, Rumania, San Marino, San Salvador, Czechoslovakia, Venezuela, Yugoslavia).

Apostolic Delegates.—The other category of representatives to the Vatican consists of the Apostolic delegates. These prelates have, as a rule, the rank of archbishop, and represent the Holy See, not with the civil authorities, but with the bishops of the country to which they are sent.

At the end of 1928 there were 19 apostolic delegations falling into three categories according to the Roman Congregations to which they are subordinate: the Consistorial Congregation is responsible for the delegations to the Antilles, Canada and Newfoundland, to Estonia, United States of America, Mexico and the Philippines. The Congregation of the Propagation of the Faith is responsible for the delegations to South Africa, Albania, Australia, China, Greece, India, Indo-China and Japan. The Congregation for the Eastern Church is responsible for the delegations to Constantinople, Egypt and Arabia, Mesopotamia, Kurdistan and Armenia, Asia Minor, Persia and Syria.

Other Missions.—The Vatican is sometimes represented in particular parts of the world by prelates who are sent on temporary missions. These are known as Apostolic Visitors. On certain occasions, generally at religious festivals, the Vatican is represented by cardinals sent by the pope with the title of legates *a latere*. Sometimes again cardinal-legates have been sent to discuss religious affairs of the highest importance with sovereigns or heads of States. Thus Cardinal Campeggio was sent as legate to Henry VIII. by Clement VII., Cardinal Pole to Mary Tudor by Julius III. and Cardinal Caprara to Bonaparte by Pius VII. after the signature of the concordat of 1801 to settle various questions connected with the concordat.

THE VATICAN COURT

The papal court, which centres round the person of the pope in the Vatican, is essentially of an ecclesiastical character. At the same time, however, it maintains a magnificence of ceremonial which derives its origin from ancient tradition and from the relations which the papacy has always maintained with the highest secular powers.

The Vatican court is divided into two main categories; the papal chapel and the papal household. The first includes the prelates and dignitaries who take part in the religious ceremonies which the pope attends; the second consists of those who have other duties to perform in the pope's entourage. The papal chapel naturally includes all the cardinals and bishops, while the papal household consists solely of the cardinals called the "cardinals palatine" (the Datary and the secretary of State) and those bishops who belong to the papal antechamber, such as the privy almoner and the papal sacristan. The latter is the parish priest of the Vatican palace. Most of the persons who hold honorary posts in connection with the Vatican belong to both categories.

When the papal court appears as a whole, in procession before the pope, at specially solemn religious ceremonies, either in the Vatican basilica or in the Sistine chapel, it provides a spectacle of dazzling splendour, notable both for its variety and for the splendour of the costumes. It includes the cardinals and bishops wearing their *cappae magnae* trimmed with ermine or their gold-embroidered ecclesiastical vestments, as well as Roman princes with cloaks edged with priceless lace, chamberlains "of cloak and sword" in Spanish 16th century costume, prelates in violet soutanes, knights of Malta in scarlet tunics, officers in armour of steel damascened with gold, and the Swiss Guards in their blue, red and yellow uniform which was designed by Michelangelo. Last in the long procession comes the pope, who is carried on the *sedia gestatoria* which is a sort of throne on a portable platform, carried on the shoulders of 12 servants wearing liveries of crimson damask. One on each side of the throne are two privy chamberlains carrying *flabelli* or immense fans adorned with ostrich feathers. Above the *sedia* is a canopy of cloth of silver, the golden supports of which are borne by eight prelates.

All classes and all ecclesiastical, military and civil orders which have relations with the Vatican are represented in this magnificent procession. A number of specially chosen bishops assist the pope and constitute the College of Bishops Assistant to the Papal Throne. The Superiors and Procurators of the religious orders also have their place in the procession. The heads of the two chief aristocratic Roman families, Prince Colonna and Prince Orsini, take it in turns to assist the pope, and are therefore known as the Princes Assistant to the Papal Throne. Other members of the highest aristocracy of Rome also hold hereditary offices. Prince Chigi is always Marshal of the Holy Roman Church, and Perpetual Guardian of the Conclave. Prince Massimo is always Minister of the Papal Posts (in the old sense of the word posts, which referred to the journeys of the pope when he travelled by post), Prince Ruspoli is always Grand Master of Hospitality (that is to say the person responsible for arranging for hospitality to sovereigns or princes who are the guests of the pope), Marquis Sacchetti is always Grand Quartermaster, or superintendent of the technical services of the Vatican, Marquis Patrizi is always *Vexillifer* or Standard-bearer of the Church, Marquis Serlupi is always Master of the Horse. The protection of the pope's person is entrusted to the papal guard, which consists of cadets of the noble families of the former Papal States, and is always commanded by a Roman prince. The pope's escort is the Swiss Guard, a corps instituted by Julius II. and consisting of Swiss citizens recruited from all cantons of the Swiss Confederation. Originally they were only recruited from the canton of Lucerne. There is always a guard of honour recruited from among the citizens of Rome (*Guardia Palatina d'onore*). A corps of police known as the *Gendarmeria Pontificia* is responsible for maintaining order in the Vatican palace.

The papal court also includes a number of ecclesiastical posts which are always entrusted to members of certain religious orders. The Master of the Sacred Palaces, or Theologian of the Papal Court, is always a Dominican; the Sacristan, or priest of the Apostolic Palaces, is always an Augustine Friar; the Apostolic Preacher who preaches the Advent and Lent sermons in the presence of the pope and his court is always a Capuchin; the Confessor to the Papal Household is always a Servite.

Papal ceremonies are always attended by the diplomatic corps accredited to the Holy See, the Roman patriciate and nobility, and the Knights of Malta and of the Order of the Holy Sepulchre, for whom special tribunes are provided.

HOLY SEE VACANCY

Special interest attaches to the procedure which is followed in the Vatican at times when the Holy See is vacant—*Sede vacante*, in the Latin phrase. During such intervals between two pon-

tificates the Sacred College of Cardinals takes over the work of ecclesiastical administration. Detailed rules are laid down for what is to be done during vacancies; the procedure has repeatedly been modified and improved by successive popes. All previous rules were abrogated by the Constitutions of Leo XIII. (May 24, 1882) and Pius X. (Dec. 25, 1904), which are incorporated in the code of canon law.

The Conclave.—Under these constitutions the seat of the cardinals during the vacancy of the Holy See and the conclave is the Vatican palace. The cardinal camerlengo of the Holy Roman Church, who is the personal representative of the Sacred College in the ordinary administration, takes up his residence there; wherever he goes in the palace he is escorted by the Swiss Guards. Every morning, from the death of the pope to the opening of the conclave, all the cardinals meet in the hall of the Consistorium to hold a congregation, that is to say to consult on current business. Assembled in that hall they receive the condolences of the diplomatic corps and of the Order of the Knights of Malta. The general congregation deals with the most important business, and in addition a special congregation meets daily to transact affairs of minor importance; it consists of the three cardinals who are respectively senior in each of the three hierarchical orders represented in the College of Cardinals (bishops, priests and deacons) as well as of the cardinal camerlengo. At the first general congregation the seals of the deceased pope (the Fisherman's Ring and the leaden seal of the Apostolic Chancellery used for the sealing of Bulls) are handed over to the Sacred College and are at once broken.

On nine consecutive days the obsequies of the pope (called for this reason *novendialia*) are celebrated; on the first six days the services are held in the Vatican basilica and on the last three in the Sistine chapel. At the last service the deceased pope's funeral sermon is preached. Until the conclave of Feb. 1922, at which Pius XI. was elected, the cardinals entered into conclave one day after the *novendialia*. In order however to give the cardinals from the most distant parts of the world, such as America and Australia, the necessary time to reach Rome, Pius XI. increased the interval between the death of the pope and the opening of the conclave to 18 days. On the morning of the day on which they go into conclave, the cardinals meet in the Pauline chapel to hear the Mass of the Holy Spirit celebrated by the doyen of the cardinals, and to listen to a sermon preached by a prelate on the election of the pope.

During the conclave the Vatican palace is closed, and all contact with the outside world is cut off by the walling up of the doors giving access to it. The walls are pierced by rotas or turning-boxes similar to those of enclosed monasteries, through which it is possible to pass objects without seeing the person to whom they are passed, and to converse provided that the voice is raised. The guardianship of the rotas is entrusted to the prelates of the different colleges, and in particular to the clerks of the Apostolic Chamber, who carry out minor administrative functions in the Vatican while the Holy See is vacant. These prelates decide in what cases persons may be authorized to converse with the cardinals through the rotas, are present at such conversations, and inspect all objects which it is desired to introduce into the conclave. The conclave is guarded from the outside by the prince marshal of the Holy Roman Church, an hereditary office vested in the Chigi family, and the prelate at the head of the papal court (the major-domo or master of the chamber). Within the Vatican are only the cardinals with their secretaries or "conclavists," the masters of the ceremonies, certain other ecclesiastics who are entrusted with definite duties, doctors, and the service staff. All matters connected with the conclave are directed by the secretary of the Sacred College and the prefect of papal ceremonies. The admission of each person who resides within the precincts of the conclave must be considered and approved in advance by the general congregation of cardinals. The interior of the Vatican palace is divided into a number of small apartments (*cellae*) corresponding to the number of cardinals; each cardinal is allotted his apartment by lot.

The Election.—Voting takes place in the Sistine chapel, in which a number of small thrones, one for each cardinal, have been placed along the lateral walls for the occasion. Each throne is surmounted by a canopy which is violet in colour in the case of those cardinals created by the deceased pope, and green in the case of those created by previous popes. Immediately after the election has taken place, all the canopies are removed except that over the throne of the cardinal who has been elected pope. In one corner of the chapel there is placed a stove in which the masters of the ceremonies burn the voting papers immediately after each vote. The stove has a small iron pipe which passes out through one of the windows of the chapel. The smoke (*sfumata*) which issues from the pipe enables the crowd assembled on the Piazza of St. Peter to guess how the voting has gone; when no candidate receives a two-thirds majority the votes are burned with wet straw so that the smoke shows black; when a pope is elected, the votes are mixed with dry straw so that the smoke is white.

As soon as the elected cardinal has accepted the pontificate, the first cardinal deacon proceeds to the central balcony in the façade of St. Peter's, and announces to the populace the election of the pope and the name that he has chosen. Soon afterwards the new pope himself, wearing the pontifical robes (for before the first vote took place three sets of robes of different sizes were placed in readiness in a cabinet adjoining the Sistine chapel) appears at the same balcony and gives his first benediction to the crowd assembled on the Piazza. After 1870, on account of the occupation of Rome by the Italian Government, Popes Leo XIII., Pius X. and Benedict XV. gave their benediction from the interior balcony of the Vatican basilica. Pius XI. returned to the older practice, and gave the benediction from the exterior balcony, stating that he did so as a token of peace towards the whole world. On the day that the election has taken place the conclave is opened and the cardinals return to their homes.

The coronation of the new pope takes place a few days later, the day being fixed by the pope himself. If the new pope does not possess episcopal rank—the last occasion on which this occurred was the election of Gregory XVI. in 1831—the privilege of consecrating him belongs to the Cardinal Bishop of Ostia.

(E. Pu.)

THE LATERAN TREATY

The Lateran treaty between the Holy See and Italy, signed Feb. 11, 1929, like all reconciliations that need careful exploration of the difficulties to be surmounted, demanded powers of negotiation of no mean order. At the outset, the conditions for such negotiations were of a favourable character, as Mussolini (*q.v.*) and his Government were also animated with the desire to end the Roman Question, perhaps being not unmindful of the oft-quoted words of Crispi, who said that the politician who settled the Roman Question would go down in history as Italy's greatest statesman. The treaty was ratified June 7, 1929.

The Negotiators.—While the supreme motive power that brought about the historic reconciliation came from Pope Pius XI. and Mussolini, no account of the great event would be complete without acknowledging the work of the negotiators of the treaty for the Vatican: Cardinal Gasparri, papal secretary of State; Mgr. Joseph Pizzardo, assistant secretary of State; Mgr. Borgongini Duca, secretary of extraordinary affairs; and Prof. Francesco Pacelli, legal adviser of the Vatican.

If only because he came into the full blaze of the limelight on account of being co-signatory with Mussolini of the treaty, Cardinal Gasparri's name is the one which is best known to the general public. But his reputation as a statesman stood very high before this event. Born in 1857 at Capovallanza di Ussita, he was ordained in 1877, and subsequently held the position of professor of canon law at the Propaganda college. In 1894 he was created a domestic prelate, and four years later he attained archiepiscopal rank and became apostolic delegate to Peru and Bolivia. Made a cardinal in 1907, Pope Benedict XV. appointed him secretary of State in Oct. 1914. In 1922 Pius XI. appointed him chamberlain of the Holy Roman Church.

Non-Interference.—Those who fear "Vatican interference" as a result of the renewal of papal sovereignty will be able to set

their fears at rest if they will examine the treaty.

On the ratification of the treaty, diplomatic relations were established by accrediting an Italian ambassador to the Holy See and an apostolic nuncio to Italy. (*See* also PAPACY; PIUS XI.; ITALY.)

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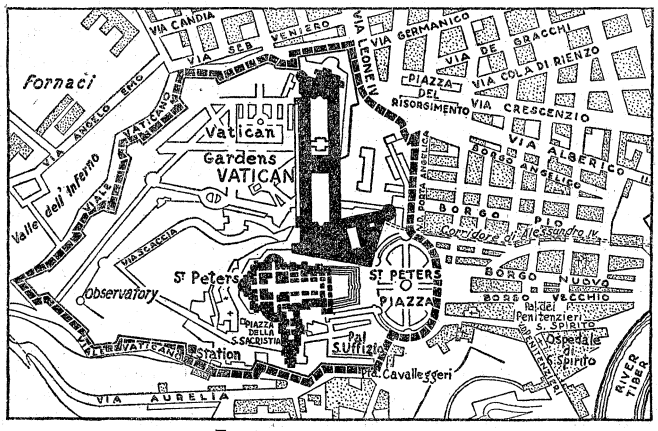
VATICAN CITY STATE, the name created for the territory in Rome belonging to the Holy See by the Lateran Treaty, signed by Cardinal Gasparri, on behalf of the Pope, and by the representative of the King of Italy, on February 11, 1929. *See* PAPACY: *The Renewal of Papal Sovereignty;* ITALY: *Conciliation of the Vatican and Italy;* VATICAN, THE.



THE VATICAN CITY STATE

VATICAN COUNCIL, THE, of 1869 and 1870, the last oecumenical council of the Roman Catholic Church, and the most important event in her historical development since the Tridentine synod. The preliminaries were surrounded by the closest secrecy. As early as the end of the year 1864, Pius IX. had commissioned the cardinals resident in Rome to tender him their opinions as to the advisability of a council. The majority pronounced in favour of the scheme, dissentient voices being rare. After March 1865 the convocation of the council was no longer in doubt. Thirty-six carefully selected bishops of diverse nationalities were privately interrogated with regard to the tasks which, in their estimation, should be assigned to the prospective assembly. Some of them proposed, *inter alia,* that the doctrine of papal infallibility should be elevated to the rank of a dogma. In public, however, Pius IX. made no mention of his design till the 26th of June 1867, when Catholic bishops from every country were congregated round him in Rome on the occasion of the great centenary of St. Peter. On the 29th of June 1868 the bull *Aeterni Patris* convened the council to Rome, the date being fixed for the 8th of December 1869. And since the Roman Catholic Church claims that all baptized persons belong to her, special bulls were issued, with invitations to the bishops of the Oriental Churches, to the Protestants and to the other non-Catholics, none of which groups complied with the request.

The object of the Council was long a mystery. The Bull of Convocation was couched in general terms, and specified no definite tasks. The first revelation was given, in February 1869, by an article in the *Civiltà Cattolica,* a periodical conducted under Jesuit auspices. It was there stated, as the view of many Catholics in France, that the council would be of very brief duration, since the majority of its members were in agreement. As a presumptive theme of the deliberations, it mentioned *inter alia* the proclamation of papal infallibility. The whole proceeding was obviously an attempt, from the Jesuit side, to gauge the prevalent opinion with regard to this favourite doctrine of ultramontanism. The repudiation was energetic and unmistakable, especially in Germany. Certain articles on "The Council and the Civiltà," published by Döllinger in the *Allgemeine Zeitung,* worked like a thunderbolt.

In France also a violent conflict broke out. Here it was principally the writings of Bishop Maret of Paris (*Du concile général et de la paix religieuse,* 2 vols., 1869), and of Bishop Dupanloup of Orleans, which gave expression to the prevalent unrest, and led to those literary controversies in which Archbishop Manning of Westminster and Dechamps of Mechlin came forward to champion the opposite cause. In Italy the freethinkers considered the moment opportune for renewing their agitations on a larger scale. That the projected dogma had weighty opponents among the higher clergy of Austria-Hungary, Italy and North America was demonstrated during the progress of the council; but before it met all was quiet in these countries.

Organization.—The Roman see exercised a more pronounced influence on the Vatican Council than upon any previous one. As early as the year 1865 a committee of cardinals had been formed as a "special directive congregation for the affairs of the future general council," a title which was usually abbreviated to that of "Central Commission." Among the earliest preliminaries, a number of distinguished theologians and canonists were retained as *consultors* to the council. The General Congregations, presided over by cardinals, were employed in considering the *schemata* (drafts) submitted to the synod; and provisory votes—not regarded as binding—were there taken. The Sessions witnessed the definitive voting, the results of which were to be immediately promulgated as ecclesiastical law by the pope. The form of this promulgation was, in itself, sufficiently characteristic; for the pope was represented as the real agent, while the acknowledgment of the share of the council was confined to the phrase *sacro approbante concilio.*

On the 8th of December the first session met, and the council was solemnly opened by Pius IX. From beginning to end it was dominated by the "Infallibility" problem.

The first transactions of the council gave proof that numerous bishops held the theory that their convocation implied the duty of serious and united work, and that they were by no means inclined to yield a perfunctory assent to the papal propositions.

The Opponents of Infallibility.—However, as the Curia could rely upon a complacent majority, it resolved to proclaim a new order of procedure, by means of which it would be possible to end these unwelcome discussions and quicken the pace of the council. By the papal decree of the 20th of February the influence of the committees was increased.

The main object, however, of this alteration in procedure was to ensure that if the council could not be induced to accept the doctrine of infallibility by acclamation, it should at least do so by resolution. From the first the general interest was almost exclusively concentrated on this question, which divided the members of the synod into two hostile camps. The presence of striking personalities, whose devotion to the Church was beyond question—Archbishop Scherr of Munich, Melchers of Cologne, Bishop Ketteler of Mainz, Bishop Hefele of Rottenburg, Cardinal Schwarzenberg of Prague, Cardinal Rauscher of Vienna, Archbishop Haynald of Kalossa, Bishop Strossmayer of Sirmium, Archbishop Darboy of Paris, Bishop Dupanloup of Orleans, to say nothing of the others—assured this group an influence which, in spite of itself, the opposing faction was bound to feel.

The Supremacy of the Church.—Among the secret propositions submitted to the council by the Curia was the schema *De Ecclesia Christi,* which was distributed to the members on the 21st of January, and which enunciated the superiority of Church to State in the same drastic terms as in the *Syllabus* of Pius IX. (1864)—a declaration of war against the modern political and social order, which in its day provoked the unanimous condemnation of public opinion. When, in spite of the injunction of secrecy, the schema became known outside Rome, its genuineness was at first impugned; but as soon as the authenticity of the text was established, this attempt to dogmatize the principles of the notorious *Syllabus* excited the most general indignation, even in the strongholds of Catholicism—France and Austria.

From the 22nd of February to the 18th of March no meetings of the General Congregations took place, on account of structural alterations in the *aula* itself. During this interval all uncertainty as to whether the question of infallibility would actually be broached was dispelled. On the 6th of March a supplementary article to the schema *De Ecclesia,* dealing with the primacy of the Roman see, was transmitted to the members, and in it the much disputed doctrine received formal expression.

The Triumph of Ultramontanism.—Meanwhile, the elaboration of the all-important business of the council had been quietly proceeding. Influenced by the alarming number of amendments to the schema *De Ecclesia,* and anxious above all to ensure an early acceptance for the dogma of infallibility, the papal Committee resolved to eliminate everything save the one question of papal authority.

In the general debate, begun on the 13th of May, Bishop Hefele of Rottenburg, author of the well-known *Konziliengeschichte,* criticized the dogma from the standpoint of history, adducing the fact that Pope Honorius I. had been condemned by the sixth oecumenical council as a heretic (680). Others were of opinion that the doctrine implied a radical change in the constitution of the Church: one speaker even characterized it as sacrilege. The contention that the dogma was necessitated by the welfare of the Church, or justified by contemporary conditions, met with repeated and energetic repudiation. The champions of infallibility were, indeed, confronted with no slight task:—to establish their theory by Holy Writ and tradition, and to defend it against the arguments of history. But to them it was no hypothesis waiting to be verified, but an already existing truth. On the 3rd of June the general debate was closed.

In the special debate, which dealt with the proposal in detail, every important declaration with regard to the pope was impugned by one party and upheld by the other; but on the 13th of July it was found possible to conclude the debate. On that day the voting in the 85th General Congregation, on the whole schema, showed that, out of 601 members present, 451 had voted *placet,* 88 *non placet* and 62 *placet iuxta modum.* That the number of prelates who rejected the *placet* would amount to 150 had not been expected.

On the 18th of July, in the fourth public session, the dogma was accepted by 535 dignitaries of the Church, and at once promulgated by the pope; only two members repeated their *non placet,* and these submitted in the same session. The council continued its labours for a few more weeks, but its main achievement was over, and the remainder of its time was occupied with affairs of secondary importance. When, coincident with the outbreak of the Franco-German War, the papal state collapsed, the pope availed himself of the altered situation, and prorogued the council by the bull *Postquam Dei munere* (October 20). The Italian government at once protested against his statement that the liberties of the council would be prejudiced by the incorporation of Rome into the kingdom of Italy.

The Pope and the Church.—The resolutions of the Vatican Council entirely revolutionized the position of the pope within the Church. He is first accredited with "complete and supreme jurisdictionary authority over the whole Church, not simply in matters of faith and morality, but also in matters touching the discipline and governance of the Church; and this authority is a regular and immediate authority, extending over each and every Church and over each and every pastor and believer."

Again, the dogma implies a fundamental change in the position of oecumenical councils, which, in conjunction with the papacy, had till then been supposed to constitute the representation of the Roman Catholic Church.

The Church and Governments.—In the sphere of politics also the *Vaticanum* was attended by important results. The secular governments could not remain indifferent to the prospect that the proclamation of papal infallibility would invest the *dicta* of the mediaeval popes, as to the relationship between Church and State, with the character of inspired doctrinal decisions, and confer dogmatic authority on the principles enunciated in the *Syllabus* of Pius IX. Nor was the fear of these and similar consequences diminished by the proceedings of the council itself. The result was that on the 30th of July, 1870, Austria annulled the Concordat arranged with the Curia in 1855.

In Prussia the so-called *Kulturkampf* broke out immediately afterwards, and in France the synod so accentuated the power of ultramontanism, that, in late years, the republic has taken effectual steps to curb it by completely separating the Church from the State.

The general position of Roman Catholicism was consolidated by the Vatican Council in more respects than one; for not only did it promote the centralization of government in Rome, but the process of unification soon made further progress, and the attempts to control the intellectual and spiritual life of the Church have now assumed dimensions which, a few decades ago, would have been regarded as anachronistic.

See also article "Vatican Council" in the *Catholic Encyclopedia.* The most important collections of the *acta* are: *Collectio Lacensis,* tome vii. (Freiburg, 1890); E. Friedberg, *Sammlung der Aktenstücke zum ersten Vatikanischen Konzil* (Tübingen, 1872); J. Friedrich, *Documenta ad illustrandum Concilium Vaticanum* (Nördlingen, 1871). For the dogmatic resolutions *see* also C. Mirbt, *Quellen zur Geschichte des Papsttums* (ed. 2, Tübingen, 1901), pp. 371–382. For the internal history of the councils one of the main sources is Quirinus, *Römische Briefe vom Konzil* (Munich, 1870); also J. Friedrich, *Tagebuch während des Vatikanischen Konzils* (Nördlingen, 1871); Lord Acton, *Zur Geschichte des Vatikanischen Konziles* (Munich, 1871, Eng. in *Hist. Essays,* 1907); J. Fessler, *Das Vatikanische Concilium* (Vienna, 1871); Manning, *The True Story of the Vatican Council* (London, 1877); E. Ollivier, *L'Église et l'état au concile du Vatican* (2 vols., Paris, 1879); Purcell, *Life of Cardinal Manning* (2 vols., 1896); F. Mourrett, *Le Concile du Vatican* (1919). (C. MI.; X.)

VATICAN STATE: *see* VATICAN CITY STATE.

VATSAUK (NOW LAWKSAWK): *see* SHAN STATES.

VATTEL, EMERIC (EMER) DE (1714–67), Swiss jurist, the son of a Protestant minister, was born at Couvet, in the principality of Neuchâtel, on April 25, 1714. He studied at Basel and Geneva. Vattel's reputation chiefly rests on his *Droit des gens, ou Principes de la loi naturelle appliqués à la conduite et aux affaires des nations et des souverains* (Neuchâtel, 1758). He died at Neuchâtel on Dec. 28, 1767.

VAUBAN, SÉBASTIEN LE PRESTRE DE (1633–1707), marshal of France, was born at Saint-Léger-Vauban (Yonne). At the age of ten he was left an orphan in poor circumstances, and his youth was spent amongst the peasantry of his native place. At the age of seventeen Vauban joined the regiment of Condé in the war of the Fronde. He was soon offered a commission which he declined. Condé then employed him in the fortification of Clermont-en-Argonne.

Soon afterwards he was taken prisoner by the royal troops, and was converted into a devoted servant of the king. He besieged and took his own first fortress, Clermont; in May 1655 he became an *ingénieur du roi.*

After the peace of Aix-la-Chapelle Vauban improved or rebuilt various fortresses. Hitherto the characteristic features of his method of fortification had not been developed, and he followed the systems of preceding engineers. Colbert and Louvois were profoundly interested in the work, and it was at the request of the latter that the engineer drew up in 1669 his *Mémoire pour servir à l'instruction dans la conduite des sièges* (this, with a memorandum on the defence of fortresses by another hand was published at Leiden, 1740).

On the renewal of war Vauban conducted the sieges of Rheinbergen and Nijmwegen 1672, Maestricht and Trier 1673, Besançon 1674.

Vauban's introduction of a systematic approach to strong places by parallels dates from the siege of Maestricht, and in principle remains to this day the standard method of attacking a fortress. Vauban became *commissaire-général des fortifications* on the death of De Clerville, and in 1681 rebuilt the fortress of Strasbourg.

At Saarlouis for the first time appeared Vauban's "first system" of fortification. He always retained what was of advantage in the methods of his predecessors. In 1682 his "second system," which introduced modifications designed to prolong the resistance of the fortress, began to appear.

In 1687 Vauban chose Landau as the chief place of arms in Lower Alsace. But side by side with this development grew up the far more important scheme of attack. He instituted a company of miners, and the elaborate experiments carried out under his supervision resulted in the establishment of all the necessary formulae for military mining (*Traité des mines,* Paris, 1740, and 1799; The Hague, 1744); at the siege of Ath in 1697 he employed ricochet fire for the first time to break down the defence. He had indeed already used it with effect at Philipsburg in 1688 and at Namur, but was hindered by the jealousy of the artillery. After the peace of Ryswick Vauban rebuilt or improved other fortresses, and finally New Breisach, fortified on his "third system"— which he called *système de Landau perfectionné.* His last siege was that of Old Breisach in 1703, which he reduced in a fortnight. On Jan. 14, Vauban had been made a marshal of France, a rank too exalted for the technical direction of sieges, and his active career came to an end with his promotion. Soon afterwards appeared his *Traité de l'attaque des places.*

But Louis XIV. was now on the defensive, and the war of the Spanish Succession saw the gradual wane of Vauban's influence, as his fortresses were taken and retaken. The various captures of Landau, his *chef-d'oeuvre,* caused him to be regarded with disfavour; he then turned his attention to the defence; but his work *De la défense des places* (ed. by General Valazé, Paris, 1829) is of far less worth than the *Attaque,* and his ideas on entrenched camps (*Traité des fortifications de campagne*) were coldly received, though they contained the elements of the "detached forts" system now universal in Europe. He now devoted himself to the arrangement of the manuscripts (*Mes oisivetés*) which contained his reflections on war, administration, finance, agriculture and the like. In 1689 he made a representation to the king in favour of the republication of the Edict of Nantes, and in 1698 he wrote his *Projet d'une dix^me^ royale* (see *Economistes financières du XVIIIe siècle,* Paris, 1851), a remarkable work foreshadowing the principles of the French Revolution.

Vauban was impressed with the deplorable condition of the peasantry, whose labour he regarded as the main foundation of all wealth, and protested against unequal taxation and the exemptions of the upper classes. His *dix^me^ royale,* a tax to be impartially applied to all classes, was a tenth of all agricultural produce payable in kind, and a tenth of money chargeable on manufacturers and merchants. This work was published in 1707, and instantly suppressed by order of the king. The marshal died heart-broken at the failure of his efforts a few days after the publication of the order (March 30, 1707). At the Revolution his remains were scattered, but in 1808 his heart was found and deposited by order of Napoleon in the church of the Invalides.

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VAUCLUSE, a department of France, formed in 1793 out of the countship of Venaissin, the principality of Orange and a part of Provence, and bounded by Drôme on the north, Basses-Alpes on the east, Bouches-du-Rhône (from which it is separated by the Durance) on the south and Gard and Ardèche (from which it is separated by the Rhône) on the west. It has also an enclave, the canton of Valréas, in the department of Drôme. Pop. (1936) 245,508. Area, 1,382 sq.mi. In the department east to west chains of the French Alps die down westwards towards the Rhône; the northernmost includes the Montagne de Lure (5,994 ft.) and Mont Ventoux (6,273 ft.) and is separated from the next, the Plateau de Saint Christol (4,075 ft.) by the Nesque river; the river Coulon separates this plateau from the Chaine du Léberon (3,691 ft.), which in turn, is bounded on the south by the Durance. The very numerous streams feed irrigation canals. The climate is that of the Mediterranean region. The valley of the Rhône suffers from the mistral, a cold and violent wind from N.N.W.; but the other valleys are sheltered by the mountains, and produce the oleander, pomegranate, olive, jujube, fig, and other southern trees and shrubs. The winter average temperature is about 41° and the summer average temperature 73°.

Wheat and potatoes are the most important crops; sugar-beet, sorghum, millet, ramie, early vegetables and fruits, notably the melons of Cavaillon, are cultivated, and also the vine, olive, mulberry and tobacco. The truffles of the regions of Apt and Carpentras, and the fragrant herbs of the Ventoux range, are renowned. Sheep are the principal live-stock, and mules are also numerous. Lignite and sulphur are mined; rich deposits of gypsum, fire-clay, ochre, etc., are worked. Beaumes-de-Venise and Montmirail have mineral springs. The industries include the spinning and weaving of silk, wool and hemp, metal-working, printing (Avignon), tanning and the making of paper, bricks, tiles, pottery, glassware and tobacco. The department is served by the P.L.M. railway, and the Rhône is navigable for 40 mi. within it. It is divided into 3 arrondissements (Avignon, Carpentras and Cavaillon), 22 cantons and 151 communes. Avignon, the capital, is the seat of an archbishop. The department belongs to the region of the XV army corps and to the *académie* (educational division) of Aix, and has its appeal court at Nîmes.

The chief towns are Avignon, Apt, Carpentras, Cavaillon, Orange and Vaison-la-Romaine (*qq.v.*).

VAUD (Ger. *Waadt*), a canton of south-western Switzerland, lying mainly between the Lake of Neuchâtel and the Lake of Geneva. It is the fourth canton in point of area (*see* VALAIS), and occupies 1,238·6 sq.m., of which 85% is reckoned as "productive" (forests cover 282·6 sq.m., exceeded only by those of Berne and the Grisons). Vaud, with 149·8 sq.m. of water surface of the larger lakes, has over one-quarter of the entire total for Switzerland; this is largely accounted for by its share of Geneva. Parts of Neuchâtel and Morat contribute to the total, but the largest lake entirely in Vaud is de Joux (3·6 sq.m.). There are over 4 sq.m. of glaciers; these and the loftiest summit in the canton (Diablerets, 10,650 ft.) occur in the western Bernese Oberland (S. Vaud). The canton, of very irregular shape, includes nearly all of the northern shore of the Lake of Geneva, and stretches from slightly beyond Bex in the south-east to the Juras on the north-west. A long, narrow eastern tongue extends past Payerne to the Lake of Neuchâtel. Just beyond its tip is the Avenches region, forming an "enclave" in Fribourg. Parts of Fribourg, in turn, form "enclaves" within Vaud along the shore of Neuchâtel. A strip of the right bank drainage of the Rhone (from just above Bex to the Lake of Geneva) lies within the canton, but north and north-east of Lausanne the land is drained by the Broye and Thièle, of the Aar-Rhine basin.

Vaud, with plains near the lakes, is hilly rather than mountainous, and is well supplied with railways, including a part of the main Simplon line through Bex. Lausanne is an important main-lines railway centre, and the canton has numerous small-gauge railways and mountain lines, such as those which connect the north-east shore settlements of the Lake of Geneva with the high lying resorts of Les Avants, Mont Pèlerin and Caux, and those which link up Bex and Aigle with the Diablerets area. In 1941 the population was 342,032; in 1930, 331,853, of whom 276,313 were French-speaking, 37,968 German-speaking, 9,954 Italian-speaking; 272,225 were Protestants, 53,522 Catholics, 1,630 Jews.

The vineyards (15.4 sq.mi.), though showing a considerable decrease during the 20th century, are still the most extensive in Switzerland. White wines predominate; the best come from Yvorne (near Aigle), while the slopes of La Vaux (east of Lausanne) produce both red and white wine. Tobacco is grown in north-east Vaud, particularly near Payerne, and cigars are made at Grandson. Manufactures, on the whole, are unimportant, but Ste. Croix, in the Jura, is world-famed for watches, gramophones, musical boxes and jewellery. The Juras produce limestones and sandstones, and the canton-owned salt-beds at Bex provide raw materials for a thriving chemical industry. Vaud is famed for its health resorts and for its educational establishments; visitors chiefly frequent Lausanne, Vevey, Montreux and Château d'Oex

in the upper Saane valley. Lausanne academy (founded 1537) was raised to university rank in 1890, and several towns are noted for schools; the modernized (12th century) castle in Yverdon was the residence and school of Pestalozzi from 1806 to 1825. Lausanne (pop. in 1941, 91,738) is the political capital and the fifth town in point of size in Switzerland. The "agglomeration" known as Montreux had, in 1936, 11,996, and in 1941 Vevey had 12,613 and Yverdon 10,856. Other important small towns in 1936 were Ste. Croix (6,340), Payerne (4,951), Nyon (5,107), Morges (5,057), Saanen (4,754), Aigle (3,912) and Château d'Oex (3,840). Among the historical spots are Avenches (the largest Roman colony in Helvetia), Grandson (scene of the first great victory of the Swiss against Charles the Bold in 1476), and the castle of Chillon (where Bonivard, lay prior of St. Victor, near Geneva, was imprisoned 1530–36 for defending the freedom of Geneva against the duke of Savoy).

The canton is divided into 19 administrative districts and contains 388 communes. The cantonal constitution dates from 1885. The legislature consists of a *Grand Conseil* of 219 deputies (one member to every 450 electors) with an executive *conseil d'état* of seven members; both bodies hold office for four years. Six thousand citizens can compel the Government to consider any project, whether legislative or constitutional; this *initiative* dates back to 1845. Since 1885 the *referendum* has existed in its "facultative" form (6,000 signatures required) for certain measures, and in its obligatory form for financial matters. The two members of the Federal *Ständerat* are named by the *Grand Conseil,* while the 15 members of the Federal *Nationalrat* are chosen by a popular vote.

History.—The early history of the main part of the territories comprised in the present canton is identical with that of south-west Switzerland generally. The Romans conquered (58 B.C.) the Celtic Helvetii and so thoroughly colonized the land that it has remained a Romance-speaking district. It formed part of the empire of Charlemagne, and of the kingdom of Transjurane Burgundy (888–1032), the memory of "good Queen Bertha," wife of King Rudolph II., being still held in high honour. After the extinction of the house of Zähringen (1218) the counts of Savoy gradually won the larger part of it, especially in the days of Peter II., "le petit Charlemagne" (d. 1268). The bishop of Lausanne (to which place the see had probably been transferred from Aventicum by Marius the Chronicler at the end of the 6th century), however, still maintained the temporal power given to him by the king of Burgundy, and in 1125 had become a prince of the empire. (We must be careful to distinguish between the present canton of Vaud and the old mediaeval Pays de Vaud: the districts forming the present canton very nearly correspond to the Pays Romand.) In 1536, both Savoyard Vaud and the bishopric of Lausanne (including Lausanne and Avenches) were overrun and annexed by Bern. Bern in 1526 sent Guillaume Farel, a preacher from Dauphiné, to carry out the Reformation at Aigle, and after 1536 the new religion was imposed by force of arms and the bishop's residence moved to Fribourg (permanently from 1663). Thus the whole land became Protestant, save the district of Échallens. Vaud was ruled very harshly by bailiffs from Bern. Political feeling was therefore much excited by the outbreak of the French Revolution, and a Vaudois, F. C. de Laharpe, an exile and a patriot, persuaded the Directory in Paris to march on Vaud in virtue of alleged rights conferred by a treaty of 1565. The French troops were received enthusiastically, and the "Lemanic republic" was proclaimed (Jan. 1798), succeeded by the short-lived Rhodanic republic, till in March 1798 the canton of Léman was formed as a district of the Helvetic republic. This corresponded precisely with the present canton minus Avenches and Payerne, which were given to the canton of Vaud (set up in 1803). The new canton was thus made up of the Bernese conquests of 1475, 1475–76, 1536 and 1555. The constitutions of 1803 and 1814 favoured the towns and wealthy men; so that an agitation went on for a radical change, which was effected in the constitution of 1831. Originally acting as a mediator, Vaud finally joined the anti-Jesuit movement (especially after the Radicals came into power in 1845), opposed the Sonderbund, and accepted the new federal constitution of 1848, of which Druey of Vaud was one of the two drafters. From 1839 to 1846 the canton was distracted by religious struggles, owing to the attempt of the Radicals to turn the Church into a simple department of State, a struggle which ended in the splitting off (1847) of the "free church." In 1882 the Radicals obtained a great majority, and in 1885 the constitution of 1861 was revised. (*See* SWITZERLAND: *History.*)

VAUDEVILLE, a term that in America is applied to an entertainment of songs, dances, dramatic sketches, acrobatic stunts, etc., each of which is announced and presented as a separate successive performance. In England the nearest corresponding term is "variety theatre" or "music hall"; "vaudeville" being sometimes used for what in America is generally known as "musical comedy" or "revue." This article will deal only with vaudeville as it is known in America.

HISTORY

The American theatrical institution of vaudeville originated in 1883, in Boston, Mass., where a former circus employee, Benjamin Franklin Keith, opened a small museum and show in a vacant candy store next to the old Adams house in Washington street. He called his first "theatre" the Gaiety Museum, and its principal attractions were Baby Alice, a midget weighing 1½ lb., and an ancient (stuffed) "Mermaid." Later among his added attractions were "The Circassian Beauties," a chicken with a human face, and a pair of rising young comedians, Weber and Fields, who performed as a team.

Determined to preserve the general plan of the variety show and at the same time give it refinement and even distinction, young Keith went after the best available stage talent, established strict rules against all forms of vulgarity on the stage, encouraged women and children to patronize his small theatre and began to advertise and describe his show as "vaudeville." He put into operation the idea of continuous performances and soon was able to pay his performers more money than they had been paid in variety and in this manner began to command the best talent available. In 1885 Edward F. Albee joined Mr. Keith and organized the Gaiety Opera Company to present at the lowest popular price the then new and sensational Gilbert and Sullivan light operas.

In 1886 the first link in what has become the longest chain of theatres in the world was added to the parent Boston house, that of the old museum in Providence; following this was the purchase of the old Low's opera house in Providence and the Bijou theatre in Boston. In Philadelphia Mr. Keith built an up-to-date theatre which, with the three other flourishing houses at his command, made possible longer engagements and better salaries to reputable artists. The four theatres were the nucleus from which was developed during the next 40 years the great chain including almost every city of the United States with a population of 100,000 or more. When B. F. Keith died (1911) vaudeville was already the most generally patronized American form of stage entertainment. There were in 1928 approximately 1,000 vaudeville theatres entertaining a daily aggregate of 2,000,000 people with well-chosen acts, feature motion pictures and news reels in every State in the United States and every province of Canada.

Early Vaudeville Artists.—Among the early-day geniuses of variety who became identified with vaudeville were The Four Cohans, of whom George M. Cohan was one, Montgomery and Stone, David Warfield and a number of eminent grand opera stars from Europe. Maurice Barrymore, head of the "Royal Family" of the American stage was one of the early stars of the drama to embark in vaudeville. Ethel and Jack Barrymore made occasional engagements on the big circuits. Mr. and Mrs. Sidney Drew, Sara Bernhardt, Lenore Ulric, Nazimova, William Faversham and hundreds of other great artists of every branch of the theatre have appeared. Dramatists began to write one-act plays and dramatic sketches for vaudeville, and there began a general accession of legitimate actors in short plays.

Growth.—Eastern successes of vaudeville found ready and able followers elsewhere. Kohl and Middleton started vaudeville in Chicago as early as 1886. That same year Gustave Walters opened the Orpheum theatre in San Francisco and launched in the Far West a vaudeville circuit which later merged

with the Keith-Albee organization and which spread and succeeded with almost equal rapidity in the Middle and Far West. F. F. Proctor, manager of the famous Twenty-third Street theatre, New York, changed his policy to continuous vaudeville in 1893; John J. Murdock opened his Masonic Temple Roof as a vaudeville theatre in 1898; Oscar Hammerstein made his Victoria theatre, 42nd street and Broadway, New York, a vaudeville house in 1899; Alex Pantages founded his Northwest Vaudeville circuit in 1900; F. F. Proctor opened his Fifth Avenue theatre (formerly Miner's) in 1900, and Gus Sun started a new Ohio circuit of his own in 1905.

The Keith and Proctor interests joined forces in 1905 to establish the United Booking Office which became the official clearing house and engagement bureau for the employment and booking of vaudeville acts and artists. The great number of minor circuits, independent owners and as yet divergent interests which had now entered the vaudeville field, made it necessary to organize the managers with a view to stabilizing the business, standardizing contracts, regulating conflicting situations and inequalities as between competing theatres and as between the employers and employees of vaudeville. In 1916 the National Vaudeville Artists' Association, Inc., was perfected under the sponsorship of leading members of this branch of the profession. This organization in 1928 listed about 15,000 artists and was regarded as the model combination of fraternal beneficiary industrial organizations.

With the increasing interest in motion pictures during the first three decades of the 20th century, vaudeville houses added picture features, news-reels, comedies, etc., to their programmes. The merger of the two major circuits in 1928—Keith-Albee in the East and the Orpheum in the West—with the simultaneous absorption of some of the foremost motion picture producing companies was one of the greatest developments of the institution of American vaudeville. The miraculous advance of wireless science as applied to motion pictures, radiography and telephonic and phonographic recording brought to public attention the possibilities of television (*q.v.*). Vaudeville was first to envisage the widening possibilities of this new era of entertainment. The Pathé-De Mille motion picture producing organization was absorbed by Keith-Albee; the Film Booking Offices, a motion picture corporation, was next. With that reinforcement major vaudeville added to its resources not only a vast picture producing unit but also the names and services of a number of pre-eminent stars of filmdom. The year 1928 witnessed the further expansion of vaudeville with the unification of the Radio-Keith-Orpheum corporation with the Radio Corporation of America.

Operation.—Vaudeville may be classified as major, minor or independent circuits—the theatres of the latter being operated locally in the same manner that local merchants everywhere may be found operating outside of the great store chain systems of trade. The major circuit and its affiliated minor circuits cooperate through the central metropolitan booking offices; also through the Vaudeville Managers' Protective Association, in which all classifications of the business are represented. This association is also in harmony with the National Vaudeville Artists' Association, with which it co-operates through a joint board of arbitration which rules upon contract forms and all matters of equity as between the employing managers and the artists employed. The cost of acts is fixed by these contracts and varies according to the real, or supposed "drawing value" of the attraction so booked. Celebrity, ability and even notoriety are considered in estimating the draw-power of vaudeville attraction, and the higher the cost the more limited must be the engagement on any circuit. The limitation of the tours of highly expensive acts is due to the fact that the small towns, poorer neighbourhoods and smaller theatres of vaudeville cannot stand the additional "overhead."

The arrangement of the programmes in vaudeville theatres is largely at the discretion of the house manager. The opening act on the stage is usually a silent (technically called "dumb") act, as of acrobats, tumblers or one in which the arrival of the audience will not spoil the effect of the performance. Contrast being deemed of prime importance, similar acts are not listed next to one another. Always there is an effort to build the vaudeville programme towards a climax, so that the most striking and effective numbers come well down upon the programme.

Every modern vaudeville theatre maintains a complete equipment of stage sets which are at the disposal of visiting artists, although most important acts carry their own special scenic, mechanical or decorative necessities, such as athletic apparatus, trick furniture and those properties essential to the full effect and success of their own special act. These they carry with them on tour, and they are handled and placed by the stage crews which every vaudeville theatre employs. Touring vaudeville artists pay their own transportation and maintenance and their salaries are paid by the local manager of the theatre upon the conclusion of their immediate engagement in that house.

(E. F. A.)

VAUGELAS, CLAUDE FAVRE, Seigneur de, Baron de Péroges (1595–1650), French grammarian and man of letters, was born at Meximieu (Ain), on Jan. 6, 1595. He became gentleman-in-waiting to Gaston d'Orléans, and continued faithful to this prince in his disgrace. Vaugelas was among the original Academicians. In his *Remarques sur la langue française* (1647), he maintained that words and expressions were to be judged by the current usage of the best society, of which, as an habitué of the Hôtel de Rambouillet, Vaugelas was a competent judge. He shares with Malherbe the credit of having purified French diction. His book fixed the current usage, and the classical writers of the 17th century regulated their practice by it. Towards the end of his life Vaugelas became tutor to the sons of Thomas Francis of Savoy, prince of Carignan. He died in Paris in Feb. 1650.

See *Remarques sur la langue française,* edited with a key by V. Conrart, and introductory notes by A. Chassang (Paris, 1880). The principles of Vaugelas's judgments are explained in the *Études critiques* (7e série) of M. Brunetière, who regards the name of Vaugelas as a symbol of all that was done in the first half of the 16th century to perfect and purify the French language. *See* also F. Brunot in the *Histoire de la langue et littérature française* of Petit de Julleville.

VAUGHAN, HENRY (1622–1695), called the "Silurist," British poet and mystic, was born of an ancient Welsh family at Newton St. Briget near Scethrog by Usk, Brecknockshire, on April 17, 1622. From 1632 to 1638 he and his twin brother Thomas (*see* next page) were privately educated by Matthew Herbert, rector of Llangattock. Anthony à Wood says that Henry was entered at Jesus college, Oxford, in 1638, but the statement is uncorroborated. He was sent to London to study law, but turning his attention to medicine, he became a physician, and settled first at Brecon and later at Scethrog to the practice of his art. He was regarded, says Wood, as an "ingenious person, but proud and humorous." It seems likely that he fought on the king's side in the Welsh campaign of 1645, and was present at the battle of Rowton Heath.

In 1646 appeared *Poems, with the Tenth Satyre of Juvenal Englished,* by Henry Vaughan, Gent. The poems in this volume are chiefly addressed to "Amoret," and the last is on Priory Grove, the home of the "matchless Orinda," Mrs. Katharine Philips. A second volume of secular verse, *Olor Iscanus,* which takes its name from the opening verses addressed to the Isca (Usk), was published by a friend, probably Thomas Vaughan, without the author's consent, in 1651. The preface is dated 1647, and the reason for Vaughan's reluctance to print the book is to be sought in the preface to *Silex Scintillans: or Sacred Poems and Pious Ejaculations* (1650). There he says: "The first that with any effectual success attempted a diversion of this foul and overflowing stream (of profane poetry) was the blessed man, Mr. George Herbert, whose holy life and verse gained many pious converts, of whom I am the least." His other works are *The Mount of Olives: or Solitary Devotions,* with a translation, *Man in Glory,* from the Latin of Anselm (1652); *Flores Solitudinis* (1654), consisting of two prose translations from Nierembergius, one from St. Eucherius and a life of Paulinus, bishop of Nola; *Hermetical Physick,* translated from the *Naturae Sanctuarium* of Henricus Nollius; *Thalia Rediviva; The Pass-Times and Diversions of a Country Muse* (1678), which includes some of his

brother's poems. Henry Vaughan died at Scethrog on April 23, 1695, and was buried in the churchyard of Llansantffraed.

As a poet Vaughan comes latest in the so-called "metaphysical" school of the 17th century. He is a disciple of Donne, but follows him mainly as he saw him reflected in George Herbert. He analyses his experiences, amatory and sacred, with excessive ingenuity, striking out, every now and then, through his extreme intensity of feeling and his close observation of nature, lines and phrases of marvellous felicity. By his mystical outlook on Nature he no doubt exercised great influence on Wordsworth, who is known to have possessed a copy of his poems, and it is difficult to avoid seeing in "The Retreat" the germ of the later poet's "Ode on Intimations of Immortality." By this poem, with "The World," mainly because of its magnificent opening stanza, "Beyond the Veil," and "Peace," his fame is assured.

The complete works of Henry Vaughan were edited for the Fuller Worthies Library by Dr. A. B. Grosart in 1871. The *Poems of Henry Vaughan, Silurist,* were edited in 1896 (reprint 1905) by E. K. Chambers, with an introduction by Canon H. C. Beeching, for the Muses' Library; *see* also an edition by L. C. Martin (Oxford, 1914), and by E. Hulton (1904); R. Sencourt, *Outlying Philosophy. A literary study of the religious element . . . in the works . . . of H. Vaughan,* etc. (1925); H. W. Wells, *The Tercentenary of Henry Vaughan* (1922).

VAUGHAN, HERBERT (1832–1903), cardinal and archbishop of Westminster, was born at Gloucester on April 15, 1832, the eldest son of lieutenant-colonel John Francis Vaughan, head of an old Roman Catholic family, the Vaughans of Courtfield, Herefordshire. His mother, a daughter of John Rolls of The Hendre, Monmouthshire, was intensely religious; and all the daughters of the family entered convents, while six of the eight sons took priest's orders, three of them rising to the episcopate, Roger becoming archbishop of Sydney, and John bishop of Sebastopolis. Herbert spent six years at Stonyhurst, and was then sent to study with the Benedictines at Downside, near Bath, and subsequently at the Jesuit school of Brugelette, Belgium, which was afterwards removed to Paris. In 1851 he went to Rome. After two years of study at the Accademia dei nobili ecclesiastici, where he became a friend and disciple of Manning, he took priest's orders at Lucca in 1854. On his return to England he became for a period vice-president of St. Edmund's College, Ware, at that time the chief seminary for candidates for the priesthood in the south of England. Since childhood he had been filled with zeal for foreign missions, and he conceived the determination to found a great English missionary college to fit young priests for the work of evangelizing the heathen. With this object he made a great begging expedition to America in 1863, from which he returned with £11,000. St. Joseph's Foreign Missionary College, Mill Hill Park, London, was opened in 1869. Vaughan also became proprietor of the *Tablet,* and used its columns vigorously for propagandist purposes. In 1872 he was consecrated bishop of Salford, and in 1892 succeeded Manning as archbishop of Westminster, receiving the cardinal's hat in 1893.

It was his most cherished ambition to see before he died an adequate Roman Catholic cathedral in Westminster, and he laboured untiringly to secure subscriptions, with the result that its foundation stone was laid in 1895, and that when he died, on June 19, 1903, the building was so far complete that a Requiem Mass was said there over his body before it was removed to its resting-place at Mill Hill Park.

See the *Life of Cardinal Vaughan,* by J. G. Snead Cox (2 vols., London, 1910).

VAUGHAN, THOMAS (1622–1666), English alchemist and mystic, was the younger twin brother of Henry Vaughan, the "Silurist." He matriculated from Jesus college, Oxford, in 1638, took his B.A. degree in 1642, and became fellow of his college. He remained for some years at Oxford, but also held the living of his native parish of Llansantffraed from 1640 till 1649, when he was ejected, under the Act for the Propagation of the Gospel in Wales, upon charges of drunkenness, immorality and bearing arms for the king. Subsequently he lived at his brother's farm of Newton and in various parts of London, and studied alchemy and kindred subjects. He married in 1651 and lost his wife in 1658. After the Restoration he found a patron in Sir Robert Murray, with whom he fled from London to Oxford during the plague of 1665. He appears to have had some employment of state, but he continued his favourite studies and actually died of the fumes of mercury at the house of Samuel Kem at Albury on Feb. 27, 1666. Vaughan regarded himself as a philosopher of nature, and although he certainly sought the universal solvent, his published writings deal rather with magic and mysticism than with technical alchemy. They also contain much controversy with Henry More the Platonist. Vaughan was called a Rosicrucian, but denied the imputation. He wrote or translated *Anthroposophia Theomagica* (1650); *Anima Magica Abscondita* (1650); *Lumen de Lumine* and *Aphorisimi Magici Eugeniani* (1651); *The Fame and Confession of the Fraternity of R.C.* (1652); and others. Most of these pamphlets appeared under the pseudonym of Eugenius Philalethes.

Vaughan was probably, although it is by no means certain, *not* the famous adept known as Eirenaeus Philalethes, who was alleged to have found the philosopher's stone in America, and to whom the *Introitus Apertus in Occlusum Regis Palatium* (1667) and other writings are ascribed. In 1896 Vaughan was the subject of an amazing mystification in the *Mémoires d'une ex-Palladiste.* These formed part of certain alleged revelations as to the practice of devil-worship by the initiates of freemasonry. The author, whose name was given as Diana Vaughan, claimed to be a descendant of Thomas and to possess family papers which showed amongst other marvels that he had made a pact with Lucifer, and had helped to found freemasonry as a Satanic society. The inventors of the hoax, which took in many eminent Catholic ecclesiastics, were some Paris journalists.

The Magical Writings of Thomas Vaughan were edited by A. E. Waite in 1888. His miscellaneous Latin and English verses are included in vol. ii. of A. B. Grosart's Fuller Worthies Library edition of the *Works* of Henry Vaughan (1871). A manuscript book of his, with alchemical and autobiographical jottings made between 1658 and 1662, forms *Brit. Mus. Sloane MS.* 1741. Biographical data are in E. K. Chambers's Muses' Library edition of the *Poems* of Henry Vaughan (1896), together with an account and criticism of the *Mémoires d'une ex-Palladiste.* These fabrications were also discussed by A. E. Waite, *Devil-Worship in France* (1896), and finally exposed by Gaston Méry, *La Vérité sur Diana Vaughan.*

VAUGHAN, WILLIAM (1577–1641), English author and colonial pioneer, son of Walter Vaughan (d. 1598), was born at Golden Grove, Carmarthenshire, his father's estate, in 1577. He was descended from an ancient prince of Powys. His brother, John Vaughan (1572–1634), became 1st earl of Carbery; and another brother, General Sir Henry or Harry Vaughan (1587–1659), was a well-known royalist leader. William was educated at Jesus college, Oxford, and took the degree of LL.D. at Vienna. In 1616 he bought a grant of land in the south coast of Newfoundland, to which he sent two batches of settlers. In 1622 he visited the settlement, which he called Cambriol, and returned to England in 1625. Vaughan apparently paid another visit to his colony, but his plans for its prosperity were foiled by the severe winters. He died at his house of Torcoed, Carmarthenshire, in Aug. 1641.

His chief work is *The Golden Grove* (1600), a general guide to morals, politics and literature, in which the manners of the time are severely criticized, plays being denounced as folly and wickedness. The section in praise of poetry borrows much from earlier writers on the subject. *The Golden Fleece . . . transported from Cambriol Colchis . . . by Orpheus jun., alias Will Vaughan,* which contains information about Newfoundland, is the most interesting of his other works.

VAUGHAN WILLIAMS, RALPH, O.M. (1872–), British composer, was born at Down Ampney, Glos., Oct. 12, 1872. He studied at Trinity College, Cambridge, where he became Mus. Bac. in 1894, and at the Royal College of Music, with Parry and Stanford. The revival of English folk-song, however, in which he became absorbed, unlocked his latent creative powers. *The Norfolk Rhapsodies* for orchestra (founded on folktunes), and the symphonic impression *In the Fen Country,* on original themes of folk-song character, show his development. Other types of distinctively national music, notably the Tudor Church composers and Purcell, strengthened his technical resources and helped to determine his own style in the direction of vigorous melodic

outline, the free use of model scales, an unflinching contrapuntal texture and a high-handed attitude towards harmony. He wrote the choral works *Toward the Unknown Region* (Leeds Festival, 1907), *A Sea Symphony* (Leeds, 1910), the libretto in both cases being drawn from Walt Whitman, and the orchestra work, *A London Symphony* (Queen's Hall, 1914).

His musical work was interrupted by the World War, in which he served first in the R.A.M.C. and then as a gunner. His greatest works date from the post war period. The most important are: *A Pastoral Symphony for Orchestra* (Royal Philharmonic Society, 1922); *A Mass in G Minor* (Westminster Cathedral, 1923); an oratorio, *Sancta Civitas* (Oxford, 1926). A stage scene from *The Pilgrim's Progress,* called *The Shepherd of the Delectable Mountains;* and the ballad opera, *Hugh the Drover* (words by Harold Child), belong to the earlier period when folklore and folk-songs were the primary inspiration of his work.

VAULT, any covering for an enclosed room, formed of small pieces of material, generally wedge-shaped and arranged with the under sides forming a generally curved surface, in such a way that each separate unit is held in place by its neighbours on either side; a continuous arch; also, loosely, any curved ceiling or covering of a room, irrespective of its material. The word is also used for a room or series of rooms built for storing valuables and enclosed with heavy walls, doors and ceilings specially constructed to withstand the effect of fire or the attacks of burglars, and entered by a burglar-proof door (*see* SAFES, STRONG-ROOMS AND VAULTS); and, by a somewhat similar extension, to a masonry enclosure in a graveyard, intended either as a permanent tomb or to receive bodies until a final grave is made.

Structural Implications.—Owing to the action of superincumbent weights upon the wedge-shaped pieces that form it, a vault, like an arch (*q.v.*), exerts side thrust, and unless its lower portions are held in place, it will collapse. Even in such nearly homogeneous structures as the Roman concrete vaults, this tendency is present, and if sufficiently weighted, these vaults, like vaults made of wedge-shaped voussoirs (*q.v.*) will fail because of the pushing apart of their lower edges. The result of this is the development either of very thick walls, whose weight and strength are themselves sufficient to withstand the thrust of vaults placed upon them, or else the balancing of thrusts of adjacent walls against each other or the reinforcement of supporting walls by buttresses. Another method of diminishing thrusts is to arrange the vault in such a manner that its haunches, the lower portions on each side, carry a much greater weight than the centre, or crown.

Another peculiarity of the vault, which tremendously affected its design, is the fact that although a vault is rigid when constructed, its component parts, or voussoirs, have to be independently supported in place in some artificial manner, until the final topmost voussoir, or keystone (*q.v.*) is in place. This problem of supporting the vault during construction has led to many experiments in the arrangement of the separate stones or bricks of a masonry vault. Frequently, for instance, the lower portion of a vault will be built with horizontal layers or courses, and only the top courses of wedge-shaped blocks. In Roman concrete vaults a thin layer of brick, light and easy to support, sometimes acted itself as the centring for the support of the concrete upon it. The most interesting development of this structural necessity was the invention of the system of ribbed vaults by the Romans and its epochal development during the late Romanesque and early Gothic periods. Essentially, this system broke up a large vault area into smaller elements separated by independent arches, whose support and construction was a comparatively easy matter. When once built, these arches themselves served to support the centring for the filling in or web of the vault between the arches.

Types.—Vaults are classified according to their shapes and their construction.

Barrel Vault, sometimes called tunnel vault, one whose cross-section is always the same; a continuous arch.

Annular Vault, a similar continuous vault whose supporting walls are concentric circles, like the vault around the apse of some Romanesque churches.

Groined Vault, one formed by the intersection of two vaults running in different directions, usually at right angles to each other, in such a manner that the area covered by the groined vault has arches on its four sides, thus allowing support to be discontinuous and broken up into piers. The lines of the intersection, generally elliptical, are known as groins. In a single, square, groined vault the direction of the thrust follows the line of the groin, and is on a line continuing the diagonals of the square. Where, however, two such square bays adjoin each other, the sum of the two diagonal thrusts is at right angles to the long dimension of the combined two bays. In addition to perfect groined vaults, in which the two elements at right angles to each other are at the same height and curvature, there are many uses of the groined vault over rectangular, instead of square, bays of which the two intersecting vaults are of different curves and heights. The geometrical intersection of such vaults is a warped and twisted line of considerable awkwardness, and various attempts to simplify the form were made either by slanting and warping the surfaces of the component vaults, or by artificially altering the geometric intersecting line to make a more pleasant pattern. The geometric intersection of a small, low vault, with a large, high one, is called a welsh groin.

Dome (*q.v.*), a vault of generally spherical curvature, whose bottom is a circle in plan.

Pendentive (*q.v.*), a small section of spherical vault used to fill in the upper corners of a square or polygonal room to form a circle at the top for the support of a dome.

Cloistered Vault, the inverse of a groined vault, also formed by the intersection of two vaults at right angles, but so arranged that from the sides of the square, unbroken sections of vault rise to a point in the centre, so that the intersections, instead of projecting like groins, are like valleys. Many so-called square and octagonal domes are square or octagonal cloistered vaults.

Ribbed Vault, a vault subdivided by independent ribs or arches; also loosely used for any vault with projecting ribs on its surface, whether independent and structurally important or not.

Corbelled Vault, the curved covering of a room, formed not by wedge-shaped pieces of material, in the manner of an arch, but by building the covering of horizontal courses, each one of which projects inward slightly over the one below. This form exerts no thrust and is not strictly a vault, although frequently so called.

HISTORY

Egypt and the Mesopotamian Valley.—The vault seems to have been independently invented in many parts of the world in the late Neolithic and early Bronze ages. The earliest important evidences of it extant are those of Chaldea and early Egypt, where it appears as early as the beginning of the 4th millennium B.C. In Chaldea, not only were drains vaulted, but vaults were also used to cover tomb chambers and probably halls in temples and palaces as well. The vault holds a dominant place in Mesopotamian architecture through all the vicissitudes of Sumerian, Babylonian and Assyrian cultures. During the Assyrian period (*c.* 1000 to 600 B.C.) vaults of unburned brick were the chief method used for covering the long, tunnel-like halls of the Assyrian palaces. The drains which were so important a feature of the palace platforms were roofed with walls of baked brick, and there is preserved an ingenious example from Nimroud (9th century B.C.) showing one method of obviating the necessity for centring. In this case the drain abuts upon a thick wall through which it passes by an arch. The rings of which the vault is formed, instead of being placed in successive vertical planes, are all inclined at 45°, so that each completed ring furnishes a certain amount of support for the one built after it. In addition to the barrel vault, the Assyrians were undoubtedly acquainted with the dome, as many Assyrian reliefs show villages with domed structures, and in some cases the curve of the dome is too flat for it to have been constructed as a corbelled vault.

Egyptian vaults were more common in the earlier periods than in the later and examples in tomb passages at Dendereh undoubtedly go back to the earliest dynasties. Under Rameses II. a granary built behind the Ramesseum at Thebes also had vaulted

chambers of which the lower courses were laid horizontal, in order to reduce the span. The Egyptians, however, apparently never appreciated the possibility of cut stone vaulting; the nearest approach to it, in the great period, was the so-called vaulted chambers in the temple built by Seti I. at Abydos.

The Aegean and Greece.—In the pre-classic Aegean, the corbelled vault achieved some of its most remarkable expressions, as in the famous tholoi, or beehive shaped tombs (*e.g.*, tholos of Atreus, at Mycenae, *c.* 1200 B.C.), which are probably modelled on tholos type huts of unburned brick, of which many foundations have been discovered in many sites in Crete and the Grecian islands. Like the Egyptians, the Greeks knew the principle of the arch and the vault, and used it occasionally, although they never gave it an important architectural position, and during the best periods the post and lintel system of construction entirely superseded the vault.

In the Hellenistic period, probably due to the close touch with western Asia that was such a marked feature of post-Alexandrian culture, the arch and the vault again appear, still, however, in isolated instances, in some of which Roman influence may be already present. Thus there is a small hall at Pergamon, Asia Minor, roofed with a groined vault which two schools of thought date differently, one claiming that it is pre-Roman and the other that it is a piece of Roman construction (G. Rivoira, *Roman Architecture,* 1925, p. 78). It is incontestable, however, that barrel vaults, both straight and sloping, were used in Hellenistic tombs and city gates.

Italy.—It is uncertain when and how the Etruscans first discovered vaults, but as early as the 6th century B.C., a tomb from Orvieto, now in Florence, had a simple barrel vault, and by the 4th century they were common, as in the so-called grotto of Pythagoras in Cortona. Moreover, such city gates as those of Falerii, Volterra and Perugia, which date from the 4th and 3rd centuries, B.C., reveal not only a definite knowledge of vault construction but an impressive attempt to give it architectural effect.

It remained for the Romans to absorb the Etruscan knowledge and develop it into the main feature of their architectural construction, and to add to the idea of the cut stone vault, vaults of brick in which the bricks were flat and the radiation taken up in the joints, and vaults of rubble or concrete, roughly dumped upon a wooden centring, whose form it took as it hardened. Vault types were also increased, the cloistered vault appearing in the early 1st century, B.C., as in the Tabularium at Rome (*c.* 80 B.C.); the cross or groined vault, in small square sections supported on arches, so that the whole could be carried by piers, as in the Septa Julia (27 B.C.); independent groined vaults over rooms, common from the time of Nero on (Golden house of Nero, *c.* A.D. 65); and the spherical vault, which appeared first, tentatively, in niche and apse tops, and reached a climactic flowering in the Pantheon of Hadrian.

Under the empire, cut stone vaults were common only in the provinces, like those in Baalbek, Syria or the ribbed vault of the beautiful so-called temple of Diana at Nîmes, France (time of Tiberius). The latter shows one of many interesting experiments made in order to localize thrust and weight; the vault consists of a series of independent stone ribs, on the upper corners of which sinkages are cut to carry stone slabs covering the space between them. A similar experimental genius was at work in the Roman province of Syria, where during the 3rd, 4th and 5th centuries many cut stone buildings were built, in which stone arch ribs supported a roof, either of horizontal stone slabs, as in the so-called basilica at Shakka, or following the curves of the arches, as in the delicately designed praetorium at Musmiyeh. In Rome, vaults were usually of brick or concrete, even when the sub-structure was cut stone, and in the great number of cases, in a combination of the two materials. Brick ribs were frequently used in important positions, and were occasionally double, with the two lines connected by occasional large tiles, forming a light but exceedingly rigid structure. In some cases the whole vault centring was covered with tiles laid flat-wise, which acted themselves as centring for the concrete, and were keyed to it by occasional tiles set end-wise. From the time of the Antonines on, vaults were extremely light, and at times daringly thin, strengthened, not only by ribs of brick, but by arches of brick, built in the plane of the vaults between the ribs. This Roman structural ingenuity grew continuously till the end of the 4th century, long after decorative art had begun to decay.

With these ingenious vaults the Romans produced their characteristically large and impressive interiors, and by the use of cross vaults, as in the great halls of the thermae (*see* BATHS), were enabled to flood them with light from clerestorey windows. Not only were all types of barrel and groined vaults used, as well as the simple dome, but constant experiments were made, almost up to the time of the fall of Rome, in new combinations and novel forms. Many attempts were made to place a dome over a polygonal or square room, thus approaching the pendentive (*q.v.*), and all sorts of scalloped and varied dome types are found, like the scalloped dome of the vestibule of the Piazza D'Oro and the niche of the Serapeum, both in the villa of Hadrian, and the daringly delicate so-called temple of Minerva Medica, at Rome, a garden building of the time of Valerian.

The earlier vaults were covered with stucco and delicately panelled in relief, occasionally further decorated with colour, as in the tepidarium of the baths of the forum at Pompeii (*c.* 80 B.C.), and various rooms in the Golden house of Nero, as well as the remarkably rich subterranean basilica outside the Porta Maggiori at Rome, which probably dates from the time of Augustus. In the later empire, the custom of coffering, or decorating with deeply sunk geometric panels, like those cut into the dome of the Pantheon at the time of Septimius Severus, became common.

The scale of many of these Roman vaults is, even to-day, astounding. Thus the throne room of the palace of Domitian had a barrel vault 97 ft. in span, 8 ft. wider than the nave of S. Peter's; the basilica of Constantine, a groined vault 84 ft. in span; and the domes of the calidarium, in the baths of Caracalla and of the Pantheon, are respectively 116 and 140 ft. in diameter. For a thorough discussion of Roman vaulting *see* G. Rivoira, *Roman Architecture,* noted above.

Byzantine.—The great contribution of the Byzantine builders to vaulting was the final logical development of the pendentive (*q.v.*) through the recognition of the fact that all of the Roman attempts to put a dome on a square plan by means of corbelling were awkward followings of a wrong method, and the discovery of the simplest and most efficient method by substituting triangular sections of a spherical vault. In this way, a dome could be supported on pendentives, which could, in turn, be supported on four great arches, so that the entire weight was brought down upon piers at the corners—a method that at once gave enormous freedom to the planning of a building. The only requirement was that sufficient buttresses should be furnished to withstand the thrust of the great arches. There is much discussion as to where and how the pendentive was finally developed; it is very probably an eastern invention, and may have originated in the cut stone work of Roman Syria. Fully developed pendentives occur during the 5th century, *e.g.*, the church of S. Sophia at Salonica, but it was in the church of S. Sophia at Constantinople (begun 532) that the possibilities of this type of construction were first taken advantage of. The use of great half domes, with smaller domed niches opening from them, at each end of the building, gained a sense of direction—a long axis—while preserving the dominance of the central dome. The two first domes built on this church both collapsed soon after construction, and it is probably only with the building of the present dome that the circle of 40 windows around the base was introduced, which not only lightens the weight of the dome but also furnishes a beautiful illumination for the interior. These windows are not placed in a drum, as in later Byzantine work, but pierced through the curving surface of the dome itself, with buttresses between them on the exterior, whose upper sides are swept up in a curve to meet the curve of the dome. Little hood arches are thrown across between the buttresses, over the windows, and on the exterior give something of the effect of a drum. There is a similar lack of drum in S. Mark's at Venice (2nd half of the 11th century);

and in many Byzantine churches, even where a marked drum exists on the exterior, there will be little or no drum inside.

Besides using pendentives to support a dome, the Byzantine designers discovered that a continuous, spherical vault, ending in arches at the walls, could be used over any square or rectangular space. This is known as the pendentive dome. An early example is in the tomb of Galla Placidia, at Ravenna (*c.* 440). This type is used in combination with all sorts of groined and intersecting vaults in various subsidiary positions. The variety and ingenuity of the side aisle vaults of S. Sophia at Constantinople is remarkable, and is matched by the similar variety in the side aisle vaults of such Italian Byzantine churches as that of S. Vitale, at Ravenna (547) and S. Lorenzo, at Milan (*c.* 560).

In the effort to lighten vaults the Byzantine builders carried to its logical conclusion a method used experimentally by the Romans—that of incorporating in the masonry of a vault, hollow jars or tubes. The dome of S. Vitale, at Ravenna, is built almost entirely of a continuous double spiral of such tubes, shaped so that one fitted into the neck of the next. For a similar reason, the dome of S. Sophia at Constantinople was built of a special type of exceedingly porous and spongy brick.

Mohammedan.—The Mohammedan builders borrowed extensively from Byzantine precedent. In Persia, there is an additional legacy from the enormous vaults built by the Sassanians. Not only did such colossal vaults as those at Firuzabad (459–485) and Ctesiphon (*c.* 550, 82 ft. span) vitally inspire the great vaulted entrances of Persian mosques, but also the wide-spread use of niche-shaped squinches, instead of pendentives under a dome, is without doubt due to the same source. But the Mohammedans developed many characteristic vaulting forms of their own. Especially noteworthy is the multiplication of niche squinches until the stalactite form is achieved, and in the Moorish and Indian styles, the ingenious use of cross ribs, in a square or polygon, to enable it to be covered with a dome of smaller size. Examples in Spain are the vaults over the Maksoura, or enclosed prayer space of the great Mosque at Cordova (11th century), and the even richer vault of the chapel Villa Viciosa, in the same mosque. In India the most remarkable example is that of the vast tomb of Mohammed Sikri at Bijapur (1626–60), in which, by arranging arched ribs in two intersecting squares, to form an eight-pointed star, in plan, a hall 135 ft. square is reduced to a central opening 97 ft. in diameter, above which is a dome 124 ft. across, so that there is a gallery around the inside of the dome at its spring. A similar scheme is used in the great mosque of the same town (*c.* 1560), in which a square 70 ft. across is reduced to a circle 57 ft. in diameter.

China.—The Chinese knew the principle of the arch and vault at an early date, probably having developed it independently. Thus vaults occur in the two "Wild Goose" pagodas at Sianfu in the province of Shensi, which are as early as the beginning of the 8th century. The most monumental extant uses of the vault, are however, chiefly of the Ming dynasty and later, and in the four northern provinces of Chili, Shantung, Shensi and Shansi. Groined vaults are not used, but barrel vaults are common in city gates (Peking, Sianfu and Taiuanfu), temple and palace entrance halls (imperial palace at Peking, Temple of Heaven, Peking, etc.) and in many beautifully designed and carefully executed cut-stone bridges. Barrel vaults are occasionally used over temple halls, set at right angles to the axis of the temple, and entered by smaller barrelled vaults and arched gateways in the thickness of the wall. The most remarkable examples of this use occur in the masonry built temple groups of Kin Tze and Shuang la Sze at Taiuanfu, both in Shansi and both dating from the later years of the Ming dynasty. Later examples are the many barrel vaults in the great monastery, temple and palace group, built in the 18th century at Jehol.

Romanesque.—Romanesque vaulting represents the slow development of untrained builders in vaulting a church structure, generally of basilican plan. In this development they made use of Roman precedent, they copied Byzantine technique and they used their own native ingenuity. The groined vault appeared early in aisles and the annular vault, around apses and for circular structures; the dome and the octagonal cloistered vault were used for the crossing. The difficulty was with naves, for the buttressing of a nave vault, high in the air, was a troublesome necessity. Barrel vaults were first tried, either semi-circular or pointed, the pointed section being used because it exerted less thrust, and buttressing was largely achieved by means of the triforium gallery vaults, over the side aisles, which were either semi-circular or quadrant shaped, as in the church of S. Sernin, at Toulouse (late 11th century). Vaulting was usually of stone, and varied from extremely rough workmanship, covered with plaster, as in S. Nectaire, in Auvergne, France (beginning of the 12th century), to the beautiful cut stone of such domed churches as that at Cahors, France (1119). The barrel vaulted nave had the drawback of being dark, as only the smallest clerestorey windows —if any—were possible, and the centring required for it was unduly heavy. The first improvement was the introduction of cross ribs, as in Valence cathedral (early 12th century), which strengthened the vault over the piers and simplified the question of centring. The matter of lighting was more difficult; an early, interesting experimental solution is that of S. Philibert, at Tournus, France, where heavy arches were thrown across the nave at each pier, and walls carried up upon them. Upon these, little barrel vaults were built, running across the nave. The result permitted large clerestorey windows and was statically correct, but the interior effect was unpleasantly discontinuous. Another remarkable solution was reached in the domed churches of Aquitania, where Byzantine influence was strong, but the most beautiful of these, such as Cahors and Angoulême (1132) have no side aisles, and the difficulty of domed churches with side aisles was just as great as in those with barrel vaults; this may be readily seen in the impressive and gloomy interior of Le Puy en Velay (12th century).

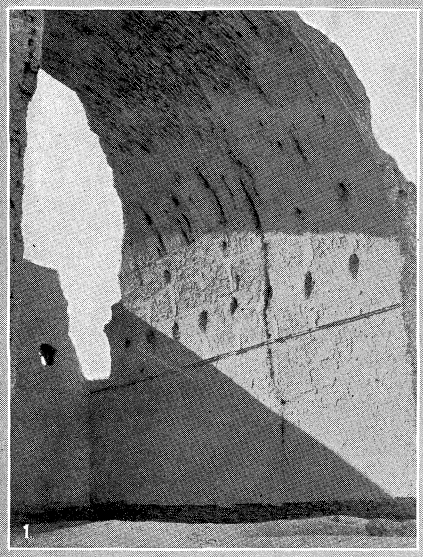
The groined vault, which was the obvious answer to the difficulty, was hard to construct because the different widths of nave and aisles, meant that square vaults over the one necessitated oblong vaults over the other. And the intersections of the oblong vaults were twisted and ugly. Furthermore, the aisle vaults around an apse presented difficulties in that the cross vaults were cone-shaped and intersected the annular surface of the aisle vault in unpleasant, twisted lines, with the point where the groins crossed below the high point. No matter how the surfaces were warped, the problem of the intersection remained.

The answer to the problem of nave vaulting was first found by the Lombards in S. Ambrogio, at Milan (begun in the 10th, but probably vaulted about the middle of the 11th century). In this vault, two bays of the aisles are made to equal one of the nave, so that all the vaulting bays are approximately square. Moreover, the system of ribs, which had only appeared tentatively before, was here applied completely; not only were cross ribs built at each alternate pier across the nave, but in addition, arched ribs were built on the groin lines. In this way, a framework of arches was created, easy to construct, and the filling in of the surfaces between, or webs, could be done in sections. The cross vaults allowed clerestorey lighting.

The Normans made the next great advance, through the introduction of an additional rib across the nave, on the piers between those that carried the cross arches, and the treatment of each of the two halves of the nave vaulting bay, with its own wall arch and window; the cross vaults thus established, ran obliquely to the centre. The result is the sexpartite or six-part vault (*q.v.*). Along with this came the solution of the buttressing problem by means of rudimentary flying buttresses. Variations of the six-part vault appear in the two great abbey churches at Caen (Abbaye aux Hommes, Abbaye aux Dames, founded by William the Conqueror and his wife and vaulted in the 12th century). In the Abbaye aux Dames, the idea is tentative only, and the intermediate rib carries a simple wall up to the ridge of the single cross vault. Durham cathedral (1128–1133) has a complete system of groined, ribbed vaults, in which the vaults are four-part instead of six-part, although alternate cross ribs are omitted.

French Gothic.—Early French Gothic vaults merely carried the Norman experiments one step further, by combining with the idea of ribbed and groined vaults the addition of pointed arches,

VAULT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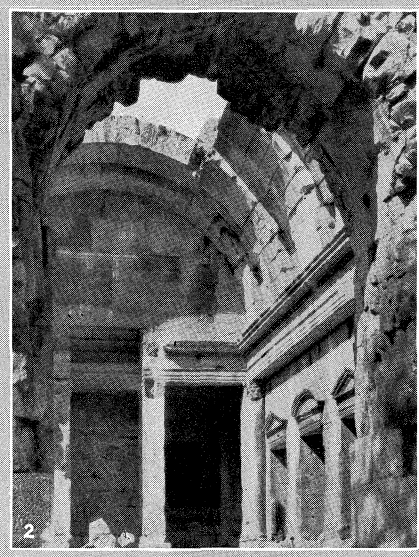
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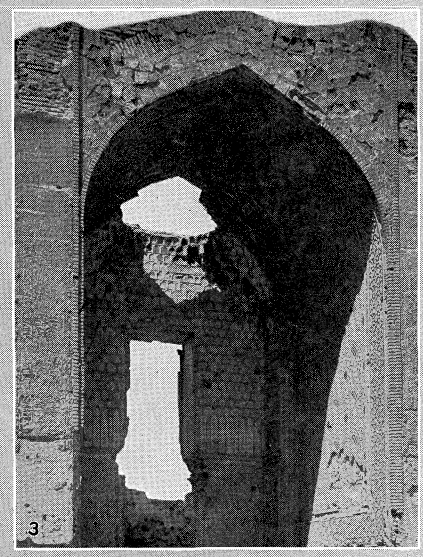
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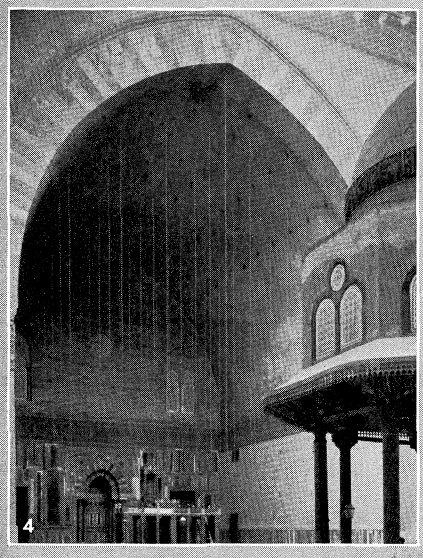
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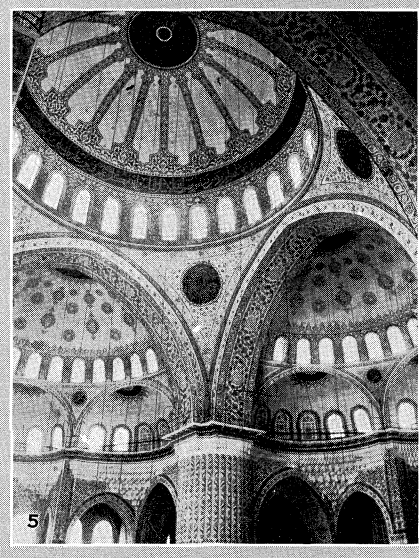
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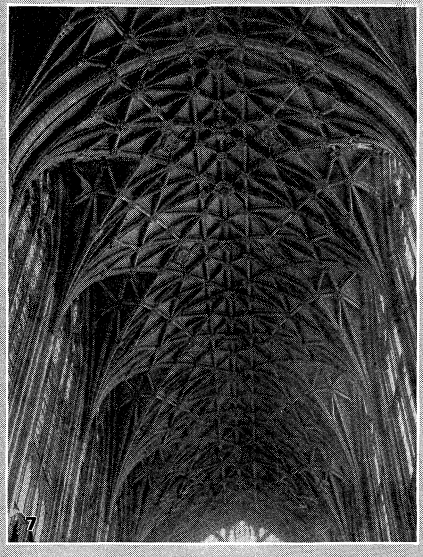
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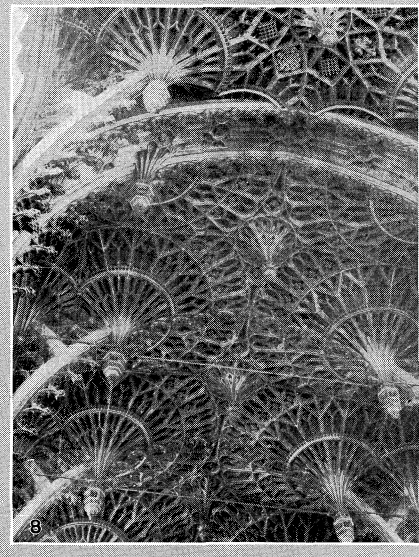
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VAULTS OF THE 1ST CENTURY B.C. TO THE 14TH CENTURY A.D.

1. The great vault at Ctesiphon, *c.* 550. 2. The Roman barrel vault of the temple of Diana at Nîmes, France, built 25 B.C. 3. Vault at Rhiwasar Rhargivd in Persia. 4. One of the vaulted halls, and 5. Dome of the mosque of Sultan Achmed at Constantinople, 1609–14. 6. Early French Gothic nave vaulting of the cathedral of Notre Dame at Paris, late 12th century. 7. Perpendicular English Gothic vault, Gloucester cathedral, 1377. 8. Vault of the nave of the Henry VII. chapel, Westminster Abbey. 9. Fan vault of King's College chapel, Cambridge

VAULT

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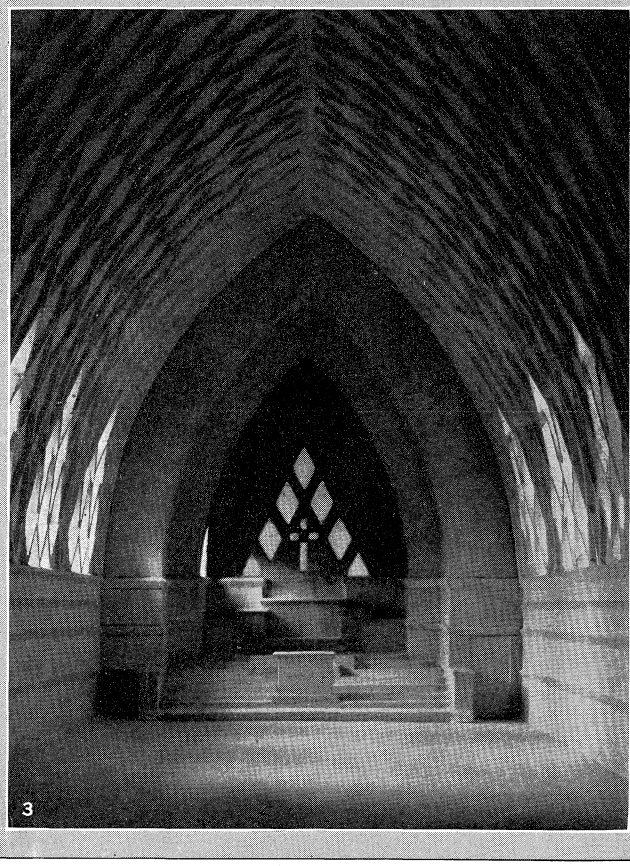

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MEDIAEVAL AND MODERN VAULTS

1. English decorated Gothic vault of the presbytery of Lincoln cathedral, 1255–80. 2. The nave of S. Ambrogio at Milan, perhaps the earliest complete ribbed, probably dating from the middle of the 11th century. It was the precursor of the Norman vaulting which led eventually to the Gothic vault. 3. The Danish church at Berlin, 1923, has a vault of wooden construction. Like a masonry vault, it exerts thrust. Architect, Otto Bartning. 4. St. Paul's chapel, Columbia University, New York, has a tile vault, of the type known as Guastavino. Architect, John Mead Howells

which still further simplify the construction. The groin ribs were usually left semi-circular, but the cross ribs, being pointed, and springing from the same level, could have their ridges at the same height. Furthermore, the wall arches, by a combination of stilting and pointing, could also be made sufficiently high, although they were so much narrower than either cross or diagonal ribs, and thus, not only was a harmonious wall produced, with ridges nearly level, but also a still further increase in the size of clerestorey windows permitted. In the early Gothic churches of France, the six-part vault was the most popular; *e.g.*, Laon (begun 1160) and Notre Dame, at Paris (begun 1163). By the end of the century, however, the four-part vault completely superseded the earlier type, and with few exceptions in very late work, remained constant throughout the Rayonnant and Flamboyant periods. In general the development was toward more and more level ridges and deeper and slimmer ribs. The web filling is characteristic; formed of slightly arched stone courses, varying in width, in such a manner as to bring the courses generally parallel to the ridge. The web was apparently built without extensive centring, merely using a curved plank under each course, the plank being arranged in two pieces so as to be adjustable in length. The stone cutting of the ribs and supports is of the most perfect type and shows a definite attempt to utilize the material in the most efficient manner. Characteristic is the fact that all the lower courses of the ribs are horizontal instead of radiating and where the ribs come close together they are all cut on one stone, the whole mass forming what is technically known as a *tas de charge*.

Other Continental Gothic.—The Gothic vaults of Germany and Austria were largely based on French forms, until the 15th century, when all sorts of fantastic ribbing came into use. Again the English influence was strong, but instead of keeping the ribs in one plane, as in English work, they were twisted and curved, until their structural basis was well nigh forgotten. The same was true to a less extent of Spanish Gothic, where the bold simplicity of the French type continued in force almost until the dawn of the Renaissance. Italian Gothic vaults were generally large in scale, with ribs unmoulded, or moulded in the simplest possible manner. The cathedral at Florence (nave begun 1357) shows how with structural ideas identical with those of the north, an utterly different effect could be produced, in which, despite the pointed arches the tradition of Roman scale is unmistakably evident.

English Gothic.—The French basis of English Gothic through the work of William of Sens at Canterbury (1175), was soon forgotten through differences in technique that developed. The first of these was a different method of web building; English webs generally consisted of courses of stone, which were equal in width throughout. Thus, due to the curving of the surfaces, they were not parallel to the ridge, and created awkward intersections there. In order to cover this intersection ridge ribs were sometimes introduced. At about the same time intermediate ribs, between cross and diagonals were introduced, which diminished the amount of web that had to be built at one time, and made its construction and support simpler. Thus in the choir of Lincoln cathedral (*c.* 1280) there are no true diagonals and the groin ribs are arranged so that the cross vaults are oblique, with intermediates running from the intersections of the groin ribs to the pier on the other side. Such intermediate ribs are called tiercerons, and in addition to assisting the structural solidity of the vault and its ease of construction, tiercerons became a great source of decorative richness. The climax is seen in the crowded spreading ribs of Exeter cathedral (1292–1367), in which there is one tierceron between each cross and diagonal rib, and two between each diagonal and wall rib. The resultant effect, in which each pier thus carries 11 separate ribs radiating from it, is inexpressibly soaring and graceful. Further richness is gained by the sculptured bosses with rich leafage, which cover the intersections of the ribs.

Later in the 14th century there is a further decorative development through the introduction of small, intermediate ribs, between tiercerons, cross and diagonal ribs, with which intricate patterns are formed. These intermediate ribs are called liernes, and by their use, the spaces between ribs are made so small that they can be covered by two or three slabs of stone. Remarkable examples of this type of vaulting exist at Norwich cathedral (15th century); Winchester (1394–1486) and Gloucester (*c.* 1350).

In Gloucester occurred the first example of the next development—the invention of the fan vault, used in the cloisters (1350–1410). In fan vaulting, each severy, or the section supported on each pier, takes a conoidal shape, so that all of the ribs upon it have approximately the same curvature. Moreover, the ribs are so multiplied and connected by little arches, that the web disappears, except as panelled areas, and the whole vault becomes a homogeneous mass of carefully cut stone. A fan vault, accordingly, is strictly not a ribbed vault at all, but merely a vault consisting of a series of conoids of panelled stone-work intersecting each other. Full advantage was taken of the freedom in line design that this system offered, and all sorts of cusps and other tracery forms were used; there was no limit to the variety of design except the ingenuity of the stone cutter. Fan vaulting reached its climax in the two almost contemporary ceilings in the King's College chapel, Cambridge, and the Henry VII. chapel at Westminster, both completed by 1515. In the former, the vault is simple, with strongly marked cross arches to give it rhythm and definiteness. In the Henry VII. chapel, however, a remarkable variation is found, for the entire vault is supported upon pendents, cut on huge stones that are part of a great cross arch, most of which is concealed. The entire exposed surface is covered with the richest possible traceried panelling, and the line of the cross arches heavily cut. The result forms one of the greatest *tours de force* of stone cutting in the world.

Renaissance.—The great contribution of the Renaissance period to vaulting was its development of the dome (*q.v.*) and especially of the dome on a drum, and with a lantern. This type of design usually necessitated a different curve for the exterior and the interior, and hence the use of domes with two or more shells. The most remarkable example of this type is the dome of S. Peter's at Rome, originally designed by Michelangelo, who completed the drum before his death in 1564, the dome itself being completed by G. della Porta and D. Fontana (1588–90). A remarkable modern instance is the triple dome of the Panthéon in Paris (1764–90) by J. Soufflot, daring in the lightness of its masonry. The greater number of these domes require chains, built in around the base to withstand the thrust.

Another purely Renaissance type of vault is the so-called cove ceiling with penetrations. This consists of a semi-elliptical vault with small cross vaults penetrating its sides, these cross vaults being designed to slope up, with a warped, conical surface, so that their intersections with the main vault, come to a point at the top and take perfect circular or elliptical curves at the sides. This was a favourite type in the Italian Renaissance, as it offered many interesting shapes and surfaces for painted and modelled decoration. Usually a moulding or painted band was carried horizontally along the sides of the vault at the level of the tops of the penetrations. The groins were sometimes decorated with a similar band. One of the most beautiful of such vaults is that over the loggia of the Villa Farnesina, designed by B. Peruzzi (1509–11), and decorated by G. Romano and F. Penni from designs by Raphael (1516–18).

In the Baroque period continuous barrel vaults were the general covering for important palace rooms, frequently built in plaster and non-structural. The decoration consisted in the main of mural paintings surrounded by scrolled and garlanded, curving, modelled frames, gilded, like the vault of the Galérie d'Apollon, in the Louvre at Paris, designed by C. Le Brun, during the reign of Louis XIV., the ceiling painting by E. Delacroix (1849).

Modern.—The two new materials which have most influenced modern vault design are structural terra cotta tile and reinforced concrete. By the use of a thin terra cotta tile, vaults generally domical, have been produced over large halls, with exceedingly slight rise, and with the added advantage of light weight. Similar tiles are also extensively used for the filling or webs of modern versions of the Gothic ribbed vault, in which the ribs are either of cut stone or reinforced concrete. An interesting example of

a tile vault of this type, with nave and choir vaulted with low, pendentive domes, and crossing covered by a dome on a drum, is the chapel of Columbia university, New York.

Concrete without reinforcement is used in the Roman manner by J. F. Bentley in the domes of Westminster cathedral, London, (1895–1903). The introduction of steel reinforcement to take the tensile stresses gave an enormous new freedom to vault design as it allowed the construction of large vaults that would exercise little or no thrust, thus forming a homogeneous arched beam. This quality has been taken advantage of in much recent work, especially on the Continent, as in the Planetarium of the Düsseldorf exposition (1926), by W. Kreis; the flat vault of the church of Notre Dame at Raincy (1924) by Perret Frères; and most remarkable of all, the great dirigible hangar at Orly, near Paris, designed by E. Freyssinet (1916). (*See* ARCH; BYZANTINE AND ROMANESQUE ARCHITECTURE; DOME; FAN VAULT; GOTHIC ARCHITECTURE; MOHAMMEDAN ARCHITECTURE; RENAISSANCE ARCHITECTURE; ROMAN ARCHITECTURE; ROOFS; SEXPARTITE VAULT.)

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(T. F. H.)

VAULTING: *see* POLE VAULTING.

VAUQUELIN, LOUIS NICOLAS (1763–1829), French chemist, was born at Hébertot in Normandy on May 16, 1763. He was laboratory boy to an apothecary in Rouen (1777–1779), and after various vicissitudes he obtained an introduction to A. F. Fourcroy, in whose laboratory he was an assistant from 1783–1791. At first his work appeared as that of his master and patron, then in their joint-names; but in 1790 he began to publish on his own authority, and between that year and 1833 his name is associated with 376 papers. Most of these were simple records of patient and laborious analytical operations, in the course of which he detected two new elements—beryllium (1798) in beryl and chromium (1797) in a red lead ore from Siberia. In organic chemistry he is known as the discoverer of quinic acid, asparagine, camphoric acid, and other naturally occurring compounds. He held various offices, and finally succeeded Fourcroy (1809) as professor of chemistry to the Medical Faculty in Paris. He died at his birthplace on Nov. 14, 1829.

He published *Manuel de l'Essayeur,* in 1812.

VAUQUELIN DE LA FRESNAYE, JEAN (1536–1608), French poet, was born at the château of La Fresnaye, near Falaise, in 1536. He studied the humanities at Paris and law at Poitiers and Bourges. He fought in the civil wars under Marshal Matignon and was wounded at the siege of Saint-Lô (1574). Most of his life was spent at Caen, where he was president, and he died there in 1608. La Fresnaye was a disciple of Ronsard, but, while praising the reforms of the Pléiade, he laid stress on the continuity of French literary history. He was a student of the trouvères and the old chroniclers, and desired to see French poetry set on a national basis. These views he expounded in an *Art poétique,* begun in 1574, but not published until 1605.

His *Foresteries* appeared in 1555; his *Diverses poésies,* including the *Art poétique,* the *Satyres françoises,* addressed to various distinguished contemporaries, and the *Idylles,* with some epigrams and sonnets, appeared in 1605. Among his political writings may be noted *Pour la monarchie du royaume contre la division* (1569).

The *Art poétique* was edited by G. Pellissier in 1885. It is summarized for English readers in vol. ii. of George Saintsbury's *History of Criticism.* A notice of the poet by J. Travers is prefixed to an edition of the *Oeuvres diverses* (Caen, 1872).

VAUVENARGUES, LUC DE CLAPIERS, MARQUIS DE (1715–1747), French moralist and miscellaneous writer, was born at Aix in Provence on Aug. 6, 1715. His family was poor though noble; he was educated at the collège of Aix, where he learned little—neither Latin nor Greek—but by means of a translation acquired a great admiration for Plutarch. He entered the army as sub-lieutenant in the king's regiment, and served for more than ten years, taking part in the Italian campaign of Marshal Villars in 1733, and in the disastrous expedition to Bohemia in support of Frederick the Great's designs on Silesia, in which the French were abandoned by their ally. Vauvenargues took part in Marshal Belle-Isle's winter retreat from Prague. On this occasion his legs were frozen, and though he spent a long time in hospital at Nancy he never completely recovered. He was present at the battle of Dettingen, and on his return to France was garrisoned at Arras. His military career was now at an end. He had long been desired by the marquis of Mirabeau, author of *L'Ami des hommes,* and father of the statesman, to turn to literature, but poverty prevented him from going to Paris as his friend wished. He wished to enter the diplomatic service, and made applications to the ministers and to the king himself.

These efforts were unsuccessful, but Vauvenargues was on the point of securing his appointment through the intervention of Voltaire when an attack of smallpox completed the ruin of his health and rendered diplomatic employment out of the question. Voltaire then asked him to submit to him his ideas of the difference between Racine and Corneille. The acquaintance thus begun ripened into real and lasting friendship. Vauvenargues removed to Paris in 1745, and lived there in the closest retirement, seeing but few friends, of whom Marmontel and Voltaire were the chief. Among his correspondents was the archaeologist Fauris de Saint-Vincens. Vauvenargues published in 1746 an *Introduction à la connaissance de l'esprit humain,* with certain *Réflexions* and *Maximes* appended. He died in Paris on May 28, 1747.

The bulk of Vauvenargues's work is small, but its interest great. His real strength is in a department which the French have always cultivated with greater success than any other modern people—the expression in more or less epigrammatic language of the results of acute observation of human conduct and motives, for which he had found ample leisure in his campaigns.

An edition of the *Oeuvres* of Vauvenargues, slightly enlarged, appeared in the year of his death. There were some subsequent editions, superseded by that of M. Gilbert (2 vols., 1857), which contains some correspondence, some *Dialogues of the Dead,* "characters" in imitation of Theophrastus and La Bruyère, and numerous short pieces of criticism and moralizing. The best comments on Vauvenargues, besides those contained in Gilbert's edition, are to be found in four essays by Sainte-Beuve in *Causeries du lundi,* vols. iii. and xiv., and in Villemain's *Tableau de la littérature française au XVIIIme siècle.*

See also M. Paléologue, *Vauvenargues* (1890); *Selections from . . . La Bruyère and Vauvenargues,* with memoir and notes by Miss Elizabeth Lee (1903); E. Gosse, *Three French Moralists* (1918).

VAUXHALL, a district on the south bank of the river Thames, in London, England, included in the metropolitan borough of Lambeth. The manor was held by Falkes de Breauté (whence the name, Falkes hall) in the time of John and Henry III. About 1661 public gardens were laid out here, known as the New Spring garden, and later as Spring gardens, but more familiar under the title of Vauxhall gardens. They soon became the favourite fashionable resort of the metropolis; but as a place of general entertainment they underwent great development from 1732 under the management of Jonathan Tyers (d. 1767) and his sons. In 1822, with the approval of George IV., who frequented the gardens before his accession, the epithet Royal was added to their title. By the middle of the 19th century, however, Vauxhall had lost its high reputation; in 1859 the gardens were finally closed, and the site was quickly built over.

VAUX OF HARROWDEN, THOMAS VAUX, 2ND BARON (1510–1556), English poet, eldest son of Nicholas Vaux, 1st Baron Vaux, was born in 1510. In 1527 he accompanied Cardinal Wolsey on his embassy to France; he attended Henry VIII. to Calais and Boulogne in 1532; in 1531 he took his seat in the House of Lords, and was made Knight of the Bath at the coronation of Anne Boleyn. He was captain of the Isle of Jersey

until 1536. He married Elizabeth Cheney, and died in Oct. 1556. Sketches of Vaux and his wife by Holbein are at Windsor, and a finished portrait of Lady Vaux is at Hampton Court. Two of his poems were included in the *Songes and Sonettes of Surrey* (Tottel's *Miscellany,* 1557). They are "The assault of Cupid upon the fort where the lover's hart lay wounded, and how he was taken," and the "Dittye . . . representinge the Image of Deathe," which the gravedigger in Shakespeare's *Hamlet* misquotes. Thirteen pieces in the *Paradise of Dainty Devices* (1576) are signed by him. These are reprinted in Dr. A. B. Grosart's *Miscellanies of the Fuller Worthies Library* (vol. iv., 1872).

VAVASSOR, in its most general sense a mediate vassal, *i.e.,* one holding a fief under a vassal. The word was, however, applied at various times to the most diverse ranks in the feudal hierarchy, being used practically as the synonym of vassal. Thus tenants-in-chief of the Crown are described by the Emperor Conrad as *valvassores majores* as distinguished from mediate tenants, *valvassores minores.* Gradually the term without qualification was found convenient for describing sub-vassals, tenants-in-chief being called *capitanei* or *barones.* Its implication, however, still varied in different places and times. Bracton ranks the *magnates seu valvassores* between barons and knights; for him they are "men of great dignity," and in this order they are found in a charter of Henry II. (1166). But in the *regestum* of Philip Augustus we find that five vavassors are reckoned as the equivalent of one knight. Finally, Du Cange quotes two charters, one of 1187, another of 1349, in which vavassors are clearly distinguished from nobles.

The derivation of the word vavassor is very obscure. Some would derive it from *vassi ad valvas* (at the folding-doors, *valvae*), *i.e.,* servants of the royal antechamber. Du Cange, with more justice, regards it merely as an obscure variant of *vassus.*

VÄXJÖ, VEXIO or **WEXIÖ,** a town and bishop's see of Sweden, capital of the district (*län*) of Kronoberg, 124 mi. north-east of Malmö by rail. Pop. (1943) 16,231. It is pleasantly situated among low wooded hills at the north end of Lake Växjö, and near the south end of Lake Helga. Its appearance is modern, for it was burned in 1843. The cathedral of St. Siegfrid dates from about 1300, but has been restored, the last time in 1898. The Småland Museum has antiquarian and numismatic collections. At Östrabo, the episcopal residence without the town, the poet Esaias Tegnér died in 1846, and he is buried in the town cemetery.

VAZOFF, IVAN (1850–1921), Bulgarian poet and novelist, was born at Sopot. In common with the founders of Bulgarian literature, Rakovsky, Karaveloff and Botev (*q.v.*), he was first inspired by the sufferings of his countrymen before the liberation. His *Trials of Bulgaria* describes the nation's struggle for freedom. A bard of the people, Vazoff's style is simple and unaffected; his *Epic Poem to the Forgotten,* celebrating the great deeds and sacrifices of the Bulgarian people, thrilled the nation, as also did *Under the Thunder of Victory* (1914), *Songs of Macedonia* (1916) and *New Echo* (1917). Vazoff's most inspired poems and novels of a descriptive character are those relating to the Bulgarian countryside and village life. He died at Sofia on Sept. 22, 1921. His chief novels are: *Under the Yoke* (Eng. trans. 1894); *Svetoslav Terter* (1907), *Hadji Ahil* and *Kazalarskata Tsaritza;* and his dramas include: *Borislav* (1910) and *Towards the Abyss.*

VEBLEN, THORSTEIN B. (1857–1929), American author and teacher, was born on July 30, 1857. He graduated at Carleton college in 1880, and studied at Johns Hopkins, Yale and Cornell universities. He was appointed reader in political economy at the University of Chicago in 1893, becoming successively instructor and assistant professor. He was associate professor of economics at Stanford university, 1906–09, lecturer in economics at the University of Missouri in 1911–18, and lecturer in the New School for Social Research, New York city, beginning in 1918. For almost ten years he was managing editor of *The Journal of Political Economy.* He was distinguished by his contributions to the theory of economics. He died at Menlo Park, Calif., on Aug. 3, 1929. He wrote the *Theory of the Leisure Class* (1899); *The Theory of Business Enterprise* (1904); *The Instinct of Workmanship* (1914); *Imperial Germany and the Industrial Revolution* (1915); *The Vested Interests and the State of the Industrial Arts* (1919); *The Engineers and the Price System* (1921); *Absentee Ownership and Business Enterprise in Recent Times* (1923).

VECTOR ANALYSIS. Some physical quantities, called scalars, can be described by specifying their magnitudes and the units of measure. Time, mass, volume, and electric charge are examples of scalar quantities. Other quantities, such as velocity, displacement, force, and electric field intensity, require the specification of direction as well as magnitude. These quantities are called vector quantities, or simply *vectors.*

Vector analysis, of comparatively recent development, was antedated by Quaternions (*q.v.*) originated by Sir William Rowan Hamilton (*q.v.*) in 1843 and *Ausdehnungslehre,* by Hermann Gunther Grassmann in 1844. Of the various forms of vector analysis which have been evolved several find their origin in these subjects. The vector analysis in ordinary use today, and reviewed below, is due largely to the work of two mathematical physicists, Josiah Willard Gibbs (*q.v.*), 1881–84, and Oliver Heaviside, 1891. In common with others working in the same field, they recognized the desideratum of developing a system of vector analysis the operational rules of which should conform as far as possible with the corresponding rules of scalar algebra. But, furthermore, each was profoundly interested in producing a system specially adapted to the needs of the mathematical physicist.

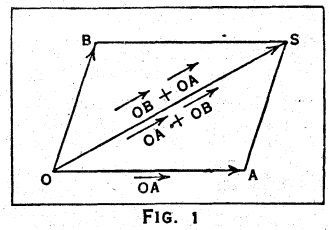

FIG. 1

In what follows, vectors in general, as is customary, will be denoted by letters in Clarendon type and their magnitudes by the same letters in ordinary type: **A, B, C,** · · · **a, b, c;** *A, B, C* · · · *a, b, c* · · · . The notation used is that introduced by Gibbs.

The simplest type of vector is a directed line segment, which can be represented graphically by an arrow from an initial point (A) to a terminal point (B). Such a vector is called a *line-vector* or *vector-step* and is conveniently denoted by $\overrightarrow{AB}$. Two vectors of the same kind are considered equal when they are of equal magnitude and have a common direction, their positions in space being otherwise immaterial. Any vector may be represented by a corresponding line-vector with the same direction and a length equal numerically to the magnitude of the vector.

The Addition of Vectors.—Two line-vectors are added in accordance with the "Parallelogram Law":—Referring to fig. 1, let $\overrightarrow{OA}$ and $\overrightarrow{OB}$ be two line-vectors drawn from a common origin O and let a parallelogram be constructed upon them as sides; then the line-vector $\overrightarrow{OS}$, from the origin O to the opposite vertex S, is by definition the sum or resultant of the two line-vectors and is denoted by $\overrightarrow{OA}+\overrightarrow{OB}$ or by $\overrightarrow{OB}+\overrightarrow{OA}$. Thus

$$\overrightarrow{OS}=\overrightarrow{OA}+\overrightarrow{OB}=\overrightarrow{OB}+\overrightarrow{OA}.$$

If the line-vectors $\overrightarrow{OA}$, $\overrightarrow{OB}$ represent any two vectors **a, b** of like kind, then the sum (or resultant) of **a** and **b** is by definition equal in magnitude (numerically) to the line-vector $\overrightarrow{OS}$ and like-directed. Consequently, if **s** denote the sum of **a** and **b,**

$$\mathbf{s}=\mathbf{a}+\mathbf{b}=\mathbf{b}+\mathbf{a}. \qquad (1)$$

The commutative law of addition for two vectors is here expressed.

If a larger number of vectors are to be added, the sum of any two of them may be found as above and added to a third, and so on until the sum of all the vectors is found, the order in which the vectors are added being immaterial.

With the parallelogram law of addition the physicist is particularly pleased for as a matter of experience he knows that when the vectors with which he deals are added in accordance with this law, the sum (in most cases) has a definite physical meaning. For example: The effect upon the motion of a body due to the

action of two forces at some one of its points is the same as would be produced by their resultant or sum as given by the parallelogram law.

Any vector with a negative sign prefixed represents a vector of the same magnitude as the original vector but oppositely directed. It follows that $\mathbf{a}-\mathbf{b}=\mathbf{a}+(-\mathbf{b})$ and hence that the process of subtraction of vectors may be reduced to one of addition.

Multiplication of a vector by a number m simply multiplies the magnitude of the vector by the factor m with reversal of direction if m be negative. Furthermore, as is easily proved by elementary geometry,

$$m(\mathbf{a}+\mathbf{b}+\cdots)=m\mathbf{a}+m\mathbf{b}+\cdots. \tag{2}$$

This equation shows that the distributive law of multiplication is valid in the multiplication of a sum of vectors by a number.

The Scalar Product of Two Vectors.—The scalar product of two vectors **a** and **b** is denoted equivalently by $\mathbf{a}\cdot\mathbf{b}$ or $\mathbf{b}\cdot\mathbf{a}$. By definition,

$$\mathbf{a}\cdot\mathbf{b}=\mathbf{b}\cdot\mathbf{a}=ab\cos(\mathbf{a},\mathbf{b}), \tag{3}$$

where $(\mathbf{a},\mathbf{b})$ denotes the angle between the directions of **a** and **b**. The definition itself makes valid the commutative law of multiplication for the scalar product of two vectors. The distribution law is also valid; for example,

$$(\mathbf{a}+\mathbf{b})\cdot(\mathbf{c}+\mathbf{d})=\mathbf{a}\cdot\mathbf{c}+\mathbf{a}\cdot\mathbf{d}+\mathbf{b}\cdot\mathbf{c}+\mathbf{b}\cdot\mathbf{d}. \tag{4}$$

The scalar product of two vectors comes naturally into evidence whenever the cosine of the angle between two directions is a matter for discussion.

The Vector Product of Two Vectors.—The vector product of a vector **a** into a vector **b** is denoted by $\mathbf{a}\times\mathbf{b}$. By definition:

$$\mathbf{a}\times\mathbf{b}=\mathbf{n}ab\sin(\mathbf{a},\mathbf{b}), \tag{5}$$

where **n** is a unit vector perpendicular to **a** and **b** and such that if **a** suffer a rotation about **n** toward **b**, the direction of **n** and that of the rotation would be related as the thrust and twist of a right-handed screw. Accordingly,

$$\mathbf{b}\times\mathbf{a}=-\mathbf{a}\times\mathbf{b}; \tag{6}$$

and the commutative law of multiplication is not valid in the present case in virtue of the reversal sign. The magnitude of $\mathbf{a}\times\mathbf{b}$ or $\mathbf{b}\times\mathbf{a}$ is numerically equal to the area of a parallelogram constructed upon line-vectors representing **a** and **b**. (*See* fig. 2.)

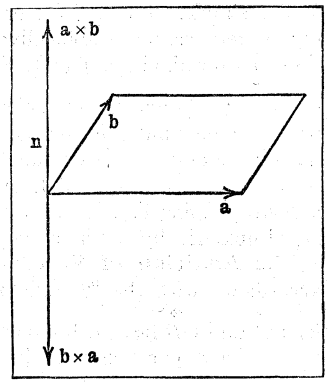

FIG. 2

In the vector multiplication of sums of vectors the distributive law is valid, provided that in expansion the order of the vectors be maintained; for example,

$$(\mathbf{a}+\mathbf{b})\times(\mathbf{c}+\mathbf{d})=\mathbf{a}\times\mathbf{c}+\mathbf{a}\times\mathbf{d}+\mathbf{b}\times\mathbf{c}+\mathbf{b}\times\mathbf{d}. \tag{7}$$

The vector product of two vectors comes naturally into evidence whenever the sine of the angle between two vectors is under consideration.

The Scalar Triple Product.—An example is furnished by the scalar quantity denoted by $\mathbf{a}\cdot\mathbf{b}\times\mathbf{c}$. Evidently,

$$\mathbf{a}\cdot\mathbf{b}\times\mathbf{c}=\mathbf{a}\cdot\mathbf{n}bc\sin(\mathbf{b},\mathbf{c})=abc\cos(\mathbf{a},\mathbf{n})\sin(\mathbf{b},\mathbf{c}), \tag{8}$$

where **n** is a unit vector in the direction of $\mathbf{a}\times\mathbf{b}$. In this product cyclical interchange of the vectors may be made and dot and cross may be interchanged without affecting its value; any single non-cyclical interchange of the vectors simply changes the sign of the product. The magnitude of the product is numerically equal to the volume of a parallelepipedon constructed upon line-vectors representing a, b, c.

The Vector Triple Product.—An example is furnished by the vector quantity denoted by $\mathbf{a}\times(\mathbf{b}\times\mathbf{c})$. The following reduction formula is important:

$$\mathbf{a}\times(\mathbf{b}\times\mathbf{c})=(\mathbf{a}\cdot\mathbf{c})\mathbf{b}-(\mathbf{a}\cdot\mathbf{b})\mathbf{c}. \tag{9}$$

Products involving more than three vectors may be formed but are rarely required.

The i, j, k-System of Unit Vectors.—Even after the advent of vector analysis writers on physics (the world of vectors) not infrequently were accustomed (in effect) to evade the vector treatment of vectors with the aid of the familiar Cartesian system of axes. That they were able to do so was due to the fact that three Cartesian scalar equations are equivalent to one vector equation. When used to supplement the vectorial treatment of vectors, and not to avoid it, Cartesian reference axes have a very useful place in vector analysis.

Let **i**, **j**, **k** be three line-vectors each of unit length in the positive directions of the X, Y, Z-axes of a rectangular Cartesian system. Then, in virtue of (3) and (5):

$$\mathbf{i}\cdot\mathbf{i}=\mathbf{j}\cdot\mathbf{j}=\mathbf{k}\cdot\mathbf{k}=1, \quad \mathbf{i}\cdot\mathbf{j}=\mathbf{j}\cdot\mathbf{k}=\mathbf{k}\cdot\mathbf{i}=0; \tag{10}$$

$$\mathbf{i}\times\mathbf{i}=\mathbf{j}\times\mathbf{j}=\mathbf{k}\times\mathbf{k}=0, \quad \mathbf{i}\times\mathbf{j}=\mathbf{k}, \ \mathbf{j}\times\mathbf{k}=\mathbf{i}, \ \mathbf{k}\times\mathbf{i}=\mathbf{j}, \tag{11}$$

Two vectors, **a** and **b**, may be expressed in the forms

$$\mathbf{a}=a_1\mathbf{i}+a_2\mathbf{j}+a_3\mathbf{k}, \tag{12}$$

$$\mathbf{b}=b_1\mathbf{i}+b_2\mathbf{j}+b_3\mathbf{k}, \tag{13}$$

where $a_1\mathbf{i}$, $a_2\mathbf{j}$, $a_3\mathbf{k}$ and $b_1\mathbf{i}$, $b_2\mathbf{j}$, $b_3\mathbf{k}$ are the vector components of **a** and **b** parallel to the X, Y, Z-axes and a_1, a_2, a_3 and b_1, b_2, b_3 are the scalar values of these components. Then

$$\mathbf{a}+\mathbf{b}=(a_1+b_1)\mathbf{i}+(a_2+b_2)\mathbf{j}+(a_3+b_3)\mathbf{k}. \tag{14}$$

In like manner the sum of any number of vectors may be expressed as a sum of **i**, **j**, **k**-components.

In virtue of (10) and the distributive law for the scalar product of vectors,

$$\mathbf{a}\cdot\mathbf{b}=(a_1\mathbf{i}+a_2\mathbf{j}+a_3\mathbf{k})\cdot(b_1\mathbf{i}+b_2\mathbf{j}+b_3\mathbf{k})=a_1b_1+a_2b_2+a_3b_3. \tag{15}$$

In particular, if $\mathbf{b}=\mathbf{a}$,

$$\mathbf{a}\cdot\mathbf{a}=a^2=a_1^2+a_2^2+a_3^2. \tag{16}$$

The vector product of **a** into **b**, in virtue of (11) and the distributive law for vector products, may be expressed as follows:

$$\begin{aligned}\mathbf{a}\times\mathbf{b}&=(a_1\mathbf{i}+a_2\mathbf{j}+a_3\mathbf{k})\times(b_1\mathbf{i}+b_2\mathbf{j}+b_3\mathbf{k})\\&=(a_2b_3-a_3b_2)\mathbf{i}\\&+(a_3b_1-a_1b_3)\mathbf{j}\\&+(a_1b_2-a_2b_1)\mathbf{k}.\end{aligned} \tag{17}$$

Vector Fields.—A region of space with each point of which is associated a vector is called a *vector field*. Examples of such are the gravitational, electric and magnetic fields of the physicist. In the theory of such fields the behaviour of a vector in the neighbourhood of any point is a matter for investigation. The attention being fixed upon a particular point $P(x, y, z)$, let the vector **v** associated with the point be expressed in the form:

$$\mathbf{v}=v_1\mathbf{i}+v_2\mathbf{j}+v_3\mathbf{k}, \tag{18}$$

where the scalar values of the vector components, v_1, v_2, v_3, are now to be regarded as functions of the co-ordinates x, y, z. Let $x+dx$, $y+dy$, $z+dz$ be the co-ordinates of any neighbouring point where dx, dy, dz represent infinitesimal increments of x, y, z. Then, if $d\mathbf{v}$ represent the infinitesimal increment in the vector **v** corresponding to the increments of the co-ordinates,

$$d\mathbf{v}=\mathbf{i}dv_1+\mathbf{j}dv_2+\mathbf{k}dv_3, \tag{19}$$

where dv_1, dv_2, dv_3 represent the infinitesimal increments in v_1, v_2, v_3 corresponding to the increments of the co-ordinates, and which may be expressed (*see* CALCULUS) as follows:

$$\begin{aligned}dv_1&=\frac{\partial v_1}{\partial x}dx+\frac{\partial v_1}{\partial y}dy+\frac{\partial v_1}{\partial z}dz,\\dv_2&=\frac{\partial v_2}{\partial x}dx+\frac{\partial v_2}{\partial y}dy+\frac{\partial v_2}{\partial z}dz,\\dv_3&=\frac{\partial v_3}{\partial x}dx+\frac{\partial v_3}{\partial y}dy+\frac{\partial v_3}{\partial z}dz,\end{aligned} \tag{20}$$

where the symbol $\frac{\partial v_1}{\partial x}$ denotes the rate at which the function v_1 would increase with respect to x if x be varied while y and z are held constant; and the other coefficients of the co-ordinate increments have an analogous significance. In all there are nine coefficients of this sort and in terms of them the character of the vector field in the neighbourhood of P can be completely specified.

The Divergence and the Curl of a Vector.—Two quantities of fundamental importance in the theory of vector fields will now be defined in terms of these coefficients.

One of these is a scalar called the *divergence* of **v** (div **v**) and defined by the equation

$$\text{div } \mathbf{v} = \frac{\partial v_1}{\partial x} + \frac{\partial v_2}{\partial y} + \frac{\partial v_3}{\partial z}. \qquad (21)$$

The other is a vector called the *curl* of **v** (curl **v**) and defined by the equation:

$$\text{curl } \mathbf{v} = \left(\frac{\partial v_3}{\partial y} - \frac{\partial v_2}{\partial z}\right)\mathbf{i} + \left(\frac{\partial v_1}{\partial z} - \frac{\partial v_3}{\partial x}\right)\mathbf{j} + \left(\frac{\partial v_2}{\partial x} - \frac{\partial v_1}{\partial y}\right)\mathbf{k}. \qquad (22)$$

The values of both these quantities can be shown to be independent of the particular set of **i**, **j**, **k**-axes used in their definitions.

If **v** represents the velocity of a moving fluid and ρ represents its density at any given point then $\rho\mathbf{v}$ is its momentum per unit volume; div $\rho\mathbf{v}$ is a measure of the rate at which the fluid is leaving the neighbourhood of the point reckoned per unit volume; curl **v** is a measure of the vortical motion of the fluid. In fig. 3, for a case of two dimensional flow, is shown, diagrammatically by means of arrows representing the velocity vector, the flow of a fluid in the vicinity of four points P, P', Q, Q'. At the points P and P' a finite divergence of the velocity is indicated (+ at P and − at P'); at Q and Q' a finite value of the curl of the velocity is indicated (clockwise at Q and counter-clockwise at Q').

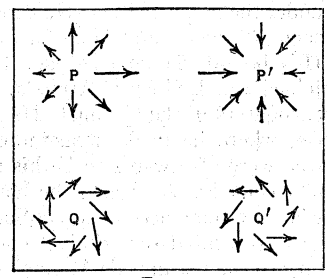

FIG. 3

If **v** denotes the magnetic field intensity at any point (the force which would act upon a positive unit magnetic pole if placed at the point) in a magnetic field due to a distribution of electric currents, then curl **v** is a measure of the electric current density (current per unit area) at the point.

Scalar and Vector Potential Functions.—If throughout a given region curl **v** = o or div **v** = o, then, as the case may be, **v** is said to have a *lamellar* or *solenoidal distribution* in the region.

In the case of a lamellar distribution (curl **v** = o) it is possible to derive **v** from a scalar function V of the co-ordinates x, y, z in accordance with the equation

$$\mathbf{v} = \mathbf{i}\frac{\partial V}{\partial x} + \mathbf{j}\frac{\partial V}{\partial y} + \mathbf{k}\frac{\partial V}{\partial z}, \qquad (23)$$

and **v** is called the *gradient* of V, often abbreviated to grad V or ∇V. The gradient of V is a vector with a direction determined by that of the greatest space rate of increase of V and a magnitude equal to this rate of increase.

The function V is called a *scalar potential function*.

In the case of a solenoidal distribution (div **v** = o) it is possible to derive **v** from a vector function **G** of the co-ordinates in accordance with the equation:

$$\mathbf{v} = \text{curl } \mathbf{G}. \qquad (24)$$

The function **G** is called a *vector potential function*.

Linear Vector Functions.—Let two vectors **p** and **q** associated with a point (x, y, z) be expressed in terms of their **i**, **j**, **k**-components as follows:

$$\mathbf{p} = p_1\mathbf{i} + p_2\mathbf{j} + p_3\mathbf{k}, \qquad (25)$$
$$\mathbf{q} = q_1\mathbf{i} + q_2\mathbf{j} + q_3\mathbf{k}, \qquad (26)$$

and suppose the two vectors so related that:

$$q_1 = a_{11}p_1 + a_{12}p_2 + a_{13}p_3,$$
$$q_2 = a_{21}p_1 + a_{22}p_2 + a_{23}p_3, \qquad (27)$$
$$q_3 = a_{31}p_1 + a_{32}p_2 + a_{33}p_3,$$

where the a-coefficients are constants or, possibly, functions of the co-ordinates x, y, z. Then **q** is called a *linear vector function* of **p**. The theory of such functions constitutes one of the most important branches of vector analysis.

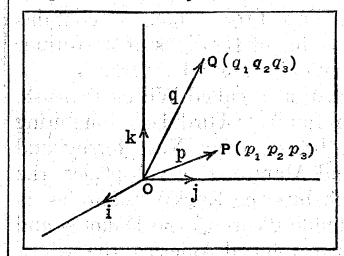

FIG. 4

By way of example, the vector **p** may represent the position vector of any point P of a material body with respect to an arbitrary point O fixed in the body. If we now suppose the body to undergo a strain, the point of the body originally at P will in general occupy a new position Q (*see* fig. 4) with position vector **q** relative to O. If the strain is of the type known as homogeneous then **q** will be a linear vector function of **p**.

The scalar coefficients p_1, p_2, p_3 and q_1, q_2, q_3 of **i**, **j**, **k** in equations (25) and (26) respectively will then be the rectangular co-ordinates of P and Q respectively on an **i**, **j**, **k**-system of axes with origin at O. The precise nature of the homogeneous strain will be determined by the values of the nine a-coefficients in equations (27). In a homogeneous strain the coefficients are constants; straight lines remain straight and parallel lines remain parallel.

Generalizations and applications of vector analysis are found in the various geometries and algebras, in tensor analysis, and in quantum mechanics and the mathematical theory of relativity.

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VEDANTA PHILOSOPHY: *see* INDIAN PHILOSOPHY.

VEDDAS or **WEDDAS,** a primitive people of Ceylon. During the Dutch occupation (1644–1796) they were found as far north as Jaffna, but are now confined to the southeastern district.

They are divided into Veddas, Village Veddas and Coast Veddas. They speak Sinhalese, greatly modified with a few words possibly of their original language.

The true Veddas are short (average 60⅜ in.). They are dark-skinned and flat-nosed, with small skulls. The brow ridges are well marked. Their black hair is long, wavy, almost curly. They live chiefly by hunting; catch fish by poisoning the water, are skilled in getting wild honey; use bows with iron-pointed arrows and breed hunting dogs. They dwell in caves or bark huts. They count on their fingers, and make fire with the fire-drill twirled by hand. They are divided into matrilineal exogamic clans. They are monogamous. Their religion is essentially a cult of the dead.

See C. G. and B. Z. Seligmann, *The Veddas* (1911).

VEDDER, ELIHU (1836–1923), American painter, was born in New York city, Feb. 26, 1836. He studied under the genre and historical painter Tompkins H. Matteson (1813–84), at Sherburne, N.Y., later under Picot, in Paris, and then, in 1857–61, in Italy. After 1867 he lived in Rome, making occasional visits to America. He was elected to full membership in the National Academy of Design, New York, in 1865. He devoted himself to the painting of genre pictures, which, however, attracted only modest attention until the publication, in 1884, of his illustrations to the *Rubaiyat* of Omar Khayyám; these immediately gave him a distinguished place in the art world. Important decorative work

came at a later date, more particularly the painting symbolizing the art of the city of Rome, in the Walker Art Gallery of Bowdoin College, Maine, and the five lunettes (in the entrance hall) symbolical of government, and the mosaic "Minerva" in the Congressional Library at Washington. He died in Rome, Jan. 29, 1923. A few days before his death, his book, *Doubt and Other Things,* was published.

VEERE, a town in the province of Zeeland, Holland, on the island of Walcheren 4 mi. N.N.E. of Middelburg, with which it is connected by canal (1867–72). Pop. (1940) 968. It contains several interesting architectural remains of the days of its former prosperity when it was an important commercial centre.

VEERY (*Hylocichla fuscescens*), also called Wilson's thrush, a well-known bird of the thrush family (Turdidae) inhabiting eastern North America, where it breeds from New Jersey and Illinois north to Newfoundland and Manitoba; a subspecies, the willow thrush (*H. f. salicicola*), inhabits the Rocky mountains as far north as British Columbia, extending east to the Dakotas and Newfoundland. Both forms winter in Central America, the willow thrush, however, also going as far south as southern Brazil. About $7\frac{1}{2}$ in. long, the veery is a uniform cinnamon brown above, white below, with greyish sides and a buff throat and breast faintly spotted with cinnamon brown. It has a fine song rich in overtones. The veery lives mainly in woods and feeds largely on insects.

VEGA, GARCILASO DE LA (1503–1536), Spanish soldier and poet, was born at Toledo. At the age of 17 he was attached to the bodyguard of Charles V., fought against the insurgent *communeros,* and afterwards gained great distinction by his bravery at the battle of Pavia (1525). In 1526 he married a lady-in-waiting to Queen Eleanor. He took part in the repulse of the Turks from Vienna in 1529, was present at the coronation of the emperor at Bologna in 1530, and was charged with a secret mission to Paris in the autumn of the same year. In 1531 he accompanied the duke of Alva to Vienna, where, for conniving at the clandestine marriage of his nephew to a maid-of-honour, he was imprisoned on an island in the Danube. During this captivity he composed the fine cancion, "Con un manso ruido de agua corriente y clara." Released and restored to favour in June 1532, he went to Naples on the staff of Don Pedro de Toledo, the newly appointed viceroy, by whom he was twice sent on public business of importance to Barcelona, in 1533 and 1534. After having accompanied the emperor on the expedition to Tunis (1535), he took part with him in the invasion of Provence and was mortally wounded while storming a fort at Muy, near Fréjus. His poems, which are among the finest in their language, include three pastorals, which rank among the finest in the Spanish language, 37 sonnets, five canciones, two elegies, and a blank verse epistle, all influenced by Italian models. An English translation was published by J. H. Wiffen in 1823. Garcilaso's delicate charm has survived all changes of taste, and by universal consent he ranks among the most accomplished and artistic of Spanish poets.

See H. Keniston, *Garcilaso de la Vega* (1922–25).

VEGA, GARCILASO DE LA, called "Inca" (*c.* 1535–1616), historian of Peru, was born at Cuzco. His father, Sebastiano Garcilaso (d. 1559), was a cadet of the illustrious family of La Vega, who had gone to Peru in the suite of Pedro de Alvarado, and his mother was of the Peruvian blood-royal, a circumstance of which he was very proud as giving him a right to the title which he claimed by invariably subscribing himself "Inca." About 1560 he removed to Spain, but failed to win the preferment for which he hoped. After long service in the army, he turned to literature, solacing himself in his rather meagre circumstances by depicting the riches of the new world. He died in Spain in 1616. He published in 1590 a translation of *Dialoghi di Amore* of Léon Hebro, but his fame depends upon *La Florida del Ynca* (1605) and his history of Peru (Pt. 1, *Commentarios Reales que tratan del origen de los Yncas,* Lisbon, 1608 or 1609; Pt. 2, Cordova, 1617). This latter work has been translated into English, French, German and Italian and has been utilized by Robertson, Prescott, Marmontel and Sheridan. The former work, a history of the De Soto expedition, was long regarded primarily as fiction. In spite of its exaggerations as to the numbers and wealth of the Indians, recent investigations have shown it to possess more ethnological value than had been hitherto supposed. Garcilaso de la Vega wrote before history was regarded as a science; by temperament and circumstances he was inclined to the romantic; nevertheless his work possesses permanent intrinsic interest and he will be remembered as the first South American in Spanish literature.

See monograph by J. Fitzmaurice-Kelly (1921) in Hispanic series, and Lima edition of the Peruvian history (1918–21) prepared by H. H. Urteaga with introduction by Don José de la Riva Agüero.

VEGA, the bright star in the constellation Lyra (*q.v.*), hence its Bayer equivalent, α Lyrae; its magnitude is 0.14, and it is the fourth brightest star in the sky and the brightest in the northern hemisphere. It is one of the sun's nearer neighbours in space, being located at a distance of about 26 light years.

VEGA CARPIO, LOPE FELIX DE (1562–1635), Spanish dramatist and poet, was born in Madrid. His father and mother, Felices de Vega and Francisca Hernandez Flores, originally came from the valley of Carriedo in Asturias. Lope began his studies at the Theatine college in Madrid, and afterwards entered the service of Don Jerónimo Manrique, bishop of Avila, who sent him to the University of Alcalá de Henares, perhaps from 1577–81. He took part in the expedition to the Azores in 1582, and from 1583–87 was secretary to the marqués de las Navas. In Feb. 1588 he was banished for circulating criminal libels against his mistress, Elena Osorio, whom he has celebrated under the name of Filis. He defied the law by returning to Madrid soon afterwards and eloping with Isabel de Urbina, sister of Philip II.'s herald; he married her by proxy on May 10, 1588, and joined the Invincible Armada, losing his brother in one of the encounters in the Channel. He settled for a short while at Valencia, where he made acquaintance with a circle of young poets who were afterwards to be his ardent supporters in founding the new comedy. He joined the household of the duke of Alva, with whom he remained till 1595. Soon afterwards he lost his wife. He was prosecuted for criminal conversation in 1596, became secretary to the marquis de Malpica (afterwards count of Lemos), and in 1598 married a second wife, Juana de Guardo, by whom he had two children (Carlos, who died in 1612, and Feliciana Felix); but she died, shortly after giving birth to the latter, in 1613. Lope then sought a refuge in the church. After having been affiliated to a tertiary order, he took priest's orders.

At this juncture, about 1614, he was in the very zenith of his glory. A veritable dictator in the Spanish world of letters, he wielded over all the authors of his nation a power similar to that which was afterwards exercised in France by Voltaire. At this distance of time Lope is to us simply a great dramatic poet, the founder of the Spanish theatre; but to his contemporaries he was much more. His epics, his pastorals, his odes, his sonnets, now forgotten, all placed him in the front rank of authorship. Such was his prestige that he dealt with his noble patrons almost on a footing of equality. The duke of Sessa in particular, his Maecenas from 1605 onwards, was also his personal friend, and the tone of Lope's letters to him is one of frank familiarity, modified only by some forms of deference. Lope's fame, too, had travelled abroad; foreigners of distinction passing through Madrid made a point of visiting him; papal legates brought him the compliments of their master; in 1627 Urban VIII., a Barberini, sent him the diploma of doctor of theology in the Collegium Sapientiae and the cross of the order of St. John of Jerusalem (whence the poet's titles of "Doctor" and "Frey"). His last days were full of sadness; the death of his son Lope, the elopement of his daughter, Antonia Clara, wounded him to the soul. Montalban tells us that every Friday the poet scourged himself, so severely that the walls of his room were sprinkled with his blood. His death, on Aug. 27, 1635, was followed by national mourning.

For a rapid survey of the works of Lope, it is convenient to begin with those which the Spaniards include under the name of *Obras Sueltas,* the title of the large collection of the poet's non-dramatic works (1776–79). We shall enumerate the most important of these, as far as possible in the order of publication. The *Arcadia* (1598), a pastoral romance, inspired by Sannazaro, is one of the poet's most wearisome productions. *La Dragontea*

(1598), is a fantastic history in verse of Sir Francis Drake's last expedition and death. *Isidro* (1599), a narrative of the life of Isidore, patron of Madrid, is called a Castilian poem on account of the rhythm in which it is composed—*quintillas* of octosyllabic verse. The *Hermosura de Angélica* (1602), in three books, is a sort of continuation of the *Orlando Furioso,* in octaves after the fashion of the original poem. Finally, the *Rimas* are a miscellany of short pieces. In 1604 was published the *Peregrino en su Patria,* a romance similar in kind to the *Aethiopica* of Heliodorus. Having imitated Ariosto, he proceeded to imitate Tasso; but his *Jerusalem conquistada* (1609) has preserved nothing of the art shown in its model and is an insipid performance. Next follows the *Pastores de Belen* (1612) a pious pastoral, dedicated to his son Carlos, which forms a pendant to his secular *Arcadia;* and incidental pieces published in connection with the solemnities of the beatification and canonization of St. Isidore in 1620 and 1622. It is enough to mention *La Filomena* (1621), *La Circe* (1624) and other poems published about the same date, as also the four prose novels, *Las Fortunas de Diana, El Desdichado por la Honra, La Más Prudente Venganza* and *Guzmán el Bravo.* The great success of the *Novelas exemplares* (1613) of Cervantes had stimulated Lope, but his novels have none of the grace, naturalness, or interest which characterize those of his rival. The last important work which has to be mentioned before we leave the narrative poetry of Lope is the *Laurel de Apolo* (1630). This piece describes the coronation of the poets of Spain on Helicon by Apollo, and it is more méritorious as a bibliographical manual of Spanish poetry at that time than as genuine poetry. One other *obra suelta,* closely akin to Lope's dramatic works, though not, properly speaking, a drama, is *La Dorotea* (1632). Lope describes it as an "action in prose," but it is rather a "romance in dialogue"; for, although divided into acts, the narrative is dramatic in form only. Of all Lope's productions *Dorotea* shows most observation and study; the style also is unusually simple and easy. Of all this mass of *obras sueltas,* filling more than 20 volumes, very little (leaving *Dorotea* out of account) holds its own in the judgment of posterity. The lyrical element alone retains some vitality. From the *Rimas* and other collections of detached pieces one could compile a pleasing anthology of sonnets, epistles, elegies and romances, to which it would be proper to add the *Gatomaquia,* a burlesque poem published along with other metrical pieces in 1634 by Lope under the pseudonym of Tomé de Burguillos.

It is, however, to his dramatic writings that Lope owes his eminent place in literary history. It is very curious to notice how he himself always treats the art of comedy-writing as one of the humblest of trades (*de pane lucrando*), and protests against the supposition that in writing for the stage his aim is glory and not money. The reason is not far to seek. The Spanish drama, which, if not literally the creation of Lope, at least owes to him its definitive form—the three-act comedy—was totally regardless of the precepts of the school, the pseudo-Aristotelianism of the doctors of the period. Lope accordingly, who stood in awe of the criticism of the *científicos,* felt bound to prove that, from the point of view of literary art, he attached no value to the "rustic fruits of his humble *vega.*" In his *Arte Nuevo de hacer comedias en este tiempo* (1609), Lope begins by showing that he knows as well as any one the established rules of poetry, and then excuses himself for his inability to follow them on the ground that the "vulgar" Spaniard cares nothing about them. "Let us then speak to him in the language of fools, since it is he who pays us." Another reason which made it necessary for him to speak deprecatingly of his dramatic works is the circumstance that the vast majority of them were written in haste and to order. The poet does not hestitate to confess that "more than a hundred of my comedies have taken only 24 hours to pass from my brain to the boards of the theatre." Nevertheless, Lope did write dramas in which the plan is more fully matured and the execution more carefully carried out; still, hurried composition and reckless production are after all among the distinctive marks of his theatrical works. Towards the close of his career Lope somewhat modified the severe and disdainful judgments he had formerly passed upon his dramatic performances; he seems to have had a presentiment that posterity, in spite of the grave defects of his work in that department, would nevertheless place it much higher than *La Dragontea* and *Jerusalem conquistada,* and other works of which he himself thought so much. We may certainly credit Lope with creative power, with the instinct which enabled him to reproduce the facts of history or those supplied by the imagination in a multitude of dramatic situations with an astonishing cleverness and flexibility of expression; but unfortunately, instead of concentrating his talent upon the production of a limited number of works which he might have brought to perfection, he dissipated it, so to say, and scattered it to the winds.

The classification of the enormous mass of Lope's plays (about 470 *comedias* and 50 *autos* are known to us) is a task of great difficulty, inasmuch as the terms usually employed, such as comedy, tragedy, and the like, do not apply here. There is not explicitness enough in the division current in Spain, which recognizes three categories:—(1) *comedias de capa y espada,* the subjects of which are drawn from everyday life and in which the persons appear as simple *caballeros;* (2) *comedias de ruido* or *de teatro,* in which kings and princes are the leading characters and the action is accompanied with a greater display of dramatic machinery; (3) *comedias divinas* or *de santos.* Some other arrangement must be attempted. In the first place, Lope's work belongs essentially to the drama of intrigue; be the subject what it may, it is always the plot that determines everything else. Lope in the whole range of his dramatic works has no piece comparable to *La Verdad Sospechosa* of Ruiz de Alarcon, the most finished example in Spanish literature of the comedy of character; and the comedy of manners is represented only by *El Galan Castrucho, El Anzuelo de Fenisa* and one or two others. It is from history, and particularly Spanish history, that Lope has borrowed more than from any other source. But it is to the class of *capa y espada* —also called *novelesco,* because the subjects are almost always love intrigues complicated with affairs of honour—that Lope's most celebrated plays belong. In these he has most fully displayed his powers of imagination (the subjects being all invented) and his skill in elaborating a plot. Among the plays of this class which are those best known in Europe, and most frequently imitated and translated, may be specially mentioned *Los Ramilletes de Madrid, La Boba para los Otros y Discreta para si, El Perro del Hortelano, La Viuda de Valencia* and *El Maestro de Danzar.* In some of them Lope has sought to set forth some moral maxim, and illustrate its abuse by a living example, as in *Las Flores de Don Juan.* Such pieces are, however, rare in Lope's repertory; in common with all other writers of his order in Spain, with the occasional exception of Ruiz de Alarcon, his sole aim is to amuse and stir his public; not troubling himself about its instruction. The strong point of such writers is and always will be their management of the plot.

To sum up, Lope found a poorly organized drama, plays being composed sometimes in four acts, sometimes in three; and, though they were written in verse, the structure of the versification was left far too much to the caprice of the individual writer. The style of drama then in vogue he adopted, because the Spanish public liked it. The narrow framework it afforded he enlarged to an extraordinary degree, introducing everything that could possibly furnish material for dramatic situations—the Bible, ancient mythology, the lives of the saints, ancient history, Spanish history, the legends of the middle ages, the writings of the Italian novelists, current events, Spanish life in the 17th century. Before him manners and the conditions of persons and characters had been barely sketched; with fuller observation and more careful description he created real types, and gave to each social order the language and drapery appropriate to it. The old comedy was awkward and poor in its versification; he introduced order into the use of all the forms of national poetry, from the old romance couplets to the rarest lyrical combinations borrowed from Italy. Hence he was justified in saying that those who should come after him had only to go on along the path which he had traced.

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Estéticas en España; A. Morel Fatio, *La Comédie espagnole du XVIIme siècle* (1885). (X.; J. F.-K.)

VEGETABLE, a general term used as an adjective in referring to any kind of plant life or plant product, viz. "vegetable matter." More commonly, and specifically, in common language, the word is used as a noun in referring to those generally herbaceous plants or any parts of such plants as are eaten by man. The edible portions of many plants considered as vegetables, are, in the botanical sense, fruits. The common distinction between fruits and vegetables (*see* FRUIT) is often indefinite and confusing, since it is based chiefly on how the plant or plant part is used, rather than on what it is. A decision of the supreme court of the United States in 1893 held, in effect, that a plant or plant part generally eaten as part of the main course of a meal is a vegetable; while a plant part that is generally eaten as an appetizer, as a dessert, or out of hand, is a fruit. This definition, like others, however, has its limitations.

For the botany and culture of vegetables *see* under the specific names, *e.g.,* POTATO, TURNIP, etc., and also HORTICULTURE, generally.

Vegetable Culture in the United States.—Vegetables are grown in greater or less variety in every state. The sources of production are home gardens, truck farms and greenhouses in the vicinity of large cities, farms devoted to raising vegetables for canning and other manufacture, and also farms in the southern states and in California for the production of winter and early spring vegetables for northern and eastern markets.

The accompanying table, prepared from reports of the U.S. department of agriculture, gives statistics regarding the more important vegetables grown for the market. In addition, broccoli, Brussels sprouts, radishes, rhubarb, squashes, turnips and other minor vegetables are grown commercially, but mostly to a much smaller extent in the country as a whole, though some are locally of considerable importance.

Commercial Production of Principal Vegetables in the United States
Showing the average annual acreage, yield and unit price for the period 1941–1942 for leading states

Vegetable and state	Acreage	Production	Unit	Price per unit ($)
Artichokes				
California	9,800	782,000	Boxes*	1.93
Asparagus (fresh)	88,450	9,129,000	Crates†	1.63
California	30,715	2,700,000	"	1.92
New Jersey	18,900	2,695,500	"	1.59
Washington	8,350	1,251,500	"	1.37
Illinois	7,650	723,000	"	1.45
South Carolina	8,150	284,500	"	1.23
Asparagus (processing)				
California	44,005	3,741,000	"	1.36
Beans (dry, edible)	1,996,500	19,055,500	Bags‡	4.45
Michigan	623,500	5,045,500	"	4.36
California	387,500	5,016,500	"	5.38
Idaho	126,500	1,956,500	"	3.79
Colorado	293,000	1,762,000	"	3.88
New York	156,000	1,444,500	"	4.96
New Mexico	242,500	1,157,500	"	3.93
Beans (lima, fresh)	23,665	1,549,000	Bu.	1.67
New York	3,700	438,500	"	1.71
Florida	6,000	302,500	"	2.14
New Jersey	3,200	271,500	"	1.60
South Carolina	4,150	176,000	"	1.37
Maryland	1,450	124,000	"	1.51
Beans (lima, processing)	65,905	38,685	Tons	75.90
Delaware	14,000	9,000	"	64.61
New Jersey	14,650	7,315	"	94.60
Virginia	6,200	2,975	"	66.75
Maryland	3,700	2,655	"	63.10
Beans (snap, fresh)	162,295	14,945,500	Bu.	1.48
Florida	61,250	5,781,500	"	1.69
California	9,750	1,415,000	"	1.94
New York	8,750	1,358,500	"	1.26
New Jersey	10,150	967,000	"	1.23
South Carolina	10,750	724,000	"	1.28
Louisiana	9,300	575,000	"	1.41
Beans (snap, processing)	109,400	185,860	Tons	66.90
Oregon	3,900	21,600	"	72.60
New York	10,725	20,700	"	80.60
Maryland	13,250	17,900	"	72.10
Wisconsin	10,650	15,800	"	60.60
Arkansas	10,650	13,500	"	84.00
Beets (fresh)	11,825	2,118,000	Bu.	.53
Texas	7,450	1,004,000	"	.27
Pennsylvania	1,100	446,500	"	.68
New Jersey	1,600	380,000	"	.80
Beets (processing)	17,250	126,250	Tons	13.50
New York	5,800	49,500	"	14.72
Wisconsin	4,700	34,550	"	10.62
Oregon	1,240	12,350	"	16.04
Michigan	955	5,750	"	13.04

Commercial Production of Principal Vegetables in the United States—Continued

Vegetable and state	Acreage	Production	Unit	Price per unit ($)
Cabbage (total)	174,830	1,308,300	Tons	16.35
New York	33,050	349,200	"	11.28
Texas	31,000	167,700	"	15.43
Wisconsin	11,850	109,350	"	10.30
Florida	14,000	84,000	"	26.21
California	7,775	72,800	"	16.35
Pennsylvania	7,000	61,850	"	21.54
Cabbage (kraut only)	19,125	185,050	"	8.92
New York	7,050	84,150	"	8.95
Wisconsin	4,585	42,050	"	7.75
Ohio	2,050	17,150	"	7.64
Carrots	58,705	19,130,500	Bu.	.92
California	22,615	7,890,500	"	1.04
Texas	12,350	2,259,000	"	.36
New York	4,400	2,188,000	"	.71
Arizona	3,165	1,220,000	"	1.37
Ohio	1,880	935,000	"	1.13
Cauliflower	32,260	9,024,500	Crates§	.91
California	16,225	4,457,000	"	.72
New York	8,125	2,463,000	"	1.34
Colorado	3,350	855,000	"	.53
Celery	41,515	13,166,000	Crates"	2.23
California	12,475	4,379,500	"	1.86
Florida	9,025	2,573,000	"	2.96
Michigan	7,100	2,140,500	"	1.90
New York	4,310	1,800,000	"	1.82
Ohio	2,395	713,000	"	2.77
Cucumbers (fresh)	42,185	4,758,000	Bu.	1.40
Florida	9,250	988,000	"	1.97
New York	3,600	461,000	"	1.47
California	1,800	455,500	"	1.65
New Jersey	2,600	435,500	"	1.26
South Carolina	5,000	417,500	"	1.46
Cucumbers (pickling)	110,410	8,409,000	"	.74
Michigan	32,250	2,371,500	"	.82
Wisconsin	14,100	1,056,500	"	.79
California	2,420	635,000	"	.57
North Carolina	7,020	565,500	"	.59
New York	2,850	340,500	"	.89
Garlic	4,415	187,000	Sacks‡	6.40
California	2,580	162,500	"	6.78
Louisiana	985	14,000	"	4.96
Texas	850	10,500	"	2.86
Eggplant	4,475	993,000	Bu.	.93
Florida	2,100	484,000	"	1.17
New Jersey	1,500	393,500	"	.66
Louisiana	525	74,500	"	1.04
Texas	350	37,000	"	.57
Escarole or endive				
Florida	1,100	639,750	"	.54
Kale				
Virginia	1,650	662,000	"	.34
Lettuce	156,735	23,450,000	Crates¶	2.12
California	94,395	14,792,000	"	2.31
Arizona	37,900	5,112,000	"	1.86
New York	3,850	1,068,500	"	1.81
New Jersey	2,300	517,000	"	1.54
Washington	2,250	482,500	"	1.48
Colorado	3,750	393,500	"	1.64
Muskmelons	115,915	12,636,000	Crates♀	1.63
California	37,085	5,611,000	"	1.93
Arizona	14,950	1,613,000	"	1.97
Indiana	6,650	605,500	"	1.42
Maryland	5,700	580,500	"	1.00
Michigan	4,500	508,500	"	1.76
Onions	117,415	16,928,000	Sacks‡	1.96
New York	15,450	3,122,000	"	2.55
Texas	45,325	2,323,000	"	2.15
Colorado	6,850	2,038,500	"	1.46
Michigan	8,250	1,714,000	"	2.32
California	7,705	1,571,500	"	1.93
Oregon	3,450	917,000	"	1.83
Peas, green (fresh)	78,515	7,069,000	Bu.	1.40
California	34,475	2,915,500	"	1.67
Colorado	14,000	1,675,000	"	.91
New York	5,200	554,500	"	1.58
Washington	1,650	340,500	"	.99
Texas	4,650	312,000	"	1.03
Peas, green (processing)	399,730	386,300	Tons	57.10
Wisconsin	140,700	124,710	"	57.00
New York	43,600	38,445	"	63.80
Washington	31,100	38,400	"	53.70
Oregon	20,800	37,685	"	52.05
Minnesota	37,750	32,125	"	55.30
Utah	14,300	19,625	"	52.60
Peas, dry	375,000	5,430,000	Bags‡	3.65
Washington	188,500	3,074,500	"	3.65
Idaho	94,500	1,204,000	"	3.79
Montana	33,500	416,000	"	3.89
Oregon	17,500	379,500	"	3.63
Peppers, green (fresh)	23,395	4,856,000	Bu.	1.09
Florida	6,850	1,707,000	"	1.66
New Jersey	7,750	1,620,000	"	.60
California	2,325	635,500	"	1.19
North Carolina	2,250	360,500	"	.88
Louisiana	1,200	211,500	"	.81
Peppers (processing)	13,400	15,860	Tons	39.00
Georgia	12,750	14,130	"	39.05
California	650	1,730	"	38.70
Potatoes	2,711,000	363,377,000	Bu.	.99
Maine	153,500	42,577,000	"	.95
Idaho	127,500	29,020,000	"	.89
New York	188,000	27,525,500	"	1.05
Pennsylvania	161,000	19,517,000	"	1.12

Commercial Production of Principal Vegetables in the United States—Continued

Vegetable and state	Acreage	Production	Unit	Price per unit ($)
Potatoes—cont'd				
Michigan	175,500	18,291,000	Bu.	.98
Minnesota	205,000	17,724,000	"	.89
North Dakota	138,000	16,485,000	"	.72
Spinach (fresh)	67,215	14,003,500	Bu.	.55
Texas	39,350	5,725,500	"	.53
California	2,675	1,474,500	"	.45
Pennsylvania	4,300	1,385,000	"	.71
Virginia	4,200	1,205,500	"	.43
New Jersey	3,700	1,134,500	"	.68
Spinach (processing)	33,090	79,650	Tons	34.60
California	11,220	37,450	"	19.85
Oklahoma	7,650	13,950	"	58.58
Virginia	3,650	9,750	"	38.30
Texas	5,000	8,200	"	22.68
Arkansas	4,250	8,050	"	62.40
Sweet corn (fresh)				
New York	22,550	121,550	1,000 ears	15.31
New Jersey	21,000	109,000	1,000 ears	15.99
Pennsylvania	10,500	54,800	1,000 ears	13.31
Sweet corn (processing)	456,390	1,190,350	Tons	11.66
Minnesota	74,000	237,050	"	9.08
Illinois	70,650	208,350	"	12.64
Wisconsin	52,450	128,500	"	10.61
Iowa	48,500	122,500	"	10.51
Indiana	57,600	102,900	"	12.32
Maryland	41,150	96,550	"	12.86
Sweet potatoes	726,500	63,762,000	Bu.	1.01
North Carolina	77,000	7,695,000	"	1.05
Georgia	102,500	7,622,500	"	1.06
Mississippi	68,000	6,460,000	"	1.01
Alabama	78,000	5,965,500	"	1.08
Louisiana	89,000	5,873,000	"	.95
South Carolina	58,500	5,145,000	"	1.02
Tomatoes (fresh)	209,450	25,250,000	Bu.	1.81
California	28,975	4,866,500	"	2.58
Texas	55,350	3,554,500	"	1.55
Florida	31,500	3,089,000	"	3.56
New York	9,200	1,978,000	"	.83
New Jersey	10,250	1,847,500	"	1.37
Maryland	7,050	1,270,500	"	.73
Tomatoes (processing)	525,260	2,977,450	Tons	17.35
California	105,470	736,600	"	16.45
Indiana	97,650	579,650	"	15.36
Maryland	60,800	306,750	"	21.98
New Jersey	36,200	235,300	"	21.52
Ohio	30,900	220,200	"	15.19
Pennsylvania	24,500	154,350	"	18.75
Watermelons	227,865	60,853	1,000 melons	184.00
Georgia	50,000	12,000	1,000 melons	146.00
California	28,600	8,883	1,000 melons	207.00
Florida	23,750	7,018	1,000 melons	218.00
Texas	39,050	4,773	1,000 melons	204.00
South Carolina	22,750	4,423	1,000 melons	179.00
Missouri	9,500	2,813	1,000 melons	188.00

*Boxes of about 40 lb. †Crates of about 24 lb. ‡Bags or sacks of 100 lb. §Crates of about 37 lb. (1½ bu.). "Crates of about 90 lb. ¶Crates of about 70 lb. ♀Crates of about 60 lb. (V. R. B.)

VEGETABLE COOKERY. The term "vegetables" other than pulses and cereals (*q.v.*) covers those plants which have edible flowers, fruit or seed, stalks, roots or leaves. Green vegetables are valuable in the diet chiefly on account of their potassium salts and vitamins, cellulose, which supplies the body with bulk or "roughage," thus assisting digestion; and for their water content (average 90–95%). Roots and tubers are heat- and energy-giving foods. The cellulose of vegetables is valuable as roughage in the intestinal tract.

Green Vegetables.—There are three distinct methods of cooking green vegetables. Steaming is one. In the second, only enough water is used to prevent the vegetables from sticking to the pan and getting burnt, and the aim is to conserve the natural salts and flavours of the vegetables. The third and more common method of cooking ordinary "greens" is to boil the vegetable in a pan of fast-boiling salted water with the lid off. Soda is frequently added to soften the water and preserve the colour but it destroys the vitamins and is not recommended.

All these methods can be used for most green vegetables with the exception of sorrel and spinach, which have a very high water content and require very little water in cooking.

To cook cabbage first wash well in salt and water to get rid of any insects, trim off outside discoloured leaves and put into a kettle full of boiling water, with at least 1 teaspoon salt to each qt. To lessen odour of cooking, do not cover. Whole young cabbage, 25–30 min., old, 30 min.–1 hr. Quartered, 10–15 min. Leaves, 5–10 min. Drain, add 1 tablespoon butter for each lb.

Cabbage may be stuffed with forcemeat (*see* STUFFINGS) or savoury rice (cooked rice and grated cheese, chopped onion and seasoning) by separating the leaves from a parboiled cabbage and rolling each leaf round the forcemeat, or the stuffing may be placed in the centre of the cabbage. If the cabbage is rolled stew in a thickened gravy.

Brussels sprouts may be dipped in batter and fried. Single leaf vegetables, *e.g.*, spinach, beet-tops, etc., may be cooked until tender, drained and passed through a sieve, then mixed with butter, cream, seasoning, and formed into a purée which can be garnished with hard-boiled eggs or served on toast. Green purée soups are made from green vegetables. It is, of course, of essential importance in the cooking of vegetables to avoid any overcooking.

White Vegetables.—To prepare white vegetables for cooking wash, scrub or scrape. Celery should be cut up in thin strips lengthwise to facilitate cooking. Have ready a pan of salted boiling water, squeeze into it a little lemon juice to keep the vegetables a good colour. In cooking certain blanched vegetables, *e.g.*, asparagus, leeks, etc., it is best to tie the vegetables in bundles. Overcooking of all white vegetables should be avoided. As a rule, 15–30 minutes (according to the age and type of vegetable being boiled) is sufficient time to allow.

Jerusalem artichokes, salsify (oyster plant), etc., may be passed through a sieve and creamed, sprinkled with grated cheese and sauce and then baked au gratin. They may also be fried in batter as fritters. Celery can be stewed in milk or brown sauce, or served au gratin. Seakale and asparagus are usually served with melted butter but may be served with other sauces, mayonnaise, etc. All white vegetables may be made into soup by passing through a sieve, thickening and mixing with milk.

Potatoes.—There are innumerable ways of cooking potatoes but for most potato dishes they must be first plain boiled. To boil in their skins, clean thoroughly and place in boiling salted water. Simmer until tender (about 30–40 minutes; but *see* note in COOKERY on boiling at high altitudes); drain off the water and allow them to steam in the pan for five minutes with the lid on. Remove the lid, allow the steam to escape for a few seconds and use as required.

To bake potatoes bake them in their skins or peel and put in a baking-dish with sufficient fat to keep them from burning and place under a piece of roasting meat so that the fat from the meat can drip on to them and so keep them moist while cooking.

Mashed potatoes are plain boiled or steamed, mashed with butter and milk, and then beaten with a wooden spoon until creamy. Potatoes may be fried either in a frying-pan, or in a pan of deep fat. Before frying thoroughly dry; then after slicing, cut into strips or fancy shapes. To cream potatoes for vegetarian dishes add eggs, cream or sauce to mashed potatoes and bake or steam as a soufflé.

VEGETABLE MARROW: *see* SQUASH.

VEGETARIANISM, a word which came into use about the year 1847, as applied to the practice of living upon foods from which fish, flesh and fowl are excluded. There have from time to time been various sects or schools of thought that have advocated narrower views. Some of these have excluded all animal products —such as milk and eggs and cheese. Some have excluded all cooked foods, and have preached the virtues of fruits and nuts and grains in their natural ripe state. Some have abstained from all underground-grown roots and tubers, and have claimed special benefits from using only those fruits and vegetables that are grown in the sunlight. Some have given up all grain and pulse foods, and have declared that old age can be best resisted by living entirely upon fruits, salads, nuts, soft water and milk products. Some have added fish to their dietary; but, speaking generally, all who are called vegetarians will be found to abstain from the use of flesh and fowl and almost invariably also from fish as food.

The fact, however, must not be overlooked that while vegetarian societies claim as "vegetarians" all who abstain from flesh foods, there is a large and growing number of people who repudiate the name of "vegetarian" because of its associations, but who none the less, for some of the reasons detailed below, abstain from eating anything that has been killed.

The reasons that are advanced for the practice of fruitarianism or vegetarianism are very comprehensive, but the chief are the

following:—

1. *Health.*—(α) On the ground that animals are affected by diseases which are communicable, and are actually communicated, to man by the ingestion of their flesh, *e.g.*, parasites, tuberculosis; (β) on the ground that the flesh of artificially fed animals is full of excretory substances, and that, therefore, *under modern conditions,* flesh-eating is injurious, and may be the cause of excretory substance and uric acid deposits or rapid tissue-destroying diseases in man; *e.g.*, gout, cancer.

2. *Economy.*—On the ground that the assimilable nutriment from a given weight of selected fruit and grain and nut and vegetable foods will cost less than the same nutriment obtained from flesh foods.

3. *Social Economy.*—On the ground that an acre of cultivable land under fruit and vegetable cultivation will produce from two to twenty times as much food as if the same land were utilized for feeding cattle.

4. *Racial Improvement.*—On the ground that the aim of every prosperous community should be to have a large proportion of hardy country yeomen, and that horticulture and agriculture demand such a high ratio of labour, as compared with feeding and breeding cattle, that the country population would be greatly increased by the substitution of a fruit and vegetable for an animal dietary.

5. *Character Improvement.*—On the ground that after the virtues of courage and valour and fearlessness have been taught in the lower stages of evolution, the virtue of gentle humaneness and extended sympathy for all that can suffer should be taught in the higher cycles of the evolutionary spiral. Flesh-eating entailing necessarily an immense volume of pain upon the sentient animal creation should be abstained from by the "higher classes" in the evolutionary scale.

Organizations have been established to advocate this method of living under the name of "Vegetarian Societies"—chiefly in the United Kingdom, America, Germany, France, Austria, Holland, Czechoslovakia, Scandinavia and Australia. Propagandism is carried on by lectures, literature, cookery demonstrations and restaurants.

In England the oldest institution is "The Vegetarian Society" of Manchester; the "London Vegetarian Society" has headquarters at 8 John Street, Adelphi, W. C. 2. An attempt at the world-wide organization of vegetarian societies as "The Vegetarian Federal Union" was unsuccessful, and gave place to the "International Vegetarian Union," the headquarters of which were set up at Warnsdorf, Czechoslovakia.

In the religious world the Seventh-Day Adventists (who are connected with many sanatoria and the manufacture of food specialties) and some Bible Christians, the worshippers of Vishnu and the Swami Narang and Vishnoi sects, amongst others, preach abstinence from flesh food. The Salvation Army, the Tolstoyans and the Doukhobors encourage it. A number of orders in the Roman Catholic church (*e.g.*, the Trappists) and in the Hindu faith (*e.g.*, the Dadupanthi Sadus) are pledged abstainers.

The general question of food values is discussed in DIET AND DIETETICS; *see* also NUTRITION. But there is no doubt that, whatever may be the view taken as to the extreme theory of vegetarianism, it has had considerable effect in modifying the excessive meat-consuming régime of previous days, and in introducing new varieties of vegetable cooking into the service of the table.

BIBLIOGRAPHY.—The literature on the subject is considerable, but the two classics are perhaps *The Ethics of Diet,* by Howard Williams, and *The Perfect Way in Diet,* by Dr. Anna Kingsford. In former years the "Vegetarian Society" was the most active in producing literature, but about 1901 the Order of the Golden Age came to the front with new and up-to-date books, booklets, and leaflets. The chief British periodicals are the *Vegetarian News* (London), *Vegetarian Messenger* (Manchester) and *The Healthy Life;* among the American periodicals are *Good Health* (Battle Creek, Mich.) and the *Vegetarian and Fruitarian* (Lewiston, Ida.). German publications are, *Vegetarische Warte; Vegetarische Presse; Vegetarianen.* (J. O.)

VEGETIUS (FLAVIUS VEGETIUS RENATUS) (4th cent.), military writer. His treatise, commonly called *De Re Militari* or *The Military Institutions of the Romans,* was a compilation from ancient sources. Vegetius was not a practical soldier and did not realize that the military reform and revival of the ancient organization of the legion he proposed had become impossible because of the evolution of warfare. By one of the strange mutations of history, when later the crossbow and gunpowder deprived cavalry of its shock-power, the tactics of Vegetius became ideal for armies, and his work became a military bible for European soldiers for hundreds of years.

In manuscript, Vegetius' work had a great vogue. In the middle ages his rules of siegecraft were much studied. During and after the Renaissance the sections dealing with training and tactics were indispensable. His work was translated into English, French and Bulgarian before the invention of printing. An English version was published by Caxton in 1489. For a detailed critical estimate of Vegetius' works and influence *see* Max Jähns, *Gesch. der Kriegwissenschaften,* i. 109–125, and Delpech, *La Tactique au 13me Siecle. The Military Institutions of the Romans* was included in Phillips' *Roots of Strategy* (1940), with brief critical introduction.

VEII, an ancient town of Etruria, Italy, situated about 10 m. N. by W. of Rome by road. It is mentioned in the earliest history of Rome as a constant enemy, being the nearest Etruscan city to Rome, but the site was occupied in the Villanova period, remains of huts having been found on the acropolis (called Piazza d'Armi) as well as numerous tombs. The story of the slaughter of the Fabii, who had encamped in the territory of Veii (perhaps in an effort to cut the communications of Veii with Fidenae) and of whom but one boy escaped, is well known. After constant warfare, the last war (the fourteenth, according to the annalists) broke out in 406 B.C. The Romans laid siege to the city, and, after a ten years' siege, M. Furius Camillus took it by storm in 396, by means, so we are told, of a tunnel leading into the citadel. According to the legend, the *emissarium* of the Alban Lake was constructed in obedience to the Delphic oracle, which declared that, until it was drained, Veii could not be taken. After the defeat of the Romans at the Allia in 390 B.C., a project was broached for abandoning Rome for Veii, which was successfully opposed by Camillus. Veii is spoken of by Propertius as almost deserted, but Augustus founded a municipality there, inscriptions of which have been found down to the time of Constantius.

Veii was reached by branch roads from the Via Clodia. The site is characteristic—a plateau, the highest point of which is 407 ft. above sea-level, divided from the surrounding country by deep ravines, and accessible only on the west, where it was defended by a wall and fosse. Remains of the city walls, built of blocks of tufa 2 ft. high, may be traced at various points in the circuit. The area covered measures about 1 sq.m. and it was thus only second to Rome in size among the cities in her neighbourhood. The site of the Forum has been discovered on the west side of the plateau; a statue of Tiberius, now in the Vatican, and the twelve Ionic columns now decorating the colonnade on the W. side of the Piazza Colonna at Rome were found there.

The acropolis was at the eastern extremity of the site, where the two ravines converge; it is connected with the rest of the plateau by a narrow neck. An Etruscan house was found on the north side of the city; while, just outside it on the south a temple of the 6th cent. B.C. with three cellae has been discovered. The most famous of the Etruscan tombs is the Grotta Campana, which contains paintings on the walls with representations of animals, among the earliest in Etruria. There are also several prominent tumuli. To a later period belongs a columbarium cut in the rock, with niches for urns. (T. A.)

VEINS, in anatomy. The veins are blood vessels which return the blood from the capillaries toward the heart. As they approach that organ they join together to form larger and larger trunks. In man and other mammals three venous systems are recognized: (1) the *general venous system;* (2) the *pulmonary system;* and (3) the *hepatic portal system.* (*See* also VASCULAR SYSTEM.)

General Venous System.—This consists of superficial and deep veins; the former lie in the superficial fascia and are often visible through the skin. They are usually accompanied by lymphatic vessels though not as a rule by arteries, and, sooner or later, they empty their blood into the deep veins, often passing through special openings in the deep fascia to do so. The deep veins always accompany arteries, and are therefore known as *venae comites.* With small and medium-sized arteries there are two of these venae comites, one on each side, connected by oc-

casional cross communications, but arteries of a larger calibre have only one companion vein. In the scalp and face the superficial veins accompany corresponding arteries more or less closely because the arteries in this region are very tortuous (*see* ARTERIES), while the veins run a comparatively straight course. *Frontal, superficial temporal, posterior auricular* and *occipital veins* are found in the scalp, their names indicating the areas they drain. Like all other superficial veins, they anastomose freely and also at certain places communicate, through foramina in the skull, with the intracranial blood sinuses; these communications are known as *emissary veins,* and act as safety-valves to the sinuses. The frontal vein on the forehead passes down on the inner side of the eyelids, where it is known as the *angular,* and then becomes the *facial vein,* which runs down to an inch in front of the angle of the jaw, whence it passes into the neck to join the common facial. In the greater part of its course it lies some distance behind the facial artery. The *superficial temporal vein* runs down in front of the ear, where it joins the internal maxillary vein from the pterygoid plexus and so forms the *temporo-maxillary trunk,* which passes down, embedded in the parotid gland, to about the angle of the jaw. Here it divides into an anterior branch, which joins the facial vein to form the common facial, and a posterior, which receives the posterior auricular vein, forming the external jugular.

The *external jugular vein* is easily recognized through the skin on the side of the neck, and eventually pierces the deep fascia above the middle of the clavicle to join the subclavian vein. The *occipital vein* sinks deeply into the back of the neck and so forms the beginning of the vertebral vein.

The *intracranial blood sinuses* lie between two layers of the dura mater and differ from the veins in having fibrous walls which do not contract or expand. The *superior longitudinal sinus* runs along the upper margin of the falx cerebri (*see* BRAIN), while the inferior longitudinal sinus runs along the lower margin; these drain the surface of the brain, and the blood passes backward in both. Where the falx meets the tentorium cerebelli, the inferior longitudinal sinus receives the *veins of Galen* from the interior of the brain and then passes backward as the *straight sinus* to join the superior longitudinal sinus at the internal occipital protuberance (*see* SKULL). This meeting-place is known as the *torcular Herophili,* and from it the blood passes outward and downward through the right and left *lateral sinuses,* which groove the cranium (*see* SKULL) until they reach the posterior lacerated foramina, through which they pass to form the beginning of the internal jugular veins. Most of the blood from the base of the brain passes into the *cavernous sinuses* which lie in the middle cranial fossa, one on each side of the pituitary fossa. These receive the ophthalmic veins from the orbit in front and, after running backward for about an inch, divide into the *superior* and *inferior petrosal sinuses,* the former of which joins the lateral sinus within the cranium, but the latter runs to the posterior lacerated foramen, after passing through which it joins the lateral sinus, which is now becoming the internal jugular vein. (*See* fig. 5.)

The *internal jugular vein* thus formed runs down at first behind and then to the outer side of the internal and common carotid arteries and at the root of the neck joins the subclavian vein of its own side to form the innominate vein. In its course down the neck it receives the common facial vein and tributaries from the tongue, pharynx, larynx and thyroid body. The deep veins of the head and face tend to form plexuses rather than venae comites; of these, *pterygoid, deep temporal, pharyngeal* and *suboccipital plexuses* are recognized.

Veins of the Upper Extremity.—On the dorsum of the hand and in front of the wrist superficial venous plexuses are easily seen through the skin. From these the blood passes up the forearm chiefly on its flexor surface by the *radial, median* and *anterior* and *posterior ulnar veins.* Just below the bend of the elbow the median vein communicates with the deep veins and then divides into two branches like the limbs of a **Y**. Of these the inner is the *median basilic* from which patients are usually bled, while the outer is the *median cephalic.* After a course of an inch or two the median basilic is joined by the anterior and posterior ulnar veins and the median cephalic by the radial. After this junction the median basilic is continued up the inner side of the arm as the *basilic* which pierces the deep fascia about the middle of the arm and in the axilla joins the venae comites of the brachial artery to form the *axillary vein,* which lies on the inner side of its artery. The median cephalic vein after joining the radial runs up the outer side of the arm as the *cephalic* and a little below the clavicle passes through the costocoracoid membrane to enter the upper part of the axillary vein. At the outer border of the first rib the axillary vein becomes the subclavian, which lies in front of and below its artery and is separated from it by the scalenus anticus muscle. The arrangement of the superficial veins, especially in front of the elbow, is liable to great variation.

Veins of the Lower Extremity.—The superficial veins of the lower extremity begin in a venous arch on the dorsum of the foot. From the inner extremity of this the *internal saphenous vein* runs up, in front of the inner ankle, along the inner side of the leg, and, passing behind the inner side of the knee, continues up the thigh, gradually working forward until it reaches the *saphenous opening* in the deep fascia of the thigh a little below the spine of the pubis. Here it pierces the deep fascia (*fascia lata*) to enter the common femoral vein. In this long course it has many valves and receives numerous tributaries, one of which, the *saphenous collateral,* runs up nearly parallel to it and on its outer side and joins it just below the saphenous opening. From the inner end of the dorsal arch of the foot the *external saphenous vein* runs up behind the outer ankle along the mid line of the calf to pierce the deep fascia in the popliteal space behind the knee and open into the popliteal vein. Among the deep veins venae comites are found until the popliteal artery is reached, while above this *superficial, deep* and *common femoral veins* accompany their respective arteries. In the groin the common femoral vein lies on the inner side of its artery.

Veins of the Abdomen.—The common femoral vein, after passing deep to Poupart's ligament, becomes the *external iliac* which runs along the brim of the true pelvis and, after a course of some three inches, joins the *internal iliac* which drains the pelvis and so forms the *common iliac vein.* In front of the body of the fifth lumbar vertebra the common iliac veins of the two sides unite to form the *inferior vena cava,* a very large trunk which runs up on the right of the abdominal aorta to an opening in the diaphragm (*q.v.*). On its way it receives spermatic or ovarian veins from the genital glands, *renal veins* from the kidneys, and *lumbar veins* from the abdominal walls. Before reaching the diaphragm it lies in a groove in the back of the liver (*q.v.*) and receives the *hepatic veins* from that organ. The hepatic portal system which lies in the abdomen will be treated later.

Veins of the Thorax.—The inferior vena cava, after piercing the diaphragm, has a very short thoracic course and opens into the lower and back part of the right auricle of the heart (*q.v.*). The *right* and *left innominate veins* are formed behind the sternal end of the clavicle by the union of the subclavian and internal jugulars of their own side. The left vein is much longer than the right and runs nearly horizontally behind the upper half of the manubrium sterni to join its fellow on the right side of that bone just below the first rib. By the junction of these the *superior vena cava* is formed, which runs down to the right auricle of the heart. The chief tributaries of the innominate veins are the *vertebral,* the *internal mammary* and the *inferior thyroid.*

The intercostal veins open into the *azygos veins,* which begin in the abdomen sometimes by a vertical trunk joining the lumbar veins known as the *ascending lumbar,* sometimes on the right side by a communication with the inferior vena cava. The right azygos vein is known as the *vena azygos major* and passes through the aortic opening of the diaphragm. Entering the thorax, it runs up in front of the thoracic vertebrae, to the right of the aorta and thoracic duct, and receives the intercostal veins of the right side. At the level of the fourth thoracic vertebra it arches forward to open into the posterior surface of the superior vena cava.

On the left side, the upper intercostal veins join to form the left superior intercostal vein, which opens into the left innominate. Lower down the intercostal veins from the fourth to the seventh spaces form the *superior hemiazygos vein,* which runs down on

the left of the spinal column and, crossing it about the level of the eighth or ninth thoracic vertebra, opens into the vena azygos major. The lower intercostal veins on the left side join the *inferior hemiazygos vein* which runs up and opens either into the superior hemiazygos or into the azygos major below the opening of that vein.

Pulmonary Venous System.—The veins emerging from the lungs bring back the oxygenated blood from those organs to the left ventricle of the heart and also the greater part, if not all, of the blood carried by the bronchial arteries to nourish the lungs. The existence of bronchial veins is asserted, but they are extremely difficult to demonstrate, and if present are quite incapable of returning all the blood which the bronchial arteries carry to the lungs. There are three pulmonary veins coming out of the right lung, while on the left there are only two. On the right side, however, two of the three veins usually unite in the root of the lung, so that there are, as a rule, two pulmonary veins entering the left auricle of the heart on each side, but it is not uncommon to find three on the right side or one on the left. The pulmonary veins have no valves.

Hepatic Portal System.—The veins which drain the blood from the stomach, intestines, spleen and pancreas unite to form a large vein which begins behind the head of the pancreas and ends by dividing into right and left branches in the transverse fissure of the liver. This is the *portal vein* which lies in front of the inferior vena cava and is about three inches long. Its formative tributaries are the *superior* and *inferior mesenteric* and the *splenic veins*. There are two marked characteristics of the portal system; one is that it has no valves and the other that it begins and ends in capillaries, since the two terminal branches of the portal vein branch and rebranch in a manner already described in the article LIVER. In the lower part of the rectum the veins run partly into the portal and partly into the general system, and in this dependent position they are liable to become varicose and to form haemorrhoids or piles.

The histology of the veins corresponds very closely to that of the arteries (*q.v.*); their walls are, however, much thinner and there is less muscular and elastic tissue. At certain places, especially where tributaries come in, the endothelial lining is raised to form semilunar pocket-like valves. In most cases there are two cusps to each valve, but three or one are sometimes found. The opening of the pocket is arranged so that it shall only be filled when there is a tendency to regurgitation of the blood.

EMBRYOLOGY

The *vitelline* or *omphalo-mesenteric veins*, returning the blood from the yolk sac, are the first to appear, and later on, with the formation of the placenta, the umbilical veins develop. Both these open into the hinder (caudal) part of the heart, which is already being constricted off as the *sinus venosus* (*see* fig. 1).

While this is going on the veins from the different body segments are received into two longitudinal trunks on each side, the anterior (cephalic) of which is the *primitive jugular* or anterior cardinal and the posterior (caudal), the *posterior cardinal* or simply *cardinal vein*. As the heart is at first situated in the region which will later be the neck of the embryo, the primitive jugular receives very few segmental veins and the cardinal very many. These two trunks join one another on each side and open into the side of the *sinus venosus* by a transverse communication the *duct of Cuvier*. The condition of the venous system at this stage is shown in the accompanying diagram (fig. 1).

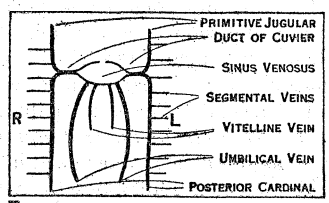
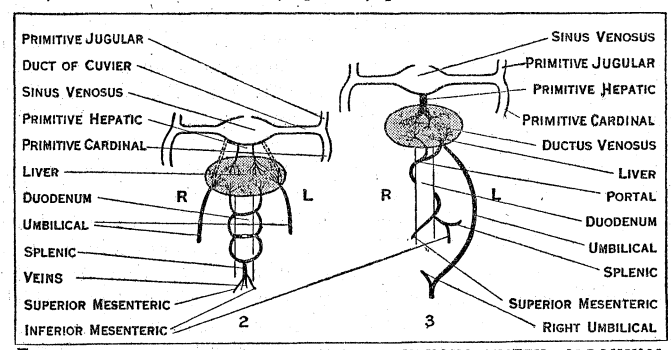


FIG. 1.—SCHEME OF FORMATION OF VENOUS SYSTEM, FIRST STAGE

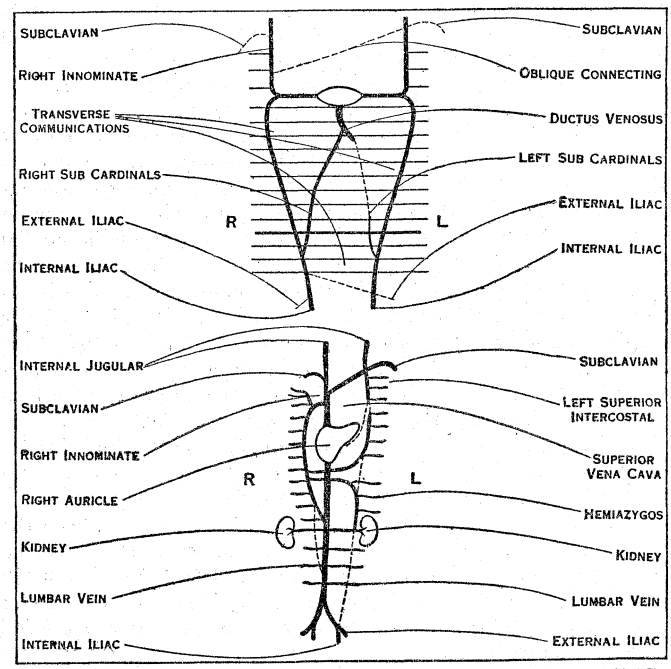
As the vitelline veins run from the yolk sac to the heart along each side of the primitive fore-gut they pick up the mesenteric veins from the intestines as well as the splenic and pancreatic veins as soon as these viscera are formed. The liver, however, is developed right across their path, and both they and the umbilical veins break up into a mass of capillaries in it, leaving that part of them which lies between the liver and the heart to form the primitive hepatic veins (fig. 2). While the vitelline veins are lying on each side of the fore-gut (future duodenum) they are connected by three transverse channels, the anterior and posterior of which appear on the ventral side of the gut, the middle on the dorsal side (*see* fig. 2). This figure of eight does not persist, however, because the anterior (cephalic) part of it on the left and the



FIGS. 2 & 3.—SCHEME OF FORMATION OF VENOUS SYSTEM, ABDOMINAL REGION

posterior (caudal) part on the right become obliterated, and what is left forms the *portal vein* (fig. 3). The two umbilical veins unite at the umbilicus (fig. 3) and soon all the blood from the placenta passes through the left one, the right becoming rudimentary.

The left umbilical vein on reaching the liver now joins the left branch of the portal vein and establishes a new communication with the left hepatic vein. This is the *ductus venosus* (fig. 3), and, as soon as it is formed, there is no longer any need that all the blood returning from the placenta should pass through the liver capillaries. The development of the cardinal veins must now be returned to. As the heart moves from the neck into the thorax the primitive jugulars elongate and it is now recognized become the internal jugulars in the greater part of their extent.



FIGS. 4 & 5.—SCHEME OF FORMATION OF VENOUS SYSTEM (SEE TEXT)

When the arms begin to bud out subclavian veins are developed (fig. 4) and an oblique connecting vein (figs. 4 and 5) is established between the point of junction of the left subclavian with the primitive jugular and the hinder part of the primitive jugular of the right side. This connection becomes the left innominate vein, while the hinder part of the primitive jugular persists as the *left superior intercostal vein* (fig. 5). On the right side that part of the primitive jugular between the subclavian and the junction with the left innominate becomes the right innominate (figs. 4 and 5) while the hinder (caudal) part of the right primitive jugular and

the right duct of Cuvier become the superior vena cava (figs. 4 and 5). The external jugular is a later formation. The right and left posterior cardinal veins receive the intercostal and lumbar segmental veins and are continued into the lower limbs as the internal iliac and eventually the sciatic veins, the primitive bloodpath from the thighs. The veins from the primitive kidneys open into the segmental veins, and when the permanent kidney is formed (*see* URINARY SYSTEM) a large *renal vein* on each side is established. There are, however, many cross communications (fig. 4) between the right and left posterior cardinal veins, some of which become very important later on, though most of them are transitory. The probable origin of the *inferior vena cava* is to be sought in a pair of veins called *subcardinals* which have been found in the rabbit embryo lying parallel and a little ventral to the posterior cardinals (fig. 4) and effecting a junction with the renals and transverse communications as they cross these. Posteriorly (caudal) they join the cardinals, but anteriorly the right one establishes a communication with the ductus venosus a little below the point at which that vessel joins the left hepatic. It is from the right one of these that the greater part of the inferior vena cava is formed. It will now be seen that the adult vena cava is formed by contributions from four embryonic veins, most anteriorly the hepatic, then the ductus venosus, then the right subcardinal and posteriorly the right posterior cardinal (F. T. Lewis, *Am. J. of Anat.* vol. 1., 229, 1902). The anterior (cephalic) part of the right posterior cardinal forms the *vena azygos major,* and an inspection of fig. 4 will show that in the adult this may rise from the renal, from an ascending lumbar vein or, by a cross communication above the renal, from the inferior vena cava. The left posterior cardinal becomes obliterated below and its segmental tributaries find their way by cross communications to the vena cava (fig. 5). Above (cephalad) the left renal vein the left cardinal forms the hemiazygos and, higher still, the hemiazygos accessoria. These open into the azygos major by persistent cross communications which lie dorsal to the heart when that organ reaches its permanent position. Some modern authorities doubt whether the azygos veins of mammals are really persistent cardinals except quite in their anterior parts, just before they join the ducts of Cuvier. The left duct of Cuvier is only represented in the human adult by the oblique vein of Marshall on the dorsum of the left auricle. The external iliac veins become fully developed, like their arteries, when the blood changes its course from the back to the front of the thigh. After birth the umbilical vein and the ductus venosus become converted into fibrous cords and the circulation in the pulmonary veins is established.

COMPARATIVE ANATOMY

In the Acrania (*Amphioxus*), although there is no heart, the blood vessels returning the blood to the subpharyngeal region are distinctly of a vertebrate type. There is a subintestinal vessel or vein bringing the blood from the intestine to the liver and breaking up into capillaries in that organ just as the portal vein does in the higher forms. From the liver a hepatic vein carries the blood forward to the region below the pharynx where the heart is formed in Vertebrata. There is no renal portal system. In the Cyclostomata (lampreys and hags) the cardinal veins are formed and the blood from the caudal vein passes directly into the posterior cardinals without any renal portal system. In fishes the single caudal vein divides into two branches, each of which runs forward to the outer side of its respective kidney and ends by giving numerous branches to that viscus. The blood returning from the kidney passes into the beginning of its own posterior cardinal vein or sinus, which lies on the inner side of the kidney. This constitutes a *renal portal system.* The cardinal veins and ducts of Cuvier closely resemble the arrangement already detailed in the human foetus, while the hepatic portal system from the intestine to the liver is constant in this and all other vertebrates.

In the Dipnoi (mud-fish) a pulmonary vein from the lung-like swim-bladder is formed and an inferior vena cava or postcaval vein carries the blood from the kidneys to the heart. This is its first appearance in the vertebrate phylum. In the lower fishes there is a vein of the lateral line on each side, but in the Dipnoi these coalesce and form a median anterior (ventral) abdominal vein which is constant in the Amphibia. Subclavian and iliac veins return the blood from the fins and open respectively into the junction of the anterior and posterior cardinals and into the caudal vein.

In the tailed Amphibia (*Urodela*) the postcaval and posterior cardinal veins are well developed, the former vessel running from the right cardinal vein a little in front of (cephalad) the kidney to the hepatic vein, in this way closely foreshadowing man's embryology. In the Anura (frogs and toads) the posterior cardinals are usually suppressed, but these are very specialized animals. The anterior abdominal vein in amphibians joins the portal vein close to the liver.

In the Reptilia the renal portal circulation persists, but is rudimentary in birds and disappears in mammals. The anterior abdominal or epigastric vein of amphibians and reptiles returns the blood from the allantois in the embryo and in higher forms becomes the umbilical vein returning the blood from the placenta; there is, therefore, a continuous line of ascent from the lateral line veins of the fish to the umbilical vein of man. In reptiles, birds, monotremes, marsupials and many rodents, insectivores, bats and ungulates, a left superior vena cava (precaval vein) is present as well as a right; it passes ventral to the root of the left lung and then dorsal to the left auricle of the heart until it reaches the coronary sinus to open into the right auricle. Its course is indicated in man by the left superior intercostal vein, the vestigial fold of Marshall (*see* COELOM AND SEROUS MEMBRANES) and the oblique vein of Marshall. It can be readily reconstructed from figs. 4 and 5 if the transverse communication (L.I.) is obliterated. In some mammals the postcaval vein is double, especially in its hinder (caudad) part, and this sometimes occurs as a human abnormality (*see* F. W. McClure, *Am. Journ. of Anat.* vol. 2, 1903, and vol. 5, 1906, also *Anat. Anzeiger,* Bd. 29, 1906).

Except in Cetacea, one or both azygos veins are always present in mammals. When there is only one it is usually the right, though a few forms among the marsupials, rodents and ungulates have only the left (F. E. Beddard, *P.Z.S.*, 1907, p. 181). In many of the lower mammals the external jugular vein is much larger than the internal and returns most of the blood from the brain through an opening called the postglenoid foramen. For this reason it was formerly regarded as the representative of the primitive jugular. It is now, however, thought that the internal jugular is that representative, and that the arrangement of man, in which the internal jugular drains the interior of the cranium, is the more generalized and primitive. (F. G. P.)

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For an account of mineral veins *see* ORE DEPOSITS.

VEJER DE LA FRONTERA, a town of southern Spain, in the province of Cádiz, on the right bank of the river Barbate and on the Cádiz-Tarifa railway. Pop. (1940) 8,709 (mun., 10,110). Vejer de la Frontera occupies a low hill overlooking the Straits of Gibraltar and surrounded by orchards and orange groves. The architecture of many of its houses recalls the period of Moorish rule, which lasted from 711 until the town was captured by St. Ferdinand of Castile in 1248.

VELA, one of the three southern constellations into which the large Ptolemaic constellation Argo (*q.v.*) was subdivided.

VELARIUM, the curtain or awning extended above the auditorium of the Roman theatres and amphitheatres to protect the spectators from sun and rain.

VELAZQUEZ, DIEGO RODRIGUEZ DE SILVA Y (1599–1660), the head of the Spanish school of painting and one of the greatest painters the world has known, was born in Seville and was baptized on June 6, 1599. His European fame is of comparatively recent origin, dating from the first quarter of the 19th century.

Early Life.—He was the son of Rodriguez de Silva, a lawyer in Seville, descended from a noble Portuguese family. Following a common Spanish usage, the artist is known by his mother's name Velazquez. He was known to his contemporaries as Diego de Silva Velazquez, and signed his name thus. He was intended for a learned profession, for which he received a good training in languages and philosophy. But the bent of the boy was towards art, and he was placed under the elder Herrera. Herrera was a bold and effective painter; but he was at the same time a man of unruly temper, and his pupils could seldom stay long with him. Velazquez soon left Herrera's studio and betook himself to the learned and pedantic Pacheco, in whose school he remained for five years, seeing all that was best in the literary and artistic circles of Seville. Here he fell in love with his master's daughter Juana de Miranda, whom he married on April 23, 1618. The young painter set himself to copy the commonest things about him—earthenware jars of the country people, birds, fish, fruit and flowers of the market-place. Carrying out this idea still further, Velazquez felt that to master the subtlety of the human face he must make this a special study, and he accordingly engaged a peasant lad to be his servant and model, making innumerable studies in charcoal and chalk, and catching his every expression. We see this model, probably, in the laughing boy of the Hermitage "Breakfast," or in the youngest of the "Musicians," acquired for the Berlin Museum in 1906. The position and fame of Velazquez were now assured at Seville. There his wife bore him two daughters—all his family so far as is known. The younger died in infancy, while the elder, Francisca, in due time married Bautista del Mazo, a painter, whose large family is that which is represented in the important picture in Vienna which was at one time called the "Family of Velazquez." This picture is now by common consent given to Mazo. Of his early Seville manner we have an excellent example in "El Aguador" (the Water-Carrier) at Apsley House (London). The brushwork is bold and broad, and the outlines firmly marked. As is usual with Velazquez at this time, the harmony of colours is red, brown and yellow, reminding one of Ribera. For sacred subjects we may turn to the "Adoration of the Magi" at Madrid, dated 1619, and the "Christ and the Pilgrims of Emmaus" in the Metropolitan Museum of Art, New York.

Life in Madrid.—But Velazquez was now eager to see more of the world. Madrid, with its fine Titians, held out strong inducements. Accordingly, in 1622, fortified with letters of introduction to Fonseca, who held a good position at court, he spent some months there. Here he painted the portrait of the poet Gongora, a commission from Pacheco (in the gallery at Madrid). In the following year he was summoned to return by Olivares, the all-powerful minister of Philip IV., fifty ducats being allowed to defray his expenses. On this occasion he was accompanied by his father-in-law. Next year (1624) he received from the king three hundred ducats to pay the cost of the removal of his family to Madrid, which became his home for the remainder of his life. King Philip remained for a period of thirty-six years the faithful and attached friend of Velazquez. By his equestrian portrait of the king, painted in 1623, Velazquez secured admission to the royal service with a salary of twenty ducats per month, besides medical attendance, lodgings and payment for the pictures he might paint. The portrait was exhibited on the steps of San Felipe, and was received with enthusiasm, being vaunted by poets, among them Pacheco. It has unfortunately disappeared. The Prado, however, has two portraits of the king in which the harshness of the Seville period has disappeared.

In 1628 Rubens visited Madrid on a diplomatic mission for nine months, and Velazquez was appointed by the king to be his guide among the art treasures of Spain. In 1627 the king had given for competition among the painters of Spain the subject of the Expulsion of the Moors. Velazquez bore off the palm for a picture no longer extant, and was appointed gentleman usher. To this was shortly afterwards added a daily allowance of twelve reals, and ninety ducats a year for dress. As an extra payment he received (though it was not paid for five years) one hundred ducats for the picture of Bacchus, painted in 1629 (Madrid gallery). The spirit and aim of this work are better understood from its Spanish name, "Los Borrachos" (the Topers), who are paying mock homage to a half-naked ivy-crowned young man seated on a wine barrel.

Visit to Italy.—In 1629 Philip gave Velazquez permission to visit Italy, without loss of salary, making him besides a present of four hundred ducats, to which Olivares added two hundred. He sailed from Barcelona in August in the company of the marquis de Spinola, the conqueror of Breda, then on his way to take command of the Spanish troops at Milan. It was during this voyage that Velazquez must have heard the details of the surrender of Breda from the lips of the victor, and he must have sketched his fine head, known to us also by the portrait by Van Dyck. But the great picture was not painted till later. In Venice Velazquez made copies of the "Crucifixion" and the "Last Supper" of Tintoretto, which he sent to the king, and in Rome he copied Michelangelo and Raphael, lodging in the Villa Medici till fever compelled him to remove into the city. Here he painted the "Forge of Vulcan" (Madrid gallery), in which Apollo narrates to the astonished Vulcan, a village blacksmith, the news of the loves of Venus, while four Cyclops listen to the scandal. The other work painted at the same time, "Joseph's Coat," now hangs in the Escorial. At Rome he also painted the two beautiful landscapes of the gardens of the Villa Medici, now in the Madrid museum, full of light, sparkle and charm. After a visit to Naples in 1631, where he worked with his countryman Ribera, and painted a charming portrait of the Infanta Maria Queen of Hungary and sister of Philip, Velazquez returned to Madrid.

Court Painter.—He then painted the first of many portraits of the young prince, Don Baltasar Carlos, the heir to the throne, dignified and lordly even in his childhood, caracoling in the dress of a field-marshal on his prancing steed. The Duke of Olivares, the king's powerful minister, was the early and constant patron of the painter. His impassive, saturnine face is familiar to us from the many portraits painted by Velazquez. Two are of surpassing excellence—the full-length in the collection of the Hispanic Society, New York, stately and dignified, in which he wears the green cross of Alcantara; the other the great equestrian portrait of the Madrid gallery. In these portraits Velazquez has well repaid the debt of gratitude which he owed to his first patron, whom he stood by in his fall, thus exposing himself to the risk of incurring the anger of the jealous Philip. The king, however, showed no sign of malice towards his favoured painter, whom he visited daily in his studio in the palace, and to whom he sat in many attitudes and costumes, as a huntsman with his dogs, as a warrior in command of his troops. His pale face and lack-lustre eye, his fair flowing hair and moustaches curled up to his eyes, and his heavy projecting Hapsburg under-lip are known in many a portrait and nowhere more supremely than in the wonderful canvas of the London National Gallery where he seems to live and breathe. Here the consummate handling of Velazquez is seen at its best, for it is in his late and most perfect manner. From one of the equestrian portraits of the king, painted in 1638, the sculptor Montañes modelled a statue which was cast in bronze by the Florentine sculptor Tacca, and which now stands in the Plaza del Oriente at Madrid. This portrait exists no more; but there is no lack of others, for Velazquez was in constant attendance on Philip, accompanying him in his journeys to Aragon in 1642 and 1644, and was doubtless present with him when he entered Lerida as a conqueror. It was then that he painted the great equestrian portrait (Madrid gallery) in which the king is represented as a great commander leading his troops. It hangs as a pendant to the great Olivares portrait—fit rivals of the neighbouring Charles V. by Titian. At Fraga in Aragon in 1644 he painted a portrait of the king in country costume the original of which seems to be in the Frick collection, New York, while the Dulwich Gallery has a copy.

But, besides the portraits of the king, we have portraits of other

members of the royal family, of Philip's first wife, Isabella of Bourbon, and her children, especially of her eldest son, Don Baltasar Carlos, of whom, besides the equestrian portrait already mentioned, there is a full-length at the Vienna Museum, one in hunting dress at the Prado, and one at the Boston Museum with a dwarf. The Admiral Pulido Pareja at the National Gallery, is said to have been taken by Philip for the living man; nevertheless, A. de Beruete is emphatic in denying Velazquez's authorship of this picture, which he attributes to Mazo. The Duke of Modena on a visit to Madrid was painted by the artist (Modena Gallery) and of the same period are two male portraits at Dresden "The Count of Benevent," "The Sculptor Martinez Montañez" in the Madrid gallery, and "The Unknown Man" at Aspley House. One wonders who "the lady with the fan" can be that adorns the Wallace collection, the splendid brunette so unlike the usual fair-haired female sitters to Velazquez. She belongs to this period of his work, to the ripeness of his middle period. The touch is firm but free, showing the easy strength of the great master. But, if we have few ladies of the court of Philip, we have in great plenty his buffoons and dwarfs. Even these deformed or half-witted creatures attract our sympathy as we look at their portraits by Velazquez, who, true to his nature, treats them gently and kindly, as in "El Primo" (the Favourite), whose intelligent face and huge folio with ink-bottle and pen by his side show him to be a wiser and better-educated man than many of the gallants of the court. We now turn to one of the greatest of historical works, the "Surrender of Breda," often known as "Las Lanzas," from the serried rank of lances breaking the sky, which is believed to have been painted between 1638 and 1644. It represents the moment when the vanquished Justin of Nassau in front of his Dutch troops is submissively bending as he offers to his conqueror Spinola the keys of the town, which, with courteous grace, the victor refuses to accept.

The greatest of the religious paintings by Velazquez belongs also to this middle period, the "Christ on the Cross" (Madrid gallery). Palomino says it was painted in 1638 for the convent of San Placido. The Saviour's head hangs on his breast and a mass of dark tangled hair conceals part of the face. The beautiful form is projected against a black and hopeless sky. The figure stands absolutely alone, without any accessory. To the same period belongs the great "Boar Hunt" at the National Gallery, a magnificent work in spite of some restorations.

Second Visit to Italy.—Velazquez's son-in-law Mazo had succeeded him as usher in 1634, and he himself had received steady promotion in the royal household, receiving a pension of 500 ducats in 1640, increased to 700 in 1648, for portraits painted and to be painted, and being appointed inspector of works in the palace in 1647. Philip now entrusted him with the founding of an academy of art in Spain. Rich in pictures, Spain was weak in statuary, and Velazquez was commissioned to proceed to Italy to make purchases. Accompanied by his faithful slave Pareja, whom he taught to be a good painter, he sailed from Malaga in 1649, landing at Genoa, and proceeding thence by Milan to Venice, buying Titians, Tintorettos and Veroneses. A noble example of the painter's third manner is the great portrait of Innocent X. in the Doria palace at Rome, where he was received with marked favour by the pope, who presented him with a medal and gold chain. Of this portrait, thought by Sir Joshua Reynolds to be the finest picture in Rome, Palomino says that Velazquez took a copy to Spain. There exist several in different galleries. The handling is rapid but unerring. Velazquez had now reached the *manera abreviada*, as the Spaniards call this bolder style. His early and laborious studies and his close observation of nature had given to him in due time, as to all great painters, the power of representing what he saw by simpler means. At Rome he painted also a portrait of his servant Pareja, probably the picture of Lord Radnor's collection which procured his election into the academy of St. Luke. Meanwhile Philip was wearying for his return; accordingly Velazquez embarked in Genoa for Barcelona in 1651, taking with him many pictures and 300 pieces of statuary, which he afterwards arranged and catalogued for the king.

Late Life.—Isabella of Bourbon had died in 1644, and the king had married Mariana of Austria, whom Velazquez now painted in many attitudes. He was specially chosen by the king to fill the high office of "aposentador major," which imposed on him the duty of looking after the quarters occupied by the court whether at home or in their journeys. His works of this period are amongst the highest examples of his style. The dwarfs "El Bobo de Coria," "El Niño de Vallecas" and "Don Antonio el Inglés" (the Englishman) with his dog, "Aesop," and "Menippus," all in the Madrid gallery, show his surest and freest manner. To these may be added the charming children's portraits of the Infanta Margarita in Vienna, among the choicest of his works. It is Margarita, the eldest daughter of the new queen, that is the subject of the well-known picture "Las Meniñas" (the Maids of Honour), in the Madrid gallery, painted in 1656, where the little lady holds court, surrounded by her ladies-in-waiting, her dwarfs and her mastiff, while Velazquez is seen standing at his easel. This is the finest portrait we have of the great painter. It is a face of much dignity, power and sweetness—like his life. The story is told that the king painted the red cross of Santiago on the breast of the painter, as it appears to-day on the canvas. Velazquez did not, however, receive the honour till 1659, three years after the execution of this work. Even the powerful king of Spain could not make his favourite a belted knight without a commission to inquire into the purity of his lineage on both sides of the house. The records of this commission have been found among the archives of the order of Santiago by M. Villaamil. Fortunately the pedigree could bear scrutiny, as for generations the family was found free from all taint of heresy, from all trace of Jewish or Moorish blood and from contamination by trade or commerce. The difficulty connected with the fact that he was a painter was got over by his being painter to the king and by the declaration that he did not sell his pictures. But for this royal appointment, which enabled him to escape the censorship of the Inquisition, we should never have had his splendid "Venus and Cupid," bought by the National Art Collections Fund for £45,000 for the National Gallery in 1905. On occasions Philip gave commissions for religious pictures to Velazquez—among others, the "Coronation of the Virgin" (Madrid gallery), splendid in colour—a harmony of red, blue and grey. It was painted for the oratory of the queen, in the palace at Madrid. Another royal commission for the hermitage of Buen Retiro was the "St. Anthony the Abbot and St. Paul the Hermit," painted in 1659 (Madrid gallery). The last of his works which we shall name is "Las Hilanderas" or the Spinners (Madrid), painted about 1656, representing the royal tapestry works.

In 1660 a treaty of peace between France and Spain was to be consummated by the marriage of the infanta Maria Theresa with Louis XIV., and the ceremony was to take place in the Island of Pheasants, in the Bidassoa. Velazquez was charged with the decoration of the Spanish pavilion and with the whole scenic display. In the midst of the grandees of the first two courts in Christendom Velazquez attracted much attention by the nobility of his bearing and the splendour of his costume. On June 26 he returned to Madrid, and on July 31 he was stricken with fever. Feeling his end approaching, he signed his will, appointing as his sole executors his wife and his firm friend Fuensalida, keeper of the royal records. He died on Aug. 6, 1660. He was buried in the Fuensalida vault of the church of San Juan, and within eight days his wife Juana was laid beside him. This church was destroyed by the French in 1811, so that his place of interment is now unknown.

Velazquez can hardly be said to have formed a school of painting. Yet his influence on those immediately connected with him was considerable. In 1642 he befriended young Murillo on his arrival in Madrid, received him into his house, and directed his studies for three years. He helped to lay the foundations of modern painting; and when centuries later the Impressionists made it their aim to study the effect of light and atmosphere Velazquez was hailed as their precursor.

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VELEIA, an ancient town of Aemilia, Italy, situated about 20 m. S. of Placentia, mentioned by Pliny. Its inhabitants were in the census of Vespasian found to be remarkable for their longevity. Nothing further was known of it until 1747, when some ploughmen found the famous *Tabula alimentaria.* This, the largest inscribed bronze tablet of antiquity (4 ft. 6 in. by 9 ft. 6 in.) contains the list of estates in the territories of Veleia, Libarna, Placentia, Parma and Luca, in which Trajan had assigned (before A.D. 102), 72,000 sesterces (£720) and then 1,044,000 sesterces (£10,440), on a mortgage bond to forty-six estates, the total value of which was reckoned at over 13,000,000 sesterces (£130,000), the interest on which at 5% was to serve for the support of 266 boys and 36 girls, the former receiving 16, the latter 12 sesterces a month. Excavations were begun in 1760, and the forum and basilica, the thermae and the amphitheatre, private houses, etc., with many statues and inscriptions (from 49 B.C. to A.D. 276) were discovered. Most of the objects found are in the museum at Parma. Oil has been extracted in the neighbourhood since 1890.

See G. Antolini, *Le Rovine di Veleia* (Milan, 1831).

VELEZ DE GUEVARA, LUIS (1579–1644), Spanish dramatist and novelist, was the author of over 400 plays, of which the best known are *Reinar despues de morir* and *Más pesa el rey que la sangre.* He won considerable fame as the author of *El Diablo cojuelo* (1641), a fantastic novel which suggested to Le Sage the idea of his *Diable boiteux.*

VÉLEZ-MÁLAGA, a town of southern Spain, in the province of Málaga, finely situated in a fertile valley at the southern base of the lofty Sierra de Alhama, and on the left bank of the small river Vélez, 1 mi. from its mouth and 27 mi. by road E.N.E. of Málaga. Pop. (1940), 10,813 (mun., 28,894). Vélez-Málaga was taken from the Moors in 1487 by Ferdinand of Castile. Under Moorish rule the citadel was built and the town became an important trading station and fortress.

VELIA, an ancient town of Lucania (Gr. Τέλη, later Ἐλέα), Italy, on the hill now crowned by the mediaeval castle of Castellammare della Bruca, 440 ft. above sea-level, on the south-west coast, 1¾ m. N.W. of the modern railway station of Ascéa, 25 m. S.E. of Paestum. Remains of the city walls, with traces of one gate and several towers, of a total length of over 3 m., still exist. It is celebrated for the philosophers who bore its name. (*See* ELEATIC SCHOOL.) About 530 B.C. the Phocaeans, driven from Corsica, seized it from the Oenotrians. Its coins were widely diffused in S. Italy, and it kept its independence till 78 B.C.

VELIKA KIKINDA, a town in the Voivodina, Yugoslavia, Pop. (1931) 28,400; about 60% being Serbs. It is one of the centres of production of the famous wheat of the Banat.

VELLEIUS PATERCULUS, MARCUS (*c.* 19 B.C.–*c.* A.D. 31), Roman historian. Although his praenomen is given as Marcus by Priscian, some modern scholars identify him with Gaius Velleius Paterculus, whose name occurs in an inscription on a north African milestone (*C.I.L.* viii. 10, 311). He belonged to a distinguished Campanian family, and early entered the army. He served as military tribune in Thrace, Macedonia, Greece and the East, and in A.D. 2 was present at the interview on the Euphrates between Gaius Caesar, grandson of Augustus, and the Parthian king. Afterwards, as praefect of cavalry and legatus, he served for eight years (from A.D. 4) in Germany and Pannonia under Tiberius. He was quaestor in A.D. 7, praetor in 15, and was still alive in 30. He may have been put to death in 31 as a friend of Seianus. He wrote a compendium of Roman history from the dispersion of the Greeks after the siege of Troy down to the death of Livia (A.D. 29). The period from the death of Caesar to that of Augustus is treated most fully, and the disproportion is accentuated by the loss of a great deal of the early history. Most of the work is professedly a compendium; where he allows himself scope his style shows distinct traces of the Silver Age: antithesis, epigram, the breakdown of the periodic sentence.

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VELLETRI (anc. *Velitrae*), a town and episcopal see of the province of Rome, Italy, at the south-east foot of the outer ring wall of the Alban crater, 26 mi. S.E. of Rome by rail and 24 by electric tramway, 1,155 ft. above sea-level. Pop. (1936) 20,419 (town), 31,029 (commune). It is the seat of the bishop of Ostia. Good wine is made in the vineyards and there is a government experimental station for viticulture. Velletri is the junction of the Terracina line and a branch to Segni, on the main line to Naples. At the highest point is the municipal palace. The internal façade of the Palazzo Ginetti is finely decorated with stucco, and has a curious detached baroque staircase by Martino Lunghi the younger. The lofty campanile of S. Maria del Trivio, erected in 1353, is in the style of contemporary brick campanili in Rome, but built mainly of black selce (lava), with white marble columns at the windows. The cathedral, reconstructed in 1660, contains traces of the 13th century structure.

The ancient city of Velitrae was Volscian in Republican times, and it is the only Volscian town of which an inscription in that language is preserved (4th century B.C.). It mentions the two principal magistrates as *medix.* Velitrae was important as commanding the approach to the valley between the Alban and Volscian mountains. Interesting terra cotta reliefs from a Volscian temple have been found (esp. 5th cent. B.C.) belonging to the period when it had regained its freedom after its first capture by Rome. It was only reduced in 338 and was punished by the destruction of its walls and the banishment of its town councillors to Etruria, while their lands were handed over to Roman colonists. It was the home of the *gens Octavia,* to which the Emperor Augustus belonged. (T. A.)

VELLORE, a town of British India, headquarters of the North Arcot district of Madras, on the river Palar and 5 m. from a station on the South Indian railway, 87 m. W. of Madras city. Pop. (1941) 71,502. It has a strongly built fortress, which was famous in the wars of the Carnatic. Dating traditionally from the 13th century, but more probably only from the 17th, it is a fine example of Indian military architecture, and contains a finely sculptured temple. In 1780 it withstood a siege for two years by Hyder Ali. After the fall of Seringapatam (1799) Vellore was selected as the residence of the sons of Tippoo Sahib, and to them have been attributed the mutiny of the sepoys here in 1806.

VELLUM: *see* PARCHMENT.

VELOCITY OF LIGHT. The fact that light is propagated with a definite speed was first brought out by Ole Roemer at Paris, in 1676, through observations of the eclipses of Jupiter's satellites made in different relative positions of the Earth and Jupiter in their respective orbits. It is possible in this way to determine the time required for light to pass across the orbit of the earth. The dimensions of this orbit, or the distance of the sun, being taken as known, the actual speed of light could be computed. (*See* also PARALLAX.) Since this computation requires a knowledge of the sun's distance, which has not yet been acquired with certainty, the actual speed is now determined by experiments made on the earth's surface. Were it possible by any system of signals to compare with absolute precision the times at two different stations, the speed could be determined by finding how long was required for light to pass from one station to another at the greatest visible distance. But this is impracticable, because no natural agent is under our control by which a signal could be communicated with a greater velocity than that of light. It is therefore necessary to reflect a ray back to the point of observation and to determine the time which the light requires to go and come. Two systems have been devised for this purpose. One is that of Armand Fizeau, in which the vital appliance is a rapidly revolving toothed wheel; the other is that of Foucault, in which the corresponding appliance is a mirror revolving on an axis in its own plane.

Fizeau, 1849.—The principle underlying Fizeau's method is

shown in the accompanying figs. 1 and 2. Fig. 1 shows the course of a ray of light which, emanating from a luminous point L, strikes the plane surface of a plate of glass M at an angle of about 45°. A fraction of the light is reflected from the two surfaces of the glass to a distant reflector R, the plane of which is at right angles to the course of the ray. The latter is thus reflected back on its own course and, passing through the glass M on its return, reaches

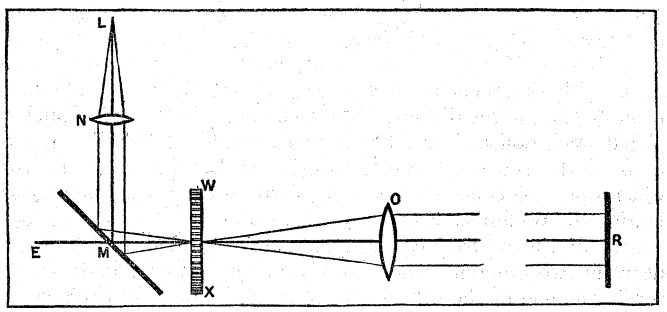


FIG. 1.—FIZEAU'S METHOD OF MEASURING THE VELOCITY OF LIGHT BY MEANS OF A TOOTHED WHEEL

a point E behind the glass. An observer with his eye at E looking through the glass sees the return ray as a distant luminous point in the reflector R, after the light has passed over the course in both directions.

In actual practice it is necessary to interpose the object glass of a telescope at a point O, at a distance from M nearly equal to its focal length. The function of this appliance is to render the diverging rays, shown by the dotted lines, nearly parallel, in order that more light may reach R and be thrown back again.

Conceiving the apparatus arranged in such a way that the observer sees the light reflected from the distant mirror R, a fine toothed wheel WX is placed immediately in front of the glass M, with its plane perpendicular to the course of the ray, in such a way that the ray goes out and returns through an opening between two adjacent teeth. This wheel is represented in section by WX in fig. 1, and a part of its circumference, with the teeth as viewed by the observer, is shown in fig. 2. We conceive that the observer sees the luminous point between two of the teeth at K. Now, conceive that the wheel is set in revolution. The ray is then interrupted as every tooth passes, so that what is sent out is a succession of flashes. Conceive that the speed of the wheel is such that while the flash is going to the distant mirror and returning again, each tooth of the wheel takes the place of an opening between the teeth. Then each flash sent out will, on its return, be intercepted by the adjacent tooth, and will therefore become invisible. If the speed be now doubled, so that the teeth pass at intervals equal to the time required for the light to go and come, each flash sent through an opening will return through the adjacent opening, and will therefore be seen with full brightness. If the speed be continuously increased the result will be successive disappearances and reappearances of the light, according as a tooth is or is not interposed when the ray reaches the apparatus on its return. The computation of the time of passage and return is then very simple. The speed of the wheel being known, the number of teeth passing in one second can be computed.

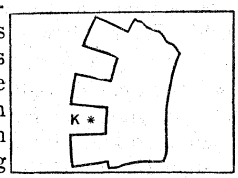


FIG. 2.—FIZEAU'S METHOD OF MEASURING THE VELOCITY OF LIGHT

Foucault, 1862.—The Foucault system is much more precise, because it rests upon the measurement of an angle, which can be made with great precision.

The vital appliance is a rapidly revolving mirror. Let AB (fig. 3) be a section of this mirror, which we shall first suppose at rest. A ray of light LM emanating from a source at L, is reflected in the direction MQR to a distant mirror R, from which it is perpendicularly reflected back upon its original course. This mirror R should be slightly concave, with the centre of curvature near M, so that the ray shall always be reflected back to M on whatever point of R it may fall. Conceiving the revolving mirror M as at rest, the return ray will after three reflections, at M, R and M again, be returned along its original course to the point L from which it emanated. An important point is that the return ray will always follow the fixed line ML no matter what the position of the movable mirror M, provided there is a distant reflector to send the ray back. Now, suppose that, while the ray is going and coming, the mirror M, being set in revolution, has turned from the position in which the ray was reflected to that shown by the dotted line. If α be the angle through which the surface has turned, the course of the return ray, after reflection, will then deviate from ML by the angle 2α, and so be thrown to a point E, such that the angle $LME = 2\alpha$. If the mirror is in rapid rotation the ray reflected from it will strike the distant mirror as a series of flashes, each formed by the light reflected when the mirror was in the position AB. If the speed of rotation is uniform, the reflected rays from the successive flashes while the mirror is in the dotted position will thus all follow the same direction ME after their second reflection from the mirror. If the motion is sufficiently rapid an eye observing the reflected ray will see the flashes as an invariable point of light so long as the speed of revolution remains constant. The time required for the light to go and come is then equal to that required by the mirror to turn through half the angle LME, which is therefore to be measured. In practice it is necessary on this system, as well as on that of Fizeau, to condense the light by means of a lens, Q, so placed that L and R shall be at conjugate foci. The position of the lens may be either between the luminous point L and the mirror M, or between M and R, the latter being the only one shown in the figure. A difficulty associated with the Foucault system in the form in which its originator used it is that if the axis of the mirror is at right angles to the course of the ray, the light from the source L will be flashed directly into the eye of the observer, on every passage of the revolving mirror through the position in which its normal bisects the two courses of the ray. This may be avoided by inclining the axis of the mirror.

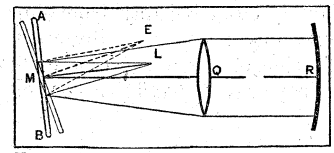


FIG. 3.—PRINCIPLE OF FOUCAULT'S METHOD OF DETERMINING THE VELOCITY OF LIGHT

In Foucault's determination the measures were not made upon a luminous point, but upon a reticule, the image of which could not be seen unless the reflector was quite near the revolving mirror. Indeed the whole apparatus was contained in his laboratory. The effective distance was increased by using several reflectors; but the entire course of the ray measured only 20 metres. The result reached by Foucault was 298,000 kilometres per second.

Cornu, 1874.—The most elaborate determination yet made by Fizeau's method was that of Cornu. The station of observation was at the Paris Observatory. The distant reflector, a telescope with a reflector at its focus, was at Montlhéry, distant 22,910 metres from the toothed wheel. Of the wheels most used one had 150 teeth, and was 35 millimetres in diameter; the other had 200 teeth, with a diameter of 45 mm. The highest speed attained was about 900 revolutions per second. At this speed, 135,000 (or 180,000) teeth would pass per second, and about 20 (or 28) would pass while the light was going and coming. But the actual speed attained was generally less than this. The definitive result derived by Cornu from the entire series of experiments was 300,400 km. per second. Further details of this work need not be set forth because the method is in several ways deficient in precision. The eclipses and subsequent reappearances of the light taking place gradually, it is impossible to fix with entire precision upon the moment of complete eclipse. The outcome of the inherent difficulties of the method is that, although Cornu's discussion of his experiments is a model in the care taken to determine so far as practicable every source of error, his definitive result is shown by other determinations to have been too great by about $\frac{1}{1000}$ part of its whole amount.

Michelson, 1878–79–82, and Newcomb, 1881–82.—The first marked advance on Foucault's determination was made by Albert A. Michelson, then a young officer on duty at the U.S. Naval academy, Annapolis. The improvement consisted in using the image of a slit through which the rays of the sun passed after reflection from a heliostat. In this way it was found possible to

see the image of the slit reflected from the distant mirror when the latter was nearly 600 metres from the station of observation. The essentials of the arrangement are those we have used in fig. 3, L being the slit. It will be seen that the revolving mirror is here interposed between the lens and its focus. It was driven by an air turbine, the blast of which was under the control of the observer, so that it could be kept at any required speed. The speed was determined by the vibrations of two tuning forks. One of these was an electric fork, making about 120 vibrations per second, with which the mirror was kept in unison by a system of rays reflected from it and the fork. The speed of this fork was determined by comparison with a freely vibrating fork from time to time. The speed of the revolving mirror was generally about 275 turns per second, and the deflection of the image of the slit about 112·5 mm. The mean result of nearly 100 fairly accordant determinations was:

Velocity of light in air	299,828 km. per sec.
Reduction to a vacuum	+82
Velocity of light in a vacuum	299,910±50.

Simon Newcomb about this time obtained the official support necessary to make a determination on a yet larger scale. The most important modifications made in the Foucault-Michelson system were the following:

1. Placing the reflector at a distance of several kilometres.

2. In order that the disturbances of the return image due to the passage of the ray through more than 7 km. of air might be reduced to a minimum, an ordinary telescope of the "broken back" form was used to send the ray to the revolving mirror.

3. The speed of the mirror was, as in Michelson's experiments, completely under control of the observer, so that by drawing one or the other of two cords held in the hand the return image could be kept in any required position. In making each measure the receiving telescope hereafter described was placed in a fixed position and during the "run" the image was kept as nearly as practicable upon a vertical thread passing through its focus. A "run" generally lasted about two minutes, during which time the mirror commonly made between 25,000 and 30,000 revolutions. The speed per second was found by dividing the entire number of revolutions by the number of seconds in the "run." The extreme deviations between the times of transmission of the light, as derived from any two runs, never approached to the thousandth part of its entire amount. The average deviation from the mean was indeed less than $\frac{1}{5000}$ part of the whole.

To avoid the injurious effect of the directly reflected flash, as well as to render unnecessary a comparison between the directions of the outgoing and the return ray, a second telescope, turning horizontally on an axis coincident with that of the revolving mirror, was used to receive the return ray after reflection. This required the use of an elongated mirror of which the upper half of the surface reflected the outgoing ray, and the lower other half received and reflected the ray on its return. On this system it was not necessary to incline the mirror in order to avoid the direct reflection of the return ray. The greatest advantage of this system was that the revolving mirror could be turned in either direction without break of continuity, so that the angular measures were made between the directions of the return ray after reflection when the mirror moved in opposite directions. In this way the speed of the mirror was as good as doubled, and the possible constant errors inherent in the reference to a fixed direction for the sending telescope were eliminated. The essentials of the apparatus are shown in fig. 4. The revolving mirror was a rectangular prism M of steel, 3 in. high and $1\frac{1}{2}$ in. on a side in cross section, which was driven by a blast of air acting on two fan-wheels, not shown in the fig., one at the top, the other at the bottom of the mirror. NPO is the object-end of the fixed sending telescope the rays passing through it being reflected to the mirror by a prism P. The receiving telescope ABO is straight, and has its objective under O. It was attached to a frame which could turn around the same axis as the mirror. The angle through which it moved was measured by a divided arc immediately below its eye-piece, which is not shown in the figure. The position AB is that for receiving the ray during an anti-clockwise rotation of the mirror; the position A′B′ that for a clockwise rotation.

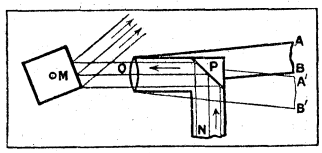


FIG. 4.—MICHELSON'S EARLIER APPARATUS FOR DETERMINING THE VELOCITY OF LIGHT

In these measures the observing station was at Fort Myer, on a hill above the west bank of the Potomac river. The distant reflector was first placed in the grounds of the Naval observatory, at a distance of 2,551 metres. But the definitive measures were made with the reflector at the base of the Washington monument, 3,721 metres distant. The revolving mirror was of nickel-plated steel, polished on all four vertical sides. Thus four reflections of the ray were received during each turn of the mirror, which would be coincident were the form of the mirror invariable. During the preliminary series of measures it was found that two images of the return ray were sometimes formed, which would result in two different conclusions as to the velocity of light, according as one or the other was observed. The only explanation of this defect which presented itself was a tortional vibration of the revolving mirror, coinciding in period with that of revolution.

In the summer of 1881 the distant reflector was removed from the Observatory to the Monument station. Six measures made in August and September showed a systematic deviation of +67 km. per second from the result of the Observatory series. This difference led to measures for eliminating the defect from which it was supposed to arise. The pivots of the mirror were reground, and a change made in the arrangement, which would permit of the effect of the vibration being determined and eliminated. This consisted in making the relative position of the sending and receiving telescopes interchangeable. In this way, if the measured deflection was too great in one position of the telescopes, it would be too small by an equal amount in the reverse position. As a matter of fact, when the definitive measures were made, it was found that with the improved pivots the mean result was the same in the two positions. But the new result differed systematically from both the former ones. Thirteen measures were made from the Monument in the summer of 1882. The mean results for the three series were:

Observatory, 1880–1.	V in air = 299,627
Monument, 1881	V in air = 299,694
Monument, 1882	V in air = 299,778

The last result being the only one from which the effect of distortion was completely eliminated, has been adopted as definitive. For reduction to a vacuum it requires a correction of +82 km. Thus the final result was concluded to be

Velocity of light in vacuo = 299,860 km. per second.

This result being less by 50 km. than that of Michelson, the latter made another determination with improved apparatus and arrangements at the Case School of Applied Science in Cleveland. The result was

Velocity in vacuo = 299,853 km. per second.

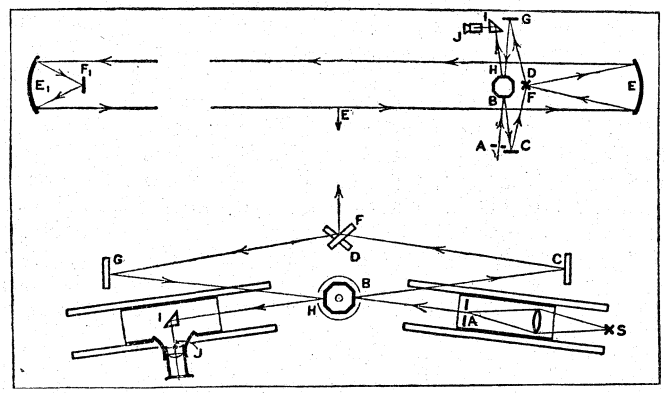
So far as could be determined from the discordance of the separate measures, the mean error of Newcomb's result would be less than ±10 km. But making allowance for the various sources of systematic error the actual probable error was estimated at ±30 km.

The angle α in Foucault's experiments cannot be measured with the required accuracy by any of the preceding methods, but, as was pointed out by Newcomb, this difficulty is avoided by giving the revolving mirror a prismatic form, and making the distance between the two stations so great that the return light is reflected at the same angle by the next following face of the prism.

Michelson, 1924–26, arranged for an attempt to realise such a project between stations on Mt. Wilson and Mt. San Antonio, near Pasadena, about 22 m. apart. For this distance, given a speed of rotation of 1,060 turns per second, the angular displacement of the mirror, during the double journey, will be 90°, or, if the speed were half as great, an angle of 45° would suffice. Accordingly, the revolving mirror may have the form of an octagon. It is, of course, very important that the angles of the octagon

should be equal, at least to the order of accuracy desired. It has been found possible, by special methods, to produce an octagon on which the average error is of the order of one-millionth, that is, about one-tenth to one-twentieth of a second.

Difficulties arise from the direct reflection and the scattered light from the revolving mirror. The former may be eliminated, as already mentioned, by slightly inclining the revolving mirror,



FROM MICHELSON, "STUDIES IN OPTICS" (UNIVERSITY OF CHICAGO)

FIG. 5.—MICHELSON'S LATER APPARATUS FOR DETERMINING THE VELOCITY OF LIGHT; THE UPPER FIGURE SHOWING THE COMPLETE DISPOSITION, AND THE LOWER FIGURE, THE APPARATUS AT THE MOUNT WILSON END IN MORE DETAIL

but to avoid scattered light, it is essential that the return ray be received on a different surface from the outgoing. Again, in order to avoid difficulty in maintaining the distant mirror perpendicular to the incident light, the return of the ray to the home station may be accomplished exactly as in Fizeau's experiment, the only precaution required being the very accurate focussing of the beam on a small plane (or better, concave) mirror at the focus at the distant collimator. Fig. 5 shows the arrangement of apparatus which fulfilled these requirements.

In Michelson's experiments the speed of rotation (529 rev. per second) of the revolving mirror was determined by an electric tuning fork. The fork was compared, before, and after every set of observations, with a free pendulum, whose rate was found by comparison with an invar pendulum furnished and rated by the Coast and Geodetic Survey. The 1924 results, gave, for the velocity of light in air 299,735 km. per second; the 1925 results—using the same fork and pendulum—299,690 km. per second; and a third series, in which the electric fork was replaced by a free fork maintained by an *audion circuit,* gave 299,704 km. per second. Applying the correction of 67 km. for reduction to vacuo gives, finally, 299,771 km. per second.

Observations with the same lay-out were resumed in the summer of 1926, with an assortment of revolving mirrors. The first of these was the small octagonal glass mirror used in the preceding work; the result obtained this year was 299,813 km. per second. The other mirrors were a steel octagon, a glass 12-sided, a steel 12-sided, and a glass 16-sided. The final results are summarized in Table A.

TABLE A

Mirror	Number of observations	Velocity of light in vacuo in kms. per sec.
Glass octagon	576	299,797
Steel octagon	195	299,795
Glass 12-sided	270	299,796
Steel 12-sided	218	299,796
Glass 16-sided	504	299,796

Weighted mean: 299,796 ± 1 km. per second.

VELOCITY AND WAVE-LENGTH

The experimental measures thus far cited have been primarily those of the velocity of light in air, the reduction to a vacuum being derived from theory alone. The fundamental constant at the basis of the whole theory is the speed of light in a vacuum, such as the celestial spaces. The question of the relation between the velocity in vacuo, and in a transparent medium of any sort, belongs to the domain of physical optics (*see* LIGHT). We shall in the present part of the article confine ourselves to the experimental results. With the theory of the effect of a transparent medium is associated that of the possible differences in the speed of light of different colours.

The question whether the speed of light in vacuo varies with its wave-length seems to be settled with entire certainty by observations of variable stars. These are situated at different distances, some being so far that light must be several centuries in reaching us from them. Were there any difference in the speed of light of various colours it would be shown by a change in the colour of the star as its light waxed and waned. The light of greatest speed preceding that of lesser speed would, when emanated during the rising phase, impress its own colour on that which it overtook. The slower light would predominate during the falling phase. If there were a difference of 10 minutes in the time at which light from the two ends of the visible spectrum arrived, it would be shown by this test. As not the slightest effect of the kind has ever been seen, it seems certain that the difference, if any, cannot approximate to $\frac{1}{1,000,000}$ part of the entire speed. The case is different when light passes through a refracting medium. It is a theoretical result of the undulatory theory of light that its velocity in such a medium is inversely proportional to the refractive index of the medium. This being different for different colours, we must expect a like difference in the velocity.

Foucault and Michelson have tested these results of the undulatory theory by comparing the time required for a ray of light to pass through a tube filled with a refracting medium, and through air. Foucault thus found, in a general way, that there actually was a retardation; but his observations took account only of the mean retardation of light of all the wave-lengths, which he found to correspond with the undulatory theory. Michelson went further by determining the retardation of light of various wave-lengths in carbon bisulphide. He made two series of experiments, one with light near the brightest part of the spectrum; the other with red and blue light. Putting V_0 for the speed in a vacuum and V_1 for that in the medium, his result was:

Yellow light	$V_0 : V_1 = 1{\cdot}758$
Refractive index for yellow	1·64
Difference from theory	+0·12.

The estimated uncertainty was only 0·02, or $\frac{1}{6}$ of the difference between observation and theory.

The comparison of red and blue light was made differentially. The colours selected were of wave-length about 0·62 for red and 0·49 for blue. Putting V_r and V_b for the speeds of red and blue light respectively in bisulphide of carbon, the mean result compares with theory as follows:

Observed value of the ratio V_r, V_b	1·0245
Theoretical value (Verdet)	1·025.

This agreement may be regarded as perfect. It shows that the divergence of the speed of yellow light in the medium from theory, as found above, holds through the entire spectrum.

Lord Rayleigh found the following explanation of the discrepancy. In the method of the toothed wheel the disturbances are propagated in the form of isolated groups of wave-trains. Let fig. 6 represent such a group of wave-trains. The wave-velocity is that required to carry a wave crest A to the position of the crest B in the wave period (T). But when a flash of light like that measured passes through a refracting medium, the front waves of the flash are continually dying away, as shown at the end of the figure, and the place of each is taken by the wave following. A familiar case of this sort is seen when a stone is thrown into a pond. The front waves die out one at a time, to be followed by others, each of which goes further than its predecessor, while new waves are formed in the rear. Hence the group, as represented in the figure by the larger waves in the middle, moves as a whole more slowly than do the individual waves. The

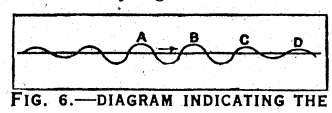


FIG. 6.—DIAGRAM INDICATING THE DIFFERENCE BETWEEN WAVE-VELOCITY AND GROUP-VELOCITY

simplest way of considering such a group analytically is to add two simple harmonic wave-trains of slightly different frequency. When the speed of light is measured the result is not the wave-velocity as above defined, but something less, because the result depends on the time of the group passing through the medium. It can be shown that this applies to measurements made with the revolving mirror method as well as the toothed wheel method. This lower speed is called the group-velocity of light. The relationship of the group velocity to the wave velocity is shown in the equation:

$$V' = V\left(1 - \frac{\lambda}{V}\frac{dV}{d\lambda}\right)$$

where V' = group velocity, V = wave velocity, and λ = wave length. In a vacuum there is no dying out of the waves, so that the group-speed and the wave-speed are identical. The value of $\left(1 + \frac{\lambda}{V}\frac{dV}{d\lambda}\right)$ for carbon disulphide for the mean wave-length of the visible spectrum is 0·93. Hence

$$\frac{V_0}{V'} = \frac{V_0}{V}\left(1 + \frac{\lambda}{V}\frac{dV}{d\lambda}\right) = \frac{1{\cdot}64}{{\cdot}93} = 1{\cdot}76$$

which agrees with the experimental order quoted above.

BIBLIOGRAPHY.—A good general account of the experimental determination of the velocity of light is given in Preston, *The Theory of Light,* ch. xix. (5th ed., 1928). *See* also A. A. Michelson, *Studies in Optics* (1927). For a detailed account of Michelson's Mt. Wilson experiments see *Astrophysical Journal,* vol. lxv., p. 1 (1927). For a discussion of the various determinations *see* M. E. J. Gheury de Bray, *Nature,* vol. cxx. (1927). (S. N.; A. A. M.)

VELOUR. The term velour (French for velvet) refers in particular to a large variety of woollen textures, and in general to several varieties both of woollen and cotton textures, and also to union fabrics, that are formed with a short furry nap or fur on either one side only or on both sides of the fabric, and developed, subsequent to weaving, by operations of milling and raising. Velour fabrics are characterized by a soft and full "handle" or "feel" and used as dress and costume fabrics, suitings, coatings and dressing gowns according to the texture. Velour is also applied as a general description of many other varieties of fabrics produced from a mixture both of wool and cotton, and to some varieties of all-cotton fabrics on which there is developed the characteristic "velour finish," after weaving.

The nap or pile surface of a velour fabric, produced by milling and raising, is not analogous to the velvet or plush pile of true velvet or plush, nor of velveteen (cotton velvet) in which the pile is produced by a series of tufts, that stand erect from a foundation texture, and are developed by severing the pile warp threads, in velvet and plush fabrics (*q.v.*), and the pile picks of weft in velveteen or cotton velvet.

VELSEN, a town of the Netherlands, in the province of North Holland, close to Ymuiden, with which it forms a single municipal administration. Pop. (1940), 47,470. It is on the North sea canal, and forms the port of entrance for Amsterdam.

VELVET. The term "velvet" applies strictly to the true type of the plain silk velvet of the lighter textures, constructed with a short "velvet" or plush pile surface, which is developed during weaving by severing certain warp threads of silk, thereby causing the severed threads to stand erect in the form of short tufts from a substantial foundation texture of silk, cotton or other textile material. Velvet has been greatly in the popular favour for many centuries as a dress material, also for garments for use on such occasions as state, social and religious ceremonies and an infinite variety of uses such as curtain drapery, hangings and furniture upholstery and many other purposes. The richest velvet fabrics are those of Dutch (Utrecht) and Genoese manufacture, and that variety known as "collar velvet" for use specially in making the collars of men's overcoats. The velvet pile warp consists of pure silk yarn, though the foundation texture may be woven from a silk warp and cotton weft, or all cotton for both warp and weft.

One of the oldest examples of velvet is that forming part of a 14th century embroidered cape in the college of Mount St. Mary, Chesterfield. In the earliest of the inventories relating to church vestments, there is a reference, in St. Paul's, London, A.D. 1295, to the use of "velvet" with its kindred web "fustian," for "chasubles": while in that of Exeter cathedral, in 1327, velvet, for the first time is mentioned as being "in two pieces not made up, of which some yards had been then sold for vestment making."

Velvet Weaving.—Velvet fabrics of the lighter textures are woven in hand-looms and produced from two distinct series of warp threads and one series of weft threads, viz., "ground" threads to form the foundation texture, and "pile" threads to form the pile, arranged in the fabric in the order of two ground threads and one pile thread, uniformly. Also, each system of warp threads is contained on a separate warp beam or roller in order to permit of the tension and rate of delivery of each system being adjusted and controlled independently. This provision is essential by reason of the two warps contracting at different rates during weaving; that of the pile warp being considerably greater than that of the ground warp, and in the ratio of about 6 or 8 to one, respectively, according to the length or depth of the pile.

During weaving, the pile is developed by raising all the pile warp threads whilst the ground threads remain down, and then inserting through the warp shed thus formed, a long, thin steel wire, having a narrow groove formed in the upper edge, and extending for its entire length. This wire, termed a "pile wire" is then beaten-up by the reed right up to the "fell" of the cloth, just as an ordinary pick of weft, after which (in one velvet structure), three picks of weft are inserted in succession. These interweave with the ground warp threads on the plain calico principle to produce a firm foundation texture for the tufts of pile. Also, for the first and third of these picks, all pile warp threads are left down, but are raised on the second or intermediate pick, thereby interweaving these threads on the principle known as "fast" or "lashed" pile which binds them very securely to the foundation texture, with less risk of their accidental withdrawal, when the fabric is in use. After these three picks of weft are inserted, another pile wire is inserted in the warp shed, formed, as before, by raising all pile warp threads only and leaving down all ground threads. Then follow the next three ground picks in succession, and so on, in the same regular sequence, uniformly.

Producing the Pile.—From this brief description, it will be apparent that all the pile warp threads simply bend over the grooved pile wires and thus form a horizontal row of loops extending across the entire width of the fabric, between the two selvedges, while those wires virtually constitute thick picks of weft which, along with the three fine picks, are all beaten-up close together, by the reed, in the usual manner. After the second pile wire has been inserted, and followed by the three ground picks, the weaver now releases the first wire by severing, with a knife specially adapted for that purpose, all the pile threads that pass over it. This wire is then removed and inserted in the next pile warp shed to be followed by three more ground picks, after which the second wire is also released, and removed to be again inserted in the next following pile warp shed, and so on, continuously. The severing of the loops formed by the pile warp threads causes these to stand erect as short tufts and thus produce the pile surface.

The instrument employed by a velvet weaver, for cutting the pile warp threads, consists of a special form of knife blade, bent at an angle and fixed adjustably in a frame described as a "trevette." This frame serves both as a handle and guide for the blade, of which the thin and sharp edge is inserted by the weaver into the narrow groove of the pile wires, and drawn quickly, by the right hand, from the left selvedge to the right, with the rear side of the "trevette" bearing against the pile wire last inserted, to serve as a guide, whilst the knife edge passes along the groove of the pile wire nearest the weaver.

Types of Velvet.—Velvet fabrics also comprise many other varieties ranging from the light, plain textures employed for personal adornment, to the heavier and stronger figured textures for furniture upholstery, curtain drapery, mats, rugs, and similar articles of a more durable character. These comprise such types as Utrecht velvet, "frieze" velvet, "moquette" velvet, and others of a similar kind. Many of these varieties of figured velvets, with the pile produced from mohair and wool, are woven in power-looms

furnished with special mechanism adapted to insert the "pile wires" into the warp sheds and afterwards withdraw them from the cloth, automatically.

Figured velvet fabrics are also sometimes embellished with both a cut or "velvet" pile and an uncut (*i.e.*, looped or "terry") pile, with very pleasing effect owing to the lighter and darker tones of colour resulting from the difference in the reflection of light from the "velvet" and "terry" pile surfaces, which appear to be of darker and lighter tones, respectively, although produced from warp threads of exactly the same material, colour and counts of yarn.

Very beautiful varieties of figured, plush pile fabrics are those described as "embossed plush pile fabrics" which are described under SILK FABRICS, ARTIFICIAL. (H. N.)

VELVETEEN. One of the most important varieties of the type of fabrics comprised under the general description of "fustians" (*q.v.*). Such fabrics are virtually "cotton velvets" constructed with a short weft pile surface and bear a very close resemblance to the true velvets (*q.v.*) constructed with a warp pile of silk.

Although "velveteen" and "velvet" have a similar general appearance, they are each constructed on distinctly different principles of fabric structure.

Before being submitted to the operation of fustian cutting, all velveteen fabrics have a smooth and even weft surface very similar to that of ordinary cotton weft-face satin textures known as "sateen" (*q.v.*), and may be made to assume, during that operation, either a plain pile surface uniformly, or else a ribbed or corded surface with the ribs extending lengthwise of the fabric, *i.e.*, in the direction of the warp threads. Although they comprise several different modifications in respect of their structural details, they all embody the same essential features in their construction.

This consists of the development of a series of short tufts of weft pile on a foundation of the plain calico, a simple twill or other elementary weave structure of a suitable character. They consist essentially of one series of warp threads and two series of weft threads, viz., "face" or pile picks and "back" picks, respectively, of the same kind of weft from a single shuttle. The warp threads and "back" picks are interwoven on some elementary principle to constitute the foundation texture, while the "face" or pile picks are allowed to "float" somewhat freely on the face, as in a sateen fabric, to be afterwards severed by the fustian knife, in order to develop the tufts of pile.

Face and back picks may be employed in any suitable ratio ranging from two to as many as nine pile picks for each ground pick, and with the face picks floating loosely over from three to eleven warp threads chiefly according to the character of texture as regards the length (or depth) and density of the pile and the weight and quality of the fabric and its particular use.

Forming the Pile.—During the operation of fustian cutting, all the floating pile weft is severed by the fustian knife, thereby causing that weft to stand erect, and thus form the short tufts of pile which lie in close formation. This operation develops the characteristic velvet or plush pile over the entire surface of the fabric.

The picks are cut by the fustian knife. This knife-blade is formed with a very fine and sharp cutting edge at the extreme end of a long, square, steel shank inserted in a wooden haft to be held by the fustian cutter.

After the velveteen fabric has been prepared in a suitable manner for cutting and stretched taut in a frame for that purpose, the fustian cutter, commencing at one selvedge, proceeds to cut that stretch of cloth one "race" or "run" at a time, taking each "race" in succession.

Varieties of Velveteen.—There are three principal varieties of velveteen, distinguished chiefly by the particular weave structure on which the foundation texture is based. Hence, they are described as "plain" or "tabby-back"; "jean" or "jeanette-back"; and "Genoa-back" velveteens.

The "tabby-back" variety signifies a foundation texture based on the plain calico weave; while "jeanback" signifies those based on the three-end ($^2/_1$) regular twill weave; and "Genoa-back" those based on the four-end two-and-two ($^2/_2$) regular twill weave; while there are many other weaves employed in their construction. In addition to these variations, some velveteens are also constructed as "fast" or "lashed" pile velveteen, a name derived from the method of interweaving the picks of pile weft with the warp threads in such a manner that the tufts of pile are thereby interlocked or "lashed" more securely in the foundation texture. Thus, instead of each tuft of pile being looped underneath only one warp thread by the usual method, each tuft in a "lashed-pile" velveteen intersects with three warp threads in succession.

See H. Nisbet, *Grammar of Textile Design* (1927). (H. N.)

VELVETLEAF (*Abutilon theophrasti*), an annual velvety-hairy plant of the mallow family (Malvaceae, *q.v.*), known also as Indian mallow, native to southern Asia and widely naturalized in the warmer parts of the United States as a weed.

It grows from 2 ft. to 8 ft. high, with heart-shaped leaves and clusters of beaked seed pods with very long-lived seeds. In China it is grown for a fine fibre called Chingma, derived from the stem.

VENAFRUM, an ancient town of Campania, Italy, close to the boundaries of both Latium Adjectum and Samnium. Its site is occupied by the modern Venafro, a village with 4,353 inhabitants, on the railway from Isernia to Caianello, 15 mi. S.W. of the former, 658 ft. above sea level.

Ancient authors tell us but little about it, except that it was one of those towns governed by a prefect sent yearly from Rome, and that in the Social War it was taken by the allies by treachery. Augustus founded a colony there and provided for the construction of an aqueduct (*cf.* the long decree relating to it in *Corp. Inscr. Lat.* x, No. 4842). It seems to have been a place of some importance.

Its olive oil was the best in Italy, and Cato mentions its brickworks and iron manufactures.

The original line of the Via Latina probably ran through Venafrum, making a detour, which the later road seems to have avoided (*see* LATINA, VIA). Rufrae was probably dependent on it. Roads also ran from Venafrum to Aesernia and to Telesia by way of Allifae.

Of ancient remains nothing is left but some traces of an amphitheatre and fragments of polygonal walls.

VENAISSIN, formerly a province of France, bounded on the north and northeast by Dauphiné, on the south by the Durance, on the east by Provence and on the west by the Rhône. It comprises the present department of Vaucluse. Its capital is Carpentras (*q.v.*).

Venaissin is a picturesque territory, varying in scenery between the foothills of the Alps and magnificent plains, which are irrigated by canals supplied by the Rhône, the Durance and the Sorgue.

The Comtat-Venaissin (*Comitatus Venassinus*), the territory of the Gallic people, the Cavares, belonged first to the counts of Provence and then to the counts of Toulouse. Ceded to the pope in 1218 by Raymond VII, count of Toulouse, and again in 1274 by Philip the Bold, it was only united to France in 1791.

The town of Avignon (*q.v.*), anciently distinct from the Comtat-Venaissin, was incorporated in it by Pope Clement VI at the beginning of the 14th century. Avignon, a bishopric since the 1st century, became an archbishopric in 1475. Carpentras was a bishopric from 483 till 1805.

For history *see* L. Loubet, *Carpentras et le Comtat-Venaissin avant et après l'annexion* (1891).

VENANTIUS: *see* FORTUNATUS, VENANTIUS HONORIUS CLEMENTIANUS.

VEND, LIMITATION OF THE, the name of the operations of a combination of north of England colliery owners, which existed between 1771 and 1844, formed for the purpose of limiting the supplies of coal to consumers to raise prices.

The system of price control by coal owners using the ports of the Tyne, the Wear and the Tees, began as early as 1665 and became systematic in 1771. The owners established a control office at

Newcastle-on-Tyne with what is described by Porter in his *Progress of the Nation* as "a very costly establishment of clerks and agents." The governing committee held regular meetings at which the quantities to be sold by each colliery were determined and the prices to the consumer fixed. By this means, during a period of nearly three-quarters of a century, every British coal consumer using seaborne coal was heavily taxed. Moreover, as the limitation of the vend only applied to coal shipments to London, which was then the great market for seaborne coal, and not to shipments made to foreign countries, the system taxed British consumers while cheapening coal prices to foreign consumers.

The limitation of the vend became the subject of a number of parliamentary enquiries. It was examined by parliamentary committees in 1800, 1829, 1830 and 1836 and finally expired in 1844.

VENDACE (*Coregonus vandesius*), a small fish of the salmon family, from the lakes of Lochmaben, in Dumfriesshire, Scotland; the name is also given to an allied form (*C. gracilior*), from Derwentwater and Bassenthwaite. These differ from other British species in having the lower jaw prominent; the scales are larger than in related species from the Arctic ocean and the countries round the Baltic. (*See* WHITEFISH, SALMON AND SALMONIDAE.)

VENDÉE, a maritime department of western France, formed in 1790 out of Bas-Poitou, and taking its name from an unimportant tributary of the Sèvre Niortaise. It is bounded by Loire-Inférieure and Maine-et-Loire on the north, by Deux-Sèvres on the east, by Charente-Inférieure on the south and by the Atlantic ocean on the west for 93 mi. Pop. (1936) 389,211. Area, 2,709 square miles. The islands of Yeu (area, 8½ sq.mi.) and Noirmoutier are included. The department stretches from the Hauteurs de la Gâtine (748 ft.) in the north-east down the wooded slopes of the Bocage Vendéen to the plain bordered towards the sea by the Marais, largely salt-marshes reclaimed during the last four centuries. The Gâtine is a south-east to north-west axial line of the Armorican system, and the Bocage on its flank is formed mainly of Palaeozoic rocks, but the plain on the edge of the Marais is of Jurassic limestone. The three chief rivers are the Sèvre Nantaise, draining the Gâtine longitudinally, the Lay, and, in the south, the Sèvre Niortaise. The climate is that of the Girondine region, mild and damp, the temperature rarely rising above 77° or falling below 18° F; 120 to 150 days of rain give an average annual rainfall of 25 in. The woodland is colder than the plain, and the marsh is unhealthy.

Vendée is served by the Ouest-État railway and has 81 m. of navigable rivers and canals. The department forms the diocese of Luçon, has its court of appeal and educational centre at Poitiers, and is in the district of the XI. Army Corps (Nantes). There are three arrondissements (La Roche-sur-Yon, Fontenay-le-Comte and Sables-d'Olonne), 30 cantons, and 306 communes. The chief towns are La Roche-sur-Yon, the capital, Les Sables-d'Olonne, Fontenay-le-Comte and Luçon (*q.v.*). Foussais, Nieul-sur-l'Autise and Vouvant have Romanesque churches; Pouzauges has a stronghold of the 13th century; Maillezais has the ruins of a 12th century cathedral; Talmont and Tiffauges possess ruined castles; and Le Bernard and Noirmoutier have dolmens.

VENDÉE, WARS OF THE, a counter-revolutionary insurrection which took place during the French Revolution (*q.v.*), not only in Vendée proper but also in Lower Poitou, Anjou, Lower Maine and Brittany. The district was mainly inhabited by peasants; it contained few important towns, and the *bourgeois* were but a feeble minority. The ideas of the Revolution were slow in penetrating to this ignorant peasant population, which had always been less civilized than the majority of Frenchmen, and in 1789 the events which roused enthusiasm throughout the rest of France left the Vendéans indifferent. Presently, too, signs of discontent appeared. The priests who had refused to submit to the Civil Constitution of the Clergy perambulated these retired districts, and stigmatized the revolutionists as heretics. In 1791 two "representatives on mission" informed the Convention of the disquieting condition of Vendée, and this news was quickly followed by the exposure of a royalist plot organized by the marquis de La Rouërie.

The signal for a widespread rising was the introduction of conscription acts for the recruiting of the depleted armies on the eastern frontiers. In February 1793 the Convention decreed a levy on the whole of France, and on the eve of the ballot the Vendée, rather than comply with this requisition, broke out in insurrection. In the month of March 1793 the officer commanding at Cholet was killed, and republicans were massacred at Machecoul and St. Florent. Giving rein to their ancient antipathy, the revolted peasantry attacked the towns, which were liberal in ideas and republican in sympathies.

These first successes of the Vendéans coincided with grave republican reverses on the frontier—war with England, Holland and Spain, the defeat of Neerwinden and the defection of Dumouriez. The *émigrés* then began to throw in their lot with the Vendéans. Royalist nobles like the marquis de Bonchamp, Charette de la Contrie, Gigot d'Elbée, Henri de la Rochejaquelein and the marquis de Lescure placed themselves at the head of the peasants. Although several of these leaders were Voltairians, they held up Louis XVI., who had been executed in Jan. 1793, as a martyr to Catholicism, and the Vendéans, who had hitherto styled themselves the Christian Army, now adopted the name of the Catholic and Royal Army.

The Convention took measures against the *émigrés* and the refractory priests. By a decree of March 19, 1793, every person accused of taking part in the counter-revolutionary revolts, or of wearing the white cockade (the royalist emblem), was declared an outlaw. The prisoners were to be tried by military commissions, and the sole penalty was death with confiscation of property. The Convention also sent representatives on mission into Vendée to effect the purging of the municipalities, the reorganization of the national guards in the republican towns and the active prosecution of the revolutionary propaganda. These measures proving insufficient, a decree was promulgated on April 30, 1793, for the despatch of regular troops; but, in spite of their failure to capture Nantes, the successes of the Vendéans continued.

At the end of Aug. 1793, the republicans had three armies in the Vendée—the army of Rochelle, the army of Brest and the *Mayençais*; but their generals were either ciphers, like Ronsin, or divided among themselves, like Rossignol and Canclaux. They were uncertain whether to cut off the Vendéans from the sea or to drive them westwards; and moreover, their men were undisciplined. Although the peasants had to leave their chiefs and work on the land, the Vendéans still remained formidable opponents. They were equipped partly with arms supplied by England, and partly with fowling-pieces, which at that period were superior to the small-arms used by the regular troops, and their intimate knowledge of the country gave them an immense advantage.

The dissensions of the republican leaders and the demoralizing tactics of the Vendéans resulted in republican defeats at Chantonnay, Torfou, Coron, St. Lambert, Montaigu and St. Fulgent. The Convention resolved to bring the war to an end before October, and placed the troops under the undivided command, first of Jean Léchelle and then of Louis Turreau, who had as subordinates such men as Marceau, Kléber and Westermann. On Oct. 7 the various divisions concentrated at Bressuire, took Châtillon after two bloody engagements, and defeated the Vendéans at Cholet, Beaupréau and La Tremblaye. After this repulse, the royalists, under Stofflet and La Rochejaquelein, attempted to rouse the Cotentin and crossed the Loire. Beaten back at Granville, they tried to re-enter the Vendée, but were repulsed at Angers. They re-formed at Le Mans, where they were defeated by Westermann, and the same officer annihilated the main body of the insurgents at Savenay (Dec. 1793).

Regular warfare was now at an end, although Turreau and his "infernal columns" still continued to scour the disaffected districts. After the 9th Thermidor attempts were made to pacify the country. The Convention issued conciliatory proclamations allowing the Vendéans liberty of worship and guaranteeing their property. Gen. Hoche applied these measures with great success. He restored their cattle to the peasants who submitted, "let the priests have a few crowns," and on July 20, 1795, annihilated an *émigré* expedition which had been equipped in England and had seized Fort Penthièvre and Quiberon. Treaties were concluded at La

Jaunaie (Feb. 15, 1795) and at La Mabillaie, and were fairly well observed by the Vendéans; and nothing remained but to cope with the feeble and scattered remnant of the Vendéans still under arms, and with the Chouans (*q.v.*). On July 30, 1796, the state of siege was raised in the western departments.

During the Hundred Days there was a revival of the Vendéan war, the suppression of which occupied a large corps of Napoleon's army, and in a measure weakened him in the northern theatre of war. (*See* WATERLOO CAMPAIGN.)

In 1832 again an abortive insurrection broke out in support of the Bourbons, at the instigation of the duchess of Berry; the Vendéan hero on this occasion was the baron de Charette.

There are numerous articles on the Vendéan insurrection of 1793 in the *Revue du Bas-Poitou, Revue historique de l'Anjou, Revue de Bretagne, de Vendée et d'Anjou, Revue historique de l'Ouest, Revue historique et archéologique du Maine,* and *La Vendée historique. See* also R. Bittard des Portes, "Bibliographie historique et critique des guerres de Vendée et de la Chouannerie" in the *Revue du Bas-Poitou* (1903 *seq.*); C. L. Chassin, *Études sur la Vendée et la Chouannerie* (*La Préparation de la guerre—La Vendée patriote—Les Pacifications de l'Ouest*) (Paris, 1892 *seq.*), 11 vols. (the best general work on the subject); C. Port, *Les Origines de la Vendée* (Paris, 1888); C. Leroux-Cesbron, "Correspondance des représentants en mission à l'armée de l'ouest (1794–95)" in the *Nouvelle Revue rétrospective* (1898); Blachez, *Bonchamps et l'insurrection vendéenne* (Paris, 1902); P. Mautouchet, *Le Conventionnel Philippeaux* (Paris, 1901). On 1815 a modern work is *Les Cent Jours en Vendée; le général Lamarque,* by B. Lasserre (Paris, 1907); on 1832 see *La Vendée,* by Vicomte A. de Courson (1909). (R. AN.)

VENDÉMIAIRE, the name given during the French Revolution to the first month of the year in the Republican calendar (from Lat. *vindemia,* vintage). Vendémiaire began on Sept. 22, 23 or 24, and ended on Oct. 22, 23 or 24, according to the year, and was the season of the vintage in the wine districts of northern France. *See* CALENDAR.

VENDETTA, the custom of the family feud, by which the nearest kinsman of a murdered man was obliged to take up the quarrel and avenge his death. (Ital. from Lat. *vindicta,* revenge.) From being an obligation upon the nearest, it grew to be an obligation on all the relatives, involving families in bitter private wars. In primitive communities, the injury done was held to be more than personal, a wrong done to the whole *gens.* The term originated in Corsica, where the vendetta long played an important part in the social life. If the murderer could not be found, his family were liable to fall victims to the vendetta.

VENDÔME, LOUIS JOSEPH, DUC DE (1654–1712), marshal of France, was the son of Louis, 2nd duke of Vendôme, and the great-grandson of Henry IV. and Gabrielle d'Estrées. Entering the army he distinguished himself in the Dutch wars, and by 1688 had risen to the rank of lieutenant-general. In the war of the Grand Alliance he rendered conspicuous service and in 1695, in command of the army operating in Catalonia, he took Barcelona. Soon afterwards he received the marshalate. In 1702, after the first unsuccessful campaign of Catinat and Villeroi, he was placed in command of the Franco-Spanish army in Italy. (*See* SPANISH SUCCESSION WAR.) During three campaigns in that country he proved a worthy antagonist to Prince Eugene, whom at last he defeated at Cassano. Next year he was sent to Flanders to repair the disaster of Ramillies with the result that his successors Marsin and Philip of Orleans were totally defeated, while in the new sphere Vendôme was merely the mentor of the pious and unenterprising duke of Burgundy, and was unable to prevent the defeat of Oudenarde. He retired in disgust to his estates, but was soon summoned to take command of the army of Philip in Spain. There he won his last victories, crowning his work with the battle of Villaviciosa. Before the end of the war he died suddenly at Vinaros on June 11, 1712.

VENDÔME, a town of north-central France, capital of an arrondissement in the department of Loir-et-Cher, 22 m. N.W. of Blois by rail. Pop. (1936) 8,100. Vendôme (*Vindocinum*) appears originally to have been a Gallic oppidum, replaced later by a feudal castle, around which the modern town arose. Christianity was introduced by St. Bienheuré in the 5th century, and the important abbey of the Trinity was founded about 1030. When the reign of the Capetian dynasty began, Vendôme was the chief town of a countship belonging to Bouchard, called "the Venerable." The succession passed by various marriages to the houses of Nevers, Preuilly and Montoire. Bouchard VII., count of Vendôme and Castres (d. *c.* 1374), left as his heiress his sister Catherine, the wife of John of Bourbon, count of la Marche. The countship of Vendôme was raised to the rank of a duchy and a peerage of France for Charles of Bourbon (1515); his son Anthony of Bourbon, king of Navarre, was the father of Henry IV., who gave the duchy of Vendôme in 1598 to his natural son Caesar (1594–1665). Caesar, duke of Vendôme, had as his sons Louis, duke of Vendôme (1612–69), who married a niece of Mazarin, and Francis, duke of Beaufort. The last of the family in the male line (1654–1712) was Louis XIV.'s famous general, Louis Joseph, duke of Vendôme (*q.v.*).

Vendôme stands on the Loir, which here divides and intersects the town. To the south stands a hill on which are ruins of the 11th century castle of the counts of Vendôme. The abbey-church of the Trinity (12th to 15th century) has a fine façade in the florid Gothic style and a transitional 12th century belfry, with a stone steeple, stands isolated in front of the church. Abbey buildings of various periods lie round the church. The church of La Madeleine (15th century) is surmounted by a stone spire, an indifferent imitation of that of the abbey. Of the church of St. Martin (16th century) only the tower remains. The town hall occupies the old gate of St. George, with two large crenelated and machicolated towers, connected by a pavilion. The 15th century chapel of the ancient hospital of St. Jacques, in the most florid Gothic style, is preserved.

VENEER, a thin sheet of superior wood, covering the surface of inferior wood. Veneers may be sliced with a knife (*knife-cut*) or cut with a saw (*saw-cut*) from a section of a tree (*flitch*).

The art of producing and using veneers dates back to the earliest days of civilization, and it may be looked upon even as a standard of human development, since efficient veneering has always followed the wake of human progress. (*See* Wilkinson's *Manners and Customs of the Ancient Egyptians,* Perrot and Chipiez' *History of Art in Chaldea and Assyria,* etc.) Intarsia and *marquetry* work are closely allied to and inter-dependent upon the art of veneering.

In the usual process of manufacture, the flitches are steamed before being cut, and the sheet of veneer thus obtained is carefully dried. Veneers may be cut along the grain, through the log, or from cross-sections of the log; the figure and design of the veneer obtained from the different methods employed vary widely and the art of veneering consists as much in the most effective utilization of the log as in the careful and suitable application and matching of the veneers afterwards. Veneers are also produced by means of the rotary cutting process as a raw material for *plywood.* A part of a log is inserted lengthwise between two pins on a rotating lathe, and a knife, pressed against it, peels off an endless ribbon of veneer. (*See* PLYWOOD.)

See Sidney J. Duly, *Timber and Timber Products* (1924); E. Vernon Knight and Meinrad Vulpi, *Veneers and Plywood* (N.Y., 1927); E. Brocard, *L'Art de découper le bois comprenant également la Marqueterie et la Sculpture Simple* (Paris, 1873). (A. MOR.)

VENER, the largest lake in Sweden and the third largest in Europe; area 2,149 sq.m.; maximum length 87 m.; maximum breadth 44 m.; maximum depth 292 ft. The surface of the lake is normally 144 ft. above the sea but may rise 10 ft. or more higher, for the lake receives numerous streams, the largest being the Klar, which drains the forests of Vermland and Kopparberg to the north. It is drained by the Göta river to the Cattegat. It is divided into two basins by two peninsulas and a group of islands, the western half being Lake Dalbo. The northern shores are high, rocky and in part wooded, the southern open and low, though isolated hills occur, such as the Kinnekulle (1,007 ft.).

By means of the Dalsland Canal from Köpmannabro, midway on the west shore of Dalbo, the lake, which is busy in the traffic in timber, iron and agricultural produce, has communication with Fredrikshald in Norway; and it is traversed from Venersborg on the south to Sjötorp on the east by the Göta (*q.v.*) Canal route.

The principal lake-ports are—on the north shore Carlstad and Cristinehamn, with iron-works and tobacco factory; on the east Mariestad, chief town of the district of Skaraborg; on the south Lidköping, and Venersborg with its iron foundries, tanneries and match and paper factories.

VENERABLE, worthy of honour, respect and reverence, especially a term applied to dignified or honourable age [Lat. *venerabilis,* worthy of reverence]. It is specifically used as a title of address given to archdeacons in the Anglican Church. It was naturally a term of respectful address from early times; thus St. Augustine (*Epist.* 76, 88, 139) cites it of bishops, and Philip I. of France was styled *venerabilis* and *venerandus* (*see* Du Cange, *Gloss.* s.v. *Venerabilitas*). In the Roman Church the granting of the title "venerable" is the first step in the long process of the canonization of saints (*see* CANONIZATION).

VENEREAL DISEASES, a general term for the diseases resulting from impure sexual intercourse. Three distinct affections are included under this term—gonorrhoea, local contagious ulcers, known as soft chancres, and syphilis. They are three distinct diseases, due to different causes. Broadly speaking, gonorrhoea attacks the mucous membranes, especially that of the urethra, the vagina, uterus and Fallopian tubes; soft chancres attack the mucous membranes and the skin; syphilis, after a short local manifestation, affects the whole body.

Though these three affections generally result from impure sexual intercourse, there are other methods of contagion, as when the accoucheur is poisoned whilst delivering a syphilitic woman, the surgeon when operating on a syphilitic patient, the wet-nurse who is suckling a syphilitic infant, and so on. An individual may be attacked by any one or any two of the three, or by all at the same time, as the result of one and the same connection. But they do not show themselves at the same time; they have different stages of incubation. In gonorrhoea and soft chancre the first symptoms appear as a rule three or four days after inoculation; in syphilis, the period of incubation is twenty-eight days, though it may be much longer.

GONORRHOEA

Gonorrhoea is a specific inflammation of the mucous membrane of the urethra and other passages caused by M. gonorrhoeæ, a diplococcus discovered by Neisser and often called the gonococcus.

The germs find entrance during coitus and multiply at enormous rate, spreading to all the glands and crevices of the membrane, and setting free in their development a toxin which causes great irritation of the passage with inflammation and swelling. They remain quietly incubating for three or four days, or even longer; then acute inflammation comes on, with profuse discharge of thick yellow matter, with much scalding during micturition, and there may be so much local pain that it is difficult for the person to move about. Microscopic examination of the discharge shows abundant pus corpuscles and epithelial cells from the membrane, together with swarms of intra- and extra-cellular diplococci (gonococci).

The inflammatory process may extend backwards and give rise to acute prostatitis (*see* BLADDER AND PROSTATE, DISEASES OF), with retention of urine; to the duct of the testes and give rise to acute epididymitis (swollen testicle); and to the bladder, causing acute cystitis. It may also cause local abscesses, or, by irritation, set up crops of warts.

In ten days or a fortnight the inflammation gradually subsides, a thin watery discharge remaining which is known as *gleet.* But inasmuch as this discharge contains gonococci it may, though scarcely noticeable, set up acute specific inflammation in the opposite sex.

In the case of the female the inflammation is apt to extend to the uterus and along the Fallopian tubes, perhaps to give rise to an abscess in the tube (pyosalpinx) which, bursting, may cause fatal peritonitis.

A lingering gleet may be due to the presence of a definite ulceration in the urethra, and this, being chronic, is accompanied by the formation of much fibrous tissue which contracts and causes narrowing of the urethra, or stricture. Thus gleet and stricture are often associated, and the occasional passage of a large bougie may suffice to cure both. Often, however, a stricture of the urethra proves rebellious in the extreme, and leads to diseases of the bladder and kidneys which may prove fatal.

One of the most important points in the management of a case of gonorrhoea is to prevent risk of the septic discharge coming into contact with the eye. If this happens, prompt and energetic measures must be taken to save the eye. If at the time of delivery a woman be the subject of gonorrhoea, there is great probability of the eyes of the infant being affected. The symptoms appear on the third day after birth, and the disease may end in complete blindness. The name of the disease is *ophthalmia neonatorum.* (*See* BLINDNESS.)

By the term *gonorrhoeal rheumatism* it is implied that the gonococci have been carried by the blood stream to one or more joints in which an acute inflammation has been set up. It is apt to occur in the third week of the disease, and may end in permanent stiffness of the joints or in abscess.

In rare cases the germs find their way to the cardiac valves, pleura or pericardium, setting up an inflammation which may end fatally.

For a man to marry whilst there is the slightest risk of his still being the subject of gonorrhoea is to subject his wife to the probability of infection, ending with chronic inflammation of the womb or of septic peritonitis. Yet it is often extremely difficult to say when a man is *cured.* That there is no longer any discharge does not suffice to show that he has ceased to be infective. Nothing less than repeated examinations of the urethral mucus by the microscope, ending in a negative result, should be accepted as evidence of the cure being complete. And these examinations should be made after he has returned to his former ways of eating, drinking and working.

LOCAL CONTAGIOUS ULCERS

Chancroid, Soft Chancre or Soft Sore is so named in contradistinction to the Hunterian sore of syphilitic infection, the great characteristic of which is its hardness. The soft chancre is a contagious ulcer of the genitals, due to the inoculation of the bacillus of Ducrey; and, provided that the specific germ of syphilis is not inoculated at the same time, the chancre is not followed by constitutional affection. In other words, the disease is purely local, and if some of the discharge of one of these ulcers is inoculated on another part of the body of the individual a sore of an exactly similar nature appears. This reproduction of the sore can be done over and over again on the same individual, always with the same result. But in the case of the Hunterian sore, inoculation of the individual from the primary sore gives no result, because the constitutional disease has rendered the individual proof against further infection. The soft sore is often multiple. It appears about three days after the exposure, and as it increases in size free suppuration takes place. Its base remains soft. In individuals broken down in health, the ulceration is apt to extend with great rapidity, and is then spoken of as *phagedaenic.*

Just as an individual may contract syphilis and gonorrhoea at the same connection, so also he may be inoculated simultaneously with the bacilli of the soft chancre and the spirochaete of syphilis. In this case the soft chancres appear, as usual, within the first three or four days, but though passing through the customary stages they may refuse quite to heal, or, having healed, they may become indurated in the second month, constitutional symptoms following in due course.

Bubo.—The bacilli from the soft sore may pass by the lymphatic vessels to the glands in the groin, when they set up inflammation.

SYPHILIS

The cause of syphilis, whether inherited or acquired, which can be demonstrated in the primary and various secondary lesions, and in the internal organs, is *Spirochaeta* or *Treponema pallida,* a motile protozoon of spiral form, from 4 to 20 μ in length and $\frac{1}{4}$ μ in diameter, with a flagellum at either extremity. Inoculations of the spirochaete in monkeys have produced the characteristic primary (Hunterian) sores, which have proved infective to other monkeys. And in the reproduced primary sores, as also in the

secondary lesions following them, the same specific micro-organism has been demonstrated. The organism can also be inoculated successfully into the testicles of rabbits.

The syphilitic virus is introduced at the seat of an abrasion either on the genital organs or on some other part of the surface of the body. It has been conveyed during a fight by abrasion of the skin covering the knuckle against the tooth of an adversary with secondary syphilis. The poison lies quiescent for an average period of four weeks. A cartilaginous, button-like hardness appears at the seat of inoculation. If this is irritated ulceration takes place; but ulceration is an accident, not an essential. The infection becomes systemic long before the chancre develops. The so-called period of quiescence does not exist. From the primary seat the system becomes infected. The virus, passing along the lymphatic vessels, attacks the nearest chain of lymphatic glands. If the original sore is in the genital organs, the glands in the groin are first attacked; if in the hand, the glands of the elbow or armpit; if on the lip, the glands below the jaw. The affected glands are indurated and painless; they may become acutely inflamed, just as the primary lesion may, but this, too, is an accident, not an essential. In due course the poison may affect the whole glandular system. Skin eruptions, often symmetrical, break out. Irritation of any mucous membrane is followed by papular eruptions with superficial ulceration, and in the later stages of the disease skin-eruptions, scaly, pimply, pustular or nodular in type, appear. These eruptions do not itch. The individual is as a general rule protected against a second attack of syphilis. In weakly people, in severe cases, or in cases that have not been properly treated, syphilitic deposits termed gummata are formed, which are very apt to break down and give rise to deep ulcerations.

Gummata.—The most characteristic form of the generalized syphilitic infection, which may not manifest itself for several years after the reception of the virus, is a nodular inflammatory formation in various organs—the liver, testes or brain, the muscles (tongue and jaw-muscles especially), the periosteum, the skin and the lungs. The deposits are called gummata from the tenacious appearance of the fresh-cut surface and of the discharge oozing from it. The structure consists of granulation-tissue in which necrosis occurs at various central points. One remarkable feature of the process is the overgrowth of cells in the inner coat of the arteries (*see* ARTERIES, DISEASES OF), within the affected area, which obliterate the vessel and are the chief cause of the central degeneration of the gumma. Gummata, and the ulcers left by them, constitute the *tertiary* manifestations of syphilis.

In a large proportion of cases only the secondary symptoms occur, and not the tertiary, the virus having presumably exhausted itself or been destroyed by treatment in the earlier manifestations.

Inherited Syphilis.—In the syphilis of the offspring it is necessary to distinguish two classes of effects—there are the effects of general intra-uterine mal-nutrition, due to the placental syphilis of the mother; and there are the true specific effects acquired by inheritance from either parent and conveyed in the sperm-elements or in the ovum. These two classes of effects are commingled in such a way as not to be readily distinguished; but it is probable that the ill-organized growth of bone, at the epiphysial line in the long bones (sometimes amounting to suppuration), and on the surfaces of the membrane-bones of the skull (*Parrot's nodes*) is a result of general placental mal-nutrition, like the corresponding errors of growth in rickets. The rashes and fissures of the skin, the snuffles and such-like well-known symptoms in the offspring are characteristic effects of the specific taint; so also the peculiar overgrowth in the liver, the interstitial pneumonia alba of the lungs and the like. It is in many cases some months after birth before the congenital syphilitic effects show themselves, while other effects come to light during childhood and youth.

The moist eruptions and ulcerations about the mouth and anus of the infant, as well as the skin affections generally, are charged with the spirochaetes and are highly contagious.

From the second to the sixth year there is commonly a rest in the symptoms that are regarded as characteristic, but the tibiae may become thickened from periostitis, or a joint may become swollen and painful.

The characteristic physiognomy gradually manifests itself if the child is not treated—the flattened nose, the square forehead, the radiating lines from the mouth, the stunted figure and pallid face. During the second dentition, the three signs, as pointed out by Jonathan Hutchinson, may be looked for—the notched incisor teeth of the upper jaw, interstitial corneitis and syphilitic deafness. Perforation of the soft or hard palate may occur, and ulcerations of the skin and cellular tissue. Destruction of the nasal bones, caries of the forehead and skull, of the long bones, may also take place.

Colles' Law.—A woman giving birth to a syphilitic infant cannot be inoculated with syphilis by the infant when she is suckling it; in other words, though the mother may have shown no definite signs of syphilis, she is immune; whereas the syphilitic infant put to the breast of a healthy woman may inoculate her nipple and convey syphilis to her. This is known as Colles' Law, and it is explained by the theory that, the mother's blood being already infected, her skin is proof against a local cultivation of germs in the form of a Hunterian sore.

General Remarks.—It by no means follows that because the infecting sore is small, unimportant or quickly healed, the attack, of which the sore is the first (*primary*) symptom, will be mild. Indeed, it not infrequently happens that the most serious forms of secondary or tertiary symptoms succeed a sore which was regarded as of such trivial nature that the individual declined to submit himself to treatment, or quickly withdrew himself from it to enter a fool's paradise. The advisability of ceasing from treatment should always be determined by the surgeon, never by the patient; treatment must be continued long after the disappearance of the secondary eruptions. It is the *disease* which the surgeon has to cure, not the *symptoms*. The patient is apt to think only of the symptoms.

"Is the disease curable?" The answer is: "Yes; beyond doubt." But the individual must be made to understand the necessity of his submitting himself to a prolonged course of treatment. A second question is whether, in the course of the disease, his hair will fall out, his body will be covered with sores and his face with blotches, and if his bones will be attacked. Here, again, the answer is that prompt submission to treatment will render all such calamities extremely improbable. Another question often put is whether the disease is contagious or infectious. During the primary and secondary stages he is infectious as far as his lesions are concerned. Obviously, if a man has a primary sore or a secondary eruption he should use his own pipe, razor, glass, cup or spoon, should refrain from kissing any one, and desist from sexual intercourse. If due care thus be taken no danger is likely to ensue.

Syphilis and Marriage.—The question as to how soon it would be safe for a person with secondary syphilis to marry is of extreme importance, and the disregard of it may cause lasting mental distress to the parent and permanent physical injury to the offspring. A man who finds himself to be the subject of secondary syphilis when he is engaged to be married would do well honourably to free himself from responsibility. But should a person who has been under regular and continuous treatment desire to marry, consent may be given when he has seen no symptoms of his disease for two full years. But even then no actual promise can be made that his troubles are at an end.

The transmission of syphilis to the third generation is quite possible, but it is difficult of absolute proof because of the chance of there having been intercurrent infection of the offspring of the second generation. (E. O.; X.)

GENERAL PREVENTIVE MEASURES

The period since 1910 has been marked by the commencement of a campaign which has developed into a world-war against venereal diseases. In this work Great Britain has taken a prominent part.

In 1913 a royal commission was set up to inquire into "the prevalence of venereal diseases in the United Kingdom, their effects on the health of the community, and the means by which those effects can be alleviated or prevented." The royal commission reported in 1916, and their recommendations were imme-

diately acted upon by the Local Government Board of England and Wales (now the Ministry of Health), and the public measures for combating venereal diseases in England and Wales are now as mentioned below, while in Scotland and Ireland the campaign is being conducted on the same principles.

Legislative Action.—1. By an Act of Parliament passed in 1917 the treatment of patients for venereal disease by others than registered medical practitioners and the sale without the prescription of a registered medical practitioner or the advertisement to the lay public of remedies for the treatment or prevention of venereal diseases are forbidden.

2. There are 193 centres chiefly in voluntary hospitals for the treatment, free of charge, of persons suffering from venereal disease.

3. Fourteen hostels exist for the care and treatment of females who are infected, and would, unless helped by shelter, become professional prostitutes.

4. Seven institutions are specially for the care of pregnant females who are infected.

5. Treatment of venereal disease is also provided in poor law institutions.

6. Arsenobenzol (salvarsan) compounds are given free of charge to medical practitioners qualified to administer these remedies.

7. Specimens from persons suspected to be suffering from venereal disease can be examined free of charge in 73 laboratories which have been approved for the purpose.

8. The work of educating the public in the dangers of venereal diseases and the importance of early and continued treatment is carried out by the British Social Hygiene Council (formerly the National Council for Combating Venereal Diseases), which receives from the Government a grant in aid of its expenses. Propagandist work is also undertaken by the county councils and county borough councils, either directly or in conjunction with the British Social Hygiene Council.

The arrangements for establishment of free treatment facilities for distribution of arsenobenzol compounds and for laboratory examinations are under the control of county councils and county borough councils, which receive from the Government 75% of their approved expenditure on this account.

Results Obtained.—Some idea of the results obtained may be gathered by comparing the returns of cases seen for the first time in 1920, when the numbers were highest, with those seen for the first time in 1924, as presented hereunder:—

Year	Syphilis	Soft Chancre	Gonorrhoea	Non-ven.	Total
1920	42,805	2,442	40,284	19,654	105,185
1924	22,010	1,098	31,272	18,842	73,222

The table discloses a substantial reduction in the number of cases of syphilis, and the figures indicate that the incidence of syphilis in the community has declined considerably. Similar results have been reported by other countries which have set up venereal-disease schemes on the principle of treating the infected. The attendance at the centres in 1920 was 1,488,514 and in 1924 had increased to 1,645,415.

Gonorrhoea.—No outstanding remedy has been discovered analogous to that of arsenobenzol in syphilis, but, particularly since 1914, improvements in detail have made the diagnosis and cure of gonorrhoea more certain. In diagnosis, improvements in methods of cultivating the gonococcus on artificial media have placed the surgeon on firmer ground when determining the question of cure. In treatment the practice of administering vaccines to raise the patient's resistance has become much more common. In complications of gonorrhoea, such as gonorrhoeal rheumatism and iritis, what is known as protein-shock therapy has proved useful.

The remedies employed in this form of treatment are quite varied; for example, colloidal silver or anti-typhoid vaccine injected into a vein; milk or turpentine injected into the muscles. They have the immediate effect of raising the patient's temperature and by the next day there is usually a definite improvement in the symptoms.

Another form of treatment which has been in use by a few for a number of years but is only now becoming more general is diathermy. (*See* ELECTRO-THERAPY.) The principle of its use in gonorrhoea and its complications is that the gonococcus is very sensitive to heat, being killed at temperatures which are supported with comparative ease by human tissues.

Good results have been obtained in gonorrhoea of females by this method, but undoubtedly its best effects are in epididymitis and in gonorrhoeal rheumatism in men. In gonorrhoeal rheumatism and iritis the reservoir from which the joints and eyes are continually being infected is commonly in the prostate and the seminal vesicles, both situated at the base of the bladder. The current is applied by means of an electrode placed in the rectum and is increased in strength until the patient feels the part becoming uncomfortably hot.

Soft Chancre or Chancroid.—The figures showing the new cases which have been seen at treatment centres indicate that chancroid is not now very prevalent in Great Britain. The treatment is now more conservative than formerly. The chancroid is viewed as possibly harbouring also the germs of syphilis, and with the object of avoiding any action which may prejudice the microscopical search for the more severe disease, the surgeon withholds for as long as possible the application of antiseptics.

When a bubo forms in the groin, a comparatively rare event under modern practice, it is more usual now to attempt to secure resolution by protein-shock therapy (see *Gonorrhoea,* above) and by aspiration of the abscess followed by injection into the abscess cavity of some drug which will lead to the destruction of the germs.

Detection of Syphilis.—Improvements in methods of detecting the germ, *Spirochaeta pallida,* under the microscope, viz., by dark-ground illumination, have made it possible to diagnose the disease very rapidly on the day it makes its first appearance. For the Wassermann and allied tests of blood and cerebro-spinal fluid for the presence of syphilis the article WASSERMANN REACTION should be consulted.

Great strides have been made in treatment since 1910 when Ehrlich introduced dioxy-diamino-arsenobenzol dihydrochloride, commonly known as "606" or salvarsan (*q.v.*), as a remedy for syphilis. The effect of a single dose of this remedy is usually to cause the spirochaetes to disappear from the discharge of syphilitic sores in 24 hours and syphilitic lesions heal with a rapidity which was a source of great wonder to those who had toiled in the treatment of syphilis with the help of only mercury and preparations of iodine.

The original preparation has largely been supplanted by a compound introduced by Ehrlich in 1912 under the name of neosalvarsan or "914," which is much more convenient to use and less disturbing to the patient than was the original preparation. These advantages are somewhat offset by a lower therapeutic activity of the newer preparation. Combinations of arsenobenzol with silver and with zinc are also used. The manufacture of arsenobenzol preparations spread during the War into the hands of a number of firms each of which has attached to the same chemical compounds trade names of their own to an extent which may be somewhat bewildering to the uninitiated.

Every arsenobenzol compound is made in batches each of which receives a distinctive mark and must pass a certain test of toxicity and of therapeutic activity before it can be issued to the public. The testing in Great Britain is carried out by the Medical Research Council. Experience has shown that, although the arsenobenzol preparations act very promptly, a number of injections in successive courses must be administered to secure eradication of syphilis and that it is advisable to supplement them by administering another metallic compound.

Arsenobenzol will not penetrate into the nerve tissue of the brain, and this limitation has led to the introduction of an arsenical preparation of another order, viz.: tryparsamide or n-phenyl glycine-amido-p-arsonic acid into the therapy of locomotor ataxy and general paresis. The results show generally that tryparsamide is valuable for this purpose.

In 1920 Sazerac and Levaditi showed that tartro-bismuthate of potassium and sodium is more powerful than mercury in destroying the spirochaetes of syphilis, and a large number of bismuth preparations have been placed on the market since it was found that it is the metal rather than the compound which matters in the therapeutic action. Generally it can be said that bismuth injections effect more towards the cure of syphilis than do mercurial and that preparations of bismuth can be used which cause less discomfort than do any mercurial.

Bismuth is useless for the cure of syphilis if given by the mouth and its injection into veins is practised very little on account of its greater toxicity when administered by this route. Bismuth is generally considered to be an adjuvant rather than a substitute for arsenobenzol treatment. It is retained in the tissues for long after a series of injections has been given, and it thus prolongs the anti-syphilitic effect after all the arsenobenzol has been excreted.

The powerful effect of the arsenobenzol and bismuth compounds on the germ of syphilis has led to a number of experiments to determine whether or not they prevent the development of syphilis after inoculation.

There is strong evidence to the effect that a few arsenobenzol injections given after contamination with syphilitic virus does protect against the disease. Kolle has produced experimental evidence tending to show that the injection of bismuth carbonate protects against infection resulting from inoculation with syphilitic virus so long as the compound remains in the muscles. Rabbits treated thus proved resistant to inoculation with syphilitic material for as long as 109 days after injection of the bismuth.

The disadvantage of injections as a method of preventing syphilis after venereal risk led Levaditi to try an arsenical compound called stovarsol or acetyl-oxyamino-phenyl arsenic acid, which is administered by the mouth. There is good evidence that the ingestion of stovarsol in suitable doses prevents infection, but considerably more work on the subject will be necessary before stovarsol can safely be given to the public as a prophylactic against syphilis.

General Paralysis of the Insane.—A great advance has been made in the treatment of a form of syphilis which is acknowledged to be the most incurable of all, namely general paralysis of the insane. This disease is one which has almost always ended fatally, defying the most intensive treatment by anti-syphilitic remedies. Its course is marked by remissions of varying length, during which the patient may appear to have recovered. It has been known for a century or more that an intercurrent infection accompanied by fever often results in a long remission, and this knowledge has led Wagner von Jauregg and his colleagues in Vienna since 1887 to inoculate patients with a variety of substances designed to make their temperatures rise. The best of all the agents has proved to be the parasite of benign tertian malaria and since its introduction in 1919 the method has been tested all over the world. The results have been very encouraging. The inoculation is by injection of malarial blood or by the bites of infected mosquitoes, and eight to twelve attacks of fever are allowed before quinine is given.

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CONTROL IN THE UNITED STATES

Efforts to stamp out syphilis and to make progress toward the control of gonococcal infections in the United States differ in certain respects from similar activities in other countries. A continuous program of disseminating accurate knowledge among leaders of public opinion promoted by the American Social Hygiene Association and affiliated groups during the past twenty-five years has paralleled the growth of medical and public health experience in practical diagnosis, treatment and control measures. To supplement the work of the qualified medical practitioners, there has been built up a sufficient body of trained clinicians, laboratory experts, nurses and medical social workers to make possible the beginning of a nation-wide program for eradication of syphilis.

In December 1936, the Surgeon-General of the United States Public Health Service arranged a notable "Conference on Venereal Disease Control Work." This conference recommended concentration upon finding all the cases and getting them under treatment as the immediate objective, with continuance of social hygiene education and promotion of preventive measures as major items of the long range program. Augmented funds of the Public Health Service, the Children's Bureau, and of other governmental bodies, available for distribution as subsidies for improving health work including control of venereal diseases made it possible to stimulate action in many states, cities and counties previously doing little or no effective work. Since December 1936 under the leadership of the Surgeon-General remarkable progress has been made and the public has adopted the slogan "syphilis is the next great plague to go." The so-called fourfold program of medical, educational, recreational and legal measures for protecting military and naval forces in war time had demonstrated what could be done by joint action of community and cantonment. It had become clear that further action could be taken.

Medical Measures.—Finding all the cases demands provision of adequate laboratory and consultation services for diagnosis. The dark-field examination of secretions from possible initial lesions of syphilis is essential. Blood and spinal fluid tests are necessary, and must be standardized and constantly checked for accuracy and availability to all people of every community. There is need also for X-ray and other special examinations in selected cases, and for the skilled services of experienced syphilologists to arrive at differential diagnoses for which ordinary examinations and laboratory tests will not suffice. In the United States the health authorities and medical profession are urged to extend these services. For example, special efforts are directed toward securing blood examinations of every expectant mother, of both men and women applying for a licence to marry, of students entering college, and of many persons seeking employment. Extensive surveys have been made of selected Negro, Indian and other population groups and inmates of institutions. Recognizing that every case comes from another case, and may lead to still others, epidemiologic studies are advocated for all sources and contacts. The purpose of all these examinations is to determine who are infected and to get them under treatment promptly.

The concentration of all available facilities and personnel for competent treatment of early cases is stressed on the ground that thereby the greatest number of infectious individuals can be rendered permanently non-infectious; and the disease prevented from seriously damaging them before they can be cured. Public opinion supports the health authorities in demanding correlation and adaptation of all the services of private practitioners, voluntary hospitals, clinics, and public institutions to the needs of syphilis patients with due regard to the latter's geographic distribution, opportunities to come for treatment outside of working hours, ability to meet expense, and willingness to follow advice and to continue treatment without interruption. The view is also rapidly gaining ground that the health officer or other proper officials

should supplement existing facilities as necessary, and should require full co-operation of all infected persons in treatment and protection of others against infection. Legislative acts covering reporting of cases, quarantine when necessary, examinations for evidence of infection before marriage, prophylactic treatment of new born babies' eyes to prevent gonococcal infection and other measures have been adopted by many states.

The magnitude of the problems of syphilis and gonorrhoea control in the United States may be suggested by the following figures, although notification is far from complete. At present the number of cases of syphilis recorded each year approximates 267,000 and of gonorrhoea 162,000. Syphilis always stands high in the total number of cases of infectious diseases recorded, being outranked only by such common diseases as measles and chicken-pox; and gonococcal infections stood seventh in the last Federal report. However, studies as to the prevalence of syphilis and gonorrhoea which have been made in certain cities and States seem to show that a larger proportion of patients suffering from syphilis than of gonococcal infection place themselves under medical care. In addition to private practice and institutional facilities, there are now in the United States approximately 1,000 clinics and dispensaries, where these diseases are treated gratuitously or for a small part of the cost. But various studies indicate that of the patients under treatment the majority are under the care of private physicians. Thus, in the United States as a whole, private physicians were treating 64% of the cases of syphilis and gonorrhoea. From all available data it is estimated that collectively 5% of all the men, women and children of the United States are infected with syphilis; and that this figure may rise to one in ten of adults. Gonorrhoea is known to be somewhat more prevalent. But of course these diseases are very unevenly distributed among different groups and population areas.

Educational Measures.—Instruction of the general public in regard to syphilis and gonococcal infections is, like other phases of public health instruction, a duty of the established educational system and official health agencies; but such voluntary organizations as the American Social Hygiene Association, and its affiliated societies, co-operate actively in demonstrating to educational, social and religious institutions and associations in the United States the means by which scientific sex instruction and knowledge of these diseases can be incorporated in the activities of schools, colleges, churches, parent-teacher associations, men's and women's clubs, and numerous other organizations. In general, it is the aim of all these educational measures to promote among the public a sound knowledge of sex problems and to integrate sex education with all forms of instruction which have for their object normal growth and development of youth and their training for marriage and family life, the promotion of ethical standards as well as a knowledge of the elements of personal hygiene. Specifically, in regard to the venereal diseases, the educational program aims to make it impossible for persons to be infected with syphilis or gonorrhoea through ignorance of the seriousness of these diseases and the means of their spread, and to make the socially sound uses of sex more appealing as a great factor in successful living. The methods and materials used in this educational work in the United States include lectures, motion pictures, exhibits and printed matter, and particularly the inclusion of appropriate sex teaching in such subjects as physiology, hygiene, biology, home economics, sociology and psychology, in the schools and colleges.

Legal and Protective Measures.—These aim to reduce commercialized prostitution and other forms of promiscuous conduct by either sex, because such conduct is anti-social and such persons tend to become carriers and disseminators of venereal diseases. Furthermore, prostitution leads to exploitation of weak and irresponsible persons of both sexes; and promotes corruption of other individuals and officials. By providing opportunities for the wholesome use of leisure, and through child guidance clinics, vocational adjustment bureaus, visiting teacher associations, voluntary protective agencies and women police, protective measures aim to prevent young people from forming habits and associations which may lead to promiscuity and prostitution. Legal measures have involved the passage and enforcement of laws which penalize the recruitment, the exploitation and the traffic in women or girls for prostitution. They aim to repress the activities of prostitutes and of their male customers. In addition to the passage of necessary laws, legal measures have included adequate training of the police, men and women. The responsibility for such measures rests upon the law enforcement and correctional officials and institutions of the cities, counties and States, and the Federal Government. In addition, there are numerous voluntary organizations.

Expected Results.—There are many indications of what may reasonably be expected in the future. The U.S. Army and Navy have continued plans of control of the venereal diseases, similar to those of the World War period. The annual admission rates in the Army have dropped from 107 per 1,000 men in 1917 to 27 per 1,000 in 1936. In civil life the State of Massachusetts has already produced impressive evidence of declining syphilis prevalence; and the situation is full of promise in New York and other States. The death rate from syphilis, locomotor ataxia and general paralysis of the insane combined has declined only 32% between the peak in 1917 and 1935 (from 19·8 per 100,000 to 13·4 per 100,000), despite constantly increasing ability to recognize syphilis in all its manifestations. The decline, it may be added, is largely due to falling rates for locomotor ataxia and general paralysis of the insane. Figures from the Metropolitan Life Insurance Company show an even more marked downward trend in the death rate from syphilis. The death rate from syphilis of infants under one year of age has decreased about one-half during the same period.

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VENETI (wĕn'ĕ-tē), name of two ancient European tribes. (1) A Celtic people in the north-west of Gallia Celtica. They were the most powerful maritime people on the Atlantic and carried on a considerable trade with Britain. In the winter of 57 B.C., they took up arms against the Romans, and in 56 were decisively defeated in a naval engagement.

(2) The inhabitants of a district in the north of Italy. It was at first included in Cisalpine Gaul, but under Augustus was the tenth region of Italy. The Veneti were a peaceful people, chiefly engaged in commercial pursuits. They carried on a trade in amber, which reached them overland from the shores of the Baltic. They were famous for their skill in the training and breeding of horses. Homer (*Il.* ii. 85) speaks of the Paphlagonian *Henetoi* as breeders of "wild mules."

The first historical mention of the Veneti occurs in connection with the capture of Rome by the Gauls, whose retreat is said to have been caused by an irruption of the Veneti into their territory. Some time during the Second Punic War they passed under Roman rule. At first, they possessed complete autonomy in internal administration; in 89 B.C. Gnaeus Pompeius Strabo bestowed upon them the *ius Latinum.*

Under the empire Venetia and Istria were included in the tenth region of Italy with capital Aquileia. Down to the time of the Antonines the country enjoyed great prosperity, which was interrupted by the invasion of the Quadi and Marcomanni and a destructive plague. It was devastated at intervals in later times by the barbarians.

VENETIA (*Venezia*), formerly a territorial division of Italy, lying between the Alps and the Adriatic, and stretching from the frontier of Carinthia and Istria (Austria) in the northeast to the lower Po and Lombardy in the southwest. World War I

led to the addition to Italy of a considerable territory which, though geographically Italian, had been Austrian since the fall of Napoleon; and Venetia was divided into three regions, which will be dealt with separately.

(1) VENETIA PROPER (VENETO) corresponds to the older division, with certain additions amounting to 465 sq.mi. in the north, comprises the provinces of Belluno, Padua, Rovigo, Treviso, Udine, Venice, Verona and Vicenza, and has an area of 9,856 sq.mi. Pop. (1881), 2,814,173; (1901) 3,192,897; (1936) 4,287,806. Marble is quarried, especially near Verona. The chief industries are the manufacture of woollens, especially in the province of Vicenza, textiles, cottons, silks, glass, laces, tobacco, straw-plait, paper, beet sugar and hemp, the breeding of silkworms, iron founding and working, timber cutting and shipbuilding. At Mira is a large candle factory.

Irrigation is widely spread, and large pumping stations have made extensive schemes of land reclamation possible. A large hydroelectric plant utilizes the upper waters of the Piave, and there are other plants on other rivers. The cotton plants were wrecked during World War I but were later rebuilt. The extensive cattle breeding industry also suffered.

The territory differs much in character; the Po and other smaller rivers, notably the torrential Tagliamento, which fall into the Adriatic, terminate in a huge and continually advancing delta which extends right along the coast, and is liable to inundation. The shore lagoons are, however, rendered healthy by the ebb and flow of the tide, which is much more considerable than elsewhere in the Mediterranean. To the north of the Po, at the foot of the mountains, is a fertile territory, while the mountains themselves are not productive. A portion of the Dolomites (*q.v.*), notably the Val d'Ampezzo, with the tourist centre of Cortina d'Ampezzo, falls into the province of Belluno. To the east come the Carnic and Julian Alps, with extensive and fertile foothills, while the isolated Euganean hills near Padua are of volcanic origin.

The density of population varies very considerably throughout Veneto; for the whole area it was 435.0 per sq.mi. in the census of 1936.

There is a main railway line from Milan to Mestre (the junction for Venice) and thence to Trieste by a line near the coast, or by Treviso, Udine and Tarvisio to the border. Another route to the border, the Brenner, leaves the Milan-Venice line at Verona, which is connected with Bologna (and so with central and southern Italy) by a railway through Nogara, while another line runs from Verona via Mantua to Modena. A main line runs from Bologna to Ferrara, Rovigo and Padua, joining the Milan-Venice line at the last-named place.

The first inhabitants of the region found shelter in the caves of the Carso (*q.v.*), in which, as well as on various sites in the Trentino, Neolithic remains have been found; while in the Bronze age positions of natural strength were preferred, commanded by the so-called *castellieri*—stone enceintes which, to some extent, recall the early citadels of Italy and the *nuraghi* of Sardinia—many of which were occupied by Roman forts or mediaeval castles.

Under the Roman republic the district was inhabited by a variety of tribes—Celts, Veneti, Raeti, etc. Under Augustus, Venetia and Histria formed the tenth region of Augustus, the latter including the Istrian peninsula as far as the river Arsia, *i.e.*, with the exclusion of the strip along the east coast (Liburnia). It was thus far the largest of the regions of Italy, but possessed comparatively few towns; though such as there were, with their large territories, acquired considerable power and influence.

The easiness of the Brenner pass and the abundance of communication with the sea led to the rise of such towns as Verona, Padua and Aquileia, and Milan only became more important than any of these when the German attacks on Italy were felt farther west.

When the Roman empire fell the towns were, many of them, destroyed by Attila. For the gradual growth of Venetian supremacy over the whole territory, and for its subsequent history, *see* VENICE, and for the eastern portion *see* FRIULI. Among the architectural features may be specially noticed the beautiful country houses of the Venetian nobility. (*See* G. K. Loukomski, *Palladio et les villas des Doges de Venise.*)

The following were the principal agricultural products for 1938:

	Acres	Tons
Wheat	754,446	825,623
Oats	19,513	16,094
Rice	17,784	34,282
Maize	820,781	1,658,631
Beans	284,791	18,408
Sugar beet	138,073	1,578,494
Hemp	13,338	5,512
Garden produce	61,750	93,696
Potatoes	45,201	269,512
Tobacco	11,362	8,488
Forage	2,193,607	4,415,814
Vines	1,461,993	89,212,782 Wine (gal.)

(2) VENETIA TRIDENTINA, consisting of the provinces of Bolzano and Trento, area 5,250 sq. mi.; pop. (1936) 669,029. The greater part is mountainous. To the northwest are the Ortler (*q.v.*), and the Stelvio pass, traversed by an important road from Bormio to the Val Venosta, the upper valley of the Adige, at the head of which is the Resia (Reschen) pass, leading into the lower Engadine. (*See* SWITZERLAND.)

The Wildspitz group of mountains separates this pass from the Brenner (*q.v.*), to the east of which the present frontier reaches the Vetta d'Italia and the Pizzo dei Tre Signori, and then turns sharply southwards, only beginning to run eastwards after crossing the railway from Dobbiaco to Lienz. Between it and the Brenner are the Dolomites (*q.v.*). There are important marble quarries, as yet imperfectly developed, and lead and zinc mines, notably that of Monteneve. A large amount of electric power is derived from hydroelectric plants on the Noce and the Adige.

About one-half of the total area is under forest, while three-fifths of the remainder is under cultivation, much use being made of irrigation for pastures, and also for maize. Vegetables and fruit are grown in the sheltered districts of Merano and Bolzano. The only main railway line is the Brenner, which near Rovereto has a short branch to Riva, at Trento has a branch for Bassano, at Bolzano for Merano and Malles, at Ponte all' Isarco for Selva, and at Fortezza (formerly Franzensfeste) for Dobbiaco and S. Candido (the Italian frontier point) and thence to Lienz and Villach.

The following were the principal agricultural products for 1938:

	Acres	Tons
Wheat	37,544	22,377
Rye	29,393	20,944
Barley	9,633	5,952
Oats	4,940	3,307
Garden produce	8,645	19,841
Potatoes	41,002	166,998
Forage	1,172,756	920,972
Vines	81,757	17,488,558 Wine (gal.)

(3) VENETIA JULIA AND ZARA, a territorial division of northern Italy, consisting of the provinces of Gorizia, Pola and Trieste (to which the detached provinces of Fiume and Zara are also aggregated). Population (1936) 977,257; area 3,456 sq.mi.

The coast line to the east of the Tagliamento is fringed by alluvial deposits and lagoons, mostly of very modern formation, for as late as the 5th century Aquileia was a great seaport. The harbour of Grado is unimportant, but to the east is the shipbuilding yard of Monfalcone, and beyond that the great port of Trieste; while the Istrian peninsula has several small harbours: Capodistria, Parenzo and Rovigno, besides Pola, formerly the chief naval port of Austria. Fiume, at the head of the gulf of that name, is another fine harbour.

The province of Gorizia, except towards the southwest, where it unites with the lowlands of Friuli (*q.v.*), is surrounded by mountains, and most of its area is occupied by mountains and hills. From the Julian Alps, which traverse the province in the north, the country descends in successive terraces towards the sea.

The principal peaks in the Julian Alps are the Monte Canin (8,469 ft.), the Monte Nero (7,367 ft.), the Matajur (5,386 ft.), and the highest peak in the whole range, the Tricorno or Triglav (9,394 ft.). The southern part of the province and that of Trieste belong to the Carso (*q.v.*), in which the caves of Postumia and San Canziano are situated.

The principal river of the district is the Isonzo, which rises in the Tricorno, and pursues a strange zigzag course for a distance of 78 mi. before it reaches the Adriatic. It is navigable only in its lowest section, where it takes the name of the Sdobba. Its principal affluents are the Idria, the Vipacco and the Torre, with its tributary the Judrio. Of special interest is the Timavus or Timavo, which appears near Duino, and after a very short course flows into the Gulf of Trieste. To the east is the desolate limestone plateau of the Carso (*q.v.*). For the province of Pola, *see* ISTRIA.

Agriculture, and especially viticulture, is the principal occupation of the population, and the vine is here planted not only in regular vineyards, but is introduced in long lines through the ordinary fields and carried up the hills in terraces locally called *ronchi.*

Gorizia (Görz) first appears distinctly in history about the close of the 10th century, as part of a district bestowed by the emperor Otto III on John, patriarch of Aquileia. In the 11th century it became the seat of the Eppenstein family, who frequently bore the title of counts of Gorizia; and in the beginning of the 12th century the countship passed from them to the Lurngau family, which continued to exist till the year 1500, and acquired possessions in Tirol, Carinthia, Friuli and Styria. On the death of Count Leonhard (April 12, 1500) the fief reverted to the house of Habsburg.

The countship of Gradisca was united with it in 1754. The province was occupied by the French in 1809, but reverted again to Austria in 1815. It formed a district of the administrative province of Trieste until 1861, when it became a separate crownland. In 1918 it passed to Italy.

The following were the principal agricultural products for 1938:

	Acres	Tons
Wheat	72,371	46,627
Barley	13,091	7,165
Garden produce	14,820	20,282
Potatoes	59,527	204,477
Forage	752,115	663,033
Vines	132,639	17,726,318 Wine (gal.)

The railway system is well developed, mainly centring on Trieste and Gorizia. Besides the line from Trieste by Monfalcone to Treviso, which is the main line of communication with the rest of Italy, there is a line from Monfalcone to Gorizia and thence up the Isonzo valley to the frontier at Piedicolle (thence to Villach and Klagenfurt), and a line direct from Trieste to Gorizia.

Trieste also has lines to Postumia, the frontier station, and thence to Lubiana (with branches to Pola and Fiume, both running through the interior of Istria) and along the coast to Capodistria, Pirano and Parenzo. Shipbuilding is carried on at Trieste, Pola and Monfalcone: Trieste (*q.v.*) is also a great port and centre of industry, with many factories, notably oil mills and refineries, jute factories, rice mills, etc., while at Monfalcone soda and other chemicals are made; at Cervignano, starch, at Capodistria, Pirano and Rovigno, preserved foods; tobacco at Rovigno, liqueurs at Rovigno and Parenzo; at Pirano and Capodistria there are large salt works. Friuli produces lead and zinc.

The district of Trieste produces coal of an inferior quality. Istria produces bauxite, treated at Mestre for the extraction of aluminum. Idria has mercury mines. The fishing industry of Istria is important, and much of the canning is done at Trieste.

See A. Tamaro, *La Vénétie Julienne et la Dalmatie* (3 vols., 1919).

(T. A.; X.)

VENETIC LANGUAGE. We have nearly 100 inscriptions which record the language spoken by the Veneti (*q.v.*) in pre-Roman days. Others have also come to light at Verona and Padua, and at different points along the great north and south route of the Brenner Pass, especially at Bolzano; and there are a few more scanty and scattered monuments in the Carinthian Alps now preserved chiefly in the museums at Klagenfurt and Vienna. The alphabet of the inscriptions, in all its varieties, is probably either derived from or at least influenced by some form of the Etruscan alphabet, since it not merely coincides with that alphabet in several characteristic signs, such as the use of the compound symbol *vh* (𐌞) with the value of *f*, but lacks the symbols for the mediae BDG. These, or the sounds which had descended from them in Venetic, were represented by using symbols which in the Western Greek alphabets denoted kindred sounds; Χ*z* where we should expect *d* (*zoto*, "he gave"), Φ*ϕ* where we should expect *b* (*ϕohιιos*, "Boius"), Ψ (*i.e.*, *χ*) where we should expect *g* (*·ϵ·χo*, "ego"). But though we find the symbols in positions where they correspond to the mediae in kindred languages, it is uncertain what was the precise variety of sound which they denoted. Thus, for example, Venetic *·ϵ·χo* is certainly equivalent to the Latin *ego*, but we cannot be certain that the sound of the two words was precisely the same. The symbol for *θ* is not used to denote *d* (since that is represented by *z*). In the inscriptions of Padua and Verona the sign is **O** and seems there to denote some variety of sound closely akin to *t*; the word which at Padua and Verona is written *·ϵ·kupeθari·s·*, probably meaning "charioteer," appears as *ecupetaris* in Latin alphabet in an inscription published by Elia Lattes ("Iscrizioni Inedite Venete ed Etrusche," *Rendiconti del R. 1st Lomb. di Sc. e Lett.*, Serie II. vol. xxxiv., 1901). The full Venetic alphabet at its best period is preserved for us on several dedicatory objects found at Este, which were offered to the goddess of the place called *Rehtia*, a name obviously equivalent to Latin *Rectia*. The offerings in question are thin bronze plates of whose surface the greater part is covered by alphabetic signs, with an inscription stating that the worshipper makes an offering of the plate to the Goddess. These plates provide enough material to place the alphabet of Este beyond all doubt. It is written from right to left, and the alternate lines curl round so that the letters proceed in the opposite direction and stand with their feet turned towards those in the preceding line. This characteristic, technically known as "serpentine boustrophedon," with the sign for *h* (I), points to some connection with the alphabets of the East Italic ("Sabellic") inscriptions (*see* SABELLIC).

The alphabet shows some marked differences from the western Greek alphabet used in Elis. The language belongs to the Indo-European group, but the forms with which the inscriptions of Este supply us are somewhat limited in number. The typical beginning for a dedication is *meχo . . . zona· s· to sahnateh rehtiiah, i.e.*, "me dedit Rectiae Sanatrici," "so and so gave me to the Healing Goddess Rectia"; and sometimes the form of the verb is simply *z·o·to*. The correspondence of these two forms with the Greek middle aorist of the verb (ἔ-δοτο), and with the Latin *donare* is obvious. One inscription of special linguistic interest is the artist's inscription of a vase of the 6th century B.C. found at Padua—

voθo kluθeari·s· vhaχ·s·to,

where the first name appears to be identical with the Latin *Ortho* and also seems to explain its aspirate, and the last word of the inscription appears to be the Venetic equivalent of the Latin *fecit*, but to be in the middle voice without any argument. If this interpretation be correct—and the use of ἐποιησε by Greek artists commends it strongly—the form illustrates the character of the language as intermediate between Greek and Latin.

BIBLIOGRAPHY.—*See* Carl Pauli (*Altital. Studien* vol. 3, "Die Veneter," Leipzig, 1891); T. Mommsen, *Die Inschriften Norditalischen Alphabets* (Zürich, 1853); and *Notizie degli Scavi* by Ghirardini in the volumes for 1880 and 1888, and by Prosdocimi in that for 1890; the Preliminary Report presented to the British Academy published

in the *Athenaeum*, Aug. 8, 1908; A. Meillet and M. Cohen, *Les Langues du Monde* (1924).

VENETTE, JEAN DE (*c.* 1307–*c.* 1370), French chronicler, born at Venette, near Compiègne, became prior of the Carmelite convent in the Place Maubert, Paris, in 1339, and was provincial of France from 1341 to 1366. In 1368 he was still living, but probably died within a year or two of that date. His Latin Chronicle, covering the years 1340 to 1368, was published by Achery (*Spicilegium*, vol. iii.) Jean de Venette was a child of the people, and his sympathies were entirely with the peasants. His point of view is thus directly opposed to that of Froissart. Jean de Venette also wrote a long French poem, *La Vie des trois Maries*, about 1347.

See Lacurne de Sainte-Palaye in *Mémoires de l'Académie*, vols. viii. and xiii.; Géraud and Déprez in *Mélanges de l'école de Rome* (1899), vol. xix.; and A. Molinier, *Les Sources de l'histoire de France* (1904), tome iv.

VENEZUELA, a republic of South America, on the coast of the Caribbean, lying between Brazil and British Guiana on the east and south, and Colombia on the west. The name means "little Venice," and is a modification of the name of Venecia (Venice), originally bestowed by Alonzo de Ojeda in 1499 on an Indian village, composed of pile dwellings on the shores of the Gulf of Maracaibo, which was called by him the Gulf of Venecia.

The area of Venezuela is 346,481 sq.mi. The population: (1941) 3,951,371; the population of Caracas, the capital: (1941) 269,030.

The population of Maracaibo, the next largest city, in 1941 was 112,519, and that of Valencia was 53,938 in 1941.

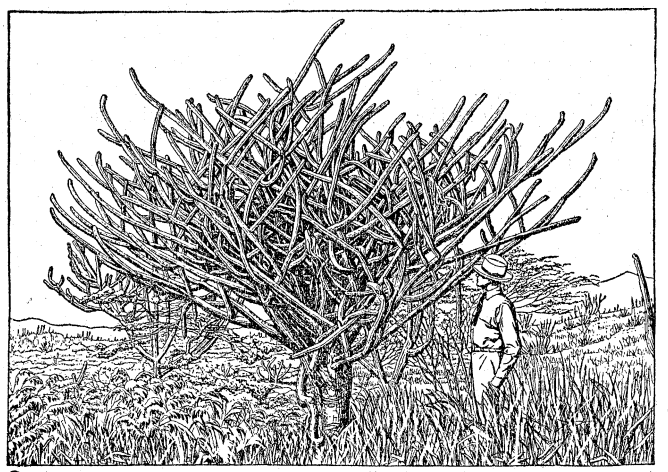
Topography.—The surface of Venezuela is broken into three irregular divisions by its mountain systems: (1) the mountainous area of the north-west and north; (2) the Orinoco basin with the *llanos* on its northern border and great forested areas in the south and south-west; and (3) the Guiana highlands. A branch of the eastern chain of the Andes enters Venezuela in the west about 7° N. lat., and under the name of the Sierra Nevada de Mérida proceeds north-eastwards towards Trieste Gulf. This branch is of parallel chains enclosing elevated valleys, in one of which lies the town of Mérida (5,410 ft.), overlooked by the highest summit of the chain (Picacho de la Sierra, 15,420 ft.). The sierra contains the water-parting between the basin of the Orinoco and those of the small rivers on the north-west. Hence it may be considered to terminate where the Río Cojedes, which drains the elevated valley in which Barquisimeto stands, after rising on its western slopes, flows eastwards into the basin of the Orinoco. Beyond the Cojedes begin two parallel ranges, the Maritime Andes of Venezuela, which stretch east and west along the coast. The valley between these two ranges is the most densely peopled part of Venezuela. Behind the bay between Cape Codera and Cumaná there is an interruption in the Maritime Andes, the *llanos* fronting on the coast for over 100 m.; but both ranges reappear between Cumaná and the Gulf of Paria. West of the Maritime Andes low ranges (3,500–5,000 ft.) trend northwards from the end of the Sierra de Mérida towards the coast on the east side of the lake of Maracaibo, while the region on the west of that lake consists of lagoon-studded lowlands. East and south of the Sierra de Mérida and the Maritime Andes the region consists of two portions—a vast mountainous area, densely wooded, in the south-east and south, and level plains in the north-west between the Orinoco and the Apure and the mountains. The latter is known as the *llanos* of the Orinoco, a vast grass-covered plain with scattered islands of wood. Along the Brazilian frontier and about the sources of the Orinoco tributaries on the eastern slopes of the Andes there are extensive forests, sometimes broken with grassy *campos*. The general elevation of the *llanos* varies from about 375 to 400 ft., rising to 600–800 ft. around its immediate margins. So uniform is the level over a great part that in the rainy season hundreds of square miles are submerged, and the country is covered with connecting channels. North of the middle Orinoco, however, a series of low gravel capped mesas break the monotony and form the divide between the water of the Orinoco and the streams that flow northward into the Caribbean. The lower basin of the Orinoco is contracted between the Guiana highlands and the northern uplands, and its tributaries come in more nearly at right angles, showing that the margins of the actual valley are nearer and higher. About 62° 30′ W. long. the river reaches what may be thought sea-level; from this point numerous channels cross the silted-up delta-plain to the sea. This region, together with that of the Guiana frontier, is heavily forested. In the extreme south (territory of Amazonas) and south-east the surface again rises into mountain ranges, which include the Parima and Pacaraima sierras on and adjacent to the Brazilian frontier, with short spurs reaching northward toward the Orinoco, such as the Mapichi, Maraguaca, Maigualida, Matos, Rincote and Usupamo. This region belongs to the drainage basin of the Orinoco, and rivers of large volume flow between these spurs. Some of the culminating points in these ranges are the Cerros Yaparana (7,175 ft.) and Duida (8,120 ft.) in the Parima sierras near the upper Orinoco, the Sierra de Maraguaca (8,228 ft.), and the flat-topped Mt. Roraima (8,595 ft.) in the Pacaraima sierras on the boundary line with Brazil and British Guiana. Near the Orinoco the general elevation drops to about 1,500 feet. This region is densely forested, and is inhabited only by Indians.

Probably not less than four-fifths of the territory of Venezuela belong to the drainage basin of the Orinoco (*q.v.*). The Orinoco is supposed to have 436 tributaries, of which, among the largest, the Caroni-Paragua, Aro, Caura, Cuchivero, Suapure, Sipapo and Ventuari have their sources in the Guiana highlands; the Suata, Manapere and Guaritico in the northern sierras; and the Apure, Uricana, Arauca, Capanaparo, Meta, Vichada and Guaviare (the last three being Colombian rivers) in the *llanos* and Andes. The Apure receives two large tributaries from the northern sierras—the Guárico and Portuguesa. Apart from these, the rivers of Venezuela are small and, except those of the Maracaibo basin, are rarely navigable. The larger are the Guanipa and Guarapiche, which flow eastwards to the Gulf of Paria; the Aragua, Unare and Tuy, which flow to the Caribbean coast east of Caracas; the Yaracui, Aroa and Tocuyo to the same coast west of Caracas; and the Motatán, Chama, Escalante, Catatumbo, Apóan and Palmar, which discharge into Lake Maracaibo. The hydrography of the region last mentioned, where the lowlands are flat and the rainfall heavy, is extremely complicated owing to the great number of small rivers and of lakes on or near the lower river courses. The deep lower courses of these streams and the lakes were once part of the great lake itself, which is being slowly filled by silt. The lakes of Venezuela are said to number 204. The largest are the Maracaibo (*q.v.*); the Zulia, with an area of 290 sq.m., a short distance south of Maracaibo among a large number of lakes, lagoons and swamps; Valencia, near the city of that name, in the Maritime Andes, about 1,350 ft. above sea-level, with an area of 216 sq.m.; Laguneta, in the State of Zulia; and Tacarigua, a coastal lagoon in the State of Miranda.

The coast outline of Venezuela is indented. The larger indentations are the Gulf of Maracaibo, or Venezuela, which extends inland through the Lake of Maracaibo, with which it is connected by a comparatively narrow and shallow channel, and is formed by the peninsulas of Goajira and Paraguaná; the Gulf of Paria, between the peninsula of that name and the island of Trinidad; the Gulf of Coro, opening into the Gulf of Maracaibo; the Gulf of Cariaco, between the peninsula of Araya and the mainland; the Golfo Triste, on the east coast of the State of Lara; and the small Gulf of Santa Fé, on the northern coast of the State of Sucre. Besides these there are small sheltered anchorages formed by islands and reefs like that of Puerto Cabello, and estuaries and open roadsteads, like those of La Guaira and Carúpano, which serve important ports. There are 71 islands, with an aggregate area of 14,633 sq.m., according to official calculations. The largest of these is the island of Margarita, north of the peninsula of Araya near which is the island of Tortuga and several groups of islets, generally uninhabited. (A. J. L.)

Geology.—Venezuela may be divided into three principal physiographic regions: (1) The Venezuela or Guiana highlands which lie south of the Orinoco and consist of a great mass of Archaean granite, gneiss and other crystalline rocks and over-

lying beds of sandstone and shale; (2) the llanos, almost treeless plains between the Orinoco and the Andes, which are in large part covered with Tertiary and Quaternary deposits of gravel, sand and clay loam; (3) the mountain ranges—the Cordillera of Mérida and the Coast or Caribbean range—which consist of cores of granite and schist flanked by sedimentary beds folded in anticlinal structure. Minor physiographic units are the delta region on the east coast, at the mouths of the Orinoco and other rivers; and the basin of Lake Maracaibo, a large structural depression. The oldest rocks in northern South America form the basement complex of the Guiana highlands. In Venezuela these rocks consist chiefly of the granites and gneisses of the southern massif and the crystalline schists which form the axis of the Cordillera and the Caribbean chain. Upon this basement lie beds of sandstone and shale, most of them of early Cretaceous age and locally much altered, which at some places are overlain by Pleistocene or Recent deposits and into which are intruded dikes and masses of basalt and other igneous rocks.



GNARLED CACTI ON THE GREAT PLAINS SURROUNDING BARQUISIMETO

The range of the Andes that enters Venezuela from Colombia continues to the N.E. with gradually diminishing elevation and merges into the Coast range. In Venezuela these mountains reach their greatest heights in the snow-capped peaks of La Columna (16,410 ft.), Monte Humboldt (16,212 ft.) and La Concha (16,146 ft). The granitic core of the Venezuelan Andes is cut by many intrusive bodies of pegmatite, basalt and quartz, and the sedimentary beds of the range, most of which are of Cretaceous and Tertiary age, are intricately folded. Cretaceous rocks crop out in places along each side of the Andes in Venezuela and along the south side of the Coast range.

Around Lake Maracaibo, which lies in a basin that is to some extent outlined by faults, there is a surface deposit of Quaternary alluvium, which is underlain by folded Tertiary beds. Petroleum seeps from springs around the lake and is obtained in large quantity from wells sunk to Cretaceous and Tertiary beds. Recent terrestrial deposits consisting of unconsolidated sand, gravel, clay and alluvium cover a large part of the lower regions in Venezuela. In the delta region at the mouths of the Orinoco these deposits are thick and are accumulating rapidly. Gold has been mined in the eastern part of the Guiana highlands near Callao. Most of it occurs in quartz veins near basaltic intrusive rock. Iron ore is mined in the Sierra Imataca south of the Orinoco. Copper is mined near Aroa and San Felipe, in the State of Yaracuy. Coal is found in Tertiary beds in the region north of the Orinoco, but it can be mined profitably at only a few places. The output of petroleum is shown in the following table:

	Barrels		*Barrels*
1917	119,692	1923	4,003,662
1918	317,467	1924	9,041,999
1919	424,735	1925	19,687,406
1920	457,010	1926	37,226,019
1921	1,433,656	1927	63,391,764
1922	2,201,114	1928 (est.)	100,000,000

Venezuela ranked third (*see* p. 52) among the petroleum producing countries of the world in 1927 and second in 1928 (*see* p. 52). (G. McL. Wo.)

Climate.—The climate of Venezuela is everywhere tropical except where modified by altitude. In the Maritime Andes at and above the altitude of Caracas it is semi-tropical, and in the still higher regions of western Venezuela it approaches the mild temperate. On the coast and the northern slopes of the Maritime Andes the tropical heat is greatly modified by the trade-winds. At La Guaira the mean temperature for the year is 81° F, at Caracas (3,025 ft.) it is 70°, at Cumaná it is 83°, at Valencia 76°, Coro 82°, Barquisimeto 78°, Yaritagua 80·6°, Mérida 61°, Trujillo 72° and Maracaibo 81°. South of the sierras, the climate is much drier and hotter. The low night temperatures in these regions lower the mean annual temperatures. At Calabozo, for instance, the mean is about 88°, though the maximum in summer is not far from 100°. The lowest temperatures recorded are those of Mucuchíes, in the State of Mérida, where the maximum is 68°, the minimum 43° and the mean 56°. The year is divided into two seasons, the dry and wet, the latter occurring from April to October, when the temperature is also the highest. On the *llanos* the dry season destroys the pasturage, dries up streams and compels animals of semi-aquatic habits to aestivate. At Caracas the annual rainfall ranged from 602 to 863 mm. between 1894 and 1902. In general the climate of Venezuela is healthful. The sanitary condition is generally bad, and many forms of disease prevail that are not due to the climate.

Fauna.—The fauna and flora of Venezuela are similar to those of the neighbouring regions of Guiana, Brazil and Colombia, the open *llanos* of the Orinoco being something of a neutral district between the great forested regions on the east, south and west. Among the animals indigenous to the country are seven species of the cat family, including the puma, the jaguar and the ocelot; the wild dog (*Canis azarae*); representatives of the marten family, including two species of *Galictis,* two of the otter (*Lutra brasiliensis* and *L. pteronura*) and one of the skunk; two species of bear (*Ursus ornatus* and *U. nasutus*); and the "kinkajou." There are six species of monkey corresponding to those of Guiana and the Amazon valley, the sloth and ant-eater, 12 known genera of rodents, including many species of *Mures,* the cavy, the capybara, the paca, the nutria, the agouti, the tree porcupine, *Loncheres cristata, Echimys cayen* and the Brazilian hare. Among the pachyderms the tapir is found in the forests of the Orinoco. There are two species of the peccary, *Dicotyles torquatus* and *D. labiatus.* There are also two species of deer, *Cervus rufus* and *C. simplicornis.* There are three species of opossum. On the coast and in the Orinoco there may be found the manatee and the dolphin. The Reptilia include 11 species of the crocodile, alligator and lizard, including the savage *jacaré* of the Amazon, several species of the turtle, four species of batrachians, and 29 species of serpents, including the striped rattlesnake (*Crotalus durissus*), *Lachesis mutus,* and a rather rare species of *Cophias.* Among the non-venomous species, the commonest are the boa-constrictor, the anaconda (*Eunectes murinus*) and the *Coluber variabilis.* Bird life is represented chiefly by migratory species, particularly of genera that inhabit the shores of streams and lagoons. In the *garzeros* of Venezuela are to be found nearly every kind of heron, crane, stork and ibis, together with an incredible number of Grallatores. Ducks are also numerous, including a small bird called the *guiriri,* in imitation of its cry. Birds of prey are numerous. One species, the guacharo (*Steatornis caripensis*), or oil-bird, is commonly said to occur only in Venezuela, though it is found in Colombia and Ecuador also. They live in caves, especially in Caripe, and are caught for the oil extracted from them. The bell-bird (*Chasmorhynchus carunculatus*) is common in the forests of the Orinoco. In the 14 orders

TAPPING A RUBBER TREE IN VENEZUELA

of insects there are no fewer than 98 families. There are eight families of Coleoptera, six of Orthoptera, 23 of Hymenoptera, 14 of Lepidoptera and seven of Diptera. Locusts are numerous in the interior. Molluscs, including the pearl oyster, are common on the coasts and in the fresh-water streams and lakes.

Flora.—The flora covers a wide range because of the vertical climatic zones. The coastal zone and lower slopes of all the mountains, including the lower Orinoco region and the Maracaibo basin, are clothed with a typical tropical vegetation. There is no seasonal interruption in vegetation. The tropical vegetation extends to an altitude of about 1,300 ft., above which it may be classed as semi-tropical up to about 3,500 ft., and temperate up to 7,200 ft., above which the vegetation is Alpine. Palms grow everywhere; among them the coco-nut palm (*Cocos nucifera*) is the most prominent. There are some exotics in this zone, like the mango, which thrive so well that they are thought to be indigenous. The cacao is at its best in the humid forests and is cultivated in the rich alluvial valleys, and the banana thrives everywhere, as well as the exotic orange and lemon. On the mountain slopes orchids grow in profusion. Sugar-cane is cultivated in the alluvial valleys and coffee on their slopes up to a height of about 7,000 feet. Among the many tropical fruits to be found in this region are guavas, mangoes, cashews, bread-fruit, aguacates, papayas, zapotes and granadillas. In the next zone are grown many cereals (including rice), beans, tobacco, sugar-cane, peaches, apricots, quinces and strawberries. The *llanos* have some distinguishing characteristics. They are extensive grassy plains, the lowest being the bed of an ancient inland lake about which is a broad terrace (*mesa*), the talus perhaps of the ancient encircling highlands. The lower level has extensive lagoons and swampy areas and suffers less from the long periodical drought. Its wild grasses are luxuriant and a shrubby growth is found along its streams. The decline in stock-breeding has resulted in a considerable growth of trees and chaparral over the greater part of the plain.

One of the most remarkable palms is the "moriche" (*Mauritia flexuosa*). The fruit is edible and its juice is made into beer; the sap of the tree is made into wine, and its pith into bread; the leaves furnish an excellent thatch, and the fibre extracted from their midribs is used for fish lines, cordage, hammocks, nets, etc., and the wood is hard and makes good building material. The fruit of the *Guilielma* is also widely used for food among the natives. Among other forest trees of economic importance are the silk-cotton tree (*Bombax ceiba*), the *palo de vaca*, or cow-tree (*Brosimum utile*), whose sap resembles milk and is used for that purpose, the *Inga saman*, the *Hevea guayanensis*, celebrated in the production of rubber, and the *Orbignya martiana*, distinguished for the length of its leaves.

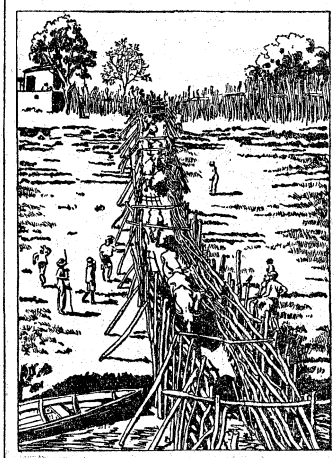
The principal economic plants of the country are cacao, coffee, cassava (manioc), called "mandioca" in Brazil, Indian corn, beans, sweet-potatoes, taro, sugar-cane, cotton and tobacco. Of these coffee and sugar-cane were introduced by Europeans.

Population.—The population of Venezuela consists of a small percentage of whites of European descent, chiefly Spaniards, a few tribes and settlements of Indians, largely of the Arawak and Carib families, and a large percentage of *mestizos*, or mixed bloods. There is some admixture of African blood.

Territorial Divisions.—Venezuela's constitution of 1936 declared that the republic was composed of 20 States, two territories, a Federal district and certain islands in the sea of the Antilles. It provided that the Federal District was to be organized by a special law and composed of the city of Caracas with the neighbouring parishes and the department of Vargas.

The States and territories, with their capitals, are now as follows: Federal District (Caracas); Anzoátegui (Barcelona); Apure (San Fernando de Apure); Aragua (Maracay); Bolívar (Ciudad Bolívar); Carabobo (Valencia); Cojedes (San Carlos); Falcón (Coro); Guárico (Calabozo); Lara (Barquísimeto); Mérida (Mérida); Miranda (Los Teques); Monagas (Maturín); Nueva Esparta (La Asunción); Portuguesa (Acariqua); Sucre (Cumaná); Táchira (San Cristóbal); Trujillo (Trujillo); Yaracuy (San Felipe); Zamora (Barinas); Zulia (Maracaibo), with the following territories: Amazonas (Atures); Delta-Amacuro (Tucupita).

Communications and Commerce.—There has been no great development of railway construction in Venezuela, partly on account of political insecurity and partly because of the backward industrial state of the country. In 1938 there were 13 railway lines with a mileage of about 670 m., including the short lines. The best known of the Venezuelan railways is the short line from La Guaira to Caracas (22¾ m.), which scales the steep sides of the mountain behind La Guaira and reaches 3,135 ft. before arriving at Caracas. It is now electrically operated. It is a British enterprise, and is one of the few railways in Venezuela that pay a dividend. The Puerto Cabello and Valencia line (34 m.) is another British undertaking and carries a good traffic. Wireless communication with the outside world is maintained through the stations at Caracas, Maracaibo, Puerto Cabello and several other places.



LOADING LLANOS CATTLE INTO A RIVER BOAT AT CIUDAD BOLÍVAR, BY MEANS OF A CHUTE WHICH LEADS TO THE LOWER DECK OF THE BOAT

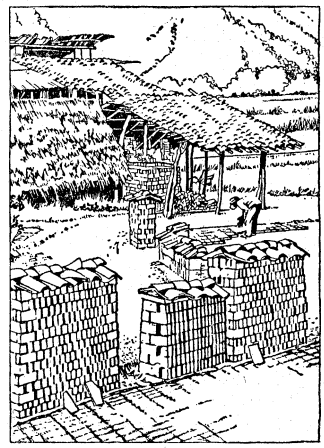
The government is devoting large sums to the construction of motor roads. According to latest reports some 5,000 m. have been opened. The greatest of these is the transandine highway from Caracas to Táchira on the Colombian frontier, 804 miles.

In domestic steamship lines it has relatively little to show. A regular service is maintained on Lake Maracaibo, one on Lake Valencia, and another on the Orinoco, Apure and Portuguesa rivers, starting from Ciudad Bolívar. That on Lake Maracaibo has assumed new importance since the development of the oil fields about the lake.

The coast of Venezuela has an aggregate length of 1,876 m., and there are 32 ports, large and small, not including those of Lakes Maracaibo and Tacarigua and the Orinoco. The majority have only a limited commerce. The first-class ports are La Guaira, Puerto Cabello, Ciudad Bolívar, Maracaibo and Carúpano, and the second-class are Sucre, Juan Griego, Guiria, Caño Colorado, Guanta, Tucacas, La Vela and Porlamar. The imports include hardware and building materials, earthenware, glassware, furniture, drugs and medicines, wines, foodstuffs and coal. The coasting trade is largely made up of products destined for exportation, or imports trans-shipped from the first-class ports to the smaller ones which have no direct relations with foreign countries. The Orinoco trade is carried on largely through Port of Spain, Trinidad, where merchandise and produce is transferred between river boats and foreign ocean-going steamers.

Industry and Commerce.—The principal industries are agricultural and pastoral. Both have suffered heavily from military operations and disturbed political conditions, but peace has now been consolidated for many years and both have progressed. Much the greater part of the Republic is fertile and adapted to cultivation. Irrigation, which has not been much used, is needed in some parts of the country and is being provided for. In other parts, as in the valleys and on the northern slopes of the Maritime Andes, the rainfall is sufficiently well distributed to meet most requirements. The long dry season of the *llanos* and surrounding slopes, which have not as yet been devoted to cultivation, will require a different system of agriculture with systematic irrigation. In colonial times the *llanos* were covered with immense herds of cattle and horses and were inhabited by a race of expert horsemen, the *llaneros*. Both sides in the War of Independence drew upon these herds, and the *llaneros* were among the bravest in both armies. The end of the war found the *llanos* almost deserted. Successive civil wars prevented their recovery, and these plains, which ought to be one of the chief sources of meat supply for the country, are comparatively destitute of stock, and

the only source of revenue from this industry is the small number of animals shipped to the West Indies. The breeding of goats and swine is an important industry in some regions. Other industries of the colonial period were the cultivation of indigo and tobacco. The former has nearly disappeared, but the latter is still an important product. The best known tobacco-producing localities are Capadare, Yaritagua, Mérida, Cumanacoa, Guanape, Guaribe and Barinas. No effort is made to improve the Venezuelan product, a part of which is exported to Cuba for cigar-making. The principal agricultural products are coffee, cacao, sugar, Indian corn and beans. Coffee was introduced from Martinique in 1784 and its exportation began five years later. A recent estimate (1926) gives the number of coffee trees in Venezuela as 250,000,000 belonging to 25,000 estates, occupying some 200,000 ac.; the average annual yield is from 85 million to 100 million pounds. Cacao (*Theobroma cacao*) is an indigenous product and is extensively cultivated on the Caribbean slopes. It requires a high temperature (about 80° F), freedom from strong winds, rich soil and a high degree of humidity for the best development of the tree. The tree has an average height of 12–13 ft., begins bearing five years after planting, the yield being from 490 to 600 lb. per ac. of 100 trees. There are two grades of Venezuelan cacao—the *criollo* or native, and the *trinitario,* or Trinidad, the first being superior in quality. The best cacao comes from Caracas and is marketed under that name. The average production in Venezuela is about 50 million pounds per year, most of which is exported, the larger part going to the United States and France. Sugar-cane is not indigenous, but it is cultivated with success in the lowlands of Zulia, and on the coast. Its principal product is "papelón," or brown sugar, which is put on the market in the shape of small cylindrical and cubical masses of $1\frac{3}{4}$ to $3\frac{1}{2}$ lb. weight. This quality is the only one which is consumed in the country, with the exception of a comparatively small quantity of refined sugar. The annual output is about 60,000 tons. Cotton was produced in several places in colonial times, but the output has now declined to a few thousand pounds. The plant is indigenous and grows well, but, unlike cacao, it requires much manual labour in its cultivation and picking and does not seem to be favoured by the planters. Indian corn is widely grown and provides the staple food of the people. Beans also are a common food, and are universally produced. Wheat was introduced by the Spaniards immediately after their occupation of Venezuela, and is grown in the elevated districts of Aragua and the western states, but the production does not exceed home consumption. Rice is a common article of food, but not enough is grown to supply the local demand. Other agricultural products are sweet-potatoes, cassava (manioc), yuca, yams, white potatoes, maguey, okra, peanuts, peas, all the vegetables of the hot and temperate climates, oranges, lemons, limes, bananas, plantains, figs, grapes, coco-nuts, pine-apples, strawberries, plums, guavas, breadfruit, mangoes and many others. There are also many wild fruits like those of the cactus and various palms, and these are largely consumed. The forest products, whose collection and preparation form regular industries, are rubber (called *caucho* or *goma*), tonka beans, vanilla, copaiba, sarsaparilla, divi-divi, dye-woods, cabinet-woods and fibres. The rubber forests are on the Orinoco and its tributaries.



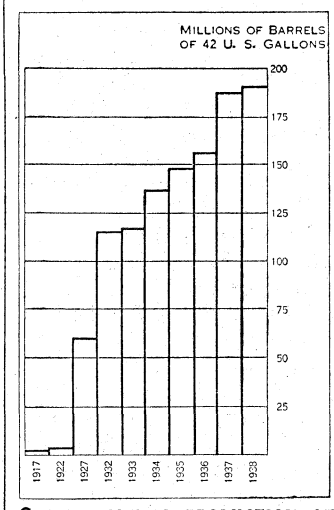
A BRICKYARD OF VENEZUELA

Mining.—The principal minerals are petroleum, gold, copper, iron, sulphur, coal and asphalt. Oil seepages were known in Venezuela before the discovery of America, particularly in the Maracaibo Basin and in the delta of the Orinoco. Deposits of asphalt, associated with these seepages, were exploited for many years, the great asphalt lake of Bermudez, like that on the adjacent British island of Trinidad, yielding large quantities for shipment. About 1912 attention was attracted to the country as a possible source of oil, and several large companies began the drilling of wells. Disturbed political conditions in Mexico probably hastened activities in Venezuela. Starting in earnest in 1920, the development came rapidly, centring on the shores of Lake Maracaibo, where, by 1924, some 5,600,000 barrels of oil were being produced. Unusually large returns were secured from some wells, resulting in a veritable oil boom, and by 1927 Venezuela had taken third place among the nations of the world in the production of petroleum. In 1928, Venezuela surpassed Russia in its output and ranked second only to the United States.

In 1938 the product totalled some 190,000,000 barrels. Almost all the actual development is confined to the Maracaibo Basin, about whose margin numerous pools have been located. The most important fields which are situated here are the Mene, Mene Grande, La Rosa, and Ambrosio; the La Paz, the Río Palmar and the Concepción; the Río de Oro and the Tarra fields; and the newer Falcón field. In eastern Venezuela is located the Guanoco field less developed than those about Lake Maracaibo.

Petroleum is produced in Venezuela under serious handicaps. Tropical heat and humidity, poorly drained lands, rank growth of vegetation, a scarcity of labour, and difficulty of transportation combine to render the task arduous. The entrance to Lake Maracaibo from the sea is so shallow that no vessels of over 11 ft. draught can enter. Consequently most of the oil must be sent out in light-draught barges or tankers to be reloaded onto ocean-going vessels. A few deep-water stations have been established on the Paraguaná peninsula, but the larger part of the oil is shipped first to the islands of Curazao or Aruba, where there are great refineries. As these islands belong to Holland there is less danger of political disorder than on Venezuelan territory.

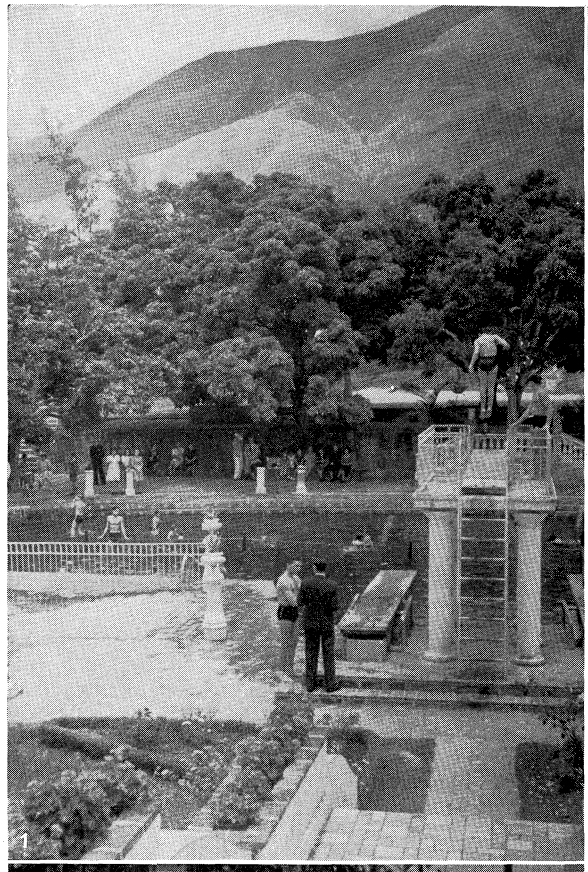
Gold is found chiefly in the Yuruari region, about 100 m. S.W. of the principal mouth of the Orinoco and near the borders of British Guiana, where the famous El Callao mines are situated. These mines have produced as much as 181,040·2 Spanish oz. in one year (1886) and a total of 1,320,929·09 oz. from 1871 to 1890, while another report gives an output valued at $23,000,000 U.S. gold in the 15 years from 1884 to 1899. Some 10 or 12 mines are still being worked and yield about one million dollars per year. There are 14 copper mines, those at Aroa, 70 m. W. of Puerto Cabello and in railway communication with Tucacas (89 m.), being the most productive. The principal coal deposits developed are at Naricual, near Barcelona, and a railway has been constructed to bring the output to the port of Guanta. Deposits are being worked also, on a small scale, near Coro in the State of Falcón, and in several places about Lake Maracaibo. Asphalt is taken from several deposits—from Maracaibo, Cumaná, Pedernales in the Orinoco delta, and the famous Bermudez asphalt lake in the eastern part of the country. Sulphur is mined near Carúpano, and salt in Zulia and on the peninsula of Araya. The latter is a government monopoly, and the high prices at which it is sold constitute a serious prejudice to the people and to industries like that of meat packing.

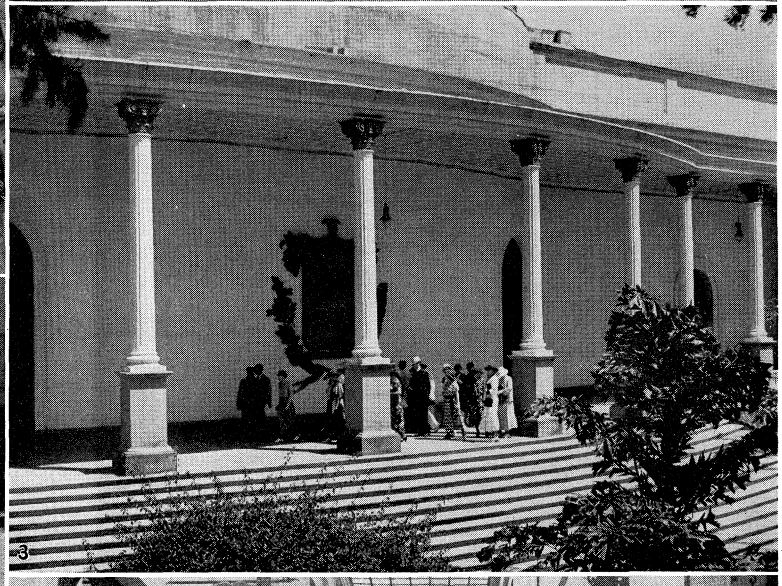


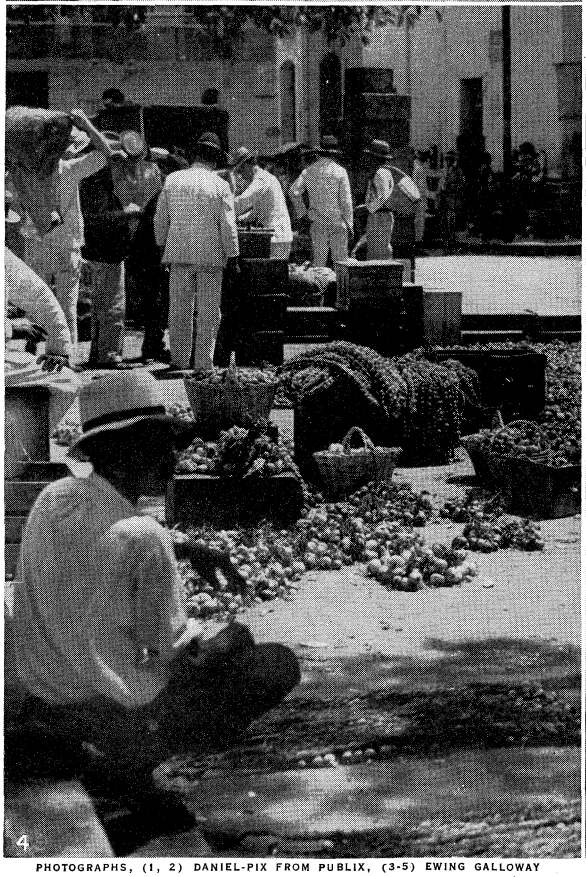
GRAPH SHOWING PRODUCTION OF CRUDE PETROLEUM IN VENEZUELA

Pearl Fisheries.—One of the oldest of Venezuelan industries, the Margarita pearl fisheries, dates from the first exploration of this coast and was probably carried on before that by the natives. The fisheries are established about the islands of Margarita, Coche and Cubagua, the best producing beds being at El Tirano

VENEZUELA





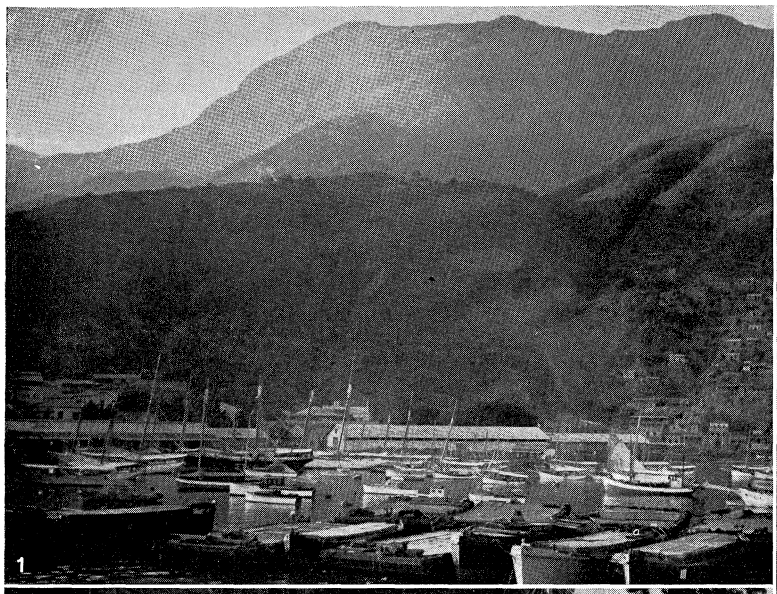


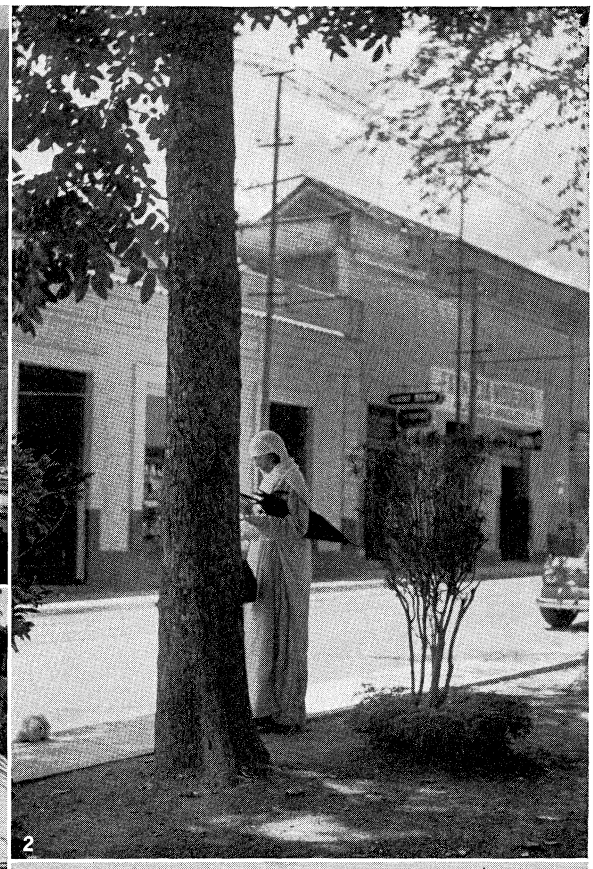
PHOTOGRAPHS, (1, 2) DANIEL-PIX FROM PUBLIX, (3-5) EWING GALLOWAY

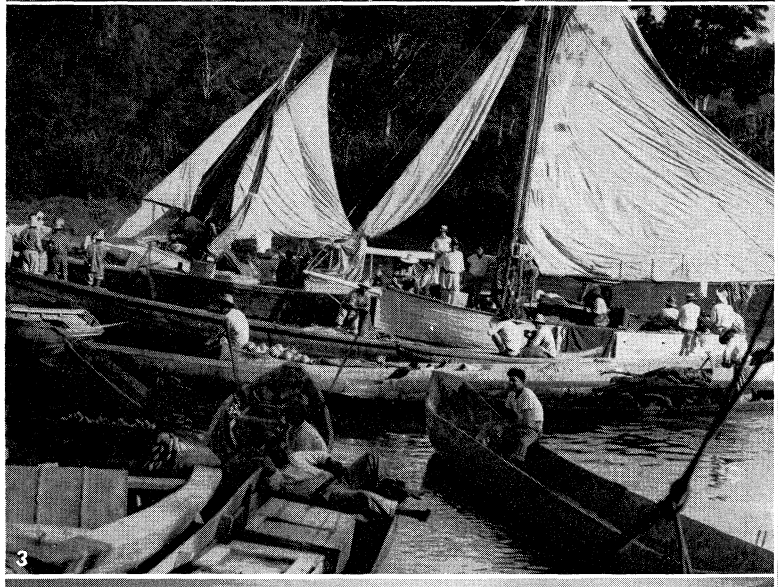
CARACAS, CAPITAL OF VENEZUELA

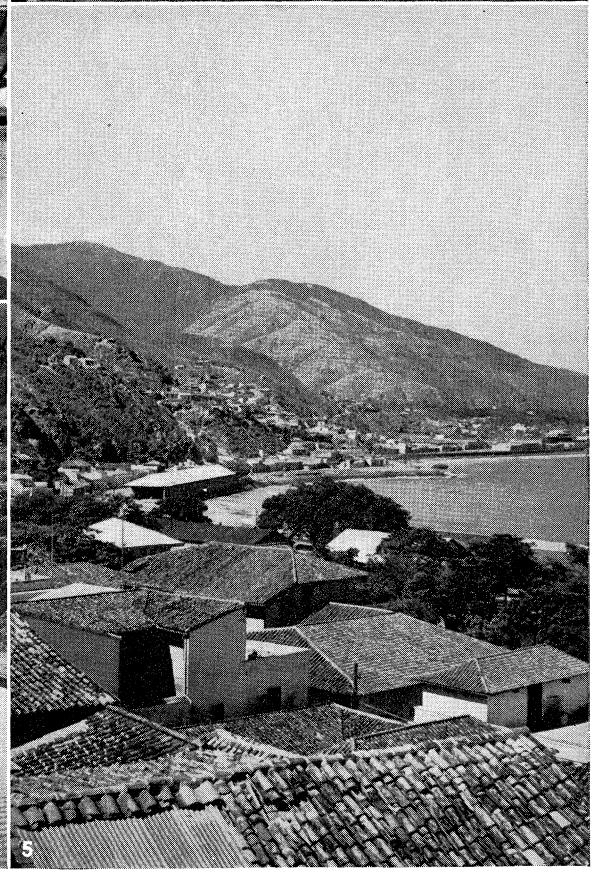
1. Swimming pool at the fashionable Florida club in Caracas
2. A typical street of the capital
3. Portico of the capitol building
4. The onion and garlic market
5. Arcade where many of the best stores are located

VENEZUELA









PHOTOGRAPHS, (1, 2) DANIEL-PIX FROM PUBLIX, (3) PIX FROM PUBLIX, (4, 5) EWING GALLOWAY

VENEZUELAN SCENES

1. Harbour of La Guaira, outlet to the sea for Caracas
2. A street in Valencia, on Lake Valencia
3. The harbour of Río Caribe, a small seaport in eastern Venezuela
4. On the highway between Caracas and La Guaira
5. General view of the harbour of La Guaira and the surrounding mountains

and Macanao, the first north-east and the other north-west of Margarita.

Manufactures.—There are few manufacturing industries, and these are usually of the parasitic type, created by official favour and protected by high tariffs on imports in competition. The manufactures of this class include aerated waters, beer, candles, chocolate, cigarettes, cotton fabrics, hats, ice, matches, boots and shoes, drugs and medicines. There are a number of electric plants, several of which use water-power, one at El Encantado, 10mi. from Caracas, one at Mérida, and another at San Cristóbal, Táchira. There are plants using steam for motive power at Caracas, Maracaibo, Valencia and Puerto Cabello.

The total foreign trade of Venezuela in 1934 amounted to 831,628,699 bolivares (1 bolívar=$.19295). The imports aggregated 159,685,860 while the exports came to 671,942,839 bolivares. The countries furnishing the largest amounts of the imports were, in order:

United States, Great Britain, Germany, the Netherlands, Belgium, France, Spain and Italy, while the countries taking the largest amounts of exports were the Netherlands, United States, Great Britain, France, Germany and Spain.

In 1934 the chief exports were valued as follows in bolivares: coffee, 32,785,469; petroleum, 549,427,949; cacao, 6,330,915; sugar, 12,493,624; balata, 63,466; hides, 429,818; cattle, 1,174,720; gold, 935,734; and pearls, 1,083,202. Since 1923, petroleum has become the largest item of export.

Government.—The Government of Venezuela is that of a Federal republic of nominally independent, self-governing States. According to the provisions of the constitution adopted in 1936, the legislative power is vested in a national Congress of two houses—the Senate and Chamber of Deputies—which meets at Caracas every year.

The Senate consists of two members from each State, or 40 members, who are elected by the State legislatures for a period of four years.

The Chamber consists of popular representatives, elected by direct vote, in the proportion of one deputy for each 35,000 of population, each State being entitled to at least one deputy, the Federal district and territories being entitled to representatives on the same terms.

The executive power is vested by the constitution in a president, and a cabinet of ministers. The president must be Venezuelan by birth and more than 30 years old, elected by the national Congress. The presidential term is five years, and the president cannot immediately succeed himself.

The president is assisted by a cabinet of ministers and the governor of the Federal district.

In case of the disability of the president, his functions are to be exercised by one of his ministers until a new president is elected by Congress.

The judicial power is vested in a supreme Federal court, called the Corte Federal y de Casación, and such subordinate tribunals as may be created by law. The Federal court consists of seven members, representing as many judicial districts of the republic, who are elected by Congress for periods of five years, and are eligible for re-election. It is the supreme tribunal of the republic, and is also a court of appeal (*Casación*) in certain cases, as defined by law.

The judicial organization of the States includes in each a supreme court of three members, a superior court, courts of first instance, district courts and municipal courts. The judicial terms in the States are for three years. In the territories there are civil and criminal courts of first instance, and municipal courts. The laws of Venezuela are well codified both as to law and procedure, in civil, criminal and commercial cases.

The State Governments are nominally autonomous and consist of legislative assemblies composed of deputies elected by ballot for a period of three years, and for each a president and two vice-presidents chosen by the legislative assembly for a term of three years. The States are divided into districts and these into *municipios,* the executive head of which is a *jefe civil.* There is a municipal council of seven members in each district, elected by the municipios, and in each municipio a communal junta appointed by the municipal council. The governors of the Federal territories are appointees of the president of the republic, and the *jefe civil* of each territorial *municipio* is an appointee of the governor. The Federal District is the seat of Federal authority, and consists of a small territory surrounding Caracas and La Guaira, known in the territorial division of 1904 as the West district, and the island of Margarita and some neighbouring islands, known as the East district.

There are two classes of citizens in Venezuela—native-born and naturalized. The first includes the children of Venezuelan parents born in foreign countries; the latter comprises four classes: natives of Spain and of Spanish-American republics, foreign-born persons of Venezuelan parentage, foreigners naturalized through special laws and foreign women married to Venezuelans. Civil rights are assured to all, except anarchists and communists. To profess such views was declared to be treason. The power of granting citizenship to foreigners is vested in the president of the republic. The right of suffrage is exercised by literate Venezuelan males over 21 years of age, and all electors are eligible to public office except where the constitution declares otherwise.

Religious toleration was to prevail, but ecclesiastical patronage belonged to the state. The national government was given power to expropriate unexploited lands for the benefit of small landowners.

Defence.—In 1938 the Venezuelan Navy consisted of six gunboats and a training ship with a personnel of a few hundred men. The standing army was composed of some 6,000 infantry, artillery and cavalry. In addition there was a reserve estimated to consist of about 100,000 men.

In 1933 military service was made compulsory for all adult male citizens with certain exceptions. Service in the army or navy for three years in peace-time and during war at the president's pleasure was made compulsory with relegation to the reserve until the age of 45. A decree of April 17, 1920, provided for a military aviation school at Maracay.

Education.—The ruling classes and the Church have taken little interest in the education of the Indians and *mestizos.* According to the law of 1921 primary education is free and compulsory between seven and 14 years. Secondary education comprises two courses; one of general study occupying four years, and one of professional study occupying two years. Normal training is furnished by two institutions at Caracas. Among the special schools are schools of commerce and modern languages at the capital and other important cities, besides two schools of industrial arts and trades. Higher education is afforded by the Central University of Venezuela at Caracas. Physical education is compulsory in all schools up to the age of 21. Expenditure on education for 1924–25 was 4,648,345 bolivares. Further educational facilities are provided by a national library with 50,000 volumes, a national museum, with a valuable historical collection, the Cajigal Observatory, devoted to astronomical and meteorological work, and the Venezuelan Academy and National Academy of History—the first devoted to the national language and literature, and the second to its history.

Religion.—Freedom of worship is nominally guaranteed by law. Almost no other form of worship exists than that of the Roman Catholic Church. There is one archbishop (Caracas) and four suffragan bishops (Mérida, Guaiana, Barquisimeto, Guárico).

Finance.—The financial situation in Venezuela was for a long time extremely complicated and discreditable, owing to defaults in the payment of public debts, complications arising from the guarantee of interest on railways and other public works, responsibility for damages to private property during civil wars and bad administration. To meet increasing obligations, taxation has been heavily increased. The public revenues are derived from customs charges on imports and exports, transit taxes, cattle taxes, profits on coinage, receipts from State monopolies, receipts from various public services such as the post office, telegraph, Caracas waterworks, etc., and sundry taxes, fines and other sources.

The public debt of Venezuela dates back to the Revolutionary

War, when loans were raised in Europe for account of the united states of Colombia, Ecuador and Venezuela. The separation of the Colombian republic into its three original parts took place in 1830, and in 1834 the foreign debt contracted was divided among the three, Venezuela being charged with 28½%, or £2,794,826, of which £906,430 were arrears of interest. Other items were afterwards added to liquidate other obligations than those included in the above, chiefly on account of the internal debt. Several conversions and compositions followed, interest being paid irregularly. In 1880–81 there was a consolidation and conversion of the republic's foreign indebtedness through a new loan of £2,750,000 at 3%, and in 1896 a new loan of 50,000,000 bolivares (£1,980,198) for railway guarantees and other domestic obligations. In Aug. 1904 these loans and arrears of interest brought the foreign debt up to £5,618,725, which in 1905 was converted into a "diplomatic" debt of £5,229,700 (3%). During these years Venezuela had been pursuing the dangerous policy of granting interest guarantees on the construction of railways by foreign corporations, which not only brought the Government into conflict with them on account of defaulted payments, but also through disputed interpretations of contracts and alleged arbitrary acts on the part of Government officials. In the civil wars the Government was also held responsible for damages to these properties and for the maltreatment of foreigners residing in the country. Some of these claims brought Venezuela into conflict with the Governments of Great Britain, Germany and Italy in 1903. Venezuelan ports were blockaded and there was an enforced settlement of the claims (about £104,417), which were to be paid from 30% of the revenues of the La Guaira and Puerto Cabello custom-houses. This settlement was followed by an adjustment of all other claims, payment to be effected through the same channels. In 1908 (July 31) the total debt of Venezuela (according to official returns) consisted of the following items:—

	Bolivares
Consolidated internal debt	63,171,818
Diplomatic debt (Spanish, French and Dutch)	7,014,569
„ „ (French, 1903–04)	5,733,490
„ „ of 1905	132,049,925
Unconsolidated debt in circulation	4,561,742
Total	212,531,544
or, at 25¼ bolivares per £	£8,417,091

Since 1909 the financial condition of Venezuela has steadily improved. The new law concerning public credit which came into force on June 15, 1923, introduced reforms in the administration of Venezuela's finances. Among other provisions it stipulated that certificates of the internal national consolidated debt which were received by the Treasury should be burned. The following details of the public debt of Venezuela in bolivares as outstanding on Dec. 31, 1923, are taken from the report of the Minister of Finance for 1924:—

External debt:	
National three per cent diplomatic debt	9,169,490·26
Three per cent diplomatic debt of 1905	58,948,145·00
Total	68,117,635·26
Internal debt:	
National internal three per cent consolidated debt	42,647,277·93
Three per cent inscribed debt	2,098,652·50
Total	44,745,930·43

The total indebtedness of the Venezuelan Government on Dec. 31, 1923 thus amounted to 112,863,565·69. The budget for 1924–25 estimated expenditure at 63,354,500 bolivares. Over one-fourth of this amount was allotted to the Ministry of Finance and Public Credit, one-fifth was assigned to the Ministry of War and the Navy, while more than one-sixth was given to the Ministry of the interior. In the budget the receipts of that year were estimated at 66,167,000 bolivares, an increase of 3,322,000 over those for 1923–24. In his message to Congress on April 25, 1925 President Gómez stated that the total national debt had been reduced to 99,445,723 bolivares by Jan. 1, 1925, and that on Dec. 31, 1924 there was in the treasury a surplus of 64,692,080·46 bolivares. On Dec. 31, 1926 the debt had been reduced still further to 85,108,452 bolivares and was being cancelled at the rate of about 8,000,000 bolivares per year. The bolívar was relatively stable during the World War. On Dec. 31, 1923 there were in circulation in Venezuela 35,129,695 bolivares of bank-notes, while the gold reserve aggregated 55,149,749. Of the paper currency 25,293,340 bolívares was supplied by the *Banco de Venezuela.* A shortage of silver in the circulating media has been met under the provisions of a law of 1918 by the minting of new silver coins.

By Dec. 1930—the centenary of the death of Bolivar—the foreign debt had been completely paid off.

The currency of Venezuela is on a gold basis, the coinage of silver and nickel is restricted, and the State issues no paper notes. Foreign coins were formerly legal tender but this has been changed by the exclusion of foreign silver coins and the acceptance of foreign gold coins as a commodity at a fixed value. Under the currency law of March 31, 1879, the thousandth part of a kilogramme of gold was made the monetary unit and was called a *bolívar,* in honour of the Venezuelan liberator. The denominations provided for are: Gold: 100, 20, *bolivares;* Silver: 5, 2, 2.50, 2, 1 *bolivares;* 50, 20 *céntimos;* Nickel: 12½ and 5 *céntimos.*

The silver 5-*bolívar* piece is usually known as a "dollar," and is equivalent to $1.61 United States currency. The old "peso" is no longer used except in accounts, and is reckoned at 4 bolivares, being sometimes described as a "soft" dollar. Silver and nickel are legal tender for 50 and 20 bolivares respectively. Paper currency is issued by the banks of Venezuela, Caracas and Maracaibo under the provisions of a general banking law, and their notes are accepted at their face value.

The metric weights and measures have been officially adopted by Venezuela, but the old Spanish units are still popularly used throughout the country. (G. M. McB.)

History.—The coast of Venezuela was the first part of the American mainland sighted by Columbus, who, during his third voyage in 1498, entered the Gulf of Paria and sailed along the coast of the delta of the Orinoco. In the following year a much greater extent of coast was traced out by Alonzo de Ojeda, who was accompanied by the more celebrated Amerigo Vespucci. In 1550 the territory was erected into the captain-generalcy of Caracas, and it remained under Spanish rule till the early part of the 19th century.

In 1810 Venezuela rose against the Spanish and on July 5, 1811 the independence of the territory was proclaimed. A war ensued which lasted for upwards of ten years, the principal events of which are described under BOLIVAR (*q.v.*), a native of Caracas and the leading spirit of the revolt. It was not till March 30, 1845 that the independence of the republic was recognized by Spain in the Treaty of Madrid. Shortly after the battle of Carabobo (June 24, 1821), by which the power of Spain in this part of the world was broken, Venezuela was united with the Federal State of Colombia, which embraced Colombia and Ecuador; but the Venezuelans were averse to the Confederation, and an agitation in 1829 resulted in the issue of a decree (Dec. 8) by Gen. Paez dissolving the union, and declaring Venezuela a sovereign and independent State. The following years were marked by recurring attempts at revolution, but on the whole Venezuela, during the period 1830–46, was less disturbed than the neighbouring republic owing to the dominating influence of Gen. Paez, who during the whole of that time exercised practically dictatorial power. In 1849 a successful revolution broke out and Paez was driven out of the country. The author of his expulsion, Gen. José Tadeo Monagas, had in 1847 been nominated, like so many of his predecessors, to the presidency by Paez, but he was able to win the support of the army and assert his independence of his patron. For a period of ten years, amidst continual civil war, Monagas was supreme. In 1854 slavery was abolished by presidential decree. After some years of civil war and confusion, Gen. Juan Crisóstomo Falcón established himself at the head of affairs where he remained from 1863 to 1868. In 1864 he divided Venezuela into 20 States and formed them into a Federal Republic. The two parties whose struggles had caused so much strife and

bloodshed were the Unionists, who desired a centralized government, and the Federalists, who preferred a federation of semi-autonomous provinces. The latter now triumphed. A revolt headed by Monagas broke out in 1868 and Falcón left the country and resigned the Presidency. In the following year Antonio Guzmán Blanco succeeded in making himself dictator, after a long series of battles in which he was victorious over the Unionists.

For two decades after the close of these revolutionary troubles in 1870 the supreme power in Venezuela was, for all practical purposes, in the hands of Guzmán Blanco. He evaded the clause in the constitution prohibiting the election of a president for successive terms of office by invariably arranging for the nomination of some adherent of his own as chief of the executive, and then pulling the strings behind this figurehead. The tenure of the presidential office was for two years, and at every alternate election Guzmán Blanco was declared to be duly and legally chosen to fill the post of chief magistrate of the republic. In 1889 there was an open revolt against the dictatorial system so long in vogue and Guzmán Blanco was overthrown. An election was held and Gen. Andueza Palacios was chosen president. A movement was set on foot for the reform of the constitution, the principal objects of this agitation being to prolong the presidential term to four years, to give Congress the right to choose the president of the republic, and to amend certain sections concerning the rights of persons taking part in armed insurrection arising out of political issues. All might have gone well for President Andueza had he not supposed that this extension of the presidential period might be made to apply to himself. His attempt to force this question produced violent opposition in 1891, and ended in a rising headed by Gen. Joaquín Crespo. This revolt, which was accompanied by severe fighting, ended in 1892 in the triumph of the insurgents, Andueza and his followers being forced to leave the country to save their lives. General Crespo became all-powerful; but he did not immediately accept the position of president. The reform of the constitution was agreed to, and in 1894 Gen. Crespo was duly declared elected to the presidency by Congress for a period of four years.

In April 1895 the long-standing dispute as to the boundary between British Guiana and Venezuela was brought to a crisis by the action of the Venezuelan authorities in arresting Inspectors Barnes and Baker, of the British Guiana police, with a few of their subordinates, on the Cuyuni river, the charge being that they were illegally exercising the functions of British officials in Venezuelan territory. Messrs. Barnes and Baker were subsequently released, and in due course made their report on the occurrence. The question began now to assume an acute stage, the Venezuelan minister in Washington having persuaded President Cleveland to take up the cause of Venezuela in vindication of the principles of the Monroe doctrine. On Dec. 17, 1895 a message was sent to the United States Congress by President Cleveland practically stating that any attempt on the part of the British Government to enforce its claims upon Venezuela as regards the boundary between that country and Guiana without resort to arbitration would be considered as a *casus belli* by his Government. The news of this message caused violent agitation in Caracas and other towns. A league was formed binding merchants not to deal in goods of British origin; patriotic associations were established against the British, and Cleveland was praised. The question was arranged in 1899 by arbitration which gave England the major part of the territory in dispute, and paid a moderate indemnity to the British officers and men who had been captured. Diplomatic relations between the two countries, which had been broken off in consequence of the dispute, were resumed in 1897.

In 1898 Gen. Crespo was succeeded as president by Señor Ignacio Andrade. Towards the end of the year a revolutionary movement took place with the object of ousting Andrade from power. The insurrection was crushed, but in one of the final skirmishes a chance bullet struck Gen. Crespo, who was in command of the Government troops, and he died from the effects of the wound. A subsequent revolt overthrew President Andrade in 1900. Gen. Cipriano Castro then became president. During 1901 and 1902 the internal condition of the country remained disturbed, and fighting went on between the Government troops and the revolutionists. President Castro was for eight years a dictator, ruling by corrupt and revolutionary methods, and in defiance of obligations to the foreign creditors of the country. The wrongs inflicted by him on companies and individuals of various nationalities, who had invested capital in industrial enterprises in Venezuela, led to a blockade of the Venezuelan ports in 1903 by English, German and Italian warships. Finding that diplomacy was of no avail to obtain the reparation from Castro that was demanded by their subjects, the three powers unwillingly had recourse to coercion. The president, however, sheltered himself behind the Monroe doctrine and appealed to the Government of the United States to intervene. The dispute was finally referred by mutual consent to The Hague Court of Arbitration. The Washington Government had indeed no cause to be well disposed to Castro, for he treated the interests of Americans in Venezuela with the same high-handed contempt as those of Europeans.

The demand of the United States of America for a revision of what is known as the Olcott Award in connection with the Orinoco Steamship Company was in 1905 met by a refusal to reopen the case. Meanwhile the country, which up to the blockade of 1903 had been seething with revolutions, now became much quieter. In 1906, the President refused to allow M. Taigny, the French minister, to land, on the ground that he had broken the quarantine regulations. In consequence, France broke off diplomatic relations. In the following year, by the decision of The Hague Tribunal, the Venezuelan Government had to pay the British, German and Italian claims, amounting to £691,160; but there was still £840,000 due to other nationalities, which remained to be settled. The year 1907 was marked by the repudiation of the debt to Belgium, and fresh difficulties with the United States. Finally, in 1908 a dispute arose with Holland on the ground of the harbouring of refugees in Curaçoa. The Dutch minister was expelled, and Holland replied by the despatch of gunboats, which destroyed the Venezuelan fleet and blockaded the ports. In Dec. Gen. Castro left upon a visit to Europe. In his absence a rising against the dictator took place at Caracas, and his adherents were seized and imprisoned. Juan Vicente Gómez, the vice-president, now placed himself at the head of affairs.

Under the constitution of 1909, on Aug. 27, 1910 Congress elected Gómez constitutional President for four years. In June and July, 1911 Venezuela observed the centenary of her declaration of independence. During the rule of Gómez suspended diplomatic relations with foreign nations were resumed, and Venezuela undertook to pay those obligations to foreign nations upon which payments had lapsed. Liberalism was repressed.

According to the constitution the term of office of President Gómez ended on April 19, 1914. Upon that day a Congress of Deputies from the Venezuelan States adopted a provisional constitutional statute for the Union, which declared that all laws not inconsistent therewith should remain in force. It further provided that this Congress should elect a commander-in-chief of the national army at the same time that it elected a provisional president of the republic. Congress was also to frame a new pact of union for Venezuela, which should be submitted to the assemblies of the States for approval. The period of provisional rule should last until the new constitution had been ratified by the States and until the constitutional functionaries had taken their posts. On the same day Congress elected Victorino Márquez Bustillos, who had been Minister of War and the Navy, provisional President, and by a decree of the same day Bustillos appointed his ministers of State. Congress elected General Gómez commander-in-chief of the national army.

On May 3, 1915 the Congress chosen under the constitution of 1914 unanimously elected Gen. Gómez President of the Republic for the term ending April 19, 1922, but the president-elect did not assume the presidency. The provisional president continued to exercise authority while Gen. Gómez remained commander-in-chief of the army with the title president-elect of the republic. In May, 1922 Gen. Gómez was unanimously re-elected to the office of President of Venezuela. On June 19, a new constitution was promulgated which made some slight but im-

portant changes in the constitution of 1914. These changes and those incorporated in a new constitution adopted in 1925 served to strengthen the hand of the president as against the authority of congress. On June 24, 1922, Gen. Gómez relieved Márquez Bustillos of the nominal authority the latter had exercised since 1915 and assumed his full responsibility as president. When reëlected at the end of his seven year term Gómez stood aside to make Dr. Juan Bautista Pérez provisional president, but a rumour of revolts caused the latter to resign in 1931 and Gen. Gómez again assumed the presidency and crushed two minor revolts. In 1935 Gómez, 78, began his 27th year as dictator, but died Dec. 17, 1935, to be succeeded by Eleazar López Contreras. Oil taxes had enabled the government to maintain its credit, the only non-defaulter in South America, but the depression compelled it to abandon its policy of economy and public works for purposes of relief.

Boundary Disputes.—The boundary dispute between Colombia and Venezuela, which had been submitted to the arbitration of the Swiss Federal Council, was decided in March, 1922 in favour of the Colombian contention; namely, that she was entitled to take possession of such portions of the territory in dispute as had been adjudged to her in accordance with the decision of the king of Spain in 1891.

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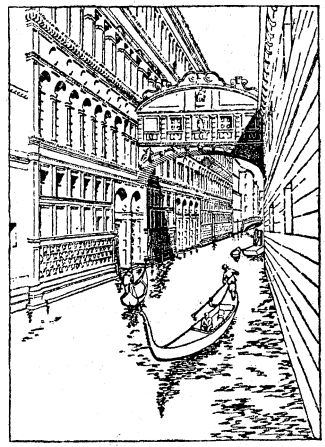
VENICE (*Venezia*), a city and seaport of Italy, occupying one of the most remarkable sites in the world. At the head of the Adriatic, between the mountains and the sea, lies that part of the Lombard plain known as the Veneto. The whole of this plain has been formed by the *débris* swept down from the Alps by the rivers Po, Ticino, Oglio, Adda, Mincio, Adige, Brenta, Piave, Livenza, Tagliamento and Isonzo. The substratum of the plain is a bed of boulders, covered during the lapse of ages by a deposit of rich alluvial soil. The rivers when they debouch from the mountains assume an eastern trend in their effort to reach the sea. The result is that the plain is being gradually extended in an easterly direction, and cities like Ravenna, Adria and Aquileia, which were once seaports, lie now many miles inland. The encroachment of land on sea has been calculated at the rate of about three miles in a thousand years. A strong current sets round the head of the Adriatic from east to west. This current catches the silt brought down by the rivers and projects it in long banks, or *lidi,* parallel with the shore. In process of time some of these banks, as in the case of Venice, raised themselves above the level of the water and became the true shore-line, while behind them lay large lagoons, formed partly by the fresh water brought down by the rivers, partly by the salt-water tide which found its way in by the channels of the river mouths. On a group of these mud banks about the middle of the lagoon of Venice stands the city of Venice. The soil is an oozy mud which can only be made capable of carrying buildings by the artificial means of pile-driving; there is no land fit for agriculture or the rearing of cattle; the sole food supply is fish from the lagoon, and there is no drinking-water save such as could be stored from the rainfall.



VENICE, SHOWING THE BRIDGE OF SIGHS, JOINING THE DUCAL PALACE TO THE STATE PRISON, BUILT BY CONTINO IN THE 16TH CENTURY

The whole site of Venice is dominated by the existence of one great main canal, the Grand Canal, which, winding through the town in the shape of the letter S, divides it into two equal parts. This great canal was probably at one time the bed of a river flowing into the lagoons near Mestre. The smaller canals all serve as arteries to the Grand Canal and their windings follow the lines of construction originally determined by the channels which traversed the islands of the lagoon. One other broad canal, once the bed of the Brenta, divides the island of the Giudecca from the rest of the city and takes its name from that island. The alleys or *calli* number 2,327, with a total length of 89¾ m.; the canals number 177 and measure 28 m. The ordinary Venetian house was built round a courtyard, and was one storey high; on the roof was an open *loggia* for drying clothes; in front, between the house and the water, ran the *fondamenta* or quay. The earliest churches were built with cemeteries for the dead; and thus we find the nucleus of the city of Venice, little isolated groups of dwellings each on its separate islet, scattered, as Cassiodorus, secretary to Theodoric the Great, says, in a letter dated A.D. 523, like sea-birds' nests over the face of the waters. Some of the islets were then still uninhabited, overrun with a dense low growth which served as cover for game and even for wolves.

Gondolas.—The characteristic conveyances on the canals of Venice are the gondolas, flat-bottomed boats, some 30 ft. long by 4 or 5 ft. wide, curving out of the water at the ends, with ornamental bow and stern pieces and an iron beak (*ferro*), resembling a halberd, which is the highest part of the boat. The gondolier stands on a *poppa* at the stern with his face towards the bow, and propels the gondola with a single oar. There is a low cabin (*felze*) for passengers; the ordinary gondolas can take four or six persons, and larger ones (*barca* or *battello*) take eight. Gondolas are mentioned as far back as 1094, and, prior to a sumptuary edict passed by the great council in 1562 making black their compulsory colour, they were very different in appearance from now. Instead of the present boat, with its heavy black cabin and absence of colouring, the older forms had an awning of rich stuffs or gold embroideries, supported on a light arched framework open at both ends; this is the gondola still seen in Carpaccio's and Gentile Bellini's pictures (*c.* 1500). There are also frequent steamer services along the Grand Canal to the Lido and the other islands of the lagoon.

Byzantine Architecture.—We can trace the continuous growth of Venice through the successive styles of Byzantine, Gothic, early Renaissance and late Renaissance architecture. (*See* Ruskin's *Stones of Venice.*) The two most striking buildings in Venice, St. Mark's and the Doge's Palace, at once give us an example of the two earlier styles, the Byzantine and the Gothic, at least in their general design, though both are so capricious in development and in decoration that they may more justly be considered as unique specimens rather than as typical examples of their respective styles. In truth, owing to its isolated position

on the very verge of Italy, and to its close connection with the East, Venetian architecture was a distinctly independent development.

St. Mark's.—The church of St. Mark's, originally the private chapel of the doge, is unique in respect of its richness of material and decoration. It was adorned with the spoils of countless other buildings, both in the East and on the Italian mainland. A law of the republic required every merchant trading to the East to bring back some material for the adornment of the fane. Indeed, the building is a museum of sculpture of the most varied kind, nearly every century from the 4th down to the latest Renaissance being represented. The present church is the third on this site. Soon after the concentration at Rialto (see *History* below), a small wooden church was erected about the year 828 for the reception of the relics of St. Mark, brought from Alexandria. St. Mark then became the patron saint of Venice in place of St. Theodore. This church was burned in 976 along with the ducal palace in the insurrection against the Doge Candiano IV. Pietro Orseolo and his successors rebuilt it on a larger scale. About 1063 the Doge Contarini began to remodel St. Mark's, Byzantine architects having a large share in the work: but Lombards were also employed, giving birth to a new style, peculiar to the district.

In plan (*see* the article ARCHITECTURE) St. Mark's is a Greek cross of equal arms, covered by a dome in the centre, 42 ft. in diameter, and by a dome over each of the arms. The plan is derived from the Church of the Holy Apostles at Constantinople, now covered by the mosque of Mahommed II., and bears a strong resemblance to the plan of St. Front at Périgueux in France (1120). The addition of a narthex before the main front and a vestibule on the northern side brings the whole western arm of the cross to a square on plan. In elevation the façade seems to have connection with the five-bayed façade of the Kahriyeh Jamè, or mosaic mosque, at Constantinople. The exterior façade is enriched with marble columns brought from Alexandria and other cities of the East. Mosaics are employed to decorate the spandrils of the arches. Only one of the original mosaics now exists. It represents the translation of the body of St. Mark, and gives us a view of the west façade of the church as it was at the beginning of the 13th century before the addition of the ogee gables. The top of the narthex forms a wide gallery, communicating with the interior at the triforium level. In the centre of this gallery stand the four colossal bronze horses which belonged to some Graeco-Roman triumphal quadriga, and were brought to Venice by the Doge Enrico Dandolo in 1204. The south façade was reconstructed in 1865–78.

Mosaic is the essential decoration of the church, and the architectural details are subordinated to the colour scheme. The oldest remaining belong to the 12th century, and many of them, for example those of the domes of the atrium, are among the finest of their kind; but the greater part have been restored in the 16th–19th centuries. Below the mosaics the walls and arches are covered with rare marbles, porphyries and alabaster from ancient columns sawn into slices and so arranged in broad bands as to produce a rich gamut of colour.

The eastern crypt, or *confessio,* extends under the whole of the choir and has three apses, like the upper church. Below the nave is another crypt. The floors of both crypts have sunk considerably and are often under water; this settlement accounts for the inequalities of the pavement. The original part of the magnificent mosaic pavement probably dates from the same period as the pavement at Murano, exactly similar in style, material and workmanship, which bears the date 1140. The pavement consists partly of *opus Alexandrinum* of red and green porphyry mixed with marbles, partly of tessellated work of glass and marble.

The choir stands about 4 ft. above the nave and is separated from it by a marble rood-screen, on the architrave of which stand fourteen figures, the signed work of Jacobello and Pietro Paolo delle Masegne, 1394.

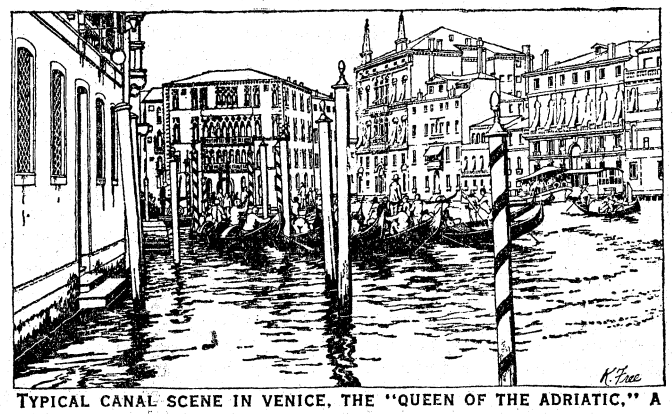
The Pala d'oro, or retable of the high altar (within which rests the body of St. Mark), is one of the chief glories of St. Mark's. It is one of the most magnificent specimens of goldsmiths' and jewellers' work in existence. It was ordered in 976 at Constantinople by the Doge Pietro I. Orseolo, and was enlarged and enriched with gems and modified in form, first by a Greek artificer in 1105, and then by Venetians between 1209 and 1345. It is composed of figures of Christ, angels, prophets and saints, in Byzantine enamel run into gold plates. The treasury of St. Mark's contains magnificent church plate and jewels.

Byzantine Palaces.—Fine examples of Venetian Byzantine palaces—at least of the façades—are still to be seen on the Grand Canal and in some of the small canals. The interiors have been modified past recognition of their original disposition. The Byzantine palace seems to have had twin angle-towers—such as those of the Ca' Molin on the Riva degli Schiavoni, where Petrarch lived. The Fondaco dei Turchi (13th century), now the Natural History Museum, also has two angle-towers. The façades presented continuous colonnades on each floor with semicircular high stilted arches, leaving a very small amount of wall space. The buildings were usually battlemented in fantastic form. A good specimen may be seen in Lazzaro Sebastiani's picture of the piazzetta, in the Museo Civico. There on the right we see the handsome building of the old bakery, occupying the site of the present library; it has two arcades of Saracenic arches and a fine row of battlements. Other specimens still in existence are Palazzo Loredan and Palazzo Farsetti (now the municipal buildings), and the splendid Palazzo Da Mosto, all on the Grand Canal. The richest ornamentation was applied to the arches and string courses while plaques of sculpture, roundels and coats of arms adorned the façades. The remains of a Byzantine façade now almost entirely built into a wall in the Rio di Ca' Foscari offer us excellent illustration of this elaborate style of decorative work.

Gothic Architecture.—Venetian Gothic, both ecclesiastical and domestic, shares most of the characteristics of north Italian Gothic generally. The material, brick and terra-cotta, is the determining cause of the characteristics of north Italian Gothic.

The Ducal Palace.—Soon after the concentration at Rialto the doge Angelo Particiaco began an official residence for the head of the state, a small, strongly fortified castle; one of its massive angle-towers is now incorporated in St. Mark's and serves as the treasury. It was burnt in 976 and again in 1106. Sebastian Ziani (1173–1179) restored and enlarged the palace. Of his work some traces still remain in the richly sculptured bands built in at intervals along the 14th-century façade on the Rio, and part of the handsome larch-wood beams which formed the loggia of the piazzetta façade, still visible on the inner wall of the present loggia.

The ducal palace was begun by Pietro Gradenigo in 1309.



TYPICAL CANAL SCENE IN VENICE, THE "QUEEN OF THE ADRIATIC," A CITY OF CANALS AND BRIDGES. THERE ARE 177 CANALS, SPANNED BY MORE THAN 400 BRIDGES

Towards the end of the 14th century, this façade, with its lower colonnade, upper loggia with handsome Gothic tracery, and the vast impending upper storey, which give to the whole building its striking appearance and audacious design, had been carried as far as the tenth column on the piazzetta side. In 1424 the building was resumed and carried as far as the north-west angle, near St. Mark's, thus completing the sea and piazzetta façades of two storeys with open colonnades, forming a long loggia on the ground

and first floors, with seventeen arches on the sea front and eighteen on the other façade. Above this is a lofty third storey, pierced with a few large windows, with pointed arches once filled with tracery, which is now lost. The whole surface of the ponderous upper storey is covered with a diaper pattern in slabs of creamy white Istrian stone and red Verona marble, giving a delicate rosy-orange hue to the building. Very beautiful sculpture, executed with an ivory-like minuteness of finish, is used to decorate the whole building with wonderful profusion. The great gateway, the Porta della Carta, was added in 1439–43 from designs by Giovanni Buon and his son Bartolomeo. The block of buildings in the interior, connecting the Porta della Carta with the Rio wing, was added about 1462. Later a fire consumed the earlier buildings along the Rio, which were replaced by the present structure.

The great internal court is surrounded with arcading. From the interior of the court access is given to the upper loggia by a very beautiful early Renaissance staircase, built in 1484–1501 by Antonio Rizzo. Two colossal statues of Neptune and Mars at the top of these stairs were executed by Jacopo Sansovino in 1554 —hence the name "giants' staircase." Owing to the fire of 1574, the fine series of early Paduan and Venetian frescoes in the chief rooms was lost. At present the magnificent council chambers for the different legislative bodies of the Venetian republic and the state apartments of the doges are highly decorated with gilt carving and panelling in the style of the later Renaissance. On the walls of the chief council chambers are a magnificent series of oil-paintings by Tintoretto and others—among them his masterpiece, "Bacchus and Ariadne," and his enormous picture of Paradise, the largest oil-painting in the world.

Gothic Churches and Palaces.—Among the many Gothic churches of Venice the largest are the Franciscan church of Santa Maria Gloriosa dei Frari (begun in 1338), and the Dominican church of SS. Giovanni e Paolo (1246–1430). The Frari is remarkable for its splendid works of art, including Titian's famous Assumption of the Virgin, and its fine choir-stalls and for the series of six eastern chapels which from outside give a very good example of Gothic brickwork, comparable with the even finer apse of the now desecrated church of San Gregorio. The church of SS. Giovanni e Paolo was the usual burying-place of the doges, and contains many noble mausoleums of various dates. Besides these two churches we may mention Santo Stefano, an interesting building of central Gothic, "the best ecclesiastical example of it in Venice." The west entrance is later than the rest of the edifice and is of the richest Renaissance Gothic, a little earlier than the Porta della Carta.

But it is in the domestic architecture of Venice that we find the most striking and characteristic examples of Gothic. The introduction of that style coincided with the consolidation of the Venetian constitution and the development of Venetian commerce both in the Levant and with England and Flanders.

The finest example of the ogival style is undoubtedly the Ca' d'Oro, so-called from the profusion of gold employed on its façade. It was built for Marino Contarini in 1422–40, a comparatively late date. With a fine collection of pictures and furniture, it was given to the State by Baron Franchetti in 1916.

Contarini was to some extent his own architect. He had the assistance of Marco d' Amadeo, a master-builder, and of Matteo Reverti, a Milanese sculptor, who were joined later on by Giovanni Buon and his son Bartolomeo. By the year 1431 the façade was nearly completed, and Contarini made a bargain with Martino and Giovanni Benzon for the marbles to cover what was yet unfinished. But Contarini was not content to leave the marbles as they were. He desired to have the façade of his house in colour. The contract for this work, signed with Master Zuan de Franza, conjures up a vision of the Ca' d' Oro ablaze with colour and gleaming with the gold ornamentation from which it took its name.

Other notable examples are the Palazzo Ariani at San Raffaelle, with its handsome window in a design of intersecting circles; the beautiful window with the symbols of the four Evangelists in the spandrils, in the façade of a house at San Stae; the row of three Giustinian palaces at S. Barnaba; the Palazzo Priuli at San Severo, with a remarkably graceful angle-window, where the columnar mullion carries down the angle of the wall; the flamboyant balconies of the Palazzo Contarini Fasan; the Palazzo Bernardo on a side canal near S. Polo, a late central Gothic building (1380–1400).

Early Renaissance.—Towards the close of the 15th century Venetian architecture began to feel the influence of the classical revival; but, lying far from Rome and retaining still her connection with the East, Venice did not fall under the sway of the classical ideals either so quickly or so completely as most Italian cities. Indeed, in this as in the earlier styles, Venice struck out a line for herself and developed a style of her own, known as Lombardesque, after the family of the Lombardi (Solari) who came from Carona on the Lake of Lugano. The essential point about the style is that it is intermediary between Venetian Gothic and full Renaissance. We find it retaining some traces of Byzantine influence in the decorated surfaces of applied marbles, and in the roundels of porphyry and verde antico, while it also retained certain characteristics of Gothic, as, for instance, in the pointed arches of the Renaissance façade in the courtyard of the ducal palace designed by Antonio Rizzo (1499).

Churches.—The most perfect example of this style in ecclesiastical architecture is the little church of S. Maria dei Miracoli begun by Pietro Lombardo in 1481. The church is without aisles, and has a semicircular roof, and the choir is raised twelve steps above the floor of the nave. The walls, both internally and externally, are encrusted with marbles. The façade has the characteristic circular pediment with a large west window surrounded by three smaller windows separated by two ornamental roundels in coloured marble and of geometric design. Below the pediment comes an arcade with flat pilasters, which runs all round the exterior of the church. Two of the bays contain round-headed windows; the other three are filled in with white marble adorned by crosses and roundels in coloured marble.

Similar results are obtained in the magnificent façade of the Scuola di San Marco, at SS. Giovanni e Paolo, which has six semicircular pediments of varying size crowning the six bays, in the upper order of which are four noble Romanesque windows. The lower order contains the handsome portal with a semicircular pediment, while four of the remaining bays are filled with quaint scenes in surprisingly skilful perspective. The façade of San Zaccaria (1458–1515), the stately design of Anton Marco Gambello and Mauro Coducci, offers some slight modifications in the use of the semicircular pediment, the line of the aisle roof being indicated by quarter-circle pediments abutting on the façade of the nave. San Salvatore, the work of Tullio Lombardo (1530), is severer and less highly ornamented than the preceding examples, but its plan is singularly impressive, giving the effect of great space in a comparatively small area. In this connection we must mention the Scuola of S. Giovanni Evangelista at the Frari, with its fore-court and screen adorned by pilasters delicately decorated with foliage in low relief, and its noble staircase whose double flights unite on a landing under a shallow cupola. This also was the work of Pietro Lombardo and his son Tullio.

Early Renaissance palaces occur frequently in Venice and form a pleasing contrast with those in the Gothic style. The Palazzo Dario with its dedication, *Urbis genio,* and the Vendramin-Calergi or *Non nobis* palace, whose façade is characterized by its round-headed windows of grouped twin lights between columns, are among the more important; though beautiful specimens, such as the Palazzo Trevisan on the Rio della Paglia, and the Palazzo Corner Reali at the Fava, are to be found all over the city.

Later Renaissance.—In this period architecture in Venice lacks any peculiarly individual imprint. It is still characterized by great splendour; indeed, the library of San Marco, begun by Jacopo Sansovino in 1536, is justly considered the most sumptuous example of Renaissance architecture in the world. It is rich, ornate, yet hardly florid, distinguished by splendid effects of light and shade, obtained by a far bolder use of projections than had hitherto been found in the somewhat flat design of Venetian façades.

The old Procuratie were built by Bartolomeo Buon about 1514, the new by Scamozzi in 1580, yet it is clear that each belongs

to an entirely different world of artistic ideas. The Procuratie Vecchie is perhaps the longest arcaded façade in the world and certainly shows the least amount of wall space; the whole design is simple, the moulding and ornamentation severe. The Procuratie Nuove, which after all is merely Scamozzi's continuation of Sansovino's library, displays all the richness of that ornate building. It contains the museum of ancient sculpture, founded by Cardinal Domenico Grimani in 1523.

Among the churches of this period those of San Giorgio Maggiore and of the Redentore are both by Palladio. In 1631 Baldassare Longhena began the fine church of Santa Maria della Salute. With a large and handsome dome, a secondary cupola over the altar, and a striking portal and flight of steps, it occupies one of the most conspicuous sites in Venice on the point of land that separates the mouth of the Giudecca from the Grand Canal. In plan it is an octagon with chapels projecting one on each side. The façades of San Moisè and of Santa Maria del Giglio are good specimens of the baroque style.

Among the palaces of the later Renaissance the more remarkable are Sansovino's Palazzo Corner della Ca' Grande, Longhena's massive and imposing Palazzo Pesaro, the Palazzo Rezzonico, from designs by Longhena with the third storey added by Massari, Sammicheli's Palazzo Corner Mocenigo at San Polo, and Massari's well-proportioned and dignified Palazzo Grassi at San Samuele, built in 1705–45.

Modern Buildings.—In recent times the general prosperity of the city has brought about a revival of domestic and civic architecture both in the Venetian Gothic and the Renaissance Lombardesque style.

Among the most remarkable buildings in Venice are the *scuole,* or gild halls, of the various confraternities. The six *scuole grandi,* San Teodoro, S. Maria della Carità, S. Giovanni Evangelista, San Marco, della Misericordia and San Rocco, built themselves magnificent gild halls. The Scuola di San Marco is now a part of the town hospital, and besides its façade, it is remarkable for the handsome carved ceiling in the main hall (1463). Other beautiful ceilings are to be found in the great hall and the hall of the Albergo in the Scuola della Carità, now the Accademia containing the famous picture gallery, with a number of works returned by Austria in 1919 by Marco Cozzi of Vicenza. But the most magnificent of these gild halls is the Scuola di San Rocco, designed by Bartolomeo Buon in 1517 and carried out by Scarpagnino and Sante Lombardo. The façade on the Campo is large and pure in conception. The great staircase and the lower and upper halls contain an unrivalled series of paintings by Tintoretto.

Campanili.—Among the more striking features of Venice we must reckon the *campanili* or bell-towers. (*See* CAMPANILE.) These were at one time more numerous, earthquakes and subsidence of foundations have brought many of them down, the latest to fall being the great tower of San Marco itself, which collapsed on July 14, 1902. Its reconstruction was at once undertaken, and completed in 1912, together with that of Sansovino's beautiful Loggetta, on its east side. In a few other cases, for example at San Giorgio Maggiore, the fallen campanili were restored; but for the most part they were not replaced. The Venetian campanile usually stands detached from the church. It is almost invariably square. The campanile is usually a plain brick shaft with shallow pilasters running up the faces. It has small angle-windows to light the interior inclined plane or staircase, and is not broken into storeys with grouped windows as in the case of the Lombard bell-towers. Above the shaft comes the arcaded bell-chamber, frequently built of Istrian stone; and above that again the attic, either round or square or octagonal, carrying either a cone or a pyramid or a cupola. Among the existing campanili the oldest are San Geremia, dating from the 11th century, San Samuele from the 12th, San Barnaba and San Zaccaria from the 13th.

Public Monuments.—Venetian sculpture is for the most part ancillary to architecture; for example, Antonio Rizzo's "Adam" and "Eve" (1464), which face the giants'-staircase in the ducal palace, are parts of the decorative scheme; Sansovino's splendid monument to Tomaso Rangone is an essential feature of the façade of San Giuliano. The most successful Venetian sculpture is to be found in the many noble sepulchral private monuments. The jealousy of the Venetian republic forbade the erection of monuments to her great men.

The sole exception is the superb equestrian statue in honour of the General Bartolomeo Colleoni, standing on the Campo SS. Giovanni e Paolo. It is by the Florentine Verrocchio, and was cast by Alessandro Leopardi, who was responsible for the graceful pedestal. Leopardi was also the creator (1505) of the three handsome bronze sockets in front of St. Mark's which held the flagstaffs of the banners of Cyprus, Morea and Crete, when the republic ruled them.

By the side of the sea in the piazzetta, on to which the west façade of the ducal palace faces, stand two ancient columns of Egyptian granite, brought as trophies to Venice by Doge Domenico Michieli in 1126.

In 1180 they were set up with their present fine capitals and bases. The grey column is surmounted by a fine bronze lion of Byzantine style, cast in Venice for Doge Ziani about 1178 and in 1329 a marble statue of St. Theodore, standing upon a crocodile, was placed on the other column.

Painting.—Painting developed relatively late in Venice, as is shown by the dates of the activity of Giacomo Bellini (1424–1470) and his sons Gentile (1429–1507) and Giovanni (1459–1516) of the Vivarini family of Murano (1440–1505) and of Vittore Carpaccio (1482–*c.* 1527). The greatest artists of the Venetian school are Titian (1477?–1576) and Tintoretto (1518–94): but Palma Vecchio (*c.* 1480–1528), Bonifacio, Paris Bordone, and Paolo Veronese are also important. Of later masters we may name Tiepolo, Canale and Guardi (*qq.v.*).

Institutions.—The arsenal was founded about the year 1104 by the doge Ordelap Falier. In 1304, on the design of Andrea Pisano, new building sheds and the rope walk were erected. Pisano's building sheds, nine in a row, with peculiarly shaped roofs, were still standing intact—until recently, but have been modified. In 1325 the second addition, the *arsenale nuovo,* was made, and a third, the *arsenale nuovissimo,* in 1473; a fourth, the *Riparto delle Galeazze,* about 1539; and in 1564 the fifth enlargement, the *Canal delle Galeazze e Vasca,* took place. The entire circuit of the arsenal, about two miles in extent, is protected by a lofty wall with turrets. The main door of the arsenal is the first example in Venice of the purely classical style. It is a noble portal, erected in 1460, from designs by Fra Giocondo, with the lion of St. Mark in the attic. The statuary, with S. Giustina on the summit of the tympanum, was added in 1571 and 1578. The whole design was modified in 1688 so as to represent a triumphal arch in honour of Morosini Peloponnesiaco, who brought from Athens to Venice the four lions in Pentelic marble which now stand before the gate. (On the largest of these lions is cut a runic inscription recording an attack on the Piraeus in the 11th century by Norse warriors of the Varangian guard, under Harold Hardrada, afterwards—1047—king of Norway.) The arsenal suffered frequently and severely from fires, the worst being those of 1509 and 1569; yet such was the wealth of Venice that her fleet crushed the Turks at Lepanto in 1571.

The Lido, which lies about 2 m. S.E. of Venice and divides the lagoon from the sea, has become a fashionable bathing-place. The point of San Nicolò del Lido is strongly fortified to protect the new entrance to the port. Inside the fortress lies the old Protestant burying-ground.

Libraries.—The library of San Marco contains upwards of 400,000 printed volumes and about 13,000 manuscripts. We may date the true foundation of the library to the donation of Cardinal Bessarion. The principal treasures of the collection, including splendid Byzantine book-covers, the priceless codices of Homer, the Grimani Breviary, an early Dante, etc., are exhibited under cases in the Sala Bessarione in the Zecca or mint where the library has been installed. Another library was left to the public by the munificence of Count Quirini-Stampalia, who bequeathed his collections and his house at Santa Maria Formosa to be held in trust for students. The state archives are housed in the Franciscan monastery at the Frari.

Harbour.—Under the republic commercial shipping used to enter Venice by the port of San Nicolò del Lido and lie along the quay called the Riva degli Schiavoni, in the basin of San Marco, and up the broad Giudecca Canal. But the mouth of the Lido entrance gradually silted up and, when trade expanded, the Italian Government resolved to reopen it. Two moles were run out in a south-westerly direction; the westerly is about 2 m., the easterly about 3 mi. in length.

The natural scour thus created gave a depth of 26 ft. of water through the sand-bank. The mean rise and fall of the tide is about 2 ft., but under certain conditions of wind the variation amounts to 5 ft. and over.

Docks were constructed near the railway station, but in 1917 plans were made for a new port for Venice on the mainland, at Marghera, south of the railway line to Padua; in 1922 the canal of approach was opened by King Victor Emmanuel, and named in his honour, and in 1924 the construction of the main works was begun. The port is accessible at all times to vessels drawing 30 ft.

The maritime station, connected with the mainland by a bridge, and the Marghera industrial port were both dredged to a depth of 33 ft. The maritime station in 1939 had a total quayage of 11,600 ft., and there were about 5,600 ft. of quayage at Giudecca Island, while other wharves and quays had a combined length of 12,590 ft.

In 1938 6,275 vessels with a net tonnage of 5,704,000 entered the port and 6,146 ships of 5,618,000 tons cleared.

The ancient glass-bead industry (*conterie*), has regained its position through the union of the different factories. Venetian beads are ordinarily sent in large quantities to colonies in Africa, and to India, Sumatra and Borneo. Similarly, the glass industry has revived.

New amalgams and methods of colouring have been discovered, and fresh forms have been diligently studied. Special progress has been made in the production of mirrors, electric lamps, candelabra and mosaics.

New industries are those of tapestry, brocades, imitation of ancient stuffs, cloth of silver and gold, and Venetian laces for the manufacture of which there is a government school, with 500 girl pupils. (*See* LACE.)

Population and Administration.—In 1548 the population of Venice was 158,069; in 1607–29, 142,804; in 1706, 140,256; in 1785, 139,095; in 1881, 132,826; in 1931, 172,654; in 1936, 170,830 (town), 264,027 (commune). The climate is mild.

Under the republic, and until modern times, the water supply of Venice was furnished by the storage of rain-water supplemented by water brought from the Brenta in boats. The famous Venetian *pozzi*, or wells for storing rain-water from the roofs and streets, consisted of a closed basin with a water-tight stratum of clay at the bottom, upon which a slab of stone was laid; a brick shaft of radiating bricks laid in a permeable jointing material of clay and sand was then built. On the ground-level perforated stones set at the four corners of the basin admitted the rain-water, which was discharged from the roofs by lead pipes; this water filtered through the sand and percolated into the shaft of the well, whence it was drawn in copper buckets. The present water supply comes from S. Ambrogio near Padova, 20 m. away.

Of the 19,000 houses in Venice only 6,000 have drains and sinks, all the others discharge sewage through pipes directly or indirectly into the canals. With the rise and fall of the tide the discharge pipes are flushed at the bottom. An important investigation undertaken by the Bacterioscopical Laboratory, with regard to the pollution of the Venetian canals by the city sewage, led to the discovery that the water of the lagoons possesses autopurifying power, not only in the large canals but even in the smallest ramifications of the waterways.

The church is ruled by the patriarch of Venice, who is usually raised to the purple. The patriarchate dates from 1451, when on the death of Domenico Michiel, patriarch of Grado, its seat of that honour was transferred to the cathedral church of Castello in Venice, and Michiel's successor, Lorenzo Giustinian, assumed the title of patriarch of Venice. On the fall of the republic St. Mark's became the cathedral church of the patriarch. There are thirty parishes in the city of Venice and fifteen in the lagoon islands and on the littoral. (X.)

HISTORY

It is usually affirmed that the State of Venice owes its origin to the barbarian invasions of north Italy; that it was founded by refugees from the mainland cities who sought refuge from the Huns in the impregnable shallows and mud banks of the lagoons. Venice, like Rome and other famous cities, was an asylum city. But it is nearly certain that long before Attila and his Huns swept down upon the Venetian plain in the middle of the fifth century, the little islands of the lagoon already had a population of poor but hardy fisherfolk living in quasi-independence, thanks to their poverty and their inaccessible site. This population was augmented from time to time by refugees from the mainland cities of Aquileia, Concordia, Opitergium, Altinum and Patavium. But these did not mingle readily with the indigenous population; as each wave of barbarian invasion fell back, these refugees returned to their mainland homes, and it required the pressure of many successive incursions to induce them finally to abandon the mainland for the lagoon, a decision which was not reached till the Lombard invasion of 568. On each occasion, no doubt, some of the refugees remained behind in the islands, and gradually built and peopled the 12 lagoon townships, which formed the germ of the State of Venice and were subsequently concentrated at Rialto or in the city we now know as Venice. These 12 townships were Grado, Bibione, Caorle, Jesolo, Heraclea, Torcello, Murano, Rialto, Malamocco, Poveglia, Chioggia and Sottomarina. The effect of the final Lombard invasion is shown by the resolve to quit the mainland and the rapid building of churches which is recorded by the *Cronaca altinate*. The people who finally abandoned the mainland and took their priests with them are the people who made the Venetian republic. But they were not as yet homogeneous.

Independence.—There is little doubt that the original lagoon population depended for its administration, as far as it had any, upon the larger cities of the mainland. There is a tradition that Venice was founded by "consuls from Padua"; and Padua claimed complete control of the course of the Brenta down to its mouth at Malamocco. The destruction of the mainland cities, and the flight of their leading inhabitants to the lagoons, encouraged the lagoon population to assert a growing independence, and led them to advance the doctrine that they were "born independent." Their development as a maritime people, engaged in small trading and intimately acquainted with their home waters, led Belisarius to seek their help in his task of recovering Italy from the Goths. He was successful; and the lagoons became, theoretically at least, a part of the Eastern empire. But the empire was vast and weak, and its capital lay far away; in practice, no doubt, the lagoon population enjoyed virtual independence.

It was from Byzantium that the Venetian people received the first recognition of their existence as a separate community. Their maritime importance compelled Narses, the imperial commander, to seek their aid in transporting his army from Grado; and when the Paduans appealed to the Eunuch to restore their rights over the Brenta, the Venetians replied by declaring that islands of the lagoon and the river mouths that fell into the estuary were the property of those who had rendered them habitable and serviceable. Narses declined to intervene, Padua was powerless to enforce its claims and Venice established a virtual independence of the mainland. Nor was it long before Venice made a similar assertion to the imperial representative, Longinus, who invited the Venetians to give him an escort to Constantinople (which they did) and also to acknowledge themselves subjects of the empire. By dint of promising large concessions and trading privileges, he induced the Venetians to make an act of submission —though not upon oath. The terms of this pact resulted in the first diploma conferred on Venice as a separate community (584). But it was inevitable that, when the barbarians, Lombard or Frank, were once established on the mainland of Italy, Venice should be brought first into trading and then into political relations with its near neighbours, who as masters of Italy also put forward a claim to sovereignty in the lagoons. It is between the

two claims of east and west that Venice struggled for and achieved recognized independence.

Internal Fusion and Consolidation.—In 466, 14 years after the fall of Aquileia, the population of the 12 lagoon townships met at Grado for the election of one tribune from each island for the better government of the separate communities, and above all to put an end to rivalries which had already begun to play a disintegrating part. But when the lagoon population was largely augmented in 568 as the result of Alboin's invasion, these jealousies were accentuated, and in 584 it was found expedient to appoint 12 other tribunes, known as the *Tribuni Maiores,* who formed a kind of central committee to deal with all matters affecting the general weal of the lagoon communities. But the *Tribuni Maiores* were equally powerless to allay the jealousies of the growing townships which formed the lagoon community. Rivalry in fishing and in trading, coupled with ancient antipathies inherited from the various mainland cities of origin, were no doubt the cause of these internecine feuds. A crisis was reached when Christopher, patriarch of Grado, convened the people of the lagoon at Heraclea, and urged them to suppress the 12 tribunes and to choose a single head of the State. To this they agreed, and in 697 Venice elected her first doge, Paulo Lucio Anafesto.

The growing importance of the lagoon townships, owing to their maritime skill, their expanding trade, created by their position between east and west, their monopoly of salt and salted fish, which gave them a strong position in the mainland markets, rendered it inevitable that a clash must come over the question of independence, when either east or west should claim that Venice belonged to them; and inside the lagoons of growing prosperity, coupled with the external threat to their liberties, concentrated the population into two well-defined parties—what may be called the aristocratic party, because it leaned towards imperial Byzantium and also displayed a tendency to make the dogeship hereditary, and the democratic party, connected with the original population of the lagoons, aspiring to free institutions, and consequently leaning more towards the Church and the Frankish kingdom which protected the Church. The aristocratic party was captained by the township of Heraclea, which had given the first doge, Anafesto, to the newly formed community. The democratic party was championed first by Jesolo and then by Malamocco.

The Franks.—The advent of the Franks determined the final solution. The Emperor Leo, the Isaurian, came to open rupture with Pope Gregory II. over the question of images. The pope appealed to Liutprand, the powerful king of the Lombards, to attack the imperial possessions in Ravenna. He did so, and expelled the exarch Paul, who took refuge in Venice and was restored to his post by the doge of the Heraclean or Byzantine party, Orso, who in return for this assistance received the imperial title of *hypatos,* and trading rights in Ravenna. The pope, however, soon had cause for alarm at the spread of the Lombard power which he had encouraged. Liutprand proceeded to occupy territory in the Ducato Romano. The pope, looking about for a saviour, cast his eyes on Charles Martel, whose victory at Tours had riveted the attention of the world. Charles's son, Pippin, was crowned king of Italy, entered the peninsula at the head of the Franks, defeated the Lombards, took Ravenna and presented it to the pope, while retaining a feudal superiority. Desiderius, the last Lombard king, endeavoured to recover Ravenna. Charlemagne, Pippin's son, descended upon Italy, broke up the Lombard kingdom (774), confirmed his father's donation to the pope, and in reprisals for Venetian assistance to the exarch, ordered the pope to expel the Venetians from the Pentapolis. Venice was now brought face to face with the Franks under their powerful sovereign, who soon showed that he intended to claim the lagoons as part of his new kingdom. In Venice the result of this menace was a decided reaction towards Byzantium. In opposition to the Frankish claim, Venice resolved to affirm her dependence on the Eastern empire. But the democratic party, the Frankish party in Venice, was powerful. Feeling ran high. A crisis was rapidly approaching. The Byzantine Doge Giovanni Galbaio attacked Grado, the see of the Francophil Patriarch Giovanni, captured it, and flung the bishop from the tower of his palace. But the murdered patriarch was succeeded by his no less Francophil nephew Fortunatus, a strong partisan, a restless and indomitable man, who along with Obelerio of Malamocco now assumed the lead of the democratic party. He and his followers plotted the murder of the doge, were discovered, and sought safety at the court of Charlemagne, where Fortunatus strongly urged the Franks to attack the lagoons.

Meantime the internal politics of Venice had been steadily preparing the way for the approaching fusion at Rialto. The period from the election of the first doge to the appearance of the Franks was characterized by fierce struggles between Heraclea and Jesolo. At length the whole population agreed to fix their capital at Malamocco, a compromise between the two incompatible parties, marking an important step towards final fusion at Rialto.

That central event of early Venetian history was reached when Pippin resolved to make good his title as king of Italy. He turned his attention to the lagoon of Venice, which had been steadily growing in commercial and maritime importance, and had, on the whole, shown a sympathy for Byzantium rather than for the Franks. Pippin determined to subdue the lagoons. He gathered a fleet at Ravenna, captured Chioggia, and pushed on up the Lido towards the capital of the lagoons at Malamocco. But the Venetians, in face of the danger, once more moved their capital, this time to Rialto, that group of islands we now call Venice, lying in mid-lagoon between the *lidi* and the mainland. This step was fatal to Pippin's designs. The intricate water-ways and the stubborn Venetian defence baffled all his attempts to reach Rialto; the summer heats came on; the Lido was unhealthy. Pippin was forced to retire. A treaty between Charlemagne and Nicephorus (810) recognized the Venetians as subjects of the Eastern empire, while preserving to them the trading rights on the mainland of Italy which they had acquired under Liutprand.

The concentration at Rialto marks the beginning of the history of Venice as a full-grown State. The external menace to their independence had welded together the place and the people; the same pressure had brought about the fusion of the conflicting parties in the lagoon townships into one homogeneous whole. There was for the future one Venice and one Venetian people dwelling at Rialto, the city of compromise between the dangers from the mainland, exemplified by Attila and Alboin, and the perils from the sea, illustrated by Pippin's attack. The position of Venice was now assured.

The first doge elected in Rialto was Angelo Particiaco, a Heraclean noble, and his reign was signalized by the building of the first church of San Marco, and by the removal of the saint's body from Alexandria, as though to affirm and to symbolize the creation of united Venice.

GROWTH OF THE REPUBLIC

The history of Venice during the next 200 years is marked externally by the growth of the city, thanks to her increasing trade. In the mainland Venice gradually acquired trading rights, partly by imperial diploma, partly by the establishment and the supply of markets on the mainland rivers, the Sile and the Brenta. Internally this period is characterized by the attempt of three powerful families, the Particiachi, the Candiani and the Orseoli, to create an hereditary dogeship, and the violent resistance offered by the people. We find seven of the Particiachi, five Candiani and three Orseoli reigning in almost unbroken succession, until, with the ostracism of the whole Orseolo family in 1032, the dynastic tendency was crushed for ever.

The growing wealth of Venice soon attracted the cupidity of her piratical neighbours on the coast of Dalmatia. The swift Liburnian vessels began to raid the Lido, compelling the Venetians to arm their own vessels and thus to form the nucleus of their famous fleet, the importance of which was recognized by the Golden Bull of the Emperor Basil, which conferred on Venetian merchants privileges far more extensive than any they had hitherto enjoyed, on condition that the Venetian fleet was to be at the disposition of the emperor. But the Dalmatian raids continued to harass Venetian trade, till, in 1000, the great doge Pietro Orseolo II. attacked and captured Curzola and stormed

the piratical stronghold of Lagosta, crushing the freebooters in their citadel. The doge assumed the title of duke of Dalmatia, and a great step was taken towards the supremacy of Venice in the Adriatic, which was essential to the free development of her commerce and also enabled her to reap the pecuniary advantages to be derived from the Crusades. She now commanded the route to the Holy Land and could supply the necessary transport, and from the Crusades her growing aristocracy reaped large profits. Orseolo's victory was commemorated and its significance affirmed by the magnificent symbolical ceremony of the "wedding of the sea" (*Sposalizio del Mar*), celebrated henceforward every Ascension day. The result of the first three crusades was that Venice acquired trading rights, a Venetian quarter, church, market, bakery, etc., in many of the Levant cities, *e.g.*, in Sidon (1102) and in Tyre (1123). The fall of Tyre marks a great advance in development of Venetian trade; the republic had now passed beyond the Adriatic, and had taken an important step towards complete command of the Levant.

Rise of the Aristocracy.—This expansion of the trade of Venice resulted in the rapid development of the wealthier classes, with a growing tendency to draw together for the purpose of securing to themselves the entire direction of Venetian politics in order to dominate Venetian commerce. To achieve their object, a double line of conduct was imposed upon them: they had to absorb the powers of the doge, and also to deprive the people of the voice they possessed in the management of State affairs by their presence in the *concione* or general assembly of the whole community, which was still the fountain of all authority. The first step towards curtailing the power of the doge was taken in 1032, when the family of the Orseoli was finally expelled from Venice and the doge Domenico Flabianico was called to the throne. A law was then passed forbidding for the future the election of a doge-consort, a device by which the Particiachi, the Candiani and the Orseoli had each of them nearly succeeded in carrying out their dynastic ambitions. Further, two ducal councillors were appointed to assist the doge, and he was compelled, not merely permitted, to seek the advice of the more prominent citizens at moments of crisis. By this reform two important offices in the Venetian constitution—the privy council (*consiglieri ducali*) and the senate (the *pregadi* or invited)—came into being. Both were gradually developed on the lines desired by the aristocracy, till we reach the year 1171.

The growth of Venetian trade and wealth in the Levant roused the jealousy of Genoa and hostility of the imperial court at Constantinople, where the Venetians are said to have numbered 200,000 and to have held a large quarter of the city in terror by their brawls. The Emperor Manuel I., urged on by the Genoese and other rivals of Venice, seized the pretext. The Venetians were arrested and their goods confiscated. Popular feeling at Venice ran so high that the State was rashly swept into war with the empire. The doge Vitale Michiel II. led the expedition in person. It proved a disastrous failure, and on the return of the shattered remnants (1171) a great constitutional reform seemed necessary. The Venetians resolved to create a deliberative assembly, which should act with greater caution than the *concione*, which had just landed the state in a ruinous campaign. Forty members were elected in each of the six divisions of the city, giving a body of 480 members, who served for one year and on retiring named two deputies for each *sestiere* to nominate the council for the succeeding year. This was the germ of the great council, the Maggior Consiglio, which was rendered strictly oligarchic in 1296. As the duties of this council were to appoint all officers of State, including the doge, it is clear that by its creation the aristocracy had considerably curtailed the powers of the people, who had hitherto elected the doge in general assembly; and at the creation of Michiel's successor, Sebastiano Ziani (1172), the new doge was presented to the people merely for confirmation.

The assembly protested, but was appeased by the empty formula, "This is your doge an it please you." Moreover, still further to limit the power of the doge, the number of ducal councillors was raised from two to six. In 1198, on the election of Enrico Dandolo, the aristocracy carried their policy one step farther, and by the *promissione ducale*, or coronation oath, which every doge was required to swear, they acquired a powerful weapon for the suppression of all that remained of ancient ducal authority. The *promissione ducale* was binding on the doge and his family, and could be, and frequently was, altered at each new election, a commission, *Inquisitori sopra il doge defunto*, being appointed to scrutinize the actions of the deceased doge and to add to the new oath whatever provisions they thought necessary to reduce the dogeship to the position of a mere figurehead.

The 4th Crusade.—In spite of the check to their trade received from the Emperor Manuel in 1171, Venetian commerce continued to flourish, the Venetian fleet to grow and the Venetians to amass wealth. When the fourth crusade was proclaimed at Soissons, it was to Venice that the leaders applied for transport, and she agreed to furnish transport for 4,500 horses, 9,000 knights, 20,000 foot, and provisions for one year: the price was 85,000 silver marks of Cologne and half of all conquests. But Zara and Dalmatia had revolted from Venice in 1166 and were as yet unsubdued. Venetian supremacy in the Adriatic had been temporarily shaken. The 85,000 marks, the price of transport, were not forthcoming, and the Venetians declined to sail till they were paid. The doge Dandolo now saw an opportunity to benefit Venice. He offered to postpone the receipt of the money if the crusaders would reduce Zara and Dalmatia for the republic. These terms were accepted. Zara was recovered, and while still at Zara the leaders of the crusade, supported by Dandolo, resolved for their own private purposes to attack Constantinople, instead of making for the Holy Land. Constantinople fell (1204), thanks chiefly to the ability of the Venetians under Dandolo. The city was sacked, and a Latin empire, with Baldwin of Flanders as emperor, was established at Constantinople. (*See* ROMAN EMPIRE, LATER.)

In the partition of the spoils Venice claimed and received, in her own phrase, "a half and a quarter of the Roman empire." To her fell the Cyclades, the Sporades, the islands and the eastern shores of the Adriatic, the shores of the Propontis and the Euxine, and the littoral of Thessaly, and she bought Crete from the marquis of Monferrat. The accession of territory was of the highest importance to Venetian commerce. She now commanded the Adriatic, the Ionian islands, the archipelago, the Sea of Marmora and the Black sea, the trade route between Constantinople and western Europe, and she had already established herself in the seaports of Syria, and thus held the trade route between Asia Minor and Europe. She was raised at once to the position of a European power. In order to hold these possessions, she borrowed from the Franks the feudal system, and granted fiefs in the Greek islands to her more powerful families, on condition that they held the trade route open for her. The expansion of commerce which resulted from the fourth crusade soon made itself evident in the city by a rapid development in its architecture and by a decided strengthening of the commercial aristocracy, which eventually led to the great constitutional reform—the closing of the Maggior Consiglio in 1296, whereby Venice became a rigid oligarchy. Externally this rapid success awoke the implacable hatred of Genoa, and led to the long and exhausting Genoese wars which ended at Chioggia in 1380.

The Venetian Constitution.—The closing of the great council was, no doubt, mainly due to the slowly formed resolution on the part of the great commercial families to secure a monopoly in the Levant trade which the fourth crusade had placed definitely in their hands. The theory of the Government, a theory expressed throughout the whole commercial career of the republic, the theory which made Venice a rigidly protective state, was that the Levant trade belonged solely to Venice and her citizens. No one but a Venetian citizen was permitted to share in the profits of that trade. But the population of Venice was growing rapidly, and citizenship was as yet undefined. To secure for themselves the command of trade the leading commercial families resolved to erect themselves into a close gild, which should have in its hands the sole direction of the business concern, the exploitation of the East. This policy took definite shape in 1297, when the Doge Pietro Gradenigo proposed and carried the following meas-

ure: the supreme court, the Quarantia, was called upon to ballot, one by one, the names of all who for the last four years had held a seat in the great council created in 1171. Those who received twelve favourable votes became members of the great council. A commission of three was appointed to submit further names for ballot. The three commissioners at once laid down a rule that only those who could prove that a paternal ancestor had sat in the great council should be eligible for election.

This measure divided the community into three great categories: (1) those who had never sat in the council themselves and whose ancestors had never sat; these were of course the vast majority of the population, and they were excluded for ever from the great council; (2) those whose paternal ancestors had sat in the council; these were eligible and were gradually admitted to a seat, their sons becoming eligible on majority: (3) those who were of the council at the passing of this act or had sat during the four preceding years; their sons likewise became eligible on attaining majority. As all offices were filled by the great council, exclusion meant political disfranchisement. A close caste was created which very seldom and very reluctantly admitted new members to its body. The Heralds' college, the *avvogadori di comun,* in order to ensure purity of blood, were ordered to open a register of all marriages and births among members of the newly created caste, and these registers formed the basis of the famous *Libro d'oro.*

The closing of the great council and the creation of the patrician caste brought about a revolution among those who suffered disfranchisement. In the year 1300 the people, led by Marin Bocconio, attempted to force their way into the great council and to reclaim their rights. The doors were opened, the ringleaders were admitted and immediately seized and hanged. Ten years later a more serious revolution, the only revolution that seriously shook the State, broke out and was also crushed. This conspiracy was championed by Bajamonte Tiepolo, and seems to have been an expression of patrician protest against the *serrata,* just as Bocconio's revolt had represented popular indignation. Tiepolo, followed by members of the Quirini family and many nobles with their followers, attempted to seize the Piazza on June 15, 1310. They were met by the Doge Pietro Gradenigo and crushed. Quirini was killed, and Tiepolo fled.

The chief importance of the Tiepoline conspiracy lies in the fact that it resulted in the establishment of the Council of Ten. Erected first as a temporary committee of public safety to hunt down the remnant of the conspirators and to keep a vigilant watch on Tiepolo's movements, it was finally made permanent in 1335. The secrecy of its deliberations and the rapidity with which it could act made it a useful adjunct to the constitution, and it gradually absorbed many important functions of the State.

With the creation of the Council of Ten the main lines of the Venetian constitution were completed. At the basis of the pyramid we get the great council, the elective body composed of all who enjoyed the suffrage, *i.e.,* of the patrician caste. Above the great council came the senate, the deliberative and legislative body *par excellence.* To the senate belonged all questions relating to foreign affairs, finance, commerce, peace and war. Parallel with the senate, but extraneous to the main lines of the constitution, came the Council of Ten. As a committee of public safety it dealt with all cases of conspiracy; for example, it tried the Doge Marino Falier and the General Carmagnola; on the same ground all cases affecting public morals came within its extensive criminal jurisdiction. In the region of foreign affairs it was in communication with envoys abroad, and its orders would override those of the senate. It also had its own departments of finance and war. Above the senate and the Ten came the *Collegio* or cabinet, the administrative branch of the constitution. All affairs of State passed through its hands. It was the initiatory body; and it lay with the *Collegio* to send matters for deliberation either before the senate or before the Ten. At the apex of the pyramid came the doge and his council.

The Genoese Wars.—To turn now to the external events which followed on the fourth crusade. These events are chiefly concerned with the long struggle with Genoa over the possession of the Levant and Black sea trade. By the establishment of the Latin empire Venice had gained a preponderance. But it was impossible that the rival Venetian and Genoese merchants, dwelling at close quarters in the Levant cities, should not come to blows. They fell out at Acre in 1253. The first Genoese war began and ended in 1258 by the complete defeat of Genoa. But in 1261 the Greeks, supported by the Genoese, took advantage of the absence of the Venetian fleet from Constantinople to seize the city and to restore the Greek empire in the person of Michael VIII. Palaeologus. The balance turned against Venice again. The Genoese were established in the spacious quarter of Galata and threatened to absorb the trade of the Levant. To recover her position Venice went to war again, and in 1264 destroyed the Genoese fleet off Trepani, in Sicilian waters. This victory was decisive at Constantinople, where the emperor abandoned the defeated Genoese and restored Venice to her former position. The appearance of the Ottoman Turk and the final collapse of the Latin empire in Syria brought about the next campaign between the rival martime powers. Tripoli (1289) and Acre (1291) fell to the Mohammedan, and the Venetian title to her trading privileges.

To the scandal of Christendom, Venice at once entered into treaty with the new masters of Syria and obtained a confirmation of her ancient trading rights. Genoa replied by attempting to close the Dardanelles. Venice made this action a *casus belli.* The Genoese won a victory in the gulf of Alexandretta (1294); but on the other hand the Venetians under Ruggiero Morosini forced the Dardanelles and sacked the Genoese quarter of Galata. The decisive engagement, however, of this campaign was fought at Curzola (1299) in the Adriatic, when Venice suffered a crushing defeat. A peace, honourable to both parties, was brought about by Matteo Visconti, lord of Milan, in that same year. But the quarrel between the republics, both fighting for trade supremacy—that is to say, for their lives—could not come to an end till one or other was thoroughly crushed. The fur trade of the Black sea furnished the pretext for the next war (1353–54), which ended in the crushing defeat of Venice at Sapienza, and the loss of her entire fleet. But though Venice herself seemed to lie open to the Genoese, they took no advantage of their victory; they were probably too exhausted. The lord of Milan again arranged a peace (1355).

We have now reached the last phase of the struggle for maritime supremacy. Under pressure from Venice the emperor John V. Palaeologus granted possession of the island of Tenedos to the republic. The island commanded the entrance to the Dardanelles. Genoa determined to oppose the concession, and war broke out. The Genoese Admiral Luciano Doria sailed into the Adriatic, attacked and defeated Vettor Pisani at Pola in Istria, and again Venice and the lagoons lay at the mercy of the enemy. Doria resolved to blockade and starve Venice to surrender. The situation was extremely critical for Venice, but she rose to the occasion. Vettor Pisani was placed in command, and by a stroke of naval genius he grasped the weakness of Doria's position. Sailing to Chioggia he blocked the channel leading from the lagoons to the sea, and Doria was caught in a trap. Finally, in June 1380 the flower of the Genoese fleet surrendered at discretion. Genoa never recovered from the blow, and Venice remained undisputed mistress of the Mediterranean and the Levant trade.

Expansion to the Mainland.—But as the city became the recognized mart for exchange of goods between east and west, the freedom of the western outlet assumed the aspect of a paramount question. It was useless for Venice to accumulate eastern merchandise if she could not freely pass it on to the west. If the various states on the immediate mainland could levy taxes on Venetian goods in transit, the Venetian merchant would inevitably suffer in profits. The geographical position of Venice and her commercial policy alike compelled her to attempt to secure the command of the rivers and roads of the mainland, at least up to the mountains, that is to say, of the north-western outlet, just as she had obtained command of the south-eastern inlet. She was compelled to turn her attention, though reluctantly, to the mainland of Italy. Another consideration drove her in the same direction. During the long wars with Genoa the Venetians realized that, as they owned no meat or corn-producing territory, a

crushing defeat at sea and a blockade on the mainland exposed them to the grave danger of being starved into surrender. Both these pressing necessities, for a free outlet for merchandise and for a food-supplying area, drove Venice on to the mainland, and compelled her to initiate a policy which eventually landed her in the disastrous wars of Cambrai. The period with which we are now dealing is the epoch of the despots, the *signori,* and in pursuit of expansion on the mainland Venice was brought into collision first with the Scaligeri of Verona, then with the Carraresi of Padua, and finally with the Visconti of Milan. Hitherto Venice had enjoyed the advantages of isolation; the lagoons were virtually impregnable; she had no land frontier to defend. But when she touched the mainland she at once became possessed of a frontier which could be attacked, and found herself compelled either to expand or to lose the territory she had acquired.

Venice had already established a tentative hold on the immediate mainland as early as 1339. She was forced into war by Mastino della Scala, lord of Padua, Vicenza, Treviso, Feltre and Belluno, as well as of Verona, who imposed a duty on the transport of Venetian goods. A league against the Scala domination was formed, and the result was the fall of the family. Venice took possession of Padua, but in the terms of the league she at once conferred the lordship on the Carraresi, retaining Treviso and Bassano for herself. But it is not till we come to the opening of the next century that Venice definitely acquired land possessions and found herself committed to all the difficulties and intricacies of Italian mainland politics. On the death of Gian Galeazzo Visconti in 1402, his large possessions broke up. His neighbours and his generals seized what was nearest to hand. Francesco II. Carrara, lord of Padua, attempted to seize Vicenza and Verona. But Venice had been made to suffer at the hands of Carrara, who had levied heavy dues on transit, and moreover during the Chioggian War had helped the Genoese and cut off the food supply from the mainland. She was therefore forced in self-defence to crush the family of Carrara and to make herself permanently mistress of the immediate mainland. Accordingly when Gian Galeazzo's widow applied to the republic for help against Carrara it was readily granted, and after some years of fighting, the possessions of the Carraresi, Padua, Treviso, Bassano, commanding the Val Sugana route, as well as Vicenza and Verona, passed definitely under Venetian rule. This expansion of mainland territory was followed in 1420 by the acquisition of Friuli after a successful war with the Emperor Sigismund, thus bringing the possessions of the republic up to the Carnic and Julian Alps, their natural frontier.

Isolation of Venice.—Venice was soon made to feel the consequences of having become a mainland power, the difficulties entailed by holding possessions which others coveted, and the weakness of a land frontier. To the west the new duke of Milan, Filippo Maria Visconti, was steadily piecing together the fragments of his father's shattered duchy. He was determined to recover Verona and Vicenza from Venice, and intended, as his father had done, to make himself master of all north Italy. The conflict between Venice and Milan led to three wars in 1426, 1427 and 1429. Venice was successful on the whole. She established her hold permanently on Verona and Vicenza, and acquired besides both Brescia and Bergamo; and later she occupied Crema. The war of Ferrara and the peace of Bagnolo (1484) gave her Rovigo and the Polesine. This, with the exception of a brief tenure of Cremona (1499–1512), formed her permanent territory down to the fall of the republic. Her frontiers now ran from the seacoast near Monfalcone, following the line of the Carnic and Julian and Raetian Alps to the Adda, down the course of that river till it joins the Po, and thence along the line of the Po back to the sea. But long and exhausting wars were entailed upon her for the maintenance of her hold. The rapid formation of this land empire, and the obvious intention to expand, called the attention not only of Italy but of Europe to this power which seemed destined to become supreme in north Italy, and eventually led to the league of Cambrai for the dismemberment of Venice.

In 1453 Constantinople fell to the Ottoman Turks, and although Venice entered at once into treaty with the new power and desired to trade with it, not to fight with it, yet it was impossible that her possessions in the Levant and the archipelago should not eventually bring her into collision with the expanding energy of Mohammedan. Europe persistently refused to assist the republic to preserve a trade in which she had established a rigid monopoly, and Venice was left to fight the Turk single-handed. The first Turkish war lasted from 1464 to 1479, and ended in the loss of Negropont and several places in the Morea, and the payment by Venice of an annual tribute for trading rights. She was consoled, however, by the acquisition of Cyprus, which came into her possession (1488) on the extinction of the dynasty of Lusignan with the death of James II. and his son James III., Caterina Cornaro, James II.'s widow, ceding the kingdom of Cyprus to Venice, since she could not hope to maintain it unaided against the Turks. The acquisition of Cyprus marks the extreme limit of Venetian expansion in the Levant; from this date onward there is little to record save the gradual loss of her maritime possessions.

DECLINE

Exhausting as the Turkish wars were to the Venetian treasury, her trade was still so flourishing that she might have survived the strain had not the discovery of the Cape route to the Indies cut the tap-root of her commercial prosperity by diverting the stream of traffic from the Mediterranean to the Atlantic. When Diaz rounded the Cape in 1486 a fatal blow was struck at Venetian commercial supremacy. The discovery of the Cape route saved the breaking of bulk between India and Europe, and saved the dues exacted by the masters of Syria and Egypt. Trade passed into the hands of the Portuguese, the Dutch and the English. Venice lost her monopoly of oriental traffic.

League of Cambrai.—To complete her misfortunes, the European Powers, the church and the small states of Italy, partly from jealous greed of her possessions, partly on the plea of her treason to Christendom in making terms with Islam, partly from fear of her expansion in north Italy, coalesced at Cambrai in 1508 for the partition of Venetian possessions. The war proved disastrous for Venice. The victory of Agnadello (1510) gave the allies the complete command of Venetian territory down to the shores of the lagoon. But the mutual jealousy of the allies saved her. The pope, having recovered the Romagna and secured the objects for which he had joined the league, was unwilling to see all north Italy in the hands of foreigners, and quitted the union. The Emperor Maximilian failed to make good his hold on Padua, and was jealous of the French. The league broke up, and the mainland cities of the Veneto returned of their own accord to their allegiance to St. Mark. But the republic never recovered from the blow, coming as it did on the top of the Turkish wars and the loss of her trade by the discovery of the Cape route. She ceased to be a great power, and was henceforth entirely concerned in the effort to preserve her remaining possessions and her very independence. The settlement of the peninsula by Charles V.'s coronation at Bologna in 1530 secured the preponderance to Spain, and the combination of Spain and the church dominated the politics of Italy. Dread of the Turks and dread of Spain were the two terrors which haunted Venice till the republic fell.

Turkish Wars.—But the decline was a slow process. Venice still possessed considerable wealth and extensive possessions. Between 1499 and 1716 she went to war four times with the Turks, emerging from each campaign with some further loss of maritime territory. The fourth Turkish war (1570–73) was signalized by the glorious victory of Lepanto (1571), due chiefly to the prowess of the Venetians under their doge Sebastian Venier. But her allies failed to support her. They reaped no fruits from the victory, and Cyprus was taken from her after the heroic defence of Famagusta by Bragadino, who was flayed alive, and his skin, stuffed with straw, borne in triumph to Constantinople. The fifth Turkish war (1645–68) entailed the loss of Crete; and though Morosini reconquered the Morea for a brief space in 1685, that province was finally lost to Venice in 1716.

So far as European politics are concerned, the latter years of the republic are made memorable by one important event: the resistance which Venice, under the guidance of Fra Paolo Sarpi, offered to the growing claims of the Curia Romana, advanced by Pope

Paul V. Venice was placed under interdict (1606), but she asserted the rights of temporal sovereigns with a courage which was successful and won for her the esteem and approval of most European sovereigns.

But the chief glory of her declining years was undoubtedly her splendid art. Giorgione, Titian, Sansovino, Tintoretto, Paolo Veronese and Palladio all lived and worked after the disastrous wars of the league of Cambrai. During these years Venice became the great pleasure city of Europe.

United Italy.—The end of the republic came when the French Revolution burst over Europe. Napoleon was determined to destroy the oligarchical government, and seized the pretext that Venice was hostile to him and a menace to his line of retreat while engaged in his Austrian campaign of 1797. The peace of Leoben left Venice without an ally.

The government resolved to offer no resistance to the conqueror, and the doge Lodovico Manin abdicated on May 12, 1797. On Oct. 17, Napoleon handed Venice over to Austria by the peace of Campo Formio, and between 1798 and 1814 she passed from France to Austria and Austria to France till the coalition of that latter year assigned her definitely to Austria. In 1848 a revolution broke out and a provisional republican government under Daniele Manin (*q.v.*) maintained itself for a brief space. In 1866 the defeat of Austria by the Prussians led to the incorporation of Venice in United Italy. (H. F. Br.)

THE TWENTIETH CENTURY

The New Port of Marghera.—By the beginning of the 19th century Venice had felt the need of a bigger port for her increasing trade and the necessity of some outlet for her growing population. It was everything not to shackle her progress and, at the same time, not to disfigure one of the most beautiful cities in the world.

Many makeshift works which proved inadequate were carried out before World War I, such as the building of the auxiliary port of Bottenighi on the mainland. At last, in 1917, a great scheme for a big port, with modern conveniences and an adjacent industrial area, was laid before the Orlando government, approved, and the work begun at once. But the disaster of Caporetto brought it to a standstill.

It was only in 1923, under the government of Mussolini, that the work was resumed and completed. The chancellor of the exchequer (1926–28), Conte Volpi di Misurata, a Venetian, had been one of the original promoters of the scheme. This new port of Marghera is on the mainland. It was the first in Italy where railway trucks can be loaded and unloaded on the quays, which are in direct communication with Mestre station.

It has a yearly potentiality in loading and unloading of at least 1,000 tons of merchandise to every 3 ft. of port frontage. The three industrial zones lying to the north, west and south of the commercial port were nearly all secured by business firms, and a number of factories were built.

Each zone has exit to the sea by means of canals; for example, the northern zone communicates with the sea by the *Canale Industriale Nord.* In the vicinity lies the *Porticciolo dei Petroliin,* the first example in Italy of a port built exclusively for inflammable merchandise. (For statistics of the Marghera port, *see* above, under *Harbour.*)

A garden-city was built on the Mestre-Padua road, linked up with the industrial area.

Population.—The necessity of a well-planned outlet on the mainland for Venice can be gauged by the following statistics. Directly after World War I the population of Venice stood at 147,000; by 1936 it had risen to 170,830 (town), 264,027 (commune).

Venetian families are patriarchal: nearly 11% are composed of ten or more members; 32% of six to nine members. The birth-rate of Venice, calculated at 33 per 1,000, is double that of the rest of Italy. Her death-rate is 17.7 per 1,000, while the average rate in Italy is 19 per 1,000.

Industries.—The Venetians depend for their livelihood on boat traffic and home industries. Flat-bottomed boats, filled with vegetables and fruit, coming across the lagoons from the mainland, are among the many picturesque sights of Venice, and have been graphically described by D'Annunzio in *Fuoco.*

The gondoliers still ply their trade, and can never be entirely replaced by the small motor launches, but they feel the rough edge of competition in a mechanical age, even in the city of the lagoons.

The glass industries, both of household goods and artistic productions, employ a number of artisans, who can earn up to 40 lire a day for the more skilled work. The various Murano factories joined in a syndicate, and their work thereafter greatly improved, since more care is taken in the use of good models. The manufacture of coloured glass beads and mosaic work is also characteristic of Venice. Even more important are the worked iron and copper industries, and much carved furniture is made. The Venetian filigree jewellery, and long, fine gold chains are also attractive and beautifully made. The lace industry is carried on in Venice to a certain extent, but more especially in the lagoon towns of Burano and Torcello. A great deal was done after World War I to revive home industries and introduce once more the fine old patterns.

Festivals.—Venice is still famous for her festivals. The chief events in her history have always been celebrated either by civic or religious functions. The 11th centenary of the "pious theft" of St. Mark's body from Alexandria was celebrated in the spring of 1928 with a procession round the Piazzetta and the Piazza of S. Marco, in which 50 bishops of Venetia and mitred Canons of San Marco, as well as other dignitaries of the church, took part, robed in gorgeous vestments and recalling the pictures of Bellini and Carpaccio.

The most characteristic feasts are the following: on Holy Thursday the Venetians used to celebrate their victory over Urico, the patriarch of Aquileia. He was forced to pay tribute of a bull and 12 pigs which were meant to represent the primate and the canons of the chapter. Art and literature have immortalized the celebration of Ascension day when the doge used to be rowed out to the lagoon by the Lido in his gala gondola, *il Bucintoro,* to perform the symbolic rite of throwing a ring into the waters, and espousing the Adriatic with these words: *Ti sposiamo, o mare nostro, in segno di vero e perpetuo dominio.* The ceremony originated from Ascension day of the year A.D. 1000, when Pietro Orseolo II set sail from Venice to conquer Istria and Dalmatia.

Two eminently popular festivals of votive origin are still kept: the Feast of the Madonna della Salute and that of *Il Redentore* (The Redeemer), to whose patronage the Venetians believed they owed their deliverance from the plague in 1576 and in 1630, and in whose honour they built the churches of the Salute and the Redentore.

On the Feast of the Salute (Nov. 1) the Venetians take votive offerings to the church, and end the day with private banquets for which it is customary to procure Dalmatian mutton as the chief dish. The Feast of the Redentore is celebrated on the third Sunday of July with a characteristic vigil kept by the people singing as they row about in boats of every size and shape which are festooned with lights. At dawn they row out to the Lido in great numbers for the sunrise.

Museums, Galleries and Libraries.—Although Venice suffered from enemy aircraft during World War I, none of her works of art was damaged. The following is a list of her museums, galleries and public libraries:—

The Doge's Palace, adjoining the Basilica of San Marco, with frescoed walls and ceilings, as well as easel-pictures by Titian, Tintoretto, Paul Veronese, etc. The names of the various halls: Sala del Collegio, del Senato, del Consiglio dei Dieci, del Maggior-Consiglio, etc., recall the days of the proud Republic.

Il Museo Archeologico occupies that part of the doge's palace where the doge used to have his apartment.

Il Museo Civico Correr, in the royal apartments, Piazza S. Marco, has valuable collections of pictures, armour, coins, maps, costumes of state, etc.

Il Museo Storico Navale, in the arsenal, has models of ancient

ships and of the Bucentauro.

L'Accademia delle Belle Arti, on the Grand canal, contains a unique collection of masterpieces of the Venetian school.

La Galleria di Arte Moderna, inaugurated in 1902, has an important collection of international works of art which have been purchased in greater part from the Biennial International Exhibition of Modern Art. This was instituted in 1895 in honour of the silver wedding of King Humbert and Queen Margherita, and is held in the public gardens. Since the Fascist Government has made it a State institution, its importance has increased.

La Pinacoteca Comunale, in Palazzo Querini, once the residence of the patriarch of Venice, has a notable collection of pictures and prints.

The State Archives are kept in the Franciscan monastery adjoining the Frari. It contains the so-called Golden Book of the patricians and documents dating from the time of Charlemagne.

La Biblioteca Nazionale Marciana, in the old quarters of St. Mark's library, was started on Sept. 4, 1362, with the collection of books given by Petrarch to the Republic. It now contains 400,000 volumes, 13,000 rare manuscripts, 1,000 editions of the Aldine press, and over 3,000 in cuneiform character.

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VENIZELOS, ELEUTHERIOS (1864–1936), Greek statesman, was born in Crete Aug. 23, 1864 of a family which had emigrated from Greece in 1770. Having been educated in the schools of Syra and Athens and having taken a degree in the University of Athens at the age of 23, he practised law in Crete, but soon became a politician, and in the insurrection of 1889 was compelled to flee from the island. After his return and the re-establishment of tranquillity, Venizelos was elected a member of the Cretan Assembly, and in 1897 came into prominence as one of the leaders of the Cretan uprising; it was he who received the British, French and Italian admirals when they came to negotiate a settlement between the insurgents and the Turks early in Feb. of that year.

In Dec. 1898 Prince George of Greece landed in Crete as the High Commissioner of the Great Powers, and a few months later Venizelos became head of the Island Executive. But he soon found himself at variance with the Prince's autocracy, and in 1904 a complete rupture occurred. Subsequently the Venizelists were defeated at the polls, but the Cretan leader organized a revolt, which greatly increased the unpopularity of the High Commissioner who was accused of misruling the people. In Sept. 1906 the Prince left the island, his place being taken by Alex. Zaimis, who was appointed not by the Powers, but by the King of Greece. From that time until 1909 Venizelos was sometimes Chief of the Cretan Government and sometimes Leader of the Opposition. But whilst the Cretans often came into sharp conflict with the Protecting Powers, Venizelos' wisdom and moderation were responsible for the generally friendly relations which existed, and his far-sightedness, particularly after the departure of M. Zaimis in Oct. 1908, and during the crisis of 1909, facilitated the union of Crete with Greece, which ultimately took place as a result of the first Balkan War.

In 1909 the military league headed a bloodless revolution against political corruption and court favouritism in Greece and invited Venizelos to come to Athens. He persuaded King George and the League that the best way out of a dangerous situation would be the revision of the Constitution by a National Assembly. Elections were held in Aug. 1910, and Venizelos, who had remained technically a Greek citizen during his Cretan political life, took his seat at Athens for the first time. The Chamber having been opened in September, a month later Venizelos became Prime Minister.

He was in a position to enforce practically any situation, including a republic, which he wished; but decided to work loyally with the King and his successors. The Constitution was successfully revised in 1911, reforms in the public services were introduced, and the reorganization of the army and of the navy were respectively placed in the hands of French and British Missions. In the spring of 1912 Venizelos was returned to power as the leader of an overwhelming majority in an ordinary Chamber which then replaced the Revisionary Assembly. By that time, too, the Prime Minister was busily occupied with the formation of the Balkan League, and on May 29, 1912, the Greco-Bulgarian Treaty was signed.

Whilst the Balkan Wars and Venizelos' diplomacy led to an unexpected Hellenic expansion, the assassination of King George at Salonika on March 18, 1913, removed a man who had always been in favour of moderation, and placed upon the throne his son Constantine, who had not forgiven, and who never really forgave, Venizelos for his attitude towards Prince George in Crete. When the World War broke out, therefore, the position of Greece was greatly complicated by the facts that she was bound to Serbia by a Treaty signed in the summer of 1913; that from the first Venizelos was an ardent supporter of the Allied cause; and that the King was in sympathy with the Central Powers. Before the entry of Turkey into the War, Venizelos openly favoured Hellenic assistance for the Entente in case of that entry, and early in 1915 the Prime Minister advocated concessions to Bulgaria, Greek support for Serbia, and Greek co-operation at the Dardanelles in exchange for the promise of important future compensations in Western Asia Minor. But though he appears originally to have approved of the idea, the King vetoed Venizelos' decision to accept this offer, and he was forced to resign, though he possessed a strong majority in the Chamber. In the election which followed in June the Venizelist party secured the return of 190 deputies out of a total of 316, of which the Chamber was then composed.

In spite of this, and with the excuse of the King's illness, Venizelos was not recalled to power until after the meeting of the Chamber in Aug. and by that time the situation had become seriously modified. The mobilization of Bulgaria on Sept. 29, 1915 brought into operation in equity if not in law, the Greco-Serbian Treaty of 1913 and bound Greece to help Serbia. A few days later, Venizelos extorted from the King reluctant consent to a Greek mobilization and to a Greek request that the Allies should furnish an army of 150,000 men to take the place of the contingent Serbia should have supplied under the Treaty.

Immediately after the original Allied landing at Salonika on Oct. 1 Venizelos secured a vote of confidence during an historic and stormy meeting of the Chamber, when he declared that if in aiding Serbia Greece was brought into contact with Germany she would act as her honour demanded. In spite of a formal protest against the Allied passage through Hellenic territory, this speech led to the second dismissal of Venizelos and to the open and final rupture between that statesman and the King, who, it would seem, always intended to withdraw his consent to an Hellenic entry into the War. Zaimis, the new Prime Minister, maintained his position for a month as a result of the patriotism of Venizelos, his friend from Cretan times, but, with the accession of Skouloudis to power, on Nov. 6 the Chamber was dissolved and a new election ordered for Dec. 19. Venizelos' party abstained from the polls in protest, M. Gounaris securing an overwhelming majority for his policy of neutrality.

Venizelos spent that winter and spring (1915–16) in endeavouring to compel the King to change his point of view. But the surrender of Eastern Macedonia to the Bulgarians in the summer of 1916 and the delay in the success of the Allied Campaign at

Salonika had strengthened the position of Constantine, and on Sept. 25, 1916, Venizelos, together with his principal supporters, sailed for Crete, whence he sent out proclamations calling upon all true patriots to flock to the standard of the Entente. Proceeding thence to Salonika, early in Oct. he founded a provisional government, which was recognized about two months later by Great Britain and France, though not by Italy.

After the dethronement and enforced departure of King Constantine, Venizelos returned to Athens on June 26, 1917, and took over the government of the whole country. The June 15 chamber was convoked, general mobilization was ordered, and Greece formally opened up hostilities upon the Allied side. But the removal of the king, the successes of the central powers, particularly in the Balkans, and an increased Greek desire for neutrality, backed up by German propaganda, were responsible for a great diminution of the prime minister's popularity.

Between the armistice of Nov. 1918 and his fall two years later, Venizelos and his colleagues, who represented Greece at the peace conference, were almost continuously absent in Paris and London and, during this period, they seemed to be reaping for Greece harvests beyond her dreams. About the end of April 1919, the Greeks were permitted, or encouraged, to land at Smyrna; a year later the conference of San Remo promised large areas to Greece, and the treaty of Sèvres (Aug. 10, 1920) coupled with the earlier treaty of Neuilly (Nov. 27, 1919) gave Greece extraordinary advantages. However, at a moment when Venizelos' triumph appeared to be complete, an attempt was made upon his life at a Paris station (Aug. 1920), and three months later (Nov. 14) he received a crushing defeat at the hands of the Greek electorate.

Many factors were present in this: the unpopularity of the war in Asia Minor and the continued mobilization, the maintenance of martial law, the bad administration of Venizelos' subordinates and injustices practised by the Corps de la Sûreté. Further, there was Venizelos' own continued absence; recollection of the foreign support on which he had called so largely, and Constantine's own increasing popularity. After the unexpected death of the young king Alexander, immediately before the election, the dynastic question, open mention of which had previously been prohibited, was brought into the forefront of the political struggle and, in what then became the direct issue between Constantine and Venizelos, the king won an overwhelming victory.

From the arrival of the king in Athens on Dec. 20, 1920, until his final abdication and second departure on Sept. 30, 1922, Venizelos took no official part in Greek affairs. After the revolution (Sept. 1922), however, he represented Greece for a time in western Europe, *inter alia* at the conference of Lausanne which culminated in the peace signed with Turkey on July 24, 1923. In the following December, when the publication of that document and various other events had aggravated the existing internal dissension and when the election (Dec. 16) had again given his party a majority, Venizelos was persuaded to return to Athens, where he arrived on Jan. 4, 1924. King George was already then on leave of absence and Venizelos was prime minister from Jan. 11 till Feb. 4, when he resigned. In 1928, he began to prepare a return to politics. M. Kaptrandair resigned from the leadership of his section of the Liberals, and Venizelos took his place, declaring this to be the best guarantee against a dictatorship. He brought about the fall of the government, formed a new government with himself as premier on July 4, and secured a large majority in the election held on Aug. 19. Thereafter he negotiated a treaty of friendship and arbitration with Mussolini, and treaties of commerce and friendship with Yugoslavia.

Venizelos resigned in May 1932, but was again premier from June to Nov. 1932, and from Jan. to March 1933. In March 1935 he put himself at the head of the republican revolt in Crete, and was sentenced to exile. He died March 18, 1936.

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VENLO, a frontier town in the province of Limburg, Holland, on the right bank of the Maas, and a junction station 43 mi. N.N.E. of Maastricht by rail. Pop. (1940), 27,602. Venlo, with narrow streets irregularly built, is not of the ordinary Dutch type in architectural style. The picturesque town hall (1595) contains some interesting paintings by Hubert Goltzius (1526–1583). The church dates from 1304. The leading industries are distilling, brewing, tanning, spinning, needlemaking and tobacco manufacture. There is also a considerable trade by river with Rotterdam. Venlo is joined by a bridge with the opposite village of Blerik.

VENNOR, GEORGE HENRY (1840–1884), Canadian geologist and meteorologist, was born at Montreal on Dec. 30, 1840. He graduated at McGill University in 1860 and was in 1866 placed on the staff of the Canadian geological survey. His studies and revised classification of the great Laurentian system of rocks brought him a wide reputation and election to the Royal Geographical society He traced the Liévre, Rouge and Gatineau rivers to their sources and called attention to the phosphate deposits of Ottawa county. Over a period of many years he studied the characters and courses of storms deducing a number of general principles. From 1877 to his death he published *Vennor's Almanac.* He was the author of *Our Birds of Prey; or the Eagles, Hawks and Owls of Canada* (1876).

VENOSA (ancient *Venusia*), a town and bishop's see of the Basilicata in the province of Potenza, Italy, on the eastern side of Mount Vulture, 52 mi. by rail S.S.E. of Foggia, 1,345 ft. above sea level. Pop. (1936) 10,885 (town), 11,045 (commune). The castle, built in 1470, contains four stables each for 50 horses Many fragments of Roman workmanship are built into the 15th century cathedral. The abbey church of SS. Trinità was consecrated in 1059 by Pope Nicholas II and passed into the hands of the Knights of St. John in 1297. In the central aisle is the tomb of Alberada, the first wife of Robert Guiscard and mother of Bohemund. An inscription on the wall commemorates the great Norman brothers William Iron Arm (d. 1046), Brogo (murdered at Venosa in 1051), Humfrey (d. 1057) and Robert Guiscard (d. at Corfu in 1085). The bones of these brothers rest together in a simple stone sarcophagus opposite the tomb of Alberada. The church also contains some 14th-century frescoes. Behind it is a larger church, which was begun for the Benedictines about 1150.

The ancient city was located on the Via Appia in the province of Apulia. It was taken by the Romans after the Samnite War of 291 B.C., and became a colony, no fewer than 20,000 men being sent there, owing to its strategic military position between two deep ravines. Throughout the Hannibalic wars it remained faithful to Rome, and had a further contingent of colonists sent in 200 B.C. to replace its losses in war. It took part in the Social War, and was recaptured by Quintus Metellus Pius. In 43 B.C. its territory was assigned to the veterans of the triumvirs. Horace was born there. It remained an important place under the Empire as a station on the Via Appia. Jewish catacombs with inscriptions in Hebrew, Greek and Latin show the importance of the Jewish population there in the 4th and 5th centuries A.D.

See O. de Lorenzo, *Venosa e la Regione del Vulture* (Bergamo, 1906).

VENTENAT, ETIENNE-PIERRE (1757–1808), French botanist, was born in Limoges in 1757. He entered the congregation of St. Geneviève and had charge of their library, but at the time of the Revolution abandoned his religious connections in order to follow his taste for botany. His writings caused him to be named professor in the Republican lyceum of Paris and made a member of the institute. His principal works are *Principes de botanique* (1794); *Tableau du règne végétal* (1794); *Le botaniste voyageur aux environs de Paris* (1803); *Le jardin de la malmaison* (1803); *Choix de plantes* (1803–1808). These were noted above all for the beauty of the plates executed under the author's direction by Redouté, Sallier, Plée, etc.

VENTIDIUS, BASSUS, Roman general, was born at Asculum. He took part in the Social War and was made prisoner by

Pompey the Elder. As a contractor for military transport he aided Caesar in raising an army for the conquest of Gaul and was later given a command under Caesar. In A.D. 46 he became a senator and tribune. After Caesar's death he supported Antony and rendered important aid in the war against D. Brutus by taking three legions, which he raised himself, in a spectacular march over the Apennines to join in the battle. He became Antony's chief lieutenant and for a brief period was consul of Rome. He was afterwards sent to the East where he carried on the wars against the Parthians with brilliant success.

VENTILATION, the process of supplying or removing air by natural or mechanical means into or out of any enclosed space. Ventilation generally is associated with control of temperature and odour, and in removal of dust and industrial by-products. The problem of securing adequate ventilation involves far more than merely the provision of enough proper air for respiration, since changing of the air around the body also has been proved necessary to comfort and health. A classical illustration of this is the test of placing a man within a small airtight cabinet while he breathes air from outside the cabinet through a mask and tubes, compared with rebreathing the air inside the cabinet through the mask and tubes while the body of the man is outside the cabinet. Discomfort develops quickly in the first experiment and is postponed indefinitely in the second one. After a small electric fan is operated within the cabinet during the first experiment the objectionable effects are delayed appreciably. Tests of this sort were conducted repeatedly in both England and America and confirmed the hypothesis that ventilation must embrace far more than consideration of the comparatively small quantity of respired air; less than 0.3 cu.ft. per minute in the case of an ordinary adult.

Atmospheric air is a complex mixture of many gases, principally, however, one-fifth oxygen and about four-fifths nitrogen. Oxygen is the active and important component without which life or combustion cannot exist. A small proportion of carbon dioxide always is present in atmospheric air, along with inconsequential amounts of other gases. An increased proportion of carbon dioxide in inspired air accelerates the rate of respiration by reaction of certain involuntary nerves and advantage is taken of this fact in resuscitation after partial asphyxiation, as in drowning. Since the proportion of carbon dioxide in air easily can be measured by laboratory analysis of a bottled sample, it is a useful index of the distribution of air within occupied enclosures. Outside atmosphere in cities contains about four parts of carbon dioxide in 10,000 parts of air. If the air in a room contains more than ten parts of carbon dioxide in 10,000 it may be reasoned that the air has had sufficient contact with animals to require dilution. The significant reasons for such dilution however, have been established not as carbon dioxide, but as the combination of temperature, water vapour content, movement, dusts and odours.

A human, for comfort and well-being, must have a bodily temperature of around 98.6°F. The normal person balances the heat output from his body, largely by transferring the surplus heat originally derived from food, into the surrounding air. It is necessary, then, in order to achieve this temperature regulation, that the air surrounding the body shall be somewhat cooler than 98.6°F. and also shall be sufficiently free from moisture to permit it to accept and carry away from the body the perspiration which is so vital a part of the temperature regulating function. Movement of air is an important consideration in ventilation because without movement there is a definite tendency for a comparatively thin layer of too-warm, too-moist air to lie against the skin, thus retarding the desirable transfer of the surplus heat from the body to the general atmosphere. Dust in air can be annoying as well as dangerous, depending on its source, and while dust is always present, the larger particles can be removed. Organic dust particles such as pollens usually can be controlled by filtering the air, and dangerous inorganic dusts such as that from silica can be removed by local high velocity exhaust ducts. Odours become manifest in air which has had intimate contact with people. Such odours have not been proved to be harmful in the concentrations encountered in unventilated relatively leaky buildings, but they do cause loss of appetite and a general feeling of ill-being.

Volume of Air for Ventilation.—Based on the abandoned premise that the carbon dioxide dilution is the item of major importance in ventilation, a minimum supply of air from out of doors of 30 cu.ft. per person per minute was stipulated in the compulsory ventilation legislation for public buildings in many communities.

Later research, especially by the American Society of Heating and Ventilating Engineers in co-operation with the U.S. bureau of mines, indicates that the introduction of so large a quantity of air from outside is unnecessary. It has been well proved for instance that odours can be controlled with as few as 10 cu.ft. of outside air per minute per occupant, and that with proper temperature, moisture, and movement of the air, the comfort and well being of the occupants will be improved at a reduced cost for heating or cooling, humidifying or dehumidifying, and for filtering the outside air. It has also been proved that the movement of air over the bodies of the occupants cannot be reduced appreciably below that inherent to the old standard of 30 cu.ft. per person per minute, since with a slower movement the stratification of too-warm, too-moist air against the skin will not be prevented. This is an interesting example of the truth so often shown that many ancient housewife remedies have a rational basis. It has been demonstrated that excellent conditions of ventilation may be obtained in heavily populated enclosures such as school class rooms if at least 30 cu.ft. of air per minute per person is introduced; one-third being from out of doors and two-thirds being recirculated.

Condition of Ventilation Air.—Dry air at a relatively high temperature may feel colder than damp air at a much lower temperature, and air motion against the skin at any moderate temperature gives a sensation of coolness. It is therefore important in all ventilation arrangements that the moisture content as well as the temperature of the air introduced into a room for ventilating purposes shall be controlled, since otherwise despite the influence of heating or cooling devices local to the room, the introduction and removal of large quantities of untreated air will bring about discomfort. Normal outdoor air in summer at 50% relative humidity may contain 54 grains of moisture per lb. of dry air and may represent an optimum condition to be provided indoors as a result of the influence of a ventilating system. In winter, air from out of doors at, say, 20°F. may not exceed 16 grains of moisture per lb. of dry air, since this is the limit of vapour which air at this temperature can carry. This air when heated to 70°F. for introduction into a room would have the same number of grains of moisture per lb. of dry air, but its volume would be so expanded by the heat that the relative humidity would be around 15% instead of the desired 50%.

In summer ventilation likewise, the outdoor air supply might be at 90°F. and 40% relative humidity, containing 84 grains of moisture per lb. of dry air. This air when cooled to 70°F. would contract in volume and therefore, with the same number of grains of moisture, would be at about 77% relative humidity; altogether too damp for comfort. It is necessary, therefore, to control the relative humidity as well as the temperature of the air introduced into rooms for purposes of comfort ventilation. In winter the usual procedure is to supply water for evaporation into the air on the warm side of the heating devices, and in summer the excess moisture may be condensed out of the air by chilling all or part of the latter below its dew point temperature before introducing it to the room. An alternative method of removal of excess moisture from a ventilation air supply is through use of *adsorbers,* which collect the moisture mechanically and which when saturated may be regenerated. In this process the latent heat in the water vapour is released as sensible heat when the vapour changes to a liquid, so that some refrigeration must be employed. The adsorption method of dehumidification of air, however, requires much less refrigeration than the sub-dew point scheme and is in successful operation in many ventilating systems. The moisture content of the air introduced into a room for ventilating purposes must be sufficiently different from that desired in the room to counteract the local additions or deductions and thus to maintain the desired happy medium.

The dry bulb temperature of the air introduced into a room for

ventilating purposes similarly must be somewhat warmer or cooler than the desired temperature in the room as may be needed to change the latter, and of course must be in sufficient volume to deliver or carry away the necessary heat. In general it has been found, for intensively occupied rooms such as classrooms and assembly halls, that if the temperature of the entering air is more than about 8°F. cooler than the room temperature at the level where the air enters, there will be noticeable draughts. It is necessary to control accurately the temperature of air introduced for counteracting excess heat from crowded rooms, and this applies as well in winter as in summer.

Distribution of Ventilation Air.—It is necessary to deliver the air to the occupied zone in each room and to remove with the air exhausted the undesirable heat, moisture, dust, odour, etc. Overhead distribution of the air supply in comfort ventilation often is the most desirable arrangement, either through the ceiling or high up through a side wall. Many successful ventilating systems operate without serious draughts when introducing the air vertically at window stool level. Accurate control of the temperature of the entering air becomes more critical as the level of the air supply openings approaches the zone of occupancy.

Many older theatre ventilating systems have air introduction through hooded nozzles in the floor under the seats, with exhaust openings overhead. They are acceptable if the entering air temperature is controlled very accurately and if nearly all seats are occupied and so have human air-heating elements. When there are many vacant seats the entering air, usually cooler than the desired room temperature, causes objectionable draughts. Most theatres use the floor nozzles for exhaust purposes with air supply overhead, but floor nozzles, for either supply or exhaust, are practicable only in theatres and similar assembly rooms having fixed seats. Ventilating systems, particularly for office rooms and restaurants of moderate size, have employed side-wall air supply openings, almost always delivering the air above head level, with exhaust openings preferably on the same side of the room as the supply openings, usually near the floor but often above or at the same level as the supply openings. For rooms of very large area, a successful distributing arrangement involves both supply and exhaust at the ceiling, preferably near the centre of each construction bay, or say one inlet-outlet for every 400 sq.ft. of floor area. The air supply is deflected horizontally in all directions close to the ceiling, while the exhaust air rises vertically in the centre of each bay. One objection to this scheme, which otherwise gives satisfaction, is that dust carried upward by the recirculated and departing air tends to be deposited against the ceiling.

An improvement in air distribution from overhead is obtained by use of an *anemostat* made usually of spun metal and capable of being combined with an electric lighting fixture or with a central exhaust grille. The anemostat delivers the air in a diagonally downward uniformly distributed manner and has solved satisfactorily many problems of ventilation without adding grilles of objectionable appearance. An axiom well proved by experience is that where mechanical ventilation is employed the distribution of the air should be accomplished by designed and positive delivery of the *supply* rather than by the exhaust. In other words the *removal* of a given volume of air from a room at a certain location cannot be depended upon to bring about the satisfactory distribution of the air supply to that area. Adjustable vanes behind the face plates of air supply openings are of great value, and are available to give directional air flow in both horizontal and vertical planes. In some cases the vanes are at right angles each to the other in close juxtaposition. The location of inlets to electric lights of heavy intensity is of importance, especially when cooling a room, since the otherwise satisfactory entering air can be overheated by contact with the lights. This effect can be avoided by arranging for the exhaust air to pass the lights on its way out, *after* having cooled the occupants of the room.

Natural and Mechanical Ventilation.—Natural ventilation depends on winds or on thermal differences. Thus with a wind and enough open doors and windows and a proper temperature outside, rooms can be ventilated with reasonable satisfaction. However, the combination of these vital features occurs rarely. If a room has an inlet from out of doors, means of heating the air which enters through this inlet, and has a chimney which is considerably warmer than the outside temperature, it is possible to achieve positive ventilation. However, the air supply volume changes with wind direction in relation to the inlet, and adequate dust removal by filters is difficult due to the slight pressure differences available. The air exhaust volume also changes with variations in the temperature difference and the direction of the air flow will reverse if the indoor temperature is cooler than that outside. Natural ventilation, therefore, is not generally approved except as applied via ordinary windows or with monitors and hoods in the roofs of certain shed-like industrial buildings.

To achieve natural ventilation for rooms it is important that separate openings for supply and escape of the ventilating air shall be provided. Thus a room with windows on two orientations will be benefited by wind pressure far more than one having exposure on one side only, and a room having a warm chimney for exhaust and a window for supply will be more easily ventilated than one with a single window. However, a room having a single window equipped with double hung sash which can be opened at both top and bottom can be ventilated, whether on the windward or leeward side of a building. The warmest air in the room will tend to escape through the upper opening and air will enter from outside through the lower opening. Natural ventilation of this type can be effected more satisfactorily with double hung sash than with casement sash, since with the latter the difference in temperature between the top and bottom of the opening is less sharply defined. It is highly desirable that insect screens shall cover the upper as well as the lower halves of windows so that the upper sash may be lowered, and that the curtains, shades, etc., shall be of such design as to permit free air passage.

In many hotels the summer comfort and ventilation are improved by having chimney flues or exhaust fans withdraw air from the interior corridors, so that when the occupant of a small room opens the window and the transom over the door he is assured of a cross draft which will ventilate the room adequately.

Building codes in many communities attempt to protect public health by requiring definite minimum standards of ventilation, especially in rooms frequented by the public, and require that the air introduced shall be at least as free from impurities as the average outside air, and shall have been warmed in cold weather. A practicable measurement-level used in some of these codes avoiding controversial intensities of occupation or varying cubic feet of space per occupant, is to require delivery or exhaust of a specific volume of air per sq.ft. of floor area per unit of time for each sort of occupancy. Table I. gives some representative values.

TABLE I.—*Rate of ventilation per square foot of floor*

	c. f. m. supply	c. f. m exhaust		c. f. m. supply	c. f. m. exhaust
Auditoriums	3	1·5	Kitchens	..	4·0
Banquet halls	2	2·0	Offices	1·2	0·9
Dance halls	3	1·5	Sales rooms	1·2	1·2
Dining rooms	1·6	1·6	Toilet rooms	..	2·0
Garage storage	..	0·5			

The universal availability of electric energy has permitted the use of the far more dependable and desirable mechanical ventilation, and the tendency is toward the use of both supply and exhaust fans in such systems. Since buildings are not air tight but have increasing leakage as they age, a supply fan alone tends to encourage wasteful outward leakage of conditioned air, and an exhaust fan alone encourages inward leakage of unconditioned air. The combination of both fans permits maintaining an indoor pressure commensurate with that out of doors and permits exact adjustment of the proportions recirculated. Thus, with the combined fans all air may be recirculated when heating or cooling a room or a building prior to occupancy, and all air may be taken from out of doors when the outside air is at the right temperature to serve without heating or cooling, with many variations between these extremes.

It is clear that any proper ventilating system should have airways, filters, heaters, etc., with air-passing clearances such as to

permit full utilization of outside air during the times when the outside air is in acceptable condition.

Fans.—Ventilating fans may be divided into two general classes; those with axial flow and those with radial flow.

Axial flow fans deliver the air in a direction parallel to the axle around which the fan revolves and may have either curved or flat blades. They cannot overcome a heavy duct resistance since under such a condition the air delivered at the relatively high speed tips of the blades tends to return against the relatively low speed blade surfaces close to the hubs. Axial flow fans, however, are useful for installation in outside walls of rooms, especially where the emerging air will not be opposed by direct wind action. Axial flow fans are objectionably noisy when run at high speed. Aeroplane propellers are axial flow fans.

Radial flow fans deliver the air at right angles to the shaft and are capable of overcoming very great resistances. They are like centrifugal pumps with paddle wheels and housings. They may have blades curved forward with reference to the direction of rotation or curved backward, and usually have anywhere from 8 to 60 blades. The physical proportions of centrifugal fans and their housings have been the subject of profound research, and strange characteristics have been discovered. For instance, the greater the resistance at a given speed the less air will be delivered, and the less power will be required.

Forward curved blades will deliver more air than backward curved blades at a given speed, with increased noise, and if the resistance is reduced will deliver still more air and may overload the driving mechanism. Backward curved blades require higher speed for the same air delivery and resistance as forward curved blades, but are less noisy and may be so designed as never to overload when the resistance is reduced. Given several forward curved blade fans working in parallel, one or the other will try to carry more than its share of the burden while two or more backward curved blade fans once placed in proper speed-relation will work together satisfactorily.

The air delivery capacity of any fan varies directly as the speed varies.

The intensity of the resistance overcome by any fan varies as the square of the speed.

The power required by any fan varies at the same rate as the cube of the speed.

Industrial Ventilation.—Industrial ventilation is associated intimately with health and safety hazards. Practically all wood-working manufacturing plants employ exhaust systems for removing shavings, sawdust, and the like through relatively small sheet metal ducts at high velocity. Exhaust ventilation is necessary in most grinding, polishing and buffing operations and even in outdoor drilling of certain types of rock. The minimum static suction pressure at the hoods of grinding and buffing wheels varies from that which will support a column of water $1\frac{1}{2}$ in. high to that which will hold a column of water 5 in. high, as set forth in Table II.

TABLE II.—*Suction Pressures Required at Hoods*

Type of Installation	Static Suction in Inches of Water
Exhausting from grinding and buffing wheels	1½–5
Exhausting from tumbling barrels	2
Exhausting from wood-working machinery—light duty	2
Exhausting from wood-working machinery—heavy duty	2–4
Shoe machinery exhaust	2–3
Exhausting from rubber manufacturing processes	2
Flint grinding exhaust	2
Exhausting from pottery processes	2
Lead dust and fume exhaust	2–4
Fur and felt machinery exhaust	2–3
Exhausting from textile machinery	2–3
Exhausting from elevating and crushing machinery	2
Conveying bulky and heavy materials	3–5

Authority: *Guide*, American Society of Heating and Ventilating Engineers.

It is desirable at all grinding, polishing, and buffing hoods to provide easily opened hoppers near the inlets to retain heavy particles and to arrange for air inlets which will open automatically to admit sufficient air to carry the material along the ducts in case the normal supply should be curtailed, as by shutting down certain branches.

The importance, with industrial exhaust ventilation systems, of providing air inlets to the rooms containing the exhaust systems with means for heating the air, should not be overlooked. In some industries there are generated noxious gases which are heavier than air and which therefore will not rise into hoods placed above the apparatuses unless these are very close to the point of generation and have unusually rapid air currents. Table III lists the more common of these, giving the specific gravity in comparison with that of air taken as 1.

TABLE III.—*Threshold Limits of Common Vapours and Gases**

Substance	Spec. Grav. of Gas or Vapour (Air 1)	Inflammable Limits (%)	Physiological Action	Maximum Allowable Concentration (ppm)
Chlorine	2·486	non-inflamm.	irritant	0·35
Ozone	5·5	do	do	0·80
Hydrogen chloride	1·2678	do	do	10·0
Sulphur dioxide	2·2638	do	do	10·0
Carbon monoxide	0·9671	12·5–74	asphyxiant	100·0
Hydrogen sulphide	1·190	4·3–46	do	85–130
Benzene	2·73	1·4–7·0	anaesthetic	100·0
Methanol	1·1	7·5–26·5	do	100·0
Carbon tetrachloride	5·3	non-inflamm.	do	100·0

*The Prevention of Occupational Diseases, by R. R. Sayers and J. M. DallaValle (*Mechanical Engineering*, Vol. 57, No. 4, April, 1935).

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(S. R. L.)

VENTIMIGLIA (Fr. *Vintimille*, anc. *Album Intimilium* or *Albintimilium*), a frontier fortress, seaport and episcopal see of Liguria, Italy, in the province of Imperia, 94 mi. W. by S. of Genoa by rail, and 4 mi. from the Franco-Italian frontier, 45 ft. above sea level. Pop. (1936) 11,216 (town), 15,787 (commune). The railway to Cuneo over the Col di Tenda (65 mi.) has been completed. The new town is important as a frontier station and for its flower market. The present Gothic cathedral is built on the ruins of an earlier Lombard church, and with the octagonal baptistery, the seminary, etc., forms a picturesque group of buildings. S. Michele is another interesting old church. Both lie in the old town, on a hill above the new. The ruins of the ancient town are situated in the plain of Nervia, 3 mi. E. of the modern. It was a *municipium* with an extensive territory, and of some importance under the Empire, but was plundered by the partisans of Otho in A.D. 69. Remains of a theatre are visible, and remains of many other buildings have been discovered, among them traces of the ancient city walls, a fine mosaic pavement and a number of tombs to the west of the theatre. The caves of the Balzi Rossi near the village of Grimaldi have proved rich in palaeolithic remains of the Quaternary period. Around Monte Bego above S. Dalmazzo di Tenda, north of Ventimiglia, are numerous engravings (over 12,000) assignable to the Bronze Age.

VENTNOR, watering place, urban district, Isle of Wight, England, $12\frac{1}{2}$ mi. S. of Ryde. Pop. (1938) 5,930. It is situated in the Undercliff district, at the foot of St. Boniface down, which is 787 ft. high. The town, built on a succession of terraces, is regarded as one of the best resorts in England for consumptives and contains several hospitals and convalescent homes. In the early 19th century it was a small fishing hamlet, but now it extends along the shore for 2 mi. Area 5.5 sq.mi.

VENTRILOQUISM, the art of producing the voice in such a manner that it shall appear to proceed from some place altogether distant from the speaker (Lat. *venter*, belly, and *loqui*, to speak). The art of ventriloquism was formerly supposed to result from a peculiar use of the stomach (whence the name) during the process of inhalation. As a matter of fact, the words are formed in the normal manner, but the breath is allowed to escape slowly, the tones being muffled by narrowing the glottis, and the mouth being opened as little as possible, while the tongue is retracted and only its tip moves. This pressure on the vocal chords diffuses the sound and the greater the pressure the greater is the illusion of distance. A figure or dummy is sometimes used by the ventriloquist to assist in the deception. The ventriloquist animates the dummy by moving its mouth at the same time his own lips remain still, thereby completing the illusion that the voice is coming from the dummy. When not using a dummy the

ventriloquist employs pantomime to direct the attention of his listeners to the location or object from which the sound presumably emanates. Ventriloquism, which is still a recognized form of conjuring entertainment, is of ancient origin. Traces of the art are found in Egyptian and Hebrew archaeology. Eurycles of Athens was the most celebrated of Greek ventriloquists, who were called after him Eurycleides, and also *Engastrimanteis* (belly-prophets). It is not impossible that the priests of ancient times were masters of this art, and that to it may be ascribed such miracles as the speaking statues of the Egyptians, the Greek oracles, and the stone in the river Pactolus, the sound of which put robbers to flight. Many uncivilized races of modern times are adepts in ventriloquism, as the Zulus, the Maoris and the Eskimos. It is well known also in Hindustan and China. It is even practised by such birds as the chickadee and the dove. (E. J. Bn.)

VENTSPILS, formerly Windau, an ice-free seaport and sea-bathing resort of Latvia, at the mouth of a river of the same name, on the Baltic sea, in 57° 24′ N., 21° 32′ E. Pop. (1939) 15,673. Its 15-acre harbour, protected by two long breakwaters, has ample quay space with a depth of 23 to 30 ft. The harbour has also been deepened to accommodate large ocean steamers. A 40% drop in tonnage handled resulted from World War I. The imports are coal and transit goods of various description and its exports timber, pit-props, butter, flax, hemp and grain. The castle dates from 1290, the town from 1343. Ventspils was occupied alternately by the U.S.S.R. and Germany in World War II.

VENTURA (officially San Buenaventura), a city of southern California, U.S.A., on the Pacific ocean, 2 mi. from the mouth of the Santa Clara river; the county seat of Ventura county. It is served by the Southern Pacific railway and by freight steamers. Pop. (1930) 11,603; 1940 federal census 13,264. It is a trading centre and shipping point for a rich agricultural region and for the neighbouring oilfields, and is the seat of the State school for girls. The city, founded in 1782, was incorporated in 1866.

VENUE, in criminal law, the proper area of jurisdiction for the trial of a crime by indictment (from the Lat. *venire*). Every criminal court has its jurisdiction limited to some part of England, and unless empowered by statute, cannot try any crimes other than those committed within its jurisdiction. For certain crimes, however, the venue may be laid in any part of England. The King's Bench division has power to change the venue. In civil matters, that is to say, in actions commenced in the high court, there is now no local venue for the trial of actions, but the place of trial is fixed (pursuant to Or. 36 r. 1 of the rules of the supreme court) on a summons for direction, which is taken out shortly after the commencement of proceedings. As a general rule the court directs that the trial shall take place at the place which is most convenient, having regard to all the circumstances, *e.g.*, the residences of the parties and their witnesses, and the dates when assizes are held, and to the fact that jurors ought not to be asked to try cases which do not arise in their own district. (*See* further, Criminal Law; Practice and Procedure; County Court.) (W. V. B.)

In American law jurisdiction to try crimes and civil cases must be distinguished from venue or the place where the trial may be had. Jurisdiction as between the various states is governed by common law principles of the conflict of laws. The right to enforce the judgment of one state in another state depends upon whether the former had jurisdiction of the subject matter and the parties, a fact which is always open to question by the courts of the latter state. But there being jurisdiction, the determination of the courts of the state in which the action is brought is conclusive upon the question whether the venue was properly laid. Constitutional or statutory provisions commonly govern the venue of different causes of action as between particular counties and the federal judicial districts. Actions such as trespass to land are ordinarily triable only in the state where the cause of action arose. Most actions may be tried in any state that has jurisdiction of the parties.

VENUS (♀) is the second of the planets in order of distance from the sun. It revolves in an orbit which has the smallest eccentricity (0.007) in the planetary system, and an inclination to the ecliptic of 3° 24′. Its mean distance from the sun is 67,200,000 miles; but, whereas at inferior conjunction it is less than 26,000,000 miles from the earth, at superior conjunction it is 160,000,000 miles. The time it takes Venus to complete a revolution in its orbit is 225 days, but its synodic period, or the period of its phases, is 584 days. At its maximum elongations it recedes about 47° or 48° from the sun, so that in middle latitudes it can set or rise over 3 hours after or before the sun. When seen in the western sky in the evenings, *i.e.*, at its eastern elongations it was called by the Ancients Ἕσπερος (Hesperus), and when visible in the mornings, *i.e.*, at its western elongations Φωσφόρος (Phosphorus). In volume and mass Venus is slightly smaller than the earth, its diameter being about 7,700 miles and its mass (deduced from its action on the earth and Mercury) 0.81 that of the earth. At superior conjunction its angular diameter is about 10″, but at inferior conjunction it exceeds 60″.

Like the earth Venus is enveloped in an atmosphere. This is shown by the fact that, near inferior conjunction, the extremely thin crescent of the visible portion of the illuminated hemisphere has often been observed to exceed 180°, while at the time of actual entry on the sun's disk during the transit of 1882, as soon as about three-quarters of the planet's body was in front of the sun, the remaining portion was completely outlined by a narrow border of light. This atmosphere of Venus is apparently heavily cloud-laden, and, as the intensity of the solar radiation is almost exactly twice what it is at the earth's distance, the planet shines with a dazzling lustre, its stellar magnitude varying from −3.3 to −4.4. Its greatest brightness is attained at about 36 days on either side of inferior conjunction, its elongation from the sun then being 39°, and its phase similar to that of a 5-days-old moon. When suitably situated the planet is easily visible at noonday with the naked eye, and after dark it readily casts a shadow.

As a telescopic object Venus is disappointing, since apart from the beauty of its phases it presents but few features of a definite nature. Its surface appears permanently screened from view by its cloud-laden atmosphere, and many observers have failed to detect any markings at all upon it beyond the general fading of light near the terminator and a brightness at the cusps or other features which appear to be merely phase effects. Occasionally diffuse faint markings of a dusky character or bright areas are seen, but these are probably nothing more than inequalities in the cloudy stratum. On Feb. 13, 1913, a very definite indentation in the terminator, or line bounding the illuminated part of the disk, was observed simultaneously by McEwen of Glasgow, and Sargent at the Durham university observatory, and similar irregularities have been recorded by previous observers.

The Planet's Rotation.—In view of what has been said as to the elusive nature of the surface features, it is not surprising that the planet has been able to preserve the character of its rotation a secret to the present day. It was concluded by some of the earlier telescopic observers such as G. D. Cassini, Bianchini and Schroeter that its period is in the neighbourhood of 24 hours; but Schiaparelli (1890), after a careful study of the available material including his own observations, formed the conviction that the rotation is very slow and that it probably takes the same time as the planet's orbital revolution. This last conclusion was also arrived at by Lowell at Flagstaff. Flammarion in his review of the recorded observations considered that no reliable deduction could be drawn from them. A slow rotation would seem to be indicated by the absence of any observable ellipticity of the planet during its transits of the sun, as well as by the failure of certain spectroscopic observations to show any definite differential radial velocity at opposite sides of the visible disk. On the other hand the radiometric observations at the Mt. Wilson and Flagstaff observatories in 1922, showing a considerable amount of heat to be emitted by the dark part of the planet's disk, favour a quick rotation, as also do photographs taken in ultra-violet light by Ross at the Mt. Wilson observatory on which dusky belts are shown perpendicular to the terminator and varying from night to night. It is, however, typical of the mystery enveloping this planet that on June 26, 1927, a dark marking was photographed at Mt. Wilson which apparently remained stationary for an hour.

It may be that the harmonizing of many of the discordances referred to will ultimately be found in the theory of Professor W. H. Pickering. Observing in Jamaica in 1921, he reported observations of dusky markings indicating a rotation in approximately 68 hours about an axis which is nearly in the plane of the orbit and in line with the radius vector in heliocentric longitude 46° 7′. This result has received general support from McEwen, and it has been pointed out that the failure of the Flagstaff spectroscopic observations in 1903 to indicate rotation is explained by the fact that, on Pickering's hypothesis, the planet's pole was at that time directed towards the earth, and that the rotation of the surface markings was accordingly almost in the plane of vision. It is to be noted that the earlier spectroscopic observations of Belopolsky at Pulkowa made under different conditions had given distinct evidence of rotation.

Habitability.—There is a point which is of considerable importance as regards the question whether Venus is fitted to be the abode of animate life. If oxygen and water vapour exist in any large quantity, we might expect their presence to be revealed by absorption lines in the spectrum of the sunlight reflected by the planet's surface. St. John, however, has found no evidence of such lines, and has concluded that the amount of oxygen above the visible surface is less than one-thousandth part of the quantity in the atmosphere of the earth. It must, however, be remembered that the visible surface of Venus is apparently only that of the upper layer of a stratum of cloud, and that, although the quantities of oxygen and water vapour above this layer are apparently small, there may be considerable amounts below it. In the absence of any certain knowledge as to the planet's rotation and other important data it is not possible to form conclusions concerning its habitability, but the resemblance of Venus to the earth in size and mass, coupled with its possession of a dense atmosphere, would suggest the probability that it supports life of some kind.

Supposed Satellite.—It was at one time thought that Venus possessed a satellite, several observers in the 17th and 18th centuries reporting that they had seen it, though others searched the neighbourhood of the planet for it in vain. Observations with more perfect instruments, however, eventually demonstrated the non-existence of any such object, and it is evident that what was seen must have been the appearance of a "ghost," caused by some fault in the construction or adjustment of the instruments used.

Transits of Venus.—As is the case with Mercury, Venus, revolving round the sun inside the earth's orbit, sometimes transits the sun's face, and is seen projected on it as a small black disk. Were the planet's orbit plane coincident with that of the earth, these transits would, of course, occur at each inferior conjunction, but owing to its inclination a transit can only happen when the two planets pass near one of the nodes of Venus at about the same time, which is possible only at present in June and December. Actually a transit happens but four times in 243 years, and the intervals between transits are successively 8, 121½, 8, 105½, 8, 121½ years *et seq.*, as illustrated in the following table of dates of these phenomena:

1518, June 2,	1769, June 3,
1526, June 1,	1874, Dec. 9,
1631, Dec. 7,	1882, Dec. 6,
1639, Dec. 4,	2004, June 8,
1761, June 6,	2012, June 6.

The first transit to be actually observed was that of 1639, the occurrence of the event having been calculated by Jeremiah Horrox, a young clergyman who was curate of Hoole near Preston in Lancashire. Dec. 4 in that year happened to be a Sunday, and Horrox missed seeing the beginning of the transit through having to take a service in church that afternoon, but on returning home he found to his great delight the black body of the planet clearly projected on the sun's disk.

Following on the suggestions of Edmund Halley a century later, transits of Venus were utilized for the determination of the solar parallax which gives the distance of the sun—a quantity of fundamental importance to the astronomer. Practical difficulties, however, in the observations, arising from the effect of irradiation in introducing uncertainties as to the precise moments of the internal contacts between the limbs of the sun and planet, rendered the method unsatisfactory, and far more effective ways of attacking the problems are now available for the purpose. (T. E. R. P.)

VENUS, Roman and Latin goddess, apparently representing beauty and growth in nature, and especially in gardens, where the Roman practical sense would most naturally see these. She had two temples in Rome, one in the grove of Libitina, with whom she was wrongly identified, and the other near the Circus Maximus, both of which had as their dedication day Aug. 19, the festival of the *Vinalia rustica,* a fact which also points in the direction of skilled cultivation as the human work of which she was protectress. But this old Latin deity was in historical times entirely absorbed by the Greek Aphrodite, and assumed the characteristics of a cult of human love, which in her original form she had never possessed. *See* APHRODITE.

VENUSIA: *see* VENOSA.

VENUS'S FLY-TRAP (*Dionaea muscipula*) is a remarkable carnivorous plant first discovered by Arthur Dobbs (1689–1765), governor of North Carolina, and reported by him to Peter Collinson in a letter dated Jan. 24, 1760, in which he called the plant the "Fly Trap Sensitive." This letter did not become public until 1843 (*Hortus Collinsonianus*). From some plants sent to England and introduced in Kew Gardens, John Ellis, a London merchant and botanist by avocation, drew a description and figure which were sent by him to Linnaeus in 1770. The latter rewrote the description in Latin, and published it in 1773. Though Dobbs had recognized the sensitivity of the leaves, this was also seen independently by Ellis, who drew Linnaeus' attention to the phenomenon. He so far appreciated the nature of the plant that he called it *miraculum naturae,* a miracle of nature. Though Ellis thought that the plant caught insects (flies) and held them, Linnaeus was not of this opinion.

The plant is a small perennial herb, with a rosette of leaves bearing tall scapes with white flowers. The leaf shows two regions, the leaf-like footstalk narrowly to broadly cordate, which is separated from the blade by a narrow isthmus. The blade consists of two trapezoidal lobes which stand at an angle of 40 to 50 degrees. The upper surface of each lobe is the site of numerous low glandular trichomes containing red sap, and lending this hue to the whole surface. These are digestive glands and become active after prey has been caught. The outer edge of the lobe is armed with a series of strong projections, suggesting fingers, about 13 in number. On the surface between them and occupying a narrow zone within the margin there are numerous nectar glands. F. M. Jones observed ants, etc., feeding on them. In addition there are, normally, three longish, bristle-like hairs, jointed near the base, and readily bent by the body of an intruding insect. The cells of the joint are extremely sensitive to unequal pressure which is provided by the bending, and, though the blade has been shown to be slightly sensitive elsewhere, it is here the normal stimulus is received. But a single stimulus does not suffice. It normally requires two stimuli (at normal temperatures), either received by the same or by different hairs, the second not less than 1.5 sec. nor longer than 20 sec. after the first, to procure a response. This consists of the rapid apposition of the two lobes, which occurs within one-fourth of a second, at normally high temperatures, till the margins approximate, and the finger-like projections overlap. If prey is present, the movement continues quite slowly till the surfaces of the lobes press against the body of the prey. The secretion of digestive enzymes then sets in and the insect body is disintegrated. This action takes about ten days, after which the lobes reopen. The process can be repeated three times, till the limit of growth is reached; it has been shown that the movement involves growth. The first rapid movement bringing the fingers into overlapping position results in a mutual posture of the lobes which, Charles Darwin held, allows very small insects of little value as food to escape. Darwin also observed that, during the period of digestion, the flow of digestive fluid was so abundant that, on cutting a small hole at the base of the trap, it flowed down the petiole or dropped to the ground.

The closure of the trap is accompanied by electrical disturbances, studied by J. Burdon-Sanderson and by H. Munk. Such

disturbances have been likened to those which occur during the stimulation of muscle, and some attempt has been made to find a structural equivalence, without result. The movement resulting from a stimulus is due to slight changes in the tensions on the parenchyma of the lobes. The mechanism of transmission of the stimulus can be only vaguely guessed. It is little wonder that Darwin said of this plant that it is the "most wonderful" in the world.

Closely related to *Dionaea,* though placed by the taxonomists in another genus, is *Aldrovanda vesiculosa,* a freely floating fresh-water plant distributed from Spain to Japan, and south to the Chobe swamp in Portuguese East Africa, though it appears to be not generally abundant. It was found in India before 1696 and later in Italy previous to 1747. It was named by Gaetano Monti in honour of an Italian naturalist, Ulisse Aldrovandi. The name was published by Linnaeus as *Aldrovanda,* apparently the result of a mistake in copying. Otherwise it should have been *Aldrovandia,* under which it has often been cited.

The plant is small, about three inches long, and flaccid, floating horizontally in the water. It produces small inconspicuous flowers. The leaves occur in whorls of eight, and each shows the same regional areas as that of *Dionaea.* The basal portion is narrow and wedge-shaped and bears, at its upper end, the trap and usually four bristle-like extensions. The lobes of the trap are approximately semicircular and have turned-in margins which, when the lobes are approximated, act as valves when pressing against each other. Each lobe has two regions. The inner region, against the midrib, is relatively thick and concave. When the lobes are closed the two inner regions fit together to form an ovate hollow container holding the prey if caught. The outer regions are thin and come slowly into close contact if prey is caught. Within the inner region there are numerous digestive glands and some 40 sensitive hairs which work like those of *Dionaea,* but are of much simpler structure. Prey coming into contact with these stimulate the lobes to close, bringing the marginal valves together. The water escapes between reaches of the margins near the midrib where the valves are absent. Small insect larvae, copepods, acarids, etc., are caught as prey, the trap closing with speed. The number of stimuli required depends on the age of the leaf. This plant never produces roots subsequent to the seedling radicle, which is of limited growth. The latter end of the plant decays as the growing end extends.

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VENUS'S LOOKING GLASS, a popular garden name for *Specularia speculum* (or *Campanula speculum*), from the old Latin name for the plant, *Speculum veneris.* It is a common cornfield plant in the south of Europe, and is grown in gardens on account of its brilliant purple flowers. In North America four native species occur, of which the American Venus's looking-glass or clasping bell-flower (*S. perfoliata*) and the small Venus's looking glass (*S. biflora*) are found across the continent, the latter extending to South America.

VERACRUZ, a long, narrow, tropical state on the Gulf coast of Mexico, bounded north by Tamaulipas, west by San Luis Potosí, Hidalgo, Puebla and Oaxaca, and southeast by Chiapas and Tabasco. Pop. (1940) 1,619,338. It is about 50 mi. wide, extending along the coast northwest to southeast, for a distance of 435 mi., with an area of 27,752 square miles. It was the seat of an ancient Indian civilization antedating the Aztecs and is filled with remarkable and interesting ruins; it is now one of the richest States of the republic. It consists of a low, sandy coastal zone, much broken with tidewater streams and lagoons, behind which the land rises gradually to the base of the sierras and then in rich valleys and wooded slopes to their summits on the eastern margin of the great Mexican plateau, from which rise the majestic summits of Orizaba and Cofre de Perote. The climate is hot, humid and malarial, except on the higher elevations; the rainfall is heavy, and the tropical vegetation is so dense that it is practically impossible to clear it away. At Coatzacoalcos the annual precipitation ranges from 125 to 140in., but it steadily decreases towards the north. On the higher slopes of the sierras prehistoric terraces are found, evidently constructed to prevent the washing away of the soil by these heavy rains. More than 40 rivers cross the State from the sierras to the coast. There are several ports on the coast—Coatzacoalcos, Alvarado, Veracruz, Nautla, Tecolutla and Tuxpam. The products of the State are chiefly agricultural—cotton, sugar, rum, tobacco, coffee, cacao, vanilla, maize, beans and fruit. Cattle-raising is followed in some districts, cattle and hides being among the exports. Among the forest products are rubber, cabinet woods, dye-woods, broom-root, chicle, jalap and orchids. Veracruz is one of the largest producers of sugar and rum in Mexico. There are a number of cotton factories (one of the largest in Mexico being at Orizaba), chiefly devoted to the making of coarse cloth for the lower classes. Tobacco factories are also numerous. Other manufactures include paper, chocolate, soap and matches.

There are four lines of railway converging at Veracruz, two of which cross the state by different routes to converge again at Mexico City. Another runs from Veracruz south to Tierra Blanca, and the fourth from Veracruz southeast to Alvarado on the Gulf coast.

The capital is Jalapa, and the principal towns are Veracruz, Orizaba, Cordova and Coatzacoalcos.

VERACRUZ, a city and seaport of Mexico, in the state of Veracruz, on a slight indentation of the coast of the Gulf of Mexico, in 19° 11′ 50″ N., 96° 20′ W., slightly sheltered by some small islands and reefs. Pop. (1940) 71,679. Veracruz is the most important port of the republic. It is 263 mi. by rail E. of the city of Mexico, with which it is connected by two lines of railway. It is built on a flat, sandy, barren beach, only a few feet above sea level. The harbour is confined to a comparatively narrow channel inside a line of reefs and small islands, which is exposed to the full force of northern storms. New port works were completed towards the end of the 19th century, which, by means of breakwaters, afford complete protection. In 1905 the four railway companies having terminal stations in Veracruz united in the organization of a joint terminal association, with union station, tracks, warehouses, quays, cranes, etc.

Veracruz dates from 1519, soon after the first landing there of Cortes. This settlement was called Villa Rica de Veracruz, but was soon after moved to the harbour of Bernal, in 1525 to a point now called Old Veracruz, and in 1599 to its present site. It was pillaged by privateers in 1653 and 1712, and this led to the erection of the celebrated fort of San Juan de Ulúa, or Ulloa, on one of the reefs in front of the city. In 1838 it was captured by the French, on March 29, 1847 by an American army under Gen. Winfield Scott, who made Veracruz a base for his march upon the City of Mexico, and in 1861 by the French. Felix Díaz, nephew of President Díaz, captured Veracruz on Oct. 15, 1912, in a revolt against the Madero Government. Surprised by Federal troops, he was taken prisoner on Oct. 22, and interned in Ulúa fort. Naval forces of the United States landed in Veracruz on April 21, 1914, seized the port and thereby brought about the resignation of President Huerta. They held the city until Nov. 23, 1914.

VERATRINE (Cevadine), the most important and the most toxic of a series of alkaloids (*q.v.*) obtained from sabadilla seeds (Merck, 1855). The name veratrine has been applied so variously that the synonym cevadine was introduced by Wright and Luff (1878) to distinguish the pure alkaloid (crystallized veratrine) which crystallizes from warm diluted alcohol in colourless rhombic prisms, melts at 205° C, and has a specific rotation $[\alpha]_D$ +12·5°. Cevadine, $C_{32}H_{49}O_9N$, forms a series of well-crystallized salts and behaves as an ester, being hydrolyzed to tiglic acid and the basic alcohol *cevine,* $C_{27}H_{43}O_8N$, which is much less toxic than the parent alkaloid. In physiological action cevadine has affinities with the even more poisonous alkaloid aconitine. The chemical structure of cevadine was not known in 1946.

VERATRUM. The Greek physicians were acquainted with a poisonous herb which they called white hellebore, and which has been supposed to represent the *Veratrum album* of modern botanists. In modern times the name has been applied to a genus of herbaceous plants belonging to the family Liliaceae. *Veratrum* is a tall-growing herb, having a fibrous root-stock, an erect stem, with numerous broad, plicated leaves placed alternately, and terminal, much-branched clusters of greenish or purplish polygamous flowers. Each perfect flower consists of six regular petals, as many stamens, whose anthers open outwardly, and a three-celled superior ovary which ripens into a three-celled, many-seeded capsule. The genus comprises 10 species, natives of the temperate regions of the northern hemisphere, generally growing in pastures or woods. *V. album* and the North American species *V. viride* are commonly grown in gardens as ornamental perennials, but their poisonous qualities should be kept in mind, particularly as they bear a considerable resemblance in foliage to the harmless *Gentiana lutea*. Both contain the potent alkaloid veratrine. (*See* also HELLEBORE.)

VERBENA. The genus *Verbena* (vervain) gives its name to the family (Verbenaceae), of which it is a member. The species are herbaceous or somewhat shrubby, with opposite or whorled leaves, generally deeply cut. The sessile flowers are aggregated into close spikes. Each flower has a tubular, ribbed calyx, a more or less irregular tubular two-lipped corolla, with four (didynamous) stamens springing from the interior of the corolla-tube. The anthers are two-celled. The ovary is entire or four-lobed, and always four-celled, with a single ovule in each cell. The fruit consists of four hard nutlets within the persistent calyx. There are about 100 species, mostly natives of tropical and subtropical America, some 20 being native to the United States, a very few species occurring also in the Old World. The garden verbenas are mostly derivatives from a few South American species, such as *V. teucrioides*, of southern Brazil, and *V. chamaedrifolia* from Argentina and southern Brazil. Various cultivated forms have been derived also from the North American *V. canadensis*. The range of colours extends from pure white to rose-coloured, carmine, violet and purple. Striped forms also are cultivated. The lemon-scented verbena of gardens, much valued for the fragrance of its leaves, was once referred to this genus under the name *V. triphylla*, subsequently called *Aloysia*, but is now referred to the genus *Lippia* as *L. citriodora;* it differs from *Verbena* in having two, not four, nutlets in the fruit. Sand verbena (*q.v.*) belongs to the genus *Abronia*.

The garden verbenas are easily raised from seeds sown in heat in February or March, but choice varieties can only be kept true when raised from cuttings. These are best secured from old plants cut down in the autumn and started into growth in gentle heat and moisture the following spring. They root readily in a compost of sandy loam. (*See* VERBENACEAE; VERVAIN.)

VERBENACEAE, a family of dicotyledonous plants, comprising about 70 genera and some 750 species of herbs, shrubs and trees, nearly all tropical and subtropical. Vervain (*q.v.*) is British. *Lippia* and *Cymbopogon* yield verbena oil and several species, as teak (*Tectona grandis*), supply useful timber. Many are lianes. Some species bear thorns; others are xerophytic. Numerous species are cultivated for ornament, as the verbena (*q.v.*), chaste tree (*Vitex agnuscastus*), glory bower (*Clerodendron*), purple wreath (*Petrea volubilis*), golden dewdrop (*Duranta repens*), bluebeard (*Caryopteris incana*) and French mulberry (*Callicarpa americana*).

VERBOECKHOVEN, EUGÈNE JOSEPH (1798–1881), Belgian painter, was born at Warneton in West Flanders on June 9, 1798, and received instruction in drawing and modelling from his father, the sculptor Barthélemy Verboeckhoven. His paintings of sheep, of horses and of cattle in landscape, somewhat after the manner of Potter, brought him universal fame, and were eagerly sought for by collectors. Precise and careful finish is the chief quality of his art, which is entirely objective and lacking in inspiration. Verboeckhoven visited England in 1826, Germany in 1828, and France and Italy in 1841. He died in Brussels on Jan. 19, 1881. Examples of his art are to be found in nearly all the important galleries of Europe and the United States. In addition to his painted work he executed some 50 etched plates.

VERCELLI (anc. *Vercellae*), a provincial capital and archiepiscopal see of Piedmont, Italy, in the province of Vercelli, 13 mi. S.W. of Novara by rail. Population (1936) 32,397 (town); 38,956 (commune). It is situated 430 ft. above sea-level on the river Sesia, at its junction with the Canterana. Vercelli is a point at which railways diverge for Novara, Mortara, Casale Monferrato and Santhià (for Turin). The Piazza Cavour has a statue of Cavour. The cathedral library contains many ancient mss., especially the *Codex Vercellensis* (*see* VERCELLI BOOK). The church of S. Andrea is a Romanesque Gothic building of 1219–24, with lofty towers and an interior in the French Gothic style and a museum of Roman antiquities in the adjacent cloister. S. Paolo, S. Francesco and S. Cristoforo possess valuable examples of the work of Gaudenzio Ferrari (1471–1546) and of his follower Lanini. The castle of the Visconti is now a prison. Vercelli was the birth place of the painter Giovanni Antonio Bazzi, called Sodoma (1477–1549). Vercelli is one of the principal Italian centres of the exportation of cereals and especially of rice.

Vercellae, originally the chief city of the Libici (a Ligurian tribe), was at the junction of Roman roads to Eporedia, Novaria and Mediolanum, Laumellum (for Ticinum) and perhaps Hasta. Remains of the theatre and amphitheatre were seen in the 16th century, and ancient streets have been traced during drainage operations. In the neighbourhood (near Rotto on the Sesia) are the Raudii Campi where Hannibal won his first victory on Italian soil (218 B.C.), and where in 101 B.C. Marius and Catulus routed the Cimbri. From about 1228 till 1372 Vercelli was the seat of a university. (T. A.)

VERCELLI BOOK (CODEX VERCELLENSIS), an O.E. ms. containing, besides homilies, *Andreas, Fates of the Apostles, Address of the Soul to the Body, Falseness of Men, Dream of the Rood, Elene* and a prose *Life of Guthlac,* found in the cathedral library of Vercelli, by Blume in 1822, and described in his *Iter Italicum* (Berlin and Stettin, 1824–36). The hand-writing dates from the beginning of the 11th century. According to Wülker the ms. probably belonged to the hospice for English pilgrims, founded by Cardinal Gualo (d. 1227), a native of Vercelli and bishop of the city, in 1219, on his return from England, where he had been papal legate. The cardinal possessed a large library, which he left to the monastery; and the Vercelli codex may well have been included in it.

Its contents were partially printed (by Thorpe from Blume's transcript) in Appendix B to Cooper's *Report of Rymeri Foedera* for 1836; by Kemble, *Poetry of the Codex Vercellensis* (Aelfric Soc., 1843–56), and in a text based directly on the ms. by Wülker in his edition of Grein's *Bibliothek der A.S. Poesie* (Leipzig, 1894). *Codex Vercellensis,* by Wülker (Leipzig, 1894), is a facsimile.

For the description and history of the ms. *see* also R. Wülker, *Grundriss der A.S. Litteratur* (1885), pp. 237–42, and A. Napier in *Zeitschrift für deutsches Altertum* (1889, vol. 21, new series; old series, vol. 33, p. 66). *See* also CYNEWULF.

VERCINGETORIX (*ob.* 45 B.C.), Gaulish chieftain, waged war with ability against Caesar in 52 B.C. For the history of the campaign *see* CAESAR. He fell into Caesar's hands at the capture of Alesia, was exhibited at Caesar's triumph in 45 and was then put to death.

See Caesar, *B.G.* VII.

VERDEN, a town in the Prussian province of Hanover, Germany, on the Aller, 3 mi. above its confluence with the Weser, 22 mi. S.E. of Bremen by the railway to Hanover. Pop. (1939) 12,258. Verden was the seat of a bishopric founded in the first quarter of the 9th century, or earlier, and secularized in 1648. The duchy of Verden was then ceded to Sweden, passed in 1719 to Hanover and was, with Hanover, annexed by Prussia in 1866. The most noticeable edifice is the Gothic cathedral. Its industries embrace the manufacture of furniture, soap and machinery, cigar-making, brewing and distilling.

VERDI, GIUSEPPE FORTUNINO FRANCESCO (1813–1901), Italian composer, was born on Oct. 10, 1813, at Le Roncole, near Busseto. His parents kept a little inn, combined with a kind of village shop. Verdi's musical education really began with his entrance into the house of business of Antonio Barezzi, a merchant of Busseto, who was a thorough musician.

He studied under Provesi, *maestro di cappella* of the cathedral and conductor of the municipal orchestra, for which Verdi wrote many marches and other instrumental pieces. His first symphony was written at the age of fifteen and performed in 1828. In 1832 Verdi went to Milan to complete his studies. He was rejected by the authorities of the Conservatorio, but remained in Milan as a pupil of Vincenzo Lavigna, with whom he worked until the death of Provesi in 1833 recalled him to Busseto. A clerical intrigue prevented him from succeeding his old master as cathedral organist, but he was appointed conductor of the municipal orchestra, and organist of the church of San Bartolomeo. After Verdi's return to Milan, his first opera, *Oberto, Conte di San Bonifacio,* was produced in 1839. His next work, a comic opera, known variously as *Un Giorno di Regno* and *Il Finto Stanislao,* and composed in peculiarly distressing circumstances (the young composer had just lost his wife and two children) was a complete failure, and Verdi, stung by disappointment, determined to write no more for the stage. But a year later Merelli, the impresario of La Scala, persuaded him to write *Nabucodonosor* (1842), which placed him in the front rank of living Italian composers. *I Lombardi* (1843) and *Ernani* (1844) followed. With *Ernani* Verdi became the most popular composer in Europe, and the incessant demands made upon him reacted upon his style.

Macbeth (1847), *Luisa Miller* (1849) and *I Masnadieri,* produced at Her Majesty's Theatre in 1847, did not enhance his reputation, but in *Rigoletto* (1851), *Il Trovatore* (1853) and *La Traviata* (1853) Verdi reached the culminating point of what may be called his second manner. *Les Vêpres Siciliennes* (1855), written for the Paris Opéra contains some fine music, but suffers from the composer's perhaps unconscious attempt to adopt the grandiose manner of French opera. Of the works written during the next ten years only *Un Ballo in Maschera* (Rome, Feb. 17, 1859) has maintained a fitful hold upon public attention. *La Forza del Destino* (Nov. 10, 1862, St. Petersburg) and *Don Carlos* (March 11, 1867, Paris) are transitional works.

At this point in his career Verdi was preparing to emancipate himself from his early conventions, and was struggling towards a freer method of expression. In *Aïda* (Dec. 1871, Cairo) an opera upon an Egyptian subject, written in response to an invitation from Ismail Pasha, Verdi entered upon the third period of his career. In this work he broke definitely with the operatic tradition inherited from Donizetti, in favour of a method of utterance, which, though perhaps affected in some degree by the influence of Wagner, still retains the main characteristics of Italian music. In *Aïda* the treatment of the orchestra shows a richness of resource which those who knew only Verdi's earlier works scarcely suspected him of possessing; while its wealth of melody, massive ensembles, picturesque local colour, and other attractive qualities have long since established the work among the most successful and popular operas ever written. In the *Requiem,* written in 1874 to commemorate the death of Manzoni, Verdi applied his newly found system to sacred music. His *Requiem* was bitterly assailed by pedants and purists, partly on the ground of its defiance of obsolete rules of musical grammar and partly because of its theatrical treatment of sacred subjects, but by saner and more sympathetic critics, of whom Brahms was not the least enthusiastic, it has been accepted as a work of genius. In 1881 a thoroughly revised version of *Simon Boccanegra* was successfully produced at Milan.

In 1887 (Feb. 5) *Otello* was produced at Milan when Verdi was nearly seventy. The libretto, from Shakespeare's *Othello,* was the work of Boito. *Otello* recalls *Aïda* in the general outlines of its structure, but voices and orchestra are treated with greater freedom than in the earlier work, and there are no set arias. *Otello* is, musically and dramatically, an immense advance upon anything Verdi had previously written; and no less applies to *Falstaff,* which was produced at Milan on Feb. 9, 1893, when the composer was in his eightieth year, and which contains, besides the dramatic power and musical skill of *Otello,* a fund of delicate and fanciful humour which recalls the gayest mood of Mozart.

Falstaff was Verdi's last work for the stage but in 1898 he produced four beautiful sacred pieces, settings of the *Ave Maria, Laudi alla Virgine* (words from Dante's *Paradiso*), the *Stabat Mater* and the *Te Deum,* the first two for voices alone, the last two for voices and orchestra. Of his other minor and non-dramatic works, very few in number, may be mentioned a string quartet, composed in 1873, a hymn written for the opening of the International Exhibition of 1862, two sets of songs, a *Paternoster* for five-part chorus, and an *Ave Maria* for soprano solo, with string accompaniment. He died at Milan on Jan. 27, 1901.

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VERDIGRIS is a basic copper acetate of varying composition. Dissolved in pine balsam, it formed one of the permanent greens of the Middle Ages. Owing to its behaviour as an oil colour (turning from dark green to black) and as a water colour (fading), it is replaced as a pigment by the more permanent chromium and cobalt greens and is now used mainly in anti-fouling compositions and wood preservatives. It is an irritant poison; the best antidote is white of egg and milk. *See* PAINTS, CHEMISTRY OF.

VERDUN, a garrison town of north-eastern France, capital of an arrondissement in the department of Meuse, on the main line of the Eastern railway between Paris and Metz, 42 mi. N.N.E. of Bar-le-Duc. Pop. (1936) 18,793.

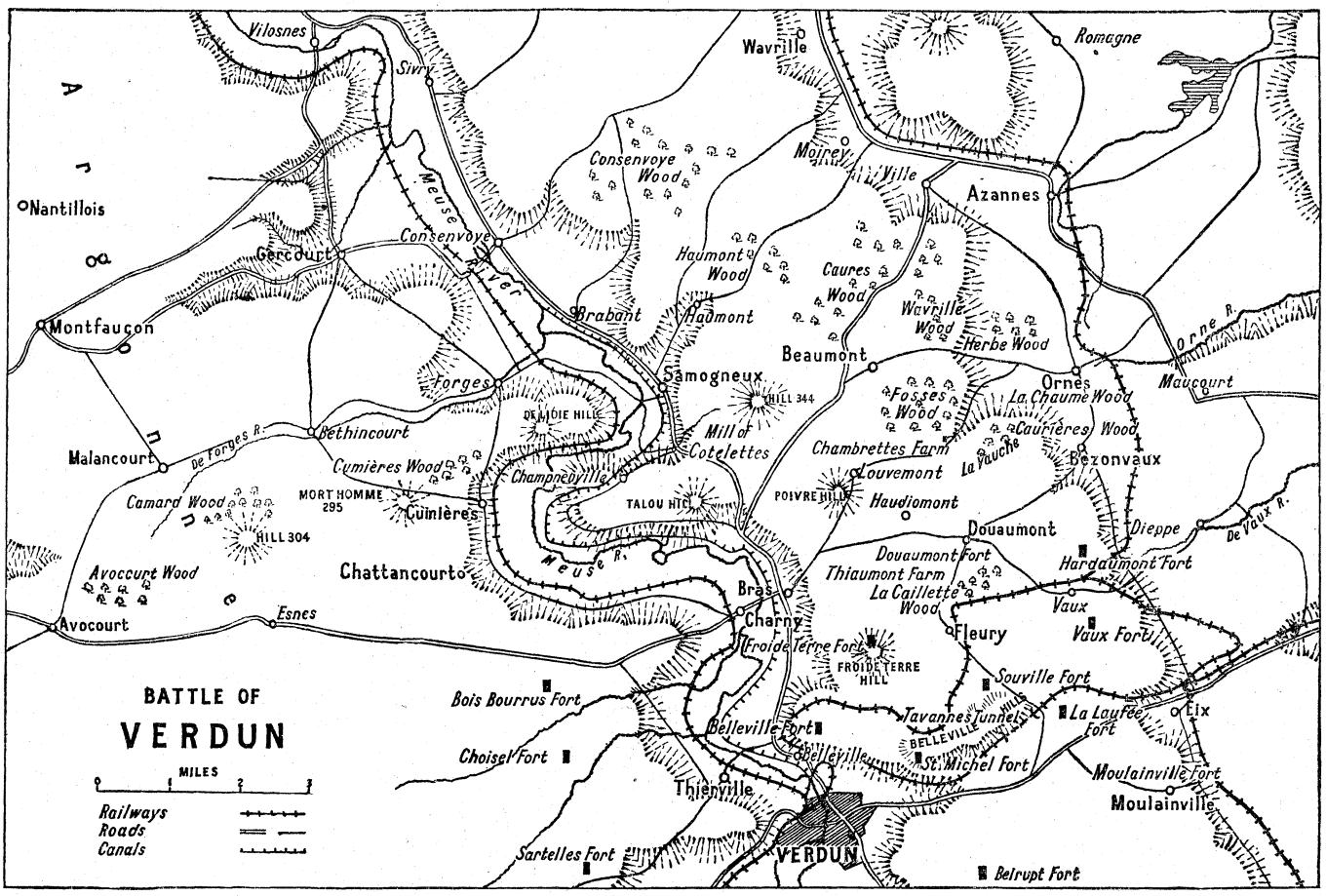
Verdun (*Verodunum*), an important town at the time of the Roman conquest, was made a part of Belgica Prima. The bishopric, held by St. Vanne (498–525), dates from the 3rd century. Verdun was destroyed during the period of the barbarian invasions, and recovered only at the end of the 5th century. Clovis seized the town in 502, and it afterwards belonged to the kingdom of Austrasia. In 843 the famous treaty was signed here by the sons of Louis the Pious. (*See* GERMANY: *Mediaeval History.*) In the 10th century Verdun was conquered by Germany and put under the temporal authority of its bishops. Together with Toul and Metz, the town and its domain formed the territory of the Trois-Évêchés. In the 11th century the burghers began a struggle with their bishops, which ended in their obtaining certain rights in the 12th century. In 1552 Henry II of France took possession of the Trois-Évêchés, which finally became French by the Treaty of Westphalia. In 1792, the citizens opened their gates to the Prussians. In 1870 the Prussians invested and bombarded it three times, till it capitulated in the beginning of November. (For the part played by Verdun in World War I *see* VERDUN, BATTLES OF; WORLD WAR I.) It was reduced to ruins during its historic resistance to the Germans.

Verdun stands on the Meuse, here canalized, and was a great fortress. The chief quarter of the town lay on the slope of the left bank of the river and was dominated by the citadel which occupied the site of the old abbey of St. Vanne founded in the 10th century.

The whole town was surrounded by a bastioned enceinte, pierced by four gates; that to the northeast, the Porte Chaussée, 15th–17th century, with two crenelated towers, was little damaged in World War I. The cathedral of Notre-Dame, in process of restoration, stands on the site of two previous churches of the Romanesque period, the first of which was burned down in 1047. There are double transepts and, till the 18th century when the western apse was replaced by a façade, there was an apse at each extremity. To the southwest of the cathedral is a fine 15th century cloister. The *hôtel-de-ville* (17th century) has been restored.

VERDUN, BATTLES OF. The invader of France coming from the east is confronted by a series of ridges between the Moselle and Paris. The second of these ridges is formed by the historic escarpment 400 metres in height, above the Meuse and called the Heights of the Meuse. Here is placed the fortress of Verdun, one of the main barriers on the road to Paris. It was the primary objective of the German campaign of 1916, and the failure to secure it had a far-reaching influence on the course of the World War.

History of the Fortress.—After the war of 1870 Gen. Séré de



Rivière, who was entrusted with the task of organising the frontier defences, constructed a protective curtain stretching from Verdun on the north to Toul on the south. Fortresses guarded the routes between these two places. On this rampart of the Heights of the Meuse Verdun formed the northern muzzle, opposite the fortified camp at Metz some 40 m. away. The fortress was planned so that the principal line of resistance faced north. Inside the two lines of forts was an old fortified enclosure of Vauban's time and a citadel dating back to Henry II. Galleries hewn out of the rocky foundation of the citadel, with workshops, bakeries, stores of food, water pumps and barracks formed a subterranean city safe against bombardment.

Verdun in 1914.—At the beginning of the War the fortress was an independent command. After the battle of the Frontiers the III. Army in retreat pivotted its right upon it as a breakwater against the German tide of advance, which turned on Sept. 13, 1914, by reason of the defeat of the German armies before Paris. (*See* MARNE, FIRST BATTLE OF.) The French lines were then established 10 km. north of Verdun and the sector was quiet for nearly 18 months. South-east of Verdun a stiff but indecisive fight took place in the spring of 1915 for the observatory of Les Eparges, and further south, in the area of St. Mihiel, by a surprise attack on Sept. 20, 1914 the Bavarians drove in a wedge and gained a foothold on the left bank of the Meuse. This wedge remained in the French front, a potential menace, until the American attack of Sept. 12, 1918. (*See* ST. MIHIEL, BATTLE OF.) West of Verdun the Crown Prince attempted to reach the Argonne in the direction of Varennes and forced the French lines back to the edge of Boureuilles and Vauquois.

The autonomy of the great fortresses was cancelled on Aug. 5, 1915 in order to make their garrisons and equipment available for the armies in the field. Dunkirk, Verdun and Belfort, the three great fortresses on the area of battle, became fortified regions linked up with the armies. The fortified region of Verdun (R.F.V.) was placed under Gen. Herr, who ranked as an army commander. The R.F.V. was on Feb. 1, 1916 attached to the group of Armies of the Centre—then commanded by Gen. Langle de Cary. On Feb. 10, 1916 Gen. Herr had available seven divisions with one in reserve, and two territorial brigades.

Germany Selects Verdun for Attack.—About Christmas 1915 Gen. von Falkenhayn submitted to the German Emperor a report setting forth the views of the German Staff as to the campaign of 1916. The report urged that France had reached the limits of exhaustion. Russia was powerless, Serbia destroyed, Italy deceived, though all were sustained by the will of Britain who was fighting against Germany as she had fought against Napoleon. Unfortunately it was not easy to reach Britain effectively either in her distant possessions by operations which could never be decisive, or on her own soil, or on the Continent. It was impossible to attack Britain directly. But she would be defeated if the Allied armies on the Continent were broken.

Where, then, was this to be done? Defeat of Italy would have little effect on England. Operations against Russia could not begin till April and then only towards the Ukraine where communications were lacking and a flank would be exposed to Rumania. The only possible line of attack was against France. It was not necessary to attack or break through in force. Behind, but close to, the French front were positions of such importance that they would have to be held to the last man. This reasoning led to the battle of Verdun. The German Command sought to force the French to accept battle under conditions of forced defence—conditions which are fatal to the defender.

The two objectives which realised Falkenhayn's conditions were Belfort and Verdun. The capture of Belfort involved the evacuation by the French of Upper Alsace. Verdun, however, was important for three reasons. From Verdun the French could launch an attack, similar to that contemplated by the Germans, upon the German communications. "Verdun," said Falkenhayn's report, "is the strongest starting point for any attempt by the enemy to threaten the whole German front in France and Belgium with relatively small forces." The French lines were but 12 m. from the German communications. Throughout the War German headquarters dreaded an Allied attack starting from Verdun.

An attack on Verdun had been foreseen by some on the French side. Col. Driant, Deputy for Nancy, who commanded a group of chasseurs in the fortified region of Verdun, wrote to the Minister for War that the decisive blow would be struck on the line Verdun-Nancy. The defensive organization of Verdun was incomplete. Gen. Herr, by the instructions of Aug. 9, 1915, had to link up the III. Army in Argonne with the I. Army in the Woëvre. That involved the revision of the defensive system of the fortress from a circular scheme to one of a series of parallel and successive lines. But the Commander-in-Chief, disturbed by the thrust of the Germans in the Argonne, also ordered Gen. Herr to prepare a defensive position on the left bank in case Verdun had to be abandoned. Gen. Herr could not manage this double programme with his resources and of four positions suggested on the right bank, only the first existed at the end of Jan. 1916.

On Dec. 3 Col. Driant was in Paris and communicated his views to his colleagues on the Commission of the Army. Gen. Pedoya, President of the Commission, passed the warning to Gen. Gallieni, the Minister for War, who wrote on Dec. 16 to Marshal Joffre inquiring whether all along the front a defensive system of at least two lines had been planned and carried out with such constructional features as were necessary in support. On the 18th Joffre replied somewhat confusedly and stated that the improvement of the double line system already existing along the whole front had been ordered on Oct. 22, that the organization of the fortified areas in the rear of the armies had also been ordered, and that this combination of defensive measures was in process of completion and at a number of points had been completed.

Gallieni replied on the 22nd that the Government hoped that the works still to be completed would be carried out with all speed and care and that the Government had full confidence in the Commander-in-Chief. In order to conceal its plans about Verdun the German Supreme Command arranged to carry out preliminary measures at several points on the front. The French Staff was for long in doubt whether the attack would come in Artois or in Champagne. But from Jan. 1916 French airmen reported enemy preparations on the Verdun front. On Jan. 16 Gen. Herr collected all this information in a formal report and asked for a division to reinforce him. This was sent to him.

I. THE GERMAN OFFENSIVE

On Feb. 8, 1916 it was discovered that the Germans had brought a mass of manoeuvre to the neighbourhood of Verdun. A deserter disclosed the presence of two corps. On the 11th an intelligence officer reported a concentration of troops on the east bank of the Meuse. The French Command at once took precautions. On Feb. 13 three divisions of the VII. Corps (14th, 37th and 48th) were moved to Souilly, a march south of Verdun, followed on the 16th by two divisions of the XX. Corps. On the 20th the Commander-in-Chief, who had inspected this front on the 19th, ordered the I. Army to place the 16th Div. at Gen. Herr's disposition, thus completing the XX. Corps.

French Supply Problems.—Transport questions arose. Ordinarily two standard gauge railways serve Verdun. The southern line had been cut by the enemy. The western line would be, and was, cut as soon as operations started. A departmental railway, the Meusien line, and a road from Bar-le-Duc still remained. To maintain supplies for an engagement in which 15 or 20 divisions are engaged, the daily requirements are 2,000 tons of munitions, 100 tons of supplies and material for each division, say 2,000 tons, and from 15,000 to 20,000 men. The Meusien Railway at best carried 800 tons daily. On the 19th Capt. Doumenc, commanding the M.T. service, undertook to carry 2,000 tons and 12,000 men daily in lorries provided that the M.T. service had sole control over the roads. Motor traffic was organized on the 20th on railway lines. From the 29th, 3,000, later 3,500, lorries passed in an endless stream along this little road only seven yards wide; 6,000 vehicles passed a given point in 24 hours, an average frequency of one vehicle every 14 seconds. At times the traffic rose to one vehicle every five seconds. In the language of the War this road was known as the "Sacred Way."

German Dispositions.—Verdun was confronted by the German V. Army—part of the command of the Crown Prince, who directed the offensive. The Germans had 26 divisions available on the Western Front. A third of these were kept as a general reserve; 17 to 18 divisions were therefore available for the Verdun attack. The German Command allotted nine divisions to the first attack, which started from the east bank. East of the Meuse was the VII. Res. Corps (one division in line, one in support); then the XVIII. Corps and the III. Corps in echelon of divisions. Farther east the XV. Corps was held in the plain of the Woëvre, ready on the breach of the French front to hurl itself on the French flank. The 113th Div., completing the assault troops, was in support. This mass of manoeuvre had been embodied in the Crown Prince's Army command and to make way for it, room was made between the V. Res. Corps and the VI. Res. Corps. The duty of the latter, on the west bank of the Meuse, was to attack the French when broken on the east bank and to bar their retreat. Thus it was engaged only on March 6.

On Feb. 21, 1916, at 7.15 A.M. the Germans commenced bombardment on a front of 25 m. from the Bois d'Avocourt to Étain. It was of unheard of intensity. Heavy shell were used in vast quantities. The woods were full of guns which fired ceaselessly with measured regularity. Observers from the air ceased to mark batteries on the map. The woods to them were masses of clouds pierced by flashes of lightning. Soon the French squadrons were chased from the sky.

The Attack Opens.—About 4.15 P.M. the first infantry attack was launched. Commandant Vouvard remarks that "It is probable that there were strong reconnoitring parties to test the efficacy of the artillery preparations and to seize trenches which had been destroyed. Beyond doubt that first day the Germans sought to put their infantry in an advantageous position and to get into line for the battle of the next day, by making it pass even the unequal intervals separating the lines." As a fact, the Germans, to effect a surprise, had not dug parallels from which to issue and moved from their lines at distances from the French lines which varied from 600 to 1,100 metres. Gillet describes their new tactics thus: "Each troop had a specific task, with an objective of limited breadth and depth. Before taking hold of it, a wave of scouts was sent forward to test the destruction by the artillery fire. If the destruction were not thorough the scouts retired and further artillery preparation was organised. The attack took place in waves about 80 metres apart. First came a line of pioneers and men with bombs. Then came the main body in single file. Then followed a reserve section carrying up ammunition, tools, sandbags, and filling up gaps in the first wave. A second line followed in the same order, passing through the first line, supporting it if checked and renewing the assault on their own initiative. The attack should now proceed by encircling movements, utilising cover and passing along ravines. Thus the centres of resistance would fall one by one. Shell fire would support the advance continually. On no account should troops attempt to overcome resistance which has not been broken by artillery fire. Units when held up must wait for fresh artillery action."

Early German Successes.—The French line rested on the village of Brabant, then on the Bois de Consenvoye, Bois d'Haumont, Bois de Caures, Bois de Ville and on Herbebois. A little in the rear the Bois de La Wavrille (southeast of the Bois de Ville) and the village of Beaumont had been strengthened with redoubts. On the extreme right the line rested on the village of Ornes. Before the German attack, what remained of the French trenches was filled with defenders. At Herbebois the Germans captured the first lines but were stopped in front of the supporting trenches. The Bois de Caures was lost but its northern part was retaken during the night. The loss of the Bois d'Haumont was a serious matter. A French counter-attack on the 22nd at 6 A.M. failed. The line had been pierced.

The Germans made good use, on the 22nd, of the advantage gained at the Bois d'Haumont. The village of Haumont was destroyed by shell fire and at 5.00 P.M. was attacked by three columns. The main redoubt, built of concrete, collapsed and buried 80 men. The remaining defenders were hunted from the cellars by bombs and liquid fire but rallied at Samogneux. Bois de Ville

was lost. Bois de Caures was then enveloped on the right and left and Col. Driant decided to withdraw his chasseurs to Beaumont. He was the last to leave the wood and was then killed. On the 23rd the village of Samogneux was overwhelmed by shells and set on fire but the garrison held on till night fell. On the extreme left the village of Brabant outflanked by the German advance became untenable and was evacuated. On the right Wavrille and Herbebois were lost and the front passed along the northern edges of Bois des Fossés and La Chaume.

In three days the Germans had captured the first of the French positions. Each side was reinforced on the 24th. A fresh regiment from the V. Res. Corps was sent to each of the German corps. The corps on the right which, having gained the greatest success, thereby became as it were a pivotal wing, also received a battalion of Jägers. On the French side the two divisions in line from the 21st were relieved, on the left by a division of the VII. Corps, on the right by two brigades from the XX. Corps. These troops, thrown at night into doubtful positions in the open country, were immediately destroyed. The 24th was the most critical day of the whole battle. On their right, where the Germans sought to move out from Samogneux, they were nailed down by the French artillery on the left bank. But they started a fresh attack immediately eastwards and captured all the line Beaumont, Bois des Fossés, Bois des Caurières. Further they penetrated towards Douaumont along the ravine of the Vauche.

The second French position was lost in one day. In the evening the situation was so grave that Gen. Langle de Cary, commanding the Centre group of Armies, ordered the II. Corps, then closely engaged in the Woëvre, to fall back on the Heights of the Meuse. This movement was carried out during the night. That same evening (24th) Gen. Joffre handed over the operations before Verdun to a fresh army, the II., commanded by Gen. Pétain, who after the Battle of Champagne had been resting at Noailles. The X. Army, on relief by the British Army, was placed in the general reserve.

New French Dispositions.—The initial task of the army under instructions of Feb. 25 at 9.00 A.M. was to concentrate the troops of the Verdun area on the west bank and to prevent the Germans from crossing the Meuse. But on the 24th at midnight Gen. Castelnau set out for Verdun armed with full powers from the commander-in-chief. He halted at Avize, headquarters of Gen. Langle de Cary, whence at 5.45 A.M. on the 25th he telephoned to Gen. Herr to order him to hold at all costs the line on the east bank facing north between the Meuse and Douaumont and, facing east, on the Heights of the Meuse. Gen. Pétain went on the morning of the 25th to Chantilly and thence to take charge of the battle, from the 25th at midnight.

During the 25th, on the French left, the Germans advanced 1,500 metres south of Samogneux up to the mill of Cotelettes. Further east they captured Bezonvaux. A party of Brandenburgers crept up to the fort of Douaumont, found it empty and took possession of it. Gen. de Bonneval, commanding the 37th Div. on the French left on the Talon and the Poivre Hills was afraid of being surrounded and ordered retreat on the Belleville Hills. This order was only partially carried out. The Zouaves held their position on the west of the Poivre. On the other hand while the 37th Div. retreated, the 39th Div. of the XX. Corps, going up into the line, passed it and covered the line Bras-Haudiomont.

On the 26th Gen. Pétain, at his headquarters at Souilly, reorganized the battle plan. He drew a sharp line—Bras-Douaumont—which he entrusted to the XX. Corps. He divided the area into four sections: (1) under Duchesne in the Woëvre, (2) under Balfourier from the Woëvre to Douaumont, (3) under Guillaumat astride the Meuse, and (4) under Bazelaire on the left bank. The artillery as it arrived was divided between these four commands. On Feb. 21 it consisted of 388 field guns and 244 heavy guns. In a few weeks there were 1,100 field guns, 225 guns of calibres from 80 to 105 mm. and 590 heavy guns. The French regained the mastery of the air. The 59th Div. was set to build two defensive positions chosen on the 27th and redoubled on March 2 by two intermediate lines. Three thousand territorials repaired and widened the Sacred Way.

Reinforcements arrived. The I. Corps was at Souilly on the 25th and the XIII. Corps at Revigny. The XXI. Corps followed it two days later. The XIV. Corps detrained on the 20th and the III. Corps on the 29th. Between the 26th and the 29th the Germans hurled violent attacks against Douaumont. On the east they reached the position of Hardaumont and attacked Bois de la Caillette. They stopped, exhausted, on the 29th.

The Second Phase.—The Germans failed to gain an immediate decision at Verdun. They soon realised that the British Army was about to attack them on the Somme. For four months they kept the battle of Verdun going with furious tenacity in order to disorganize the attack prepared by the Allies in Picardy. For the French Staff the problem was to hold on at Verdun without ceasing to prepare for the Somme. On March 6, as Gen. Pétain had expected and feared from the beginning, the Germans extended the action to the west bank. The attack was made by two corps, the VI. Res. and the X. Res., the latter taken from the General Reserve. On the 6th they captured the Hill de l'Oie and on the 10th Bois de Cumières. They were thus enabled to attack one of the pillars of the main line of defence, the Mort Homme. On the 14th they captured the lower crest of that double hill. The higher crest, Peak 295, could be held by neither side and was No Man's Land.

The second pillar of the French line, further to the west, and known as Hill 304, was attacked on March 20 by the 11th Bavarian Div. which took the Bois d'Avocourt but could not issue thence.

The Germans brought up fresh troops and the battle began again on March 28 on the west bank. It ended on April 8 by the French losing all that remained of their former front line. The new front passed thereafter by the redoubt at Avocourt, the first slopes of Hill 304, the southern reverse of the Mort Homme and the north of Cumières. On the right bank on March 31 the Germans captured the village of Vaux, which had held out till then, and on April 2 took the lake behind the village. Then on April 9 the Crown Prince attacked on both banks on a scale not known since the first attacks in February. The results were insignificant. On the morrow Gen. Pétain wrote in his orders of the day "the 9th April was a glorious day for our Armies . . . Courage. *Nous les aurons.*"

On April 20 the French counter-attacked on the east bank in order to clear the Mort Homme. But on May 3 the Germans renewed the offensive by an attack on Hill 304. On the 8th they captured Bois Camard, west of the Hill. On the 13th and 16th they attempted without success to advance from this position. They then organized a new attack on the 18th with a fresh corps, the XVIII. Res. Corps and two divisions of the XVIII. and added on the 22nd the 22nd. Res. Division. This violent battle ended on the 24th with the capture of Cumières. As the Germans had no reserves available the tired units could not be relieved and on the 26th they lost a portion of the trenches they had won.

There had been changes in the command. On April 2 the east bank sector had been placed under the orders of Gen. Nivelle, the west bank under Gen. Berthelot. At the end of April Pétain was called to command the Armies of the Centre and handed the II. Army over to Nivelle. The Germans, too, from March had divided the field of battle into two sections, Gen. von Mudra commanding on the right bank, Gen. von Gallwitz on the left bank. In April Mudra was replaced by Lochow. In July François relieved Gallwitz. The Allies' preparations on the Somme took definite shape. Before all things the Germans had to prevent the French from taking part in these operations. For this a new success in the Meuse was necessary.

The main French line of defence on the east bank was the Côte de Froide Terre—Fleury—Fort de Souville. On the right this position was covered by the fort of Vaux, on the left by the crest of Thiaumont. It was first necessary to capture Vaux and Thiaumont. On June 1 these two positions were attacked. Vaux was taken on the 9th. Thiaumont farm, taken by the Germans on the 1st, was recaptured by the French on the 2nd, who lost it again on the 9th. German attacks on the Thiaumont outworks behind

the farm failed completely. They succeeded in establishing themselves on the west and opposite side in the ravine of La-Dame. At the same time battle was resumed on the west bank. Between May 29 and 31 the Germans took Cumières but tried vainly to move out of Bois Camard against Hill 304.

Time pressed more and more. On June 4 Gen. Brusilov started a wide offensive in Volhynia. In these conditions the Germans delivered a large scale attack on the line Froide Terre–Souville on June 21. On the west the Bavarian Corps took the fortified post of Thiaumont but was checked in front of the fort at Froide Terre. In the centre the Alpine Corps captured Fleury. On the west the 103rd Div. took the first line of trenches in front of Souville but failed before the second line. So serious was the situation for the French that on June 23 Pétain warned Gen. Joffre and suggested moving to the west bank if the enemy reached the counterscarps. Joffre's answer on the 27th was a peremptory order to hold on to the east bank.

Meanwhile the preliminaries of the great Franco-British offensive on the Somme started on June 24 and the actual battle began on July 1. On July 11 the Germans made yet another attack on Verdun—from Vaux to Souville. It crumpled up on the slopes of Souville, the principal objective. On Aug. 3 the French retook Thiaumont and Fleury on Aug. 4. The Germans regained Thiaumont on the 8th. Throughout the whole month there was local fighting. The last German attack on Sept. 3 also failed. The battle of Verdun, properly called, had come to an end. From Feb. 21 to June 15 the Army at Verdun had seen 66 divisions on its front. Up to July 1 the Germans had used up 43½ divisions. It is true that they maintained them on the ground by depots situated a march behind the front and left them fighting till worn out. The French artillery fired 10,300,000 rounds with the field artillery, 1,200,000 rounds of medium and 600,000 rounds of large calibre.

II. THE FRENCH COUNTER-OFFENSIVE

On Sept. 13 M. Poincaré handed to Verdun the cross of the Legion of Honour and Allied decorations. The ceremony took place in the casemates of the citadel. From that moment began a new phase, that of the liberation of Verdun. To a large extent the glory of this feat belongs to Gen. Mangin. Called from the battlefield of Verdun on June 22 he was placed in command of Group D, which then stretched from the Meuse to Fleury and was progressively enlarged right up to the cliffs of the Meuse. On Sept. 17 in a report to Nivelle he set forth reasons for abandoning operations in detail and for seeking to free Verdun by a plan on broad lines.

The first scheme, approved by Nivelle on Sept. 21, dealt only with an advance up to 300 metres north of the farm of Thiaumont. The scheme of the 24th went further and included the fort of Douaumont as far as possible. A third scheme, that of Oct. 9, covered the capture of the fort of Douaumont and perhaps that of the fort of Vaux. A formidable artillery preparation with 650 guns started on Oct. 21. The assault was delivered on Oct. 24 at 11.40 A.M. by three divisions, the 38th on the left, 133rd in the centre, and 74th on the right. The first waves marched under a creeping barrage which progressed according to a set time-table, so that the infantry were as it seemed fastened to a wall of steel. By night Douaumont was taken with 6,000 prisoners. The division on the right had not reached the fort of Vaux which was evacuated by the Germans on Nov. 2, the day before the date fixed for attack by the 63rd Division.

In order to develop this success to the full Gen. Mangin was obliged to restore his ammunition reserves by continued economy. He intended to attack again on Dec. 5 over a front of 10 m. in order to retake at one blow the whole of the former second French line which had been lost on Feb. 24. Artillery preparation started on Nov. 29 with 750 guns. Bad weather intervened. The Germans had been warned and the value of a surprise was lost. In order to upset the plans of the French the Germans made a violent attack on Dec. 6 and captured Hill 304. Fine weather returned on the 9th and Nivelle recommenced the artillery preparation. On the 15th at 10 A.M. the attack was made. The German barrage started two minutes too late. The attack had started, four divisions being in line. By night they had retaken the whole of Poivre Hill. The line ran in front of Hill 378, stopped 20 metres south of the farm at Chambrettes, then turned south across Bois d'Hardaumont and la Vauche up to the outwork at Bezonvaux. The French captured 115 guns and 9,000 prisoners. This, known as the battle of Louvemont, was completed on the 18th by the recapture of Chambrettes. The spring passed in organising the area conquered and preparing for the final battle.

The Final Battle.—In the summer of 1917 Pétain formulated plans for a series of limited offensives for the purposes of raising the spirit of the army and decided on an operation on the northern front of Verdun on both banks having as objectives Mort Homme on the left and Samogneux and Beaumont on the right. The attack planned by Pétain was delivered on Aug. 20 after six days' heavy artillery preparation. The XIII. and XVI. Army Corps attacked on the left bank, the XV. and XXII. on the right bank, 16 divisions in all being engaged. Mort Homme was captured on the 20th, Hill 304 on the 24th. On the right bank Hill 344 was taken on the 20th, Samogneux on the 21st. More than 10,000 prisoners were taken. Beaumont alone remained in German hands. This was the final battle of Verdun.

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VERE, SIR FRANCIS (1560–1609), English soldier, nephew of the 16th earl of Oxford, served under Leicester in the Low Countries from 1585, distinguishing himself at Sluys; he was given the chief command of the English troops there from 1589, and by a series of brilliant campaigns secured the independence of the country. He served in the Cadiz expedition of 1596, negotiated a treaty between England and Holland, and was appointed governor of Brill in 1598. On July 2, 1600, he and Prince Maurice completely defeated the Spaniards under the archduke Albert at Nieuwport, and defended Ostend successfully from July 1601 to March 1602. Vere retired from the Dutch service in 1604 and died in 1609. His *Commentaries of the Divers Pieces of Service wherein he had Command* (1657), was reprinted in Arber's *English Garner* (1883).

His younger brother, SIR HORACE VERE, BARON VERE OF TILBURY (1565–1635), served under his brother in Holland from 1590 to 1594, took part in the Cadiz expedition and held a command at Nieuwport and Ostend. On his brother's retirement he assumed command of the English troops until 1607. From 1609 to 1616 he was governor of Brill, and in 1610 was present at the siege of Jülich. He commanded the futile expedition to the Rhine and the Main, in aid of the elector palatine (1620); after the fall of Mannheim in 1622 he returned to England. After a brilliant attempt to relieve Breda (1624), which was foiled by Spinola, Vere was made Baron Vere of Tilbury. He retired from active service soon after serving at the sieges of Bois-le-duc and Maestricht, and died in 1635.

See Clements C. Markham, *The Fighting Veres* (1888).

VEREINIGTE GLANZSTOFF-FABRIKEN A.G., a German company, was established at Elberfeld in the year 1899. The object of the company is activity in the chemical and textile industry territory, and it deals chiefly with the manufacture of artificial silk and staple fibre (Zellwolle). The company owns valuable patents concerning the manufacture of artificial silk and staple fibre by the viscose process, and this process also finds application in numerous similar undertakings which the company has established in various countries. The company's capital, which amounted at foundation to M.2,000,000, has now increased to M.76,500,000, of which M.75,000,000 represent ordinary shares and M.1,500,000 6% preference shares. In 1929 the company joined its interests with the Algemeene Kunstzijde Industrie N.V., Arnhem (AKU). The company's artificial silk production, which

has developed since the beginning of the century from small beginnings, amounts in the German works belonging to the company and in the works of its German affiliated companies, employing 15,000 workers, to about 35,000,000 kilos artificial silk and about 46,000,000 kilos staple fibre yearly.

VEREINIGTE INDUSTRIE-UNTERNEHMUNGEN AKTIENGESELLSCHAFT (United Industrial Corporation), or VIAG as it is commonly known, was formed in 1923 as holding company for industrial companies owned by the German government. All these holdings emanated from World War I. The backbone of the Viag concern is the wholesale production of electric power and its use for electrochemical production. By combining various subsidiaries engaged in the supply of electricity the Viag has become by far the largest public utility concern in Europe.

The Electrowerke A.G., the most important subsidiary of the group, owns various big power stations in central Germany all erected in connection with brown coal mines.

The Alpen-Electrowerke A.G., the Innwerke A.G. and other subsidiaries are exploiting water power in Bavaria and Austria. Part of the electricity is sold to various towns, including Berlin, to the German Railway corporation and to industrial centres; part is supplied to the concern's own aluminium and cyanimide works.

The aluminium production of the Viag is organized in the Vereinigte Aluminium-Werke A.G., which became the second greatest producer of aluminium in the world. The cyanimide works in Bavaria and Silesia, controlled by the Viag, are of great importance for the production of nitrogenous fertilizers in Germany. The Viag also owns the total share capital of the Reichs-Kredit-Gesellschaft A.G., which developed after World War I to a very active *banque d'affaires,* belonging to the Berlin "big five" banks. Though owned by the government the concern is managed strictly on commercial lines. (H. E. L.)

VERESHCHAGIN, VASSILI VASSILIEVICH (1842–1904), Russian artist and traveller, was born at Tcherepovets, in the government of Novgorod, on Oct. 26, 1842. His father was a Russian landowner of noble birth, and from his mother he inherited Tatar blood. When he was eight years old he was sent to Tsarskoe Selo to enter the Alexander cadet corps, and three years later he entered the naval school at St. Petersburg, making his first voyage in 1858. He graduated first in the list from the naval school, but left the service immediately to begin the study of drawing in earnest. He studied at St. Petersburg and then at Paris under Gérôme. In the Salon of 1866 he exhibited a drawing of "Doukhobors chanting their Psalms," and in the next year he accompanied General Kauffmann's expedition to Turkestan, his military service at the siege of Samarkand procuring for him the cross of St. George. He was an indefatigable traveller—in Turkestan in 1869, the Himalayas, India and Tibet in 1873, and again in India in 1884. After a period of hard work in Paris and Munich he exhibited some of his Turkestan pictures in St. Petersburg in 1874, among them two which were suppressed for the time on the representations of Russian soldiers—"The Apotheosis of War," a pyramid of skulls dedicated "to all conquerors, past, present and to come," now in the Tretiakov Gallery, Moscow, and "Left Behind," the picture of a dying soldier deserted by his fellows. Vereshchagin was with the Russian army during the Turkish campaign of 1877; he was present at the crossing of the Shipka Pass and at the siege of Plevna, where his brother was killed; and he was dangerously wounded during the preparations for the crossing of the Danube near Rustchuk. At the conclusion of the war he acted as secretary to General Skobelev at San Stefano.

After the war Vereshchagin settled at Munich, where he produced his war pictures, which had a didactic aim, so rapidly that he was freely accused of employing assistants. He aroused much controversy by his series of three pictures of a Roman execution (the Crucifixion), of sepoys blown from the guns in India, and of the execution of Nihilists in St. Petersburg. A journey in Syria and Palestine in 1884 furnished him with an equally discussed set of subjects from the New Testament. The "1812" series on Napoleon's Russian campaign, on which he also wrote a book, seem to have been inspired by Tolstoi's *War and Peace,* and were painted in 1893 at Moscow, where the artist eventually settled. Vereshchagin was in the Far East during the Chino-Japanese War, with the American troops in the Philippines, and with the Russian troops in Manchuria. He perished in the sinking of the flagship, "Petropavlovsk," on the 13th of April, 1904.

VERGA, GIOVANNI (1840–1922), Italian novelist, was born at Catania, Sicily. In 1865 he published *Storia di una peccatrice* and *I Carbonari della montagna,* but his literary reputation was established by his *Eva* and *Storia di una capinera* (1869). Other novels followed, *Malavoglia* (1881) and *Maestro Don Gesualdo* (1889 Eng. trans. 1923). His finest work, however, is seen in his short stories and sketches of Sicilian peasantry, *Medda* (1874) and *Vita dei campi* (1880); and his *Cavalleria Rusticana* (Eng. trans. of this and other stories 1928) acquired new popularity from its dramatization and from Mascagni's opera on this subject. Verga and Fogazzaro between them may be said to have faithfully chronicled the inner and popular life of southern and northern Italy. D. H. Lawrence translated many of Verga's works into English. Verga died in Rome on Jan. 27, 1922.

BIBLIOGRAPHY.—Laura Gropallo, *Autori italiani d'oggi—Giovanni Verga, etc.* (1903); L. Russo, *Giovanni Verga* (1920); C. A. Levi, *Autori drammatici italiani, G. Verga, etc.* (1922); N. Scalia, *Giovanni Verga* (1922).

VERGENNES, CHARLES GRAVIER, COMTE DE (1717–1787), French statesman, was born at Dijon on Dec. 20, 1717. He entered the diplomatic service under his uncle M. de Chavigny, at Lisbon. He became ambassador at Constantinople and then in Sweden, where he assisted Gustavus III. in the revolution of 1772.

With the accession of Louis XVI. Vergennes became foreign minister. His general policy was one of friendly relations with Austria, combined with the limitation of Joseph II.'s ambitious designs; the protection of Turkey; and opposition at all points to England. His hatred of England led to his support of the American States in the War of Independence. Vergennes sought to secure the armed neutrality of the Northern Powers eventually carried out by Catherine II.; he ceded to the demands of Beaumarchais that France should secretly provide the Americans with arms and volunteers. In 1777 he informed the American commissioners that France was willing to form an offensive and defensive alliance with the new Republic. In 1781 he became chief of the council of finance. Vergennes died on Feb. 13, 1787.

See P. Fauchelle, *La Diplomatie française et la Ligue des neutres de 1780* (1776–83) (1893); John Jay, *The Peace Negotiations of 1782–83 as illustrated by the Confidential Papers of Shelburne and Vergennes* (New York, 1888); L. Bonneville de Marsangy, *Le Chevalier de Vergennes, son ambassade à Constantinople* (1894); G. Grosjean, *La politique rhénane de Vergennes* (1925).

VERGNIAUD, PIERRE VICTURNIEN (1753–1793), French orator and revolutionist, was born on May 31, 1753 at Limoges. The son of a merchant of that town, he attracted the notice of Turgot, who was then intendant of Limousin. Turgot secured his admission to the college of Plessis in Paris, where he received a solid classical education. On leaving college he became secretary to Duputy, president of the parlement of Bordeaux. Vergniaud was thereafter called to the bar (1782). In 1789 Vergniaud was elected a member of the general council of the department of the Gironde. He was chosen a representative of the Gironde to the National Legislative Assembly in August 1791.

The extremists used the passions which his oratory awakened for objects he did not foresee. This happened even with his first Assembly speech, on the *émigrés.* His proposal was mainly that a treble annual contribution should be levied on their property; but the Assembly confiscated their goods and decreed their deaths. Step by step he was led on to palliate violence and crime, to the excesses of which his eyes were only opened by the massacres of September, and which ultimately overwhelmed the party of Girondists which he led. It has always been held against him that on March 19, 1792, when the perpetrators of the massacre of Avignon had been introduced to the Assembly by Collot d'Herbois, Vergniaud spoke indulgently of their deeds and lent

the authority of his voice to their amnesty. In language sometimes turgid, but nearly always of pure and powerful eloquence, he worked at the theme of the *émigrés,* as it developed into that of the counter-revolution; and the project of an address to the French people which he presented to the Assembly on Dec. 27, 1791, shook the heart of France; and, especially by his call to arms on Jan. 18, he shaped the policy which culminated in the declaration of war against the king of Bohemia and Hungary on April 20. This policy in foreign affairs, which he pursued through the winter and spring of 1791–92, he combined with another—that of fanning the suspicions of the people against the monarchy, which he identified with the counter-revolution, and of forcing on a change of ministry. On March 10, Vergniaud delivered a powerful oration in which he denounced the intrigues of the court and uttered his famous apostrophe to the Tuileries: "In ancient times fear and terror have often issued from that famous palace; let them re-enter it to-day in the name of the law!" The speech overthrew De Lessart, whose accusation was decreed; and Roland, the nominee of the Girondists, entered the ministry. The Mountain used Vergniaud, whose lofty and serene ideas they applauded and travestied in action. Then came the riot of June 20, and the invasion of the Tuileries. He rushed among the crowd, but was powerless to quell the tumult. But his speeches breathe the very spirit of the storm, and they were perhaps the greatest single factor in the development of the events of the time. On Aug. 10, the Tuileries was stormed, and the royal family took refuge in the Assembly. Vergniaud presided. To the request of the king for protection he replied in dignified and respectful language.

On Dec. 31, 1792, Vergniaud delivered one of his greatest orations. He pictured the consequences of that temper of vengeance which animated the Parisian mob and was fatally controlling the policy of the Convention, and the prostration which would ensue to France after even a successful struggle with a European coalition, which would spring up after the murder of the king. On Jan. 16, 1793, the vote began to be taken in the Convention upon the punishment of the king. Vergniaud voted early, and voted for death. The action of the great Girondist was and will always remain inscrutable, but it was followed by a similar verdict from nearly the whole party which he led. On the 17th Vergniaud presided at the Convention, and it fell to him to announce the fatal result of the voting. Then for many weeks he was silent.

When the institution of a revolutionary tribunal was proposed, Vergniaud vehemently opposed the project, denouncing the tribunal as a more awful inquisition than that of Venice, and avowing that his party would all die rather than consent to it. Their death by stratagem had already been planned, and on March 10 they had to go into hiding. On the 13th Vergniaud boldly exposed the conspiracy in the Convention. The antagonism caused by such an attitude had reached a significant point when on April 10 Robespierre himself laid his accusation before the Convention. He fastened especially upon Vergniaud's letter to the king and his support of the appeal to the people as a proof that he was a moderate in its then despised sense. Vergniaud made a brilliant extemporaneous reply, and the attack for the moment failed. But now, night after night, Vergniaud and his colleagues found themselves obliged to change their abode, to avoid assassination, a price being even put upon their heads. Still with unfaltering courage they continued their resistance to the dominant faction, till on June 2, 1793, things came to a head. The Convention was surrounded with an armed mob, who clamoured for the "twenty-two." In the midst of this it was forced to continue its deliberations. The decree of accusation was voted, and the Girondists were proscribed.

Vergniaud was offered a safe retreat. He accepted it only for a day, and then returned to his own dwelling. He was kept under surveillance there for nearly a month, and in the early days of July was imprisoned in La Force. The Girondists appeared before the Revolutionary tribunal on Oct. 27. Early on the morning of Oct. 31, 1793, they went to the scaffold. Vergniaud was executed last. He died unconfessed, a philosopher and a patriot.

See Gay de Vernon, *Vergniaud* (Limoges, 1858); and L. de Verdière, *Biographie de Vergniaud* (Paris, 1866); E. Lentilhac, *Vergniaud, Le drame des Girondins* (1920). (SH.; X.)

VERHAEREN, ÉMILE (1855–1916), Belgian poet, born at St. Amand, near Antwerp, on May 21, 1855, studied at Ghent and at the university of Louvain, and was admitted to the bar at Brussels in 1851. But he soon devoted his whole energies to literature, and especially to the organs of "young Belgium," *La Jeune Belgique* and *L'Art moderne,* making himself especially the champion of the impressionist painters. Verhaeren learned his art of poetry from the great Flemish artists, and in his early works, *Les Flamandes* (1883), and *Les Moines* (1886) displays similar qualities of strength, sometimes degenerating into violence and even into coarseness. A period of despair and disillusionment is reflected in his *Les Soirs* (1887), *Les Débâcles* (1888), *Les Flambeaux noirs* (1889) and *Les Apparus dans mes chemins* (1891). Wandering over Europe from 1887 to 1892, Verhaeren found a new interest in social problems, and his *Campagnes hallucinées* (1893) and *Les Villes tentaculaires* (1895) both deal with the growth of industrialism and its evils.

A genuine optimism based on an appreciation of the greatness of human life and progress appears in *Les Visages de la vie* (1899), *Les Forces tumultueuses* (1902) and *La Multiple Splendeur* (1906), and a delight in natural beauty runs through his chief work *Toute la Flandre,* a collection of lyrics in 5 vols. (1904–11), the first volume dealing with the memories of his boyhood, *Les tendresses premières,* being the best. The others describe: the Flemish coast, *La Guirlande des dunes;* various episodes of Flemish history, *Les héros;* life in the small towns, *Les villes à Pignons;* and the Flemish countryside, *Les plaines* and *Les blés mouvants.* In 1911 Verhaeren published *Les heures du soir,* a series of intimate poems dedicated to his wife, completing two previous series *Les heures de l'après-midi* (1905) and *Les heures claires* (1896). During World War I, the poet wrote *Les ailes rouges de la guerre* (1916) which contains an ode to Rupert Brooke, and two short volumes of prose, *La Belgique sanglante* (1915, Eng. trans. 1915), and *Parmi les cendres* (1916). He died on Nov. 27, 1916, a victim of a railway accident in Rouen station.

Among Verhaeren's subsidiary activities may be mentioned his critical studies, some of which have been published as *Impressions* (Paris, 1927), and his plays, *Les Aubes* (1898), *Le Cloître* (1900, Eng. trans. 1915), *Philippe II* (1901) and *Hélène de Sparte* (1912), translated in 1916.

A selection of his poems has been translated by M. Strettell (2nd ed. 1915) and his *Love Poems* by F. S. Flint (1916). *See* also L. Bazalgette, *É. Verhaeren* (1907); S. Zweig, *É. Verhaeren* (Eng. trs. 1914); A. Mockel, *Un Poète de l'énergie, É. Verhaeren* (1917); J. de Smet, *É. Verhaeren,* 2 vols. (1909–20); L. Charles-Baudouin, *Le Symbole chez Verhaeren* (4th ed. 1924), and P. Mansell Jones, *É. Verhaeren* (Cardiff, 1926, bibliography).

VERKHNE-UDINSK: *see* ULAN UDE.

VERLAINE, PAUL (1844–1896), French lyric poet, was born at Metz on March 30, 1844. He was the son of one of Napoleon's soldiers, who had become a captain of engineers. Paul Verlaine was educated in Paris, and became clerk in an insurance company. He was a member of the Parnassian circle, with Catulle Mendès, Sully Prudhomme, François Coppée and the rest. His first volume of poems, the *Poèmes saturniens* (1866), was written under Parnassian influences, from which the *Fêtes galantes* (1869), as of a Watteau of poetry, began a delicate escape; and in *La Bonne Chanson* (1870) the defection was still more marked. He married in 1870 Mlle. Mautet. During the Commune he was involved with the authorities for having sheltered his friends, and was obliged to leave France. In 1871 the strange young poet Jean Arthur Rimbaud came somewhat troublingly into his life, into which drink had already brought a lasting disturbance.

With Rimbaud Verlaine wandered over France, Belgium, England, until a pistol-shot, fortunately ill-aimed, against his companion brought upon him two years of imprisonment at Mons. Solitude, confinement and thought converted a pagan into a Catholic, without, however, rooting out what was most human in the pagan; and after many years' silence he published *Sagesse* (1881), a collection of religious poems, which, for humble and passionate conviction, as well as originality of poetic beauty, must be ranked with the finest religious poems ever written. *Romances sans*

paroles, composed during the intervals of wandering, appeared in 1874, and shows us Verlaine at his most perfect moment of artistic self-possession, before he has quite found what is deepest in himself. He returned to France in 1875. His wife had obtained a divorce from him, and Verlaine made another short stay in England, acting as a teacher of French. After about two years' absence Verlaine was again in France. He acted as teacher in more than one school and even tried farming. The death of his mother, to whom he was tenderly attached, dissolved the ties that bound him to "respectable" society. During the rest of his life he lived in poverty, often in hospital, but always with the heedless and unconquerable cheerfulness of a child. After a long obscurity, famous only in the Latin Quarter, among the cafés where he spent so much of his days and nights, he enjoyed at last a European celebrity. In 1894 he paid another visit to England, this time as a distinguished poet. He died in Paris on Jan. 8, 1896.

His 18 volumes of verse (among which may be further mentioned *Jadis et naguère,* 1884; *Amour,* 1888; *Parallèlement,* 1889; *Bonheur,* 1891) vary greatly in quality. (A. Sy.)

His *Oeuvres complètes* were published in 1899 and in later editions, and his *Oeuvres posthumes* in 1903. His *Poètes maudits* (1888) and *Confessions* (1895) throw light on his own life. A bibliography of Verlaine, with an account of the existing portraits of him, is included in the *Poètes d'aujourd'hui* (11th ed., 1905) of A. van Bever and P. Léautaud. *See* monographs by C. Morice (1888), M. Dullaert (Ghent, 1896), B. E. Delahaye (1919), and H. Nicolson (1921); E. Lepelletier, *Paul Verlaine, sa vie, son oeuvre* (1907, Eng. trans. 1909); F. A. Cazals and G. Le Rouge, *Les Derniers Jours de P. Verlaine* (1923); L. Eckhoff, *P. Verlaine og Symbolismen* (Oslo, 1923).

VERMEER, JAN VAN DELFT or Jan van der Meer (1632–1675), Dutch artist, was born in Delft on Oct. 31, 1632, and was a pupil of Carel Fabritius, whose junior he was by only eight years. In 1653 he married Catherine Bolens, and entered the gild of St. Luke of Delft, becoming one of the heads of the gild in 1662 and again in 1670. He died at Delft on Dec. 15, 1675, leaving a widow and eight children. At his death he left 26 pictures undisposed of, and his widow had to apply to the court of insolvency to be placed under a curator, who was Leeuwenhoek, the naturalist. For more than two centuries Vermeer was almost completely forgotten, and his pictures were sold under the names of the more popular De Hooch, Metsu, Ter Borch, and even of Rembrandt. Attention was recalled to this most original painter by Thoré (pseudonym, W. Bürger), an exiled Frenchman, who described his works in *Musées de la Hollande* (1858–60).

Vermeer's pictures are rarely dated, but one of the most important, in the Dresden gallery, bears the date 1656, and thus gives us a key to his styles. With the exception of the "Christ with Martha and Mary" in the National Gallery of Scotland, Edinburgh, it is perhaps the only one, hitherto recognized, that has figures of life size. The Dresden picture of a "Woman and Soldier," with two other figures, is painted with remarkable power and boldness; for strength and colour it more than holds its own beside the neighbouring Rembrandts. To this early period of his career belong, from internal evidence, the "Reading Girl" of the same gallery, the luminous and masterly "View of Delft" in the museum of The Hague, the "Milk-Woman" and the small street view, both identified with the Six collection at Amsterdam, and now in the Rijksmuseum; the magnificent "The Letter" also at Amsterdam, "Diana and the Nymphs" at The Hague gallery and others. In all these we find the same brilliant style and vigorous work, a solid impasto, and a crisp, sparkling touch. His first manner seems to have been influenced by the pleiad of painters circling round Rembrandt, a school which lost favour in Holland in the last quarter of the century. During the final ten or 12 years of his life Vermeer adopted a second manner. We now find his painting smooth and thin, and his colours paler and softer. Instead of masculine vigour we have refined delicacy and subtlety, but in both styles beauty of tone and perfect harmony are conspicuous. Through all his work may be traced his love of lemon-yellow and of blue of all shades. Of his second style typical examples are to be seen in "The Coquette" of the Brunswick gallery, in the "Woman Reading" in the Van der Hoop collection now at the Rijksmuseum at Amsterdam, in the "Lady at a Casement" in the Metropolitan Museum of Art at New York, and in the "Music Master and Pupil" belonging to the King (exhibited at the Royal Academy, 1876).

Vermeer's authentic pictures in public and private collections amount to 37. There is but one in the Louvre, the "Lace Maker"; Berlin has three, all acquired in the Suermondt collection, and the Czernin gallery of Vienna possesses a picture of the artist in his studio.

In the Arenberg gallery at Meppen and in The Hague Museum there are two remarkable heads of girls.

See Thoré, a monograph in *Gazette des Beaux Arts* (1866); Harvard, *Van der Meer* (1888); Hofstede de Groot, *Jan Vermeer von Delft* (Leipzig, 1909); E. V. Lucas, *Vermeer, the Magical* (1929).

VERMES, the term used by Linnaeus to include all invertebrates except insects. Restricted and modified by subsequent authors, and considered by many to be obsolete, it remains in use in the 20th century, as in Kükenthal and Krumbach's *Handbuch der Zoologie,* and comprises a heterogenous assemblage of segmented and unsegmented wormlike animals.

Consult L. Hyman, *The Invertebrates,* Ch. 1. (G. E. P.)

VERMICELLI: *see* Macaroni.

VERMIGLI, PIETRO MARTIRE, generally known as Peter Martyr (1500–1562), born at Florence on May 8, 1500, was son of Stefano Vermigli, a follower of Savonarola, by his first wife, Maria Fumantina. Educated in the Augustinian cloister at Fiesole, he was transferred in 1519 to the convent of St. John of Verdara near Padua, where he graduated D.D. about 1527 and made the acquaintance of the future Cardinal Pole. In 1530 he was elected abbot of the Augustinian monastery at Spoleto, and in 1533 prior of the convent of St. Peter *ad Aram* at Naples. About this time he read Bucer's commentaries on the Gospels and the Psalms and also Zwingli's *De vera et falsa religione;* and his Biblical studies began to affect his views. He was accused of erroneous doctrine, and the Spanish viceroy of Naples prohibited his preaching.

The prohibition was removed on appeal to Rome, but in 1541 Vermigli was transferred to Lucca, where he again fell under suspicion. Summoned to appear before a chapter of his order at Genoa, he fled in 1542 to Pisa and thence to another Italian reformer, Bernardino Ochino, at Florence. Ochino escaped to Geneva, and Vermigli to Zürich, thence to Basel, and finally to Strasbourg, where, with Bucer's support, he was appointed professor of theology and married his first wife, Catherine Dammartin of Metz.

Vermigli and Ochino were both invited to England by Cranmer in 1547, and given a pension of forty marks by the government. In 1548 Vermigli was appointed regius professor of divinity at Oxford. In 1549 he took part in a great disputation on the Eucharist.

He had abandoned Luther's doctrine of consubstantiation and adopted the doctrine of a Real Presence conditioned by the faith of the recipient. This was similar to the view now held by Cranmer and Ridley, but it is difficult to prove that Vermigli had any great influence in the modifications of the Book of Common Prayer made in 1552. He was consulted on the question, but his recommendations seem hardly distinguishable from those of Bucer, the effect of which is itself disputable. He was also appointed one of the commissioners for the reform of the canon law.

On Mary's accession Vermigli returned to Strasbourg, where he was reappointed professor of theology, but his increased alienation from Lutheranism drove him to Switzerland. He was professor of Hebrew at Zürich, where he died on Nov. 12, 1562.

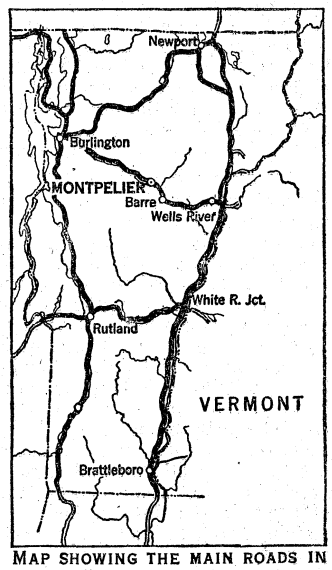
Josias Simler's *Oratio,* published in 1563 and translated into English in 1583, is the basis of subsequent accounts of Vermigli. The best lives are by F. C. Schlosser (1809) and C. Schmidt (1858). *See* also Parker Soc. Publ. (General Index), especially the Zürich *Letters,* Strype's *Works;* Foxe's *Acts and Monuments;* Burnet's *Hist.,* ed. Pocock (1865); Dixon's *History* (6 vols., 1878–1902); and *Dict. of Nat. Biogr.* lviii. 253–256.

VERMILLION, a city of South Dakota, U.S.A., and county seat of Clay county. Pop. 1940 Federal census, 3,324. A trading post was established here soon after the first steamboat came up

the Missouri river in 1832, and numerous settlers came before the public land was thrown open in 1859. The city was incorporated in 1877. A monument marks the site of the first school building erected in the State. The university was established (and located in Vermillion) by the first Territorial Legislature of Dakota in 1862, but was not opened until 1882. The enrolment in 1940 was 933.

VERMONT, the Green Mountain State, so named from the evergreen forests of its mountains, is a North Atlantic State of the United States of America, and the most north-westerly of the so-called New England group. It is situated between 42° 44′ and 45° 0′ 43″ N. lat. and 71° 28′ and 73° 26′ W. longitude. It is bounded north by the Canadian province of Quebec, east by New Hampshire, from which it is separated by the Connecticut river, south by Massachusetts, and west by New York, from which it is separated for about two-thirds the distance by Lake Champlain. In length, north and south, the State measures 157·6 mi.; its approximate width at the northern border is 90 mi., at the southern border 40 miles. Its total area is 9,609 sq.mi., and of this 331 sq.mi. is water surface.

Physical Features.—The mean elevation of the State above the sea is approximately 1,000 ft., extremes varying from 95 ft., the surface of Lake Champlain, to 4,406 ft. at the summit of Mt. Mansfield, 25 m. E. of that lake. The general surface is much broken by mountain ranges. The most prominent feature is the Green mountains, which extend nearly north and south through the State a little west of the middle. Farther north, the Green mountains are cut deep by the Winooski and Lamoille rivers which rise to the east and break through it to flow into Lake Champlain. The Missisquoi river also rises east of the range but flows just north of the Canadian boundary, and then back into Vermont and west to Lake Champlain. The crest line of the Green mountains is generally more than 2,000 ft. high, with the following summits: Mt. Mansfield, 4,406 ft.; Killington Peak, 4,241 ft.; Mt. Ellen, 4,135 ft.; Camel's Hump, 4,083 ft.; and Mt. Abraham, 4,052 ft. Distributed along the eastern border of the state are conical shaped mountain masses. Mt. Ascutney rises abruptly from the floor of the Connecticut valley to a height of 3,320 feet. Other prominent peaks are Jay Peak, Burke and Belvidere mountains. In the southern half of Vermont and near the western border are the Taconic mountains, a range nearly parallel with the Green mountains and extending northward toward the centre of the State. To the northward of the Taconic ranges extends a series of broken uplifts known as the Red Sandrock mountains. These are near Lake Champlain, and, standing in a low country, are unusually conspicuous. The least broken section of Vermont is on the somewhat gentle slope of the Green mountains in the northwest and on Grand isle, North Hero island and Isle La Motte in Lake Champlain. The forms of Vermont's mountains, even to the highest summits, were to a great extent rounded by glaciation, but as the rocks vary much in texture and are often steeply inclined, stream erosion has cut valleys deep and narrow, often mere gorges. The Green Mountain club, since 1910, has been building a well marked "Long Trail" reaching from Massachusetts to Canada which follows the Green mountain range.



MAP SHOWING THE MAIN ROADS IN VERMONT

Lake Champlain lies in a beautiful valley between the Green and Adirondack mountains, and a little more than half its area is in Vermont. The lake is about 118 m. long, and in its northern portion are numerous islands which are attractive resorts during the summer season. These islands are large enough to constitute an entire county in themselves, and are connected with each other and with the mainland by bridges. On the north border of the State is Lake Memphremagog with islands, a rugged prominence known as Owl's Head on its west border, Jay Peak farther back, and a beautiful farming country to the eastward. The lake is 30 m. long and from 1 to 4 m. wide but two-thirds of its area lies in Canada. The Vermont tributaries to Memphremagog are the Barton and the Black rivers from the south and the Clyde river from the east. There are many other lakes and ponds in the State, the section in which they are most numerous being the north-eastern part. Here Willoughby lake is one of the largest and one of the most beautiful, lying as it does in a narrow valley between Mt. Pisgah and Mt. Hor. Lakes Morey and Fairlee, in the Connecticut river valley, are popular resorts. Lake Dunmore in Salisbury and Leicester, Lake Bomoseen in Castleton, and Hubbardton, Lake St. Catherine in Wells and Poultney and Lake Hortonia in Sudbury, west of the Green mountains, are noted for the charm of their scenery.

Most important of the Vermont tributaries of the Connecticut river are the Nulhegan, Passumpsic, Wells, Waits, Ompompanoosuc, White, Ottauquechee, Black, Williams, Saxtons, West and Deerfield, the last-named emptying into the Connecticut in Massachusetts. The south-western part of the State is drained to the Hudson river by the Battenkill and Hoosac rivers, while Otter creek flows north and slightly west to Lake Champlain. The streams are usually swift-flowing and in comparatively narrow and beautiful valleys. On the headwaters of the Deerfield are great power developments. In the valleys are soils of great fertility, while the low rolling hills and uplands make excellent pasture. On the lower slopes of the mountains are white pine and hemlock; on the higher slopes spruce and fir are common. Among deciduous trees the State is especially noted for its sugar maples. Birch and beech are to be expected on the hills and in the lower areas oak, elm, hickory, ash, poplar, basswood, willow and butternut are to be found. Among indigenous fruit-bearing trees, shrubs, vines and plants are the plum, cherry, grape, blackberry, raspberry, cranberry and strawberry. There were in 1940, 34 state forests and state forest parks with an area of 71,986 ac. These were patrolled by the state forest service which since its establishment in 1909 has done much reforestation.

The temperature, the amount of moisture and the winds are favourable to the health of the people and to the productiveness of the soil. The mean annual temperature varies from 40° to 47° F., the eastern part of the State being generally colder than the western part, and the mountainous part of the centre coldest of all. The average annual precipitation over a long period of years is approximately 37·5 inches. Snow often appears in November in the higher altitudes but does not come to stay before December. It remains until the latter part of March. The average fall throughout the State is about 90 in. annually, but there is less snow near Lake Champlain and in the south-western part than in central and eastern Vermont. Also spring comes earliest in these sections and in the lower portion of the Connecticut valley.

Population.—The population of Vermont in 1790 was 85,425; in 1850, 314,120; in 1910, 355,956; and in 1940, 359,231, or 0·1% less than in 1930. Of the 1940 population, 123,239, or 34·3%, lived in urban places, that is, in cities and villages of 2,500 or more; and 99·9% of the total were white. The population of the state and of its principal cities is summarized in the following table:

Area	Population			Per cent of increase	
	1940	1930	1920	1930–40	1920–30
The State	359,231	359,611	352,428	—0·1	2·0
Urban	123,239	118,766	109,976	3·8	8·0
Rural	235,992	240,845	242,452	—2·0	—0·7
Per cent urban	34·3	33·0	31·2	..	..
Principal cities:					
Burlington	27,686	24,789	22,779	11·7	8·8
Rutland	17,082	17,315	14,954	—1·3	15·8
Montpelier	8,006	7,837	7,125	2·2	10·0

Government.—The state is governed under a constitution

adopted in 1777, but since amended in important respects. An amendment in 1870 provided that every ten years the senate, by a two-thirds vote, is authorized to propose amendments, which proposals, if concurred in by the majority of the members of the house of representatives, are published in the principal newspapers of the state. If they are again approved by a majority of each house in the next succeeding general assembly, they are submitted to a direct popular vote, a majority of the votes cast being decisive. The amendment sessions are those in years ending with the figure one, such as 1921, 1931, etc. In the 1921 session 21 proposals were submitted to the senate of which four ultimately became part of the constitution. The right of suffrage is possessed by all citizens above 21 years of age who have lived in the state for one year, and who are "of a quiet and peaceable behaviour" and will take the freeman's oath.

The legislative department consists of a senate of 30 members, apportioned among the counties according to population, but with the proviso that each county must have at least one senator, and a house of representatives of 248 members, one from each township. The members of both houses are elected biennially. Sessions are also held biennially beginning on the first Wednesday after the first Monday of January in odd-numbered years. The governor has power to call special sessions when he deems it necessary. The most important executive officers of the state are the governor, lieutenant governor, secretary of state, treasurer, auditor of accounts and attorney general, all elected by the people for terms of two years. In 1923 and later there were created ten administrative departments, each presided over by a commissioner or other officer. They are: agriculture, education, highways, motor vehicles, public service, industrial relations, public health, conservation and development, public welfare, military.

The supreme court consists of one chief justice and four associate justices. Annually five general terms are held at Montpelier and special sessions at St. Johnsbury, Rutland and Brattleboro. The supreme court justices are elected biennially by the senate and house of representatives in joint session. At the same session, in like manner, six superior judges are elected for two year terms to preside over the county courts to which they are assigned. A superior judge has two assistant judges in each county who are elected by the freemen of that county, and these three compose the county court, two sessions of which are held annually in each county.

Finance.—Vermont is not a wealthy state, being mainly agricultural, with no large concentration of population, but its occupational life is steady, the people frugal, and extremes of wealth and poverty are not marked. State and individual budgets have a habit of balancing.

The gross receipts of the state treasury for the fiscal year ending June 30, 1940, amounted to $19,779,497.40. Disbursements for the same period were $16,567,003.26. The balance in the treasury at the end of the fiscal year was $3,212,494.14. Of the receipts, $7,226,438.23 was provided by taxes and $12,553,059.17 by miscellaneous sources, including $2,599,272.70 in motor vehicle and other fees, $2,010,063.78 from the earnings of departments, $1,942,601 from federal grants. Among the chief sources of revenue from taxes were income, $806,131.02; liquor, $611,759.25; cigarettes, $501,266.02; old-age assistance, $402,277.50.

The trend of government assistance, which rose between 1915 and 1940 from about $1,500,000 to about $15,000,000, continued to expand upward, but the state was in 1941 in sound financial condition and improved methods in the supervision of collecting and expending funds were being employed. The state debt in 1940 was $8,544,031.90, of which $3,825,000 represented 1927 flood bonds, $1,700,000 1938 storm bonds and $488,000 1919 war bonds.

There were on Dec. 31, 1939, 42 state banks and 43 national banks in Vermont, with 12 co-operative savings and loan associations and two federal associations. The total assets and liabilities of the state banks were $133,682,223.91. The total resources of the state savings and loan associations were approximately $4,000,000. Another $2,300,000 was represented by the federal savings and loan associations, while the capital in the national banks stood at about $5,250,000.

Education.—The public school system is directed by the board of education, and administered by the commissioner of education, assisted by superintendents in each district. Attendance is compulsory for all children between 8 and 16 years of age. Vermont was the first state, in 1777, to make constitutional provision for a complete state system of education. The idea of state support has long been accepted. In 1857 the state was bearing 35.4% of the educational expense; in 1939, 13.3%. To every district having a grand list of $10,000 or less, which contributes 17 cents on the grand list for school costs, the state guarantees an additional amount sufficient to provide $15 per equated pupil. Districts having a grand list larger than $10,000 have their state aid reduced according to definite percentages set by law. Thus educational opportunities are more nearly equalized. The total number of teachers in the state during 1939–40 was 2,745, of which 2,337 were women and 408 men. Of the total number 673 were teaching in high schools, 2,072 in the grades. The median salary for all elementary teachers, based on a study made in 1937–38, was $735. From 1931 to 1938 the median age of rural teachers increased 4.3 years, that of grade teachers 2.7 years.

There are normal school courses given at the University of Vermont, and in normal schools at Castleton, Johnson and Lyndon. One-year teachers' training courses are given in some of the high schools. In 1922 high school graduation was made a requirement for entering all the various normal courses offered by the state.

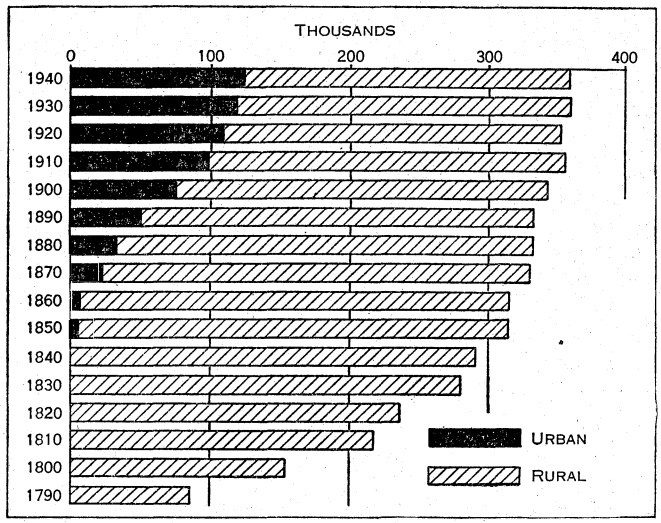
The University of Vermont, chartered by the state in 1791, occupies a 75-ac. campus on a hill overlooking the city of Burlington and the Champlain valley. It is composed of an arts and sciences college, college of engineering, college of medicine and college of agriculture. Its libraries, containing about 150,000 volumes and 50,000 pamphlets, constitute the largest collection of books in the state. Middlebury college, at Middlebury, chartered in 1800, is a liberal arts college of excellent standing. Norwich university at Northfield is a high ranking military college at which engineering courses and military training are emphasized. Bennington college for women is at Bennington. Trinity, a Roman Catholic college for women, is at Burlington, and St. Michael's, for men, at Winooski park. There are three junior colleges and a state school of agriculture.

Charities and Correction.—The department of public welfare is charged with the scientific treatment and care of the state's unfortunates. It also has charge of administration of the state charitable and penal institutions, which are as follows: School for Feeble-minded Children at Brandon; the Weeks School for Delinquent Boys and Girls at Vergennes; State Prison and House of Correction for Men at Windsor; State Prison and House of Correction for Women at Rutland; Hospital for the Insane at Waterbury; the Vermont Sanatorium for Incipient Tuberculosis at Pittsford; Washington County tuberculosis sanatorium at Barre; Kinstead Receiving home for dependent and neglected children at Montpelier. Semi-state institutions are Brattleboro Retreat for the insane; Austine institution, Brattleboro, for the deaf; Soldiers' home, Bennington; Caverly preventorium, Pittsford, for undernourished or tubercular children.

Agriculture and Livestock.—Of the total land area of the state —approximately 5,937,920 ac.—61.8% or 3,666,835 ac. was in farm land in 1940, and of this 1,022,581 ac. represented crop land harvested. This was divided among 23,582 farms, as compared with 27,061 farms in 1935 and 24,898 farms in 1930. The average size of farms was 155.5 ac. In classifying the farm land of the state the acreage was about evenly distributed in 1939 among (1) crop land, (2) woodland, (3) pasture and other land, with woodland being slightly predominant. There were 19,342 full owners of farms in the state in 1940; 1,610 part owners and 2,344 tenants, showing a decade decrease. The value of land and buildings was estimated at $145,935,241 in 1930; $115,996,472 in 1935, and $111,108,534 in 1940. Between 1930 and 1940 land decreased nearly $19,000,000 in value, the value of buildings nearly $6,000,000 and implements and machinery $4,000,000. The average value per farm of land and buildings was $9,301 in 1930; $5,950 in 1935; $7,867 in 1940. The general picture shows a shrinkage in the number of farms in the state during the decade 1930–40, with their size remaining about the same, and a corresponding drop in valuation of the property.

Dairying is the most important agricultural industry in the state. More than 30 years ago Vermont enacted a law designed to protect its dairy farmers against losses through the sale of their products to financially irresponsible purchasers, and this bonding law is proving of much protective value. A uniform inspection law which places dairy farms producing milk for local consumption under state instead of local inspection has worked out favourably. The state became a bovine tuberculosis free area in 1936, and the struggle was then transferred to Bang's disease and mastitis. In 1940 there were 84 licensed creamery companies in the state, operating 137 dairy plants. More than 5,000 dairy farm inspections were made by state inspectors during 1939–40 for the purpose of assisting producers to qualify for out-of-state shipping permits. The total fluid milk distribution of the state in 1939 was 1,092,448,999 lb.

The hay crop is the most important in Vermont, as it is of vital necessity to the dairy industry. But, Vermont farmers are variety producers, and potatoes, corn and northern grains are to be found on almost every farm. Considerable experimentation is being done with soybeans. Poultry raising is on the increase in the state. The fresh egg law under which eggs must be strictly classified according to their quality and sold on their merits is a benefit to producers and an incentive to expansion. Vermont-labelled turkeys are popular on the market. Vermont apples also are receiving the benefits of grading and supervision. Bee-keeping in Vermont as compared with the industry in many other states is a small but old enterprise. In 1940 there were about 10,000 colonies of bees in the state, kept by more than 1,000 small and large beekeepers. The maple industry of the state suffered severely in the hurricane of 1938, but about one-third of the 1,354,000 trees blown down, according to farms reporting on the loss, was replaced by young trees coming into production or old trees brought back into production. New trees are not used for tapping until they are approximately 40 years old. Many other farm crops, buildings and equipment were also damaged by the storm at an estimated grand total loss of $7,622,000. A more chronic source of loss to Vermont farmers is stream-bank erosion, and the State Soil Conservation committee was in 1941 actively engaged on the problem.



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URBAN AND RURAL POPULATION OF VERMONT: 1790–1940

Mines and Quarries.—The mineral wealth of the state except for talc mines comes entirely from quarries. The leading products in 1939–40 were granite and marble, slate, clay products, asbestos, limestone and dolomite, talc, mica and garnet. The total value of these products exceeded $12,000,000. Other products included soapstone, jasper, sand, gravel and crushed stone. The Vermont asbestos industry reached a new high point in 1939, with the state producing more than all of the other states combined. In the southwest section of the state are enormous deposits of China clay, once productive, on which researches are being conducted to find a substitute for English China clay, imports of which became restricted by the war which began in Europe in 1939. Vermont's largest mineral industry is granite, constituting, on a dollar valuation, about 60% of her mineral production. In 1939 the industry showed an improvement; the state stood first in dollar value, with $1,909,895, of which $1,849,890 was for monumental stone, but the business was still in a depressed condition. The quarrying centre is at Barre. For many years Vermont stood first in marble production, but the industry was seriously affected by the downward prosperity curve. The total production in 1938 of all classes of marble was 223,574 cu.ft., valued at $1,324,677, and in 1939 the production was 269,752 cu.ft., valued at $1,533,824. The chief marble and slate belts are in Rutland county, the slate belt running along the western border and extending into New York state. In 1939 Vermont stood second in the production of slate, showing an increase of 26% in quantity and 29% in value over 1938, but, through lack of sectional organization, the business was operating at only about 40% of normal. A large variety of colours is found: various greens, purples, variegated, mottled and freak colours. Vermont rated second in tonnage production of talc and soapstone in 1938, but the output was not as high grade as that of some states.

Manufacturing.—Vermont's industrial units are, in general, not large in comparison with those of other states with denser centres of population, more convenient markets and greater facilities for production, but limited production has perhaps been conducive to quality production.

From 1900 to 1914 manufacturing increased slowly in the state, but during the World War of 1914–18 expansion was rapid. In 1919 products amounted in value to $168,108,000, and there were 33,491 wage earners. Another production peak was reached in 1929, followed by an economic depression which reached its depth in 1933.

Granite and marble form two of the largest industries in Vermont. There are about 120 granite manufacturing plants. In the 101 plants of the Barre district approximately 2,750 men were employed in 1941, with an annual pay roll of some $5,200,000. During 1939 and 1940 $330,000 was spent on suction equipment to preserve the health of these men. The valuation of the business in the Barre area for 1939 amounted to $7,104,142.50. The total quarry output of rough stock in that year amounted to 614,256 cu.ft. About 500,000 cu.ft. of quarried marble and 275,000 cu.ft. of the finished product, at a valuation of $2,000,000, constitutes an average year in the marble industry. High-grade machine tools are manufactured in Springfield, Windsor and other points of the state, giving employment to 8,000 people previous to the 1941 war boom. In 1939 there were 31 textile plants, notably wool and cotton, providing work for 6,000 persons. The manufacture of paper, distributed in several localities throughout the state, supplies employment for 1,500 individuals. The total circulation of the ten Vermont daily newspapers, taking care of 400 employees, numbers from 65,000 to 75,000, and the 51 weekly papers and job printers employ about 600 more. Around 1,200 persons are engaged in dairy plants, handling wholesale milk, cream, butter, cheeses, condensed milk, milk powder, ice cream and casein. Perhaps 1,100 workers are absorbed by scattered furniture and woodworking shops. Among the other important industries are the manufacture of scales, employing about 1,000 workmen, slate, rubber goods, garden tools, organs, paints, hosiery, cereals, dyes, clothespins and roofing. The principal industrial centres are Barre, Bellows Falls, Bennington, Brattleboro, Burlington, Montpelier, Rutland, St. Johnsbury, Springfield and Windsor.

Transportation.—There has been no railway building since 1910, in which year the mileage was 1,100. In 1937 the mileage was 961. The chief railways are two main lines which run north and south along the western and eastern borders, and four lines which cross the state in a general east and west direction. To cross from west to east at other places is impossible by rail, and there is some difficulty in getting from the southwest corner to points along the Connecticut river toward the northeast. The lack of railway facilities has been overcome to an agreeable extent since 1923 by the establishment of motorbus lines on many of the main highways, and to villages not on the railway lines. There were 1,765 mi. of road in the state highway system in 1936, of which 1,747 mi. were surfaced. Expenditures on the state highway in 1938, including federal aid, amounted to $6,889,000.

A canal connects the head of Lake Champlain with the Hudson river so that through Lake Champlain and its outlet, the Richelieu river, there is an uninterrupted waterway from the St. Lawrence river to New York city harbour, a waterway that is open for navigation at least seven months each year. On Lake Champlain there are steamship lines which regularly serve the chief towns of the lake. A bridge across Lake Champlain, connecting Crown Point, N.Y., with Chimney Point, Vt., was opened on Aug. 26, 1929.

History.—The first white man to visit the region now known as Vermont, so far as the records show, was Samuel Champlain, "Father of New France." Joining an Algonquin war party, on a foray into the Iroquois country, July 4, 1609, he entered the lake which he named Lake Champlain. For well nigh a century and a half the Champlain valley was French territory. The increase of the Iroquois compelled the French in Canada to erect a chain of forts to command the approach by way of Lake Champlain and its outlet, the Richelieu river, the great trunk line highway from the valley of the St. Lawrence river to southern New England and the Hudson valley. As the English settlements in Massachusetts and adjacent colonies grew stronger, the Indians gradually withdrew into Canada, and, sullen and revengeful, were ready to join the French in raids upon the English settlements.

The first permanent English settlement was a blockhouse erected in 1724, in the town of Brattleboro, and known as Ft. Dummer. Later in the same year a group of Dutch squatters settled in the town of Pownal, in the southwestern corner of Vermont. But not until the British captured Canada, in 1760, did the tide of emigration flow into the state. Benning Wentworth, royal governor of New Hampshire, assuming that the rather vague limits of his province, like those of Connecticut and Massachusetts, extended westward to a line 20 mi. east of the Hudson river, proceeded to make grants of land between the Connecticut river and Lake Champlain. From 1749 to 1764 he granted 131 townships and the region was commonly known as the New Hampshire Grants. Lieutenant Governor Colden of New York challenged the right of the New Hampshire executive to grant these lands. For 14 years the ownership of the disputed region was debated and on July 20, 1764, an order of the king in council gave a decision in favour of New York. Thereupon the New York governors proceeded to grant lands in what is now the

State of Vermont.

Following the close of the French and Indian War and prior to the outbreak of the American Revolution, several thousand persons, largely from Connecticut and Massachusetts, had purchased lands in the New Hampshire Grants, had cleared farms, built houses and planted crops. In 1770 a test case was brought in the New York courts, in an ejectment suit, concerning property in the town of Shaftsbury, and the court refused to consider the New Hampshire charter as evidence. Ethan Allen, in charge of the defence, returned to Bennington, where the town voted to protect its rights by force if necessary. A military organization was formed, which came to be known as the Green Mountain Boys, Ethan Allen being its commander. In eastern Vermont New York authority was recognized, and no attempt was made to dispossess settlers, but in western Vermont New York authority was successfully defied. New Hampshire titles were defended.

With the Revolution the Green Mountain Boys, commanded by Ethan Allen, with some aid from Connecticut and Massachusetts, on May 10, 1775, captured the fortress of Ticonderoga, on Lake Champlain. The capture was the first aggressive act on the part of the Americans in the Revolutionary War. Vermonters participated in the invasion of Canada in the autumn of 1775, and Ethan Allen was captured by the British in an unsuccessful attempt to take Montreal.

A rudimentary form of government was maintained through committees of safety. Conventions were held in 1776 looking toward statehood, Ira Allen being active in behalf of a separate government. On Jan. 16, 1777, a declaration of independence was adopted and the name New Connecticut was given the new State. This name was soon abandoned, as it had been used elsewhere, and the name Vermont was substituted. In July 1777, a State Constitution was drafted in a convention held at Windsor. This was the first Constitution adopted by an American State to forbid slavery and to establish manhood suffrage. The new State government was set up in March 1778, with Thomas Chittenden as governor.

The British under Gen. Burgoyne captured the Lake Champlain forts in July 1777, and the rear guard of the American army, retreating from Ticonderoga, was defeated at Hubbardton, Vt., July 7, 1777. In an attempt to capture American stores at Bennington, British detachments under Cols. Baum and Breymann were defeated by an American force, consisting of Vermont, New Hampshire and Massachusetts troops commanded by Gen. John Stark, on Aug. 16, 1777. This was the beginning of Burgoyne's reverses which ended in his surrender to Gen. Gates.

The new State of Vermont continued to function, although opposed by foes at home and abroad. In 1790 New York, under the leadership of Alexander Hamilton, recognized the independence of Vermont conditioned upon the payment of $30,000, and on Mar. 4, 1791, the Green Mountain Commonwealth was the first State admitted to the Union after the original 13.

Settlement was rapid during the latter years of the Revolutionary War. A rough census showed about 7,000 people in the State in 1771. In 1791 the number rose to 85,525. After her declaration of independence the State granted her own lands. In 1779 the legislature planned that they were to be in townships 6 m. square with 70 rights or divisions in each. Five divisions in each were reserved, one for the support of a college, one for a county grammar school, one for an English school, one for the support of preaching and one for the first settled minister. The legislature convened in several of the larger towns of the State until 1808, when the capital was permanently situated at Montpelier.

Many little iron mines were opened, and small forges put in operation with charcoal as fuel. This was an industry which is no longer found. The iron and other businesses were stimulated by the War of 1812. In this war Vermont troops took part in the battles of Chippewa, Lundy's Lane, Lake Erie and Plattsburgh, but the only engagement in the State itself was the defence of Ft. Cassin at the mouth of Otter creek in 1813.

Steady expansion followed. Farm produce and cattle were sold South to older markets. The lumber business began to be developed in the Connecticut valley and along the shores of Lake Champlain where water transportation was available, the demand at first being principally for ship timber. During the winter the lines of sledges took the produce of the Champlain region to Montreal, just as that from the south-western part was taken to Albany, and that from the Connecticut valley to Portsmouth or Boston. The opening of the Champlain canal in 1823, connecting Lake Champlain and the Hudson river, largely increased commerce with New York and diverted trade from Canada. Stage lines began to carry the mail and passengers throughout the State. Many towns to which they went had a larger population in 1820 than in 1920. The decade between 1820 and 1830 was the last one in which there was a marked increase of population in the State. After that many Vermonters were seized with the desire to go west and so they helped to build many of the northern States of the Mississippi valley. Many also went south to the rising industrial centres of Massachusetts and Connecticut. Despite these great losses the population continued to increase, aided in later years by an influx of French Canadians from Canada.

During the Civil War a small band of Confederates crossed the frontier from Canada and raided the town of St. Albans. In 1870 St. Albans was the headquarters of an attempted Fenian invasion of Canada. Sheep raising was an important farm industry before and after the Civil War, but after 1880 declined rapidly because of competition from the Western States and Australia. The Vermont Central, between Windsor and Burlington, and the Rutland from Bellows Falls to Burlington, were completed in 1849. In presidential campaigns the State was Federalist, 1792–1800; Democratic-Republican, 1804–20; Adams-Republican, 1824–28; Anti-Masonic, 1832; Whig, 1836–52; and Republican since 1856.

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VERMOREL, AUGUSTE JEAN MARIE (1841–1871), French journalist, was born at Denicé, France, on June 20, 1841. A radical and socialist, he was attached to the staff of the *Presse* (1864) and the *Liberté* (1866); in 1866 he became editor of the *Courrier Français* and in 1869 of *La Réforme,* being twice imprisoned. He took an active part in the Commune, and was dangerously wounded while fighting at the barricades. He died a prisoner at Versailles, on June 20, 1871.

VERMOUTH. An alcoholic beverage, the basis of which consists of white wine. The wine is fortified with spirit up to a strength of about 15% of alcohol, and is then stored in casks exposed to the sun's rays for a year or two. Another portion of the wine is fortified up to a strength of about 50% of alcohol, and in this various aromatic and tonic materials are macerated in casks which are exposed to the sun in the same way as the bulk of the wine. The two liquids are then mixed in such proportions as to make the strength of the ultimate product about 17% of alcohol by volume. Italian vermouth is sweet in taste and darker than the dry French vermouth.

VERNE, JULES (1828–1905), French author, was born at Nantes on Feb. 8, 1828. After completing his studies at the

Nantes lycée, he went to Paris to study law. About 1848, in conjunction with Michel Carré, he wrote librettos for two operettas, and in 1850 his verse comedy, *Les Pailles rompues*, in which Alexandre Dumas fils had some share, was produced at the Gymnase. For some years his interests alternated between the theatre and the bourse, but some travellers' stories which he wrote for the *Musée des Familles* revealed to him the true direction of his talent—the delineation, viz., of delightfully extravagant voyages and adventures, in which he foresaw, with marvellous vision, the achievements of scientific and mechanical invention of the generation of 1900. "For the last twenty years," said Marshal Lyautey, "the advance of the peoples is merely living the novels of Jules Verne." Verne was a real pioneer in the wide literary genre of *voyages imaginaires*. His first success was obtained with *Cinq semaines en ballon*, which he wrote for Hetzel's *Magazin d'Éducation* in 1862, and thenceforward, for a quarter of a century, scarcely a year passed in which Hetzel did not publish one or more of his amazing stories. The most successful include: *Voyage au centre de la terre* (1864); *De la terre à la lune* (1865); *Vingt mille lieues sous les mers* (1869); *Les Anglais au pôle nord* (1870); and *Voyage autour du monde en quatre-vingts jours*, which first appeared in *Le Temps* in 1872. The adaptation of this last (produced with immense success at the Porte St. Martin theatre on Nov. 8, 1874) and of another excellent tale, *Michael Strogoff* (at the Châtelet, 1880), both written in conjunction with Adolphe d'Ennery, proved the most acceptable of Verne's dramas.

His novels delight by reason of their sparkling style, their picturesque *verve*—inherited from Dumas—their good-natured national caricatures, and the ingenuity with which the love element is subordinated. He was a member of the Legion of Honour, and several of his romances were crowned by the French Academy, but he was never enrolled among its members. He died at Amiens on March 24, 1905. The novels of Jules Verne are dreams come true, dreams of submarines, aeroplanes, television; they look forward, not backward. Therefore they are still the books of youth.

See C. Lemire, *Jules Verne, 1828–1925* (1908); M. Allotte de la Fuÿe, *Jules Verne, sa vie et son oeuvre* (1928).

VERNET, the name of three eminent French painters.

I. Claude Joseph Vernet (1714–1789), who was born at Avignon on Aug. 14, 1714, when only fourteen years of age aided his father, a skilful decorative painter. The sight of the sea at Marseilles and his voyage thence to Civita Vecchia made a deep impression on him, and immediately after his arrival he entered the studio of a marine painter, Bernardino Fergioni. For twenty years Vernet lived on in Rome, producing views of seaports, storms, calms, moonlights, etc., when he was recalled (1753) to Paris, and executed, by royal command, the remarkable series of the seaports of France (Louvre) by which he is best known. He died Dec. 3, 1789.

II. Antoine Charles Horace Vernet (1758–1836), commonly called Carle, the youngest child of the above, was born at Bordeaux in 1758. His first important work, was his "Triumph of Paulus Aemilius"; in this picture he broke with reigning traditions in classical subjects, and drew the horse with the forms he had learnt from nature in stables and riding-schools. The Revolution, and his sister's death on the scaffold, stopped his artistic career. When he again began to produce, it was as the man of another era: his drawings of the Italian campaign brought him fresh laurels; his vast canvas, the "Battle of Marengo," obtained great success; and for his "Morning of Austerlitz" Napoleon bestowed on him the Legion of Honour. His hunting-pieces, races, landscapes, and work as a lithographer (chiefly under the Restoration) had a great vogue. In 1827 he accompanied his son Horace (*see* below) to Rome, and died in Paris on his return, on Nov. 27, 1836.

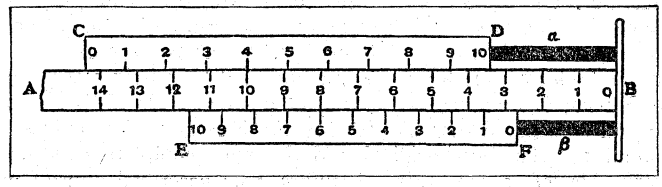
III. Horace Vernet (1789–1863), born in Paris on June 30, 1789, was one of the most characteristic of the military painters of France. He was just twenty when he exhibited the "Taking of an Entrenched Camp"—a work which showed no depth of observation, but was distinguished by a good deal of character. His picture of his own studio (the rendezvous of the Liberals under the Restoration), in which he represented himself painting tranquilly, whilst boxing, fencing, drum- and horn-playing, etc., were going on, in the midst of a medley of visitors, horses, dogs and models, is one of his best works, and, together with his "Defence of the Barrier at Clichy" (Louvre), won for him an immense popularity. He was appointed director of the school of France at Rome, from 1828 to 1835, and thither he carried the atmosphere of racket in which he habitually lived. After his return the whole of the Constantine room at Versailles was decorated by him in the short space of three years. He died at Paris on Jan. 17, 1863.

See Lagrange, *Joseph Vernet et la peinture au XVIIIe siècle* (1861); C. Blanc, *Les Vernet* (1845); A. Dayot, *Les Vernet* (1898).

VERNEUIL, a town of northwestern France. Pop. (1936) 3,871. Verneuil stands on the left bank of the Avre. The church of La Madeleine (11th to 17th century) has the façade flanked by a square tower of the first half of the 16th century. The church contains old stained glass, an ironwork pulpit and other works of art. The church of Notre Dame (12th and 16th centuries) possesses Romanesque stone carvings. The Tour Grise is a cylindrical keep built in 1120 by Henry I.

VERNIER, PIERRE (*c.* 1580–1637), inventor of the instrument which bears his name, was born at Ornans (near Besançon) in Burgundy about 1580. He was for a considerable time commandant of the castle in his native town. In 1631 he published at Brussels a treatise entitled *Construction, usage et propriétés du quadrant nouveau de mathématiques*, in which the instrument associated with his name is described. He died at Ornans in 1637.

VERNIER INSTRUMENT, a measuring device which enables either linear or angular magnitudes to be read with a degree of accuracy many times greater than is possible with a scale as ordinarily divided and subdivided. The principle of the vernier is readily understood from the following figure and illustration.



Let AB (*see* fig.) be the normal scale, *i.e.* a scale graduated according to a standard of length, CD, a scale (placed in contact with AB for convenience) graduated so that 10 divisions equal 11 divisions of the scale AB, and EF a scale placed similarly and graduated so that 10 divisions equal 9 divisions of the scale AB. Consider the combination AB and CD. Obviously each division of CD is $\frac{1}{10}$th greater than the normal scale division. Let α represent a length to be measured, placed so that one end is at the zero of the normal scale, and the other end in contact with the end of the vernier CD marked 10. It is noted that graduation 4 of the vernier coincides with a division of the standard, and the determination of the excess of α over 3 scale divisions reduces to the difference of 7 divisions of the normal scale and 6 divisions of the vernier. This is ·4, since each vernier division equals 1·1 scale divisions. Hence the scale reading of the vernier which coincides with a graduation of the normal scale gives the decimal to be added to the normal scale reading. Now consider the scales AB and EF, and let β be the length to be measured; the scale EF being placed so that the zero end is in contact with an end of β. Obviously each division of EF is $\frac{1}{10}$th less than that of the normal scale. It is seen that division 6 of the vernier coincides with a normal scale division, and obviously the excess of β over two normal scale divisions equals the difference between 6 normal scale divisions and 6 vernier divisions, *i.e.* 0·6. Thus again in this case the vernier reading which coincides with a scale reading gives the decimal to be added to the normal scale. The second type of vernier is that more commonly adopted, and its application to special appliances is quite simple.

VERNIS MARTIN, a generic name, derived from a distinguished family of French artist-artificers of the 18th century, given to a brilliant translucent lacquer extensively used in the decoration of furniture, carriages, sedan chairs and a multitude of small articles such as snuff-boxes and fans. There were four brothers of the Martin family: Guillaume (d. 1749), Simon Étienne, Julien and Robert (1706–1765), the two first named being the elder. They were the children of Étienne Martin, a tailor, and began life as coach-painters. They neither invented, nor claimed to have invented, the varnish which bears their

name, but they enormously improved, and eventually brought to perfection, compositions and methods of applying them which were already more or less familiar. Oriental lacquer speedily acquired high favour in France, and many attempts were made to imitate it. Some of these attempts were passably successful, and we can hardly doubt that many of the examples in the possession of Louis XIV. at his death were of European manufacture. Chinese lacquer was, however, imported in large quantities, and sometimes panels were made in China from designs prepared in Paris, just as English coats of arms were placed upon Chinese porcelain in its place of origin. At the height of their fame the brothers directed at least three factories in Paris, and in 1748 they were all classed together as a "Manufacture nationale." One of them was still in existence in 1785. The literature of their day had much to say of the frères Martin. In Voltaire's comedy of *Nadine,* produced in 1749, mention is made of a *berline* "bonne et brillante, tous les panneaux par Martin sont vernis"; also in his *Premier discours sur l'inégalité des conditions* he speaks of "des lambris dorés et vernis par Martin." The marquis de Mirabeau in *L'Ami des hommes* refers to the enamelled snuff-boxes and varnished carriages which came from the Martins' factory. At its best Vernis Martin has a splendour of sheen, a perfection of polish, a beauty of translucence which compel the admiration due to a consummate specimen of handiwork. Every variety of the lacquer of the Far East was imitated and often improved upon by the Martins—the black with raised gold ornaments, the red, and finally in the wonderful green ground, powdered with gold, they reached the high-water mark of their delightful art. Of the larger specimens from the Martins' factories a vast quantity has disappeared, or been cut up into decorative panels. It would appear that none of the work they placed in the famous hotels of old Paris is now *in situ,* and it is to museums that we must go for really fine examples—to the Musée de Cluny for an exquisite children's sedan chair and the coach used by the French ambassador to Venice under Louis XV.; to the Wallace collection for the tables with richly chased mounts that have been attributed to Dubois; to Fontainebleau for a famous commode. It has been generally accepted that of the four brothers Robert Martin accomplished the most original and the most completely artistic work. He left a son, Jean Alexandre, who described himself in 1767 as "Vernisseur du Roi de Prusse." He was employed at Sans Souci, but failed to continue the great traditions of his father and his uncles. The Revolution finally extinguished a taste which had lasted for a large part of the 18th century. Since then the production of lacquer has, on the whole, been an industry rather than an art. (J. P.-B.)

VERNON, EDWARD (1684–1757), English admiral, was born in Westminster on Nov. 12, 1684, the second son of James Vernon, secretary of State in 1697–1700. Edward Vernon entered the navy in 1707, and saw much active service in various seas. During the long peace under Walpole he sat in the House of Commons (1722–34); he clamoured for war with Spain, and in 1739 declared he would capture Portobello with a squadron of six ships. He got the command and the ships and captured Portobello on Nov. 22, with a loss of only seven men. In 1740, with a large squadron, he attacked Cartagena without success, and had to retire to Jamaica (this episode is described in *Roderick Random,* chap. xiii., etc.). Vernon suffered another reverse at Santiago de Cuba in 1741, and returned home in 1743. He had been elected M.P. for Ipswich in 1741, and continued to sit for that borough. He was in command in the Downs in 1745, but in annoyance at intervention from Whitehall he published some of his instructions, and was struck off the flag list. He died on Oct. 30, 1757, at Nacton, Suffolk.

VERNON, a town of northwestern France. Pop. (1936) 10,018. Vernon in 1196 was ceded by its count to Philip Augustus, Richard I resigning his suzerainty. The first estates of Normandy were held at Vernon in 1452. Vernon is on the left bank of the Seine. The church of Notre-Dame dates from the 12th to the 15th centuries, and there is a cylindrical keep built by Henry I of England.

VERNON, a city of northern Texas, U.S.A., on the Pease river, the county seat of Wilbarger county. The population was 9,137 in 1930 and 9,277 in 1940 (95% native white) by federal census. It is the shipping point for a region producing cotton, wheat, alfalfa and cattle. The oil fields in the county are many and provide employment for hundreds. Vernon was settled about 1880, incorporated in 1901, and chartered as a city in 1914.

VEROLI, an episcopal see of Frosinone province, Italy, 1,870 ft. above sea-level. Pop. (1936) 2,943 (town); 18,258 (commune). The town is situated on the site of the Hernican town of Verulae. It retains remains of its ancient polygonal enceinte, especially near the summit of the hill, later occupied by a mediaeval castle. The cathedral treasury contains the breviary of S. Louis of Toulouse.

VERONA, a city and episcopal see of Venetia, Italy, the capital of the province of Verona, situated 194 ft. above sea-level in a loop of the Adige (anc. *Athesis*). Pop. (1936) 85,724 (town), 153,708 (commune). It is the point of departure to the Brenner.

Churches.—The Romanesque basilica of S. Zeno (the first bishop of Verona and its patron saint), outside the ancient city, was remodelled in 1117–38, including the richly sculptured west front and the open *confessio* or crypt, raising the choir high above the nave. The nave (11th century) has frescoes of the 11th–14th centuries.

The cathedral, consecrated in 1187, stands at the northern end of the ancient city, by the bank of the Adige; it is smaller than S. Zeno, but has a fine west front, rich with Romanesque sculpture (1135); the upper part was added during 1565–1606. It has a noble Romanesque cloister, with two storeys of arcading. The campanile by Sammicheli is unfinished. Its baptistery, rebuilt early in the 12th century, is a quite separate building, with nave and apse, forming a church dedicated to S. Giovanni in Fonte. Pope Lucius III. (d. 1185) is buried in the cathedral. The very fine Gothic Dominican church of S. Anastasia (1290–1481), consists of a nave in six bays, aisles, transepts, each with two eastern chapels, and an apse, all vaulted with simple quadripartite brick groining. It is specially remarkable for its very beautiful and complete scheme of coloured decoration. The vaults are gracefully painted with floreated bands along the ribs and central patterns in each "cell," in rich soft colours on a white plastered ground. There are many fine frescoes in the interior including Pisanello's beautiful painting of St. George. This church also contains fine sculptured tombs of the 14th and 15th centuries. S. Fermo Maggiore was rebuilt in 1313 at a higher level than the earlier church (1065–1138). The roof is magnificent. Delicate patterns cover all the framework of the panelling and fill the panels themselves. Rows of half-figures of saints are painted on blue or gold grounds, forming a scheme of indescribably splendid decoration. A simpler roof of the same class exists at S. Zeno; it is trefoil-shaped in section, with a tie-beam joining the cusps. The church of S. Maria in Organo (1481), with a façade of 1592 from Sammicheli's designs, contains paintings by various Veronese masters, and some fine choir-stalls of 1499 by Fra Giocondo. Though not built till after his death, the church of S. Giorgio di Braida, on the other side of the river, was also designed by Sammicheli, and possesses many good pictures of the Veronese school. The Romanesque churches of S. Lorenzo and S. Stefano are fine. That dedicated to Thomas Becket was rebuilt in the 15th century.

The strongly fortified castle (Castel Vecchio) built by Cangrande II. della Scala (1354) stands on the line of the wall of Theodoric, close by the river. It contains the municipal museum and picture gallery. There are five bridges across the Adige: one, the graceful Ponte di Pietra, rests upon ancient foundations, while the two arches nearest to the left bank are Roman; but it has been frequently restored. Remains of another ancient bridge were found in the river itself behind S. Anastasia. The 16th-century lines of fortification enclose a very much larger area than the Roman city. On a steep elevation stands the castle of St. Peter, originally founded by Theodoric, on the site, perhaps, of the earliest citadel, mostly rebuilt by Gian Galeazzo Visconti in 1393, and dismantled by the French in 1801. The episcopal palace contains the ancient and valuable chapter library, of about 12,000 volumes and over 500 mss. (*See* GAIUS.) The Piazza delle Erbe

(fruit and vegetable market) on the site of the ancient Forum and the Piazza dei Signori, adjoining one another in the oldest part of the city, are very picturesque and beautiful, being surrounded by many fine mediaeval buildings, notably the Palazzo del Comune, with a tower 273 ft. high, while in the north-east corner of the latter Piazza is the fine early Renaissance Loggia del Consiglio (1476–1493), most likely designed by Fra Giocondo. The Piazza Vittorio Emanuele II. (also called Bra, from the Latin *pratum*, a meadow) to the south-west of the amphitheatre, is the tramway centre and the site of the cattle market. On it fronts the Gran Guardia, a large palace of 1610, now the Bourse.

Roman Remains.—The Roman remains of Verona surpass those of any other city of northern Italy. The most conspicuous of them is the great amphitheatre, a building of the end of the 1st century A.D., which closely resembled the Flavian amphitheatre (Colosseum) in Rome. Its axes measured 505 and 404 ft. Almost the whole of its external arcades, with three tiers of arches, have now disappeared; it was partly thrown down by an earthquake in 1183, and subsequently used to supply building materials. The interior, with seats for about 25,000 people, has been restored. There are also remains of a well-preserved Roman theatre, close to the left bank of the river adjacent to which is the archaeological museum. The Museo Lapidario contains a fine collection of Roman and Etruscan inscriptions and sculpture, begun by Scipione Maffei in 1714.

Veronese Art, Painting and Sculpture.—Painting in Verona may be divided into four periods. (i.) The first is characterized by wall paintings of purely native style, *e.g.*, in SS. Nazaro e Celso (996). (ii.) The Byzantine period lasted during the 12th and 13th centuries. (*See* S. Zeno for examples.) (iii.) The Giottesque period begins contemporaneously with Altichieri and Giacomo d'Avanzo (second half of the 14th century). These two painters, among the ablest of Giotto's followers, adorned Verona and Padua with very beautiful frescoes, rich in composition, delicate in colour, and remarkable for their highly finished modelling and detail. (iv.) To the fourth period belong several important painters. Pisanello or Vittore Pisano, a charming painter and the greatest medallist of Italy, probably a pupil of Altichieri, has left a beautiful fresco in the church of S. Anastasia, representing St. George and the Princess after the conquest of the Dragon. His only other existing fresco is an Annunciation in S. Fermo Maggiore. (*See* PAINTING.) His pupils include Liberale da Verona, Domenico and Francesco Morone, Girolamo dai Libri (1474–1556), etc. Domenico del Riccio, usually nicknamed Brusasorci (1494–1567), was a prolific painter whose works are very numerous in Verona. Paolo Cagliari or Paul Veronese, and Bonifacio, though natives of Verona, belong rather to the Venetian school.

Verona is specially rich in early examples of decorative sculpture. (i.) The first period is that of northern influence, exemplified in the reliefs which cover the western façades of the church of S. Zeno and the cathedral, dating from the 12th century, and representing both sacred subjects and scenes of war and hunting, mixed with grotesque monsters. Part of the western doors of S. Zeno are early examples of caste bronze reliefs. (ii.) In the 13th century the sculpture lost its vigour, without acquiring grace or refinement, *e.g.*, the font in the cathedral baptistery. (iii.) The next period is that of Florentine influence, exemplified in the magnificently sculptured tombs of the Della Scala lords, those of Cangrande I. (d. 1329), Mastino II. (d. 1351) and (the most elaborate of all) of the fratricide Can Signorio, adorned with statuettes of the virtues, executed during his lifetime (*c.* 1370), by the sculptor Bonino da Campione. (iv.) In the 15th century Florence influenced Verona by way of Venice.

Architecture.—The architecture of Verona, like its sculpture, passed through Lombard, Florentine and Venetian stages. The early Renaissance developed into very exceptional beauty, mainly through the genius of Fra Giocondo (1435–1514), a native of Verona, who was at first a friar in the monastery of S. Maria in Organo. He rose to great celebrity as an architect, and designed many graceful and richly sculptured buildings in Venice, Rome and even in France; he used classical forms with great taste and skill, and with much of the freedom of the older mediaeval architects, and was specially remarkable for his rich and delicate sculptured decorations. Another of the leading architects of the next stage of the Renaissance was the Veronese Michele Sammicheli (1484–1559), a great military engineer, and designer of an immense number of magnificent palaces in Verona, among which the most outstanding are the Bevilacqua, Canossa and Pompei palaces.

History.—The ancient Verona was a town of the Cenomani, a Gaulish tribe, whose chief town was Brixia. It became a Latin colony in 89 B.C. Inscriptions testify to its importance, indicating that it was the headquarters of the collectors of the 5% inheritance tax under the Empire in Italy beyond the Po. Its territory stretched as far as Hostilia on the Padus (Po), 30 m. to the south. It lay on the road between Mediolanum and Aquileia, while here diverged to the north the roads over the Brenner. It was the birthplace of the poet Catullus. In A.D. 69 it became the headquarters of the legions which were siding with Vespasian. It was defended by a river along two-thirds of its circumference. The existing remains of walls and gates date from the period between the 3rd of April and the 4th of December of the year 265. A very handsome triumphal arch, now called the Porta de' Borsari, was restored in this year by Gallienus and became one of the city gates. The same was the case with the Porta dei Leoni, on the east of the city, and with a third arch, the Arco dei Gavi, demolished in 1805. The emperor Constantine, while advancing towards Rome from Gaul, besieged and took Verona (312); it was here, too, that Odoacer was defeated (499) by Theodoric the Goth, Dietrich von Bern—*i.e.*, Verona—of German legends, who built a castle at Verona and frequently resided there. He enlarged the fortified area by constructing a wall and ditch (now called Adigetto), to the S.W. of the amphitheatre, and also built thermae and restored the aqueducts, which had long been out of use.

In the middle ages Verona gradually grew in size and importance. Alboin, the Lombard king, captured it in 568, and it was one of the chief residences of the Lombard, and later of the Frankish, monarchs; and though, like other cities of northern Italy, it suffered much during the Guelph and Ghibelline struggles, it rose to a foremost position both from the political and the artistic point of view under its various rulers of the Scaliger or Della Scala family. The first prominent member of this family and founder of his dynasty was Mastino I. della Scala, who ruled over the city from 1260 till his death in 1277. Verona had previously fallen under Ezzelino da Romano (1227–1259). Alberto della Scala (d. 1301) was succeeded by his eldest son Bartolomeo, who was confirmed as ruler of Verona by the popular vote, and died in 1304. It was in his time that Romeo and Juliet are said to have lived. Alboino, the second son, succeeded his brother, and died in 1311, when the youngest son of Alberto, Can Grande, who since 1308 had been joint-lord of Verona with his brother, succeeded to the undivided power. Can Grande (Francesco della Scala, d. 1329) was the best and most illustrious of his line, and is specially famous as the hospitable patron of Dante (*q.v.*). Other princes of this dynasty, which lasted for rather more than a century, were Giovanni (d. 1350), Mastino II. (d. 1351), Can Grande II. (d. 1359) and Can Signorio (d. 1375). In 1387 Gian Galeazzo Visconti, duke of Milan, became by conquest lord of Verona. Soon after his death the city fell by treacherous means into the hands of Francesco II. di Carrara, lord of Padua. In 1404–1405 Verona, together with Padua, was finally conquered by Venice, and remained subject to the Venetians till the overthrow of the republic by Napoleon in 1797, who in the same year, after the treaty of Campo Formio, ceded it to the Austrians with the rest of Venetia. They fortified it strongly in 1814, and with Peschiera, Mantua and Legnago it formed part of the famous quadrilateral which until 1866 was the chief support of their rule in Italy. The town was greatly damaged by a flood in 1882.

See the various works by Scipione Maffei (*Verona Illustrata*, 1728; *Museum Veronense*, 1749); A. Wiel, *The Story of Verona* (London, 1902); R. Peyre, *Padoue et Vérone* (1907); E. Giani, *L'Antico teatro di Verona* (Verona, 1908); A. M. Allen, *History of Verona* (1910); E. R. Williams, *Plain Towns* (1912); M. Ludwig, *Auf Veronas Dächern* (1919). (J. H. Mi.; T. A.)

VERONA, CONGRESS OF, the last of the series of international conferences or congresses based on the principle enunciated in Art. 6 of the treaty of Paris of Nov. 20, 1815 (*see* EUROPE: *History*). It met at Verona on Oct. 20, 1822. The emperor Alexander I of Russia was present in person. There were also present Count Nesselrode, the Russian minister of foreign affairs; Prince Metternich, representing Austria; Prince Hardenberg and Count Bernstorff, representing Prussia; MM. de Montmorency and Chateaubriand, representing France; and the duke of Wellington, representing Great Britain in place of Lord Londonderry (Castlereagh), whose tragic death occurred on the eve of his setting out to the congress.

In the instructions drawn up by Londonderry for his own guidance, which had been handed to Wellington by Canning without alteration, was clearly defined the attitude of Great Britain toward the three questions which it was supposed would be discussed: the Turkish question (Greek insurrection); the question of intervention in favour of the royal power in Spain together with that of the revolted Spanish colonies; and the Italian question. As regards the last, it was laid down that Great Britain could not charge herself with any superintendence of a system in which she had merely acquiesced, and the duty of the British minister would be merely to keep himself informed and to see that nothing was done "inconsistent with the European system and the treaties." To make this attitude quite clear, Wellington was further instructed not to hand in his credentials until this question had been disposed of, his place being meanwhile taken by Lord Londonderry (Stewart), Castlereagh's half-brother and successor in the title, who had fulfilled the same function at Troppau and Laibach. In the Spanish question Wellington was to give voice to the uncompromising opposition of Great Britain to the whole principle of intervention. In the Turkish question, the probable raising of which had alone induced the British government to send a plenipotentiary to the congress, he was to suggest the eventual necessity for recognizing the belligerent rights of the Greeks and, in the event of concerted intervention, to be careful not to commit Great Britain beyond the limits of good offices.

The immediate problems arising out of the Turkish question had been settled between the emperor Alexander and Metternich at the preliminary conferences held at Vienna in September, and at Verona the only question raised was that of the proposed French intervention in Spain. The discussion was opened by three questions formally propounded by Montmorency: (1) Would the Allies withdraw their ministers from Madrid in the event of France's being compelled to do so? (2) In case of war, under what form and by what acts would the powers give France their moral support, so as to give to her action the force of the alliance and inspire a salutary fear in the revolutionaries of all countries? (3) What material aid would the powers give, if asked by France to intervene, under restrictions which she would declare and they would recognize?

The reply of Alexander, who expressed his surprise at the desire of France to keep the question "wholly French," was to offer to march 150,000 Russians through Germany to Piedmont, where they could be held ready to act against the Jacobins whether in Spain or France. Wellington, who had been instructed to express the uncompromising opposition of Great Britain to the whole principle of intervention, refused to have anything to do with the suggestion, made by Metternich, that the powers should address a common note to the Spanish government in support of the action of France.

Finally, Metternich proposed that the Allies should "hold a common language, but in separate notes, though uniform in their principles, and objects." This solution was adopted by the continental powers; and Wellington, in accordance with his instructions, took no part in the conferences that followed. On Oct. 30 the powers handed in their formal replies to the French memorandum. Russia, Austria and Prussia would act as France should in respect of their ministers in Spain and would give to France every countenance and assistance she might require, the details "being reserved to be specified in a treaty." Wellington, on the other hand, replied on behalf of Great Britain that "having no knowledge of the cause of dispute, and not being able to form a judgment upon a hypothetical case, he could give no answer to any of the questions."

Thus was proclaimed the open breach of Great Britain with the principles and policy of the Great Alliance, which is what gives to the congress its main historical interest. (W. A. P.)

VERONAL, a crystalline substance extensively used in medicine as a hypnotic. Chemically, veronal is diethylmalonyl urea or diethyl-barbituric acid $(C_2H_5)_2C[CO\ NH]_2CO$. It is prepared by condensing diethylmalonic ester with urea in the presence of sodium ethylate, or by acting with ethyl iodide on the silver salt of malonyl urea; it forms a white crystalline powder which is odourless and has a slightly bitter taste. Its introduction followed the investigations of Emil Fischer and J. v. Merling on the pharmacological properties of certain open and closed ureides.

Led thereto by the impression that hypnotic action appears to be largely dependent on the presence of ethyl groups, they prepared diethylacetyl urea, diethylmalonyl urea, and dipropylmalonyl urea. All three were found to be hypnotics: the first was about equal in power to sulphonal, while the third was four times as powerful, but its use was attended by prolonged aftereffects. Veronal was found to be midway. It is best given in cachets (10 to 15 grains). As it does not affect the circulatory or respiratory systems, or temperature, it can be employed in many disease conditions of the heart and lungs as well as in mental disturbances, acute alcoholism, morphinomania and kidney disease. If taken during a prolonged period it seems to lose its effect. A soluble salt of veronal has been introduced under the name of medinal. Although the toxicity of veronal is low, the unreasonable consumption by persons suffering from insomnia has led to many deaths. (*See* BARBITURIC ACID.)

VERONESE, PAOLO (1528–1588), the name given to Paolo Caliari or Cagliari, Italian painter of the Veronese and Venetian schools, who was born in Verona in 1528. His father, Gabriele Caliari, was one of a family of stone-carvers come to Verona from Bissone on the Lake of Lugano. Paolo was at first trained under his father as a stone-carver, but the boy showed more propensity for painting and was therefore transferred to his uncle, Antonio Badile, a painter of small ability who cannot have helped him much. Vasari states that Paolo then became the pupil of Giovanni Caroto, a distinguished architect and archaeologist as well as a painter, but there seems to be no stylistic connection between them.

Other Veronese artists such as Domenico Brusasorci and the Farinati probably influenced his development. "The Holy Family and St. John," in the Cannon collection at Fiesole, is an example of his early style. It is essentially Veronese, simple, solid, sincere; the inimitable brilliance of the flesh tones and the space arrangement presage the later and more accomplished work of his Venetian period. In the spring of 1552 Cardinal Ercole Gonzaga commissioned Paolo and three other Veronese painters, Battista del Moro, Paolo Farinato and Domenico Brusasorci, to paint a series of altarpieces for the cathedral at Mantua. Paolo's altarpiece, "The Temptation of St. Anthony," has recently been identified with a picture in the museum at Caen. At this early period he also worked in several country places with his fellow townsman, Battista Zelotti, on large decorations of churches and palaces. Some of this work is still to be seen in the church of Castelfranco. The frescoes of ladies standing behind a balustrade in the Villa Giacomelli at Maser, though much restored, are good examples of this decorative type of work. In 1555 we find Paolo settled in Venice, but it is now thought that he worked in Venice even before that date, and that he executed the paintings for the Sala del Consiglio dei Dieci with "Jupiter Thrusting Thunderbolts" (Louvre) about the year 1554. Among his earliest work in Venice are the paintings in the sacristy and the church of S. Sebastian, where an uncle of his was prior of the monastery. The subjects on the vaulting are taken from the history of Esther, and they excited so much admiration that henceforward Paolo, then about 28, ranked almost on a par with Tintoretto, aged about 45, or with Titian, who was 80. Besides the Esther subjects, these

buildings contain his pictures of the "Baptism of Christ," the "Martyrdom of St. Marcus and St. Marcellinus," the "Martyrdom of St. Sebastian" and others. There is a vague tradition that Paolo painted the last of these, which is dated about 1563, when he had taken refuge in the monastery.

In 1556 he was asked to paint three tondi with allegorical subjects for the library of St. Mark's. Six other painters were employed on similar tasks, but Paolo's work was generally recognized as the best, and he was tendered a golden chain as an honorary distinction. It is doubtful whether Paolo ever visited Rome. Ridolfi states that he went there in the company of Girolamo Grimani, the Venetian ambassador, whose journey took place about 1560. On June 6, 1562, he received the commission for "The Marriage at Cana" for the refectory of S. Giorgio in Venice. This gigantic and stupendous picture obtained for him perhaps his greatest celebrity. It contains about 120 figures or heads, those in the foreground being larger than life. Several of them are portraits. Among the personages specified, some of them probably without sufficient reason, are Queen Eleanor of France, Francis I, Queen Mary of England, Charles V, Tintoretto, Titian and Paolo himself. The painting, completed in 1563, was one of the treasures taken to France by the armies of the Revolution, and it was placed in the Salon Carré in the Louvre. Its great size and the difficulty of moving it served as an excuse for retaining it when, in 1815, other pictures had to be returned.

In 1566 Paolo went to Verona, where he had a commission to paint in his own parish church, and there married the daughter of his former master, Badile. In 1573 he painted another great banquet scene—"The Feast of Levi"—for the refectory of S. Giovani e Paolo in Venice—but he had to appear before the tribunal of the Inquisition to explain that the dwarfs and fools and other figures introduced for decorative effect meant no disparagement to religion. In 1575 he painted "The Martyrdom of St. Giustina" at Padua. Meanwhile, fires had destroyed several rooms in the doge's palace and Paolo was called in to make good the damage. In the Sala del Collegio he painted the "Commemoration of the Battle of Lepanto." For the rich ceiling designed by Ant. del Ponte he painted a "Glorification of Venice," and for the ceiling of the Sala del Gran Consiglio he painted the "Triumph of Venice."

Beyond his magnificent performances as a painter, the known incidents in the life of Paolo Veronese are very few. He was honoured and loved, being kind, amiable, generous and an excellent father. His person is well known from the portraits left by himself and others: he was a dark man, rather good-looking than otherwise, somewhat bald in early middle age, and with nothing to mark an exceptional energy or turn of character.

The qualities that strike one in Paolo's works are their splendour and spaciousness. He was eminent as a decorator of large architectural spaces and supreme in representing numerous figures in a luminous and diffused atmosphere, while in richness of contemporary costumes he surpassed all other Venetians. The colour effects are orchestral in richness and variety; and his silvery tone, obtained by the juxtaposition of warm and cold hues, is essentially Paolo and differentiates his best works from the golden lustre of Titian.

Paolo Veronese died in Venice on April 19, 1588. He was buried in the church of S. Sebastiano, and his bust, by Camillo Bozzetti, was placed over his grave by his brother and his sons. In his workshops in Venice he employed many assistants, among whom were his relatives, notably his brother Benedetto (1538–1598), his nephew Alvise Benfatto (1544–1609), and his two sons, Gabriele (1568–1631) and Carlo, known as Carletto (1570–1596). Certain pictures executed after Paolo's death, those for instance in the doge's palace, are signed Heredes Paoli.

It is impossible to enumerate all the great works of this prolific master. Among his most celebrated works are: "The Family of Darius at the Feet of Alexander," in which the principal figures are portraits of the Pisani family—in the National gallery, London. Here the master displays his great gift of portraiture, and his gift of combining in groups the members of some patrician family as taking part in some historical event. The Dresden gallery has some fine examples: "The Madonna of the Cuccina Family" and the "Adoration of the Magi." In the Louvre is the "Feast in the House of Simon the Pharisee," painted for the Servites in Venice (1570–78), and "The Marriage at Cana"; the Venetian academy has some of the finest works of the master: "The Marriage of St. Catherine," painted for the church of Sta. Caterina, and "Ceres and Venice," a ceiling painting from the doge's palace, besides the "Feast in the House of Levi."

See C. Ridolfi, *Le Maraviglie dell Arte* (edit. D. v. Hadelm, 1914); Dal Pozzo, *Vite de pittori Veronesi;* Zanetti, *Della pittura Veneziana;* P. Caliari, *Paolo Veronese* (Verona, 1888); A. Bell, *Paolo Veronese* (1904); Giuseppe Fiocco, *Paolo Veronese* (Bologna, 1928).
(I. A. R.)

VERONICA, ST. According to legend, Veronica was a pious woman of Jerusalem who, moved with pity by the spectacle of Jesus carrying His cross to Golgotha, gave Him her kerchief in order that He might wipe the drops of agony from His brow. He accepted the offering, and after using the napkin handed it back to her with the image of His face miraculously impressed upon it.

This, however, is not the primitive form of the legend, which a close examination shows to be derived from a story related by Eusebius in his *Historia Ecclesiastica* (vii, 18). He tells how, at Caesarea Philippi, lived the woman whom Christ healed of an issue of blood (Matt. ix, 20). At the door of her house stood, on one side a statue of a woman in an attitude of supplication, and on the other side that of a man stretching forth his hand to the woman. It was said that the male figure represented Christ and that the group had been set up in recognition of the miraculous cure. Legend was not long in providing the woman of the Gospel with a name. In the West she was identified with Martha of Bethany; in the East she was called Berenike, or Beronike, the name appearing in as early a work as the *Acta Pilati,* the most ancient form of which goes back to the 4th century.

Toward the 6th century the legend of the woman with the issue of blood became merged in the legend of Pilate, as is shown in the writings known in the middle ages as *Cura sanitatis Tiberii* and *Vindicta Salvatoris.* According to the former of these accounts Veronica caused a portrait of the Saviour to be painted. The emperor Tiberius, when sick, commanded the woman to bring the portrait to him, worshipped Christ and was cured. The legend continued to gather accretions, and a miraculous origin came to be assigned to the image. According to the legends in France, Veronica was married to Zaccheus, who had been converted by Christ, and went with him to Quiercy, where he became a hermit. She then joined Martial in his apostolic preaching. In the Bordeaux district, Veronica is said to have brought relics of the Virgin to Sonlac, where she died and was buried. In the 12th century the image began to be identified with one at Rome, and in the popular speech the image too was called Veronica. It is interesting to note that the fanciful derivation of the same Veronica from the words *Vera icon* (εἰκών) "true image" dates back to the *Otia Imperialia* (iii, 25) of Gervase of Tilbury (*fl.* 1211), who says: "Est ergo Veronica pictura Domini vera."

See *Acta Sanctorum,* February, i, 449–457; L. F. C. Tischendorf, *Evangelia apocrypha* (2nd ed., Leipzig, 1877), p. 239; E. von Dobschütz, *Christusbilder* (Leipzig, 1899); H. Thurston, *The Stations of the Cross* (London, 1906).

VERPLANCK, GULIAN CROMMELIN (1786–1870), U.S. author and politician, was born in New York city, Aug. 6, 1786. He was educated at Columbia college, which later became Columbia university, graduating in 1801 at the age of 15. He was the youngest person ever to receive the Bachelor of Arts degree at the college until that time. In 1807 he was admitted to the New York bar. Four years later he became involved in a political battle with DeWitt Clinton, then mayor of New York city. Verplanck had taken the part of a Columbia student who was not being allowed to graduate, and for his alleged role in the disorderly commencement exercises in Trinity church that year, he was tried and fined by a court over which Clinton presided. This incident had great influence on Verplanck's later writing, much of which, particularly in the next ten years, consisted of satires

directed against Clinton.

In 1820 he was elected a member of the New York assembly by the Bucktail party, an anti-Clinton group, and he remained in that office until 1823. Concurrently (1821–24), he held the professorship of the evidences of Christianity at the Protestant Episcopal General Theological seminary. He served in the United States house of representatives from 1825–33 and in the New York senate from 1838–41. He died March 18, 1870, in New York city.

Besides his political pamphlets, Verplanck's works include *Procès Verbal of the Ceremony of Installation* (1820); *Essays on the Nature and Uses of the Various Evidences of Revealed Religion* (1824); *Essay on the Doctrine of Contracts* (1825); *Discourses and Addresses on American History, Arts and Literature* (1833); and a three-volume edition of Shakespeare's plays, with a biography and critical notes (1847). In addition Verplanck, William Cullen Bryant and Robert C. Sands for three years edited *The Talisman,* an annual to which the three contributed extensively.

VERRALL, ARTHUR WOOLLGAR (1851–1912), British scholar, was born at Brighton on Feb. 5, 1851. Educated at Wellington college and Trinity college, Cambridge, he graduated in 1873, becoming fellow and tutor of his college. He was admitted to the bar in 1877. He wrote important studies on Horace, particularly his *Studies, Literary and Historical, in the Odes of Horace* (1884) and on other Latin authors, including Martial and Statius. His work on Propertius is especially valuable.

His true interest, however, was the ancient Greek drama, and he published editions of many of the classical plays. In 1887 appeared *Seven Against Thebes,* followed by Agamemnon (1889), *Choephoroe* (1893), *Eumenides* (1908) and the *Bacchae* (1910). In addition he was the author of *Euripides the Rationalist* (1895) and *Essays on Four Plays of Euripides* (1905).

Verrall was an original critic and a frequent contributor to *The Classical Review* and other journals. In Feb. 1911 he was appointed to fill the new King Edward VII professorship of literature at Cambridge. He had a high reputation as a teacher, exceeded only by his reputation as a classical scholar. He died at Cambridge, June 18, 1912.

VERRAZANO, GIOVANNI DA (*c.* 1480–*c.* 1527), Florentine navigator, was born near Florence but while he was still in his 20s became associated with the French fleet. It is almost certain that in the early 16th century he made some raids on the Indies, and it is known that in 1522 he was responsible for capturing the two ships which Cortes had dispatched, loaded with spoils, from Mexico to Spain. The captured wealth convinced Francis I of France that America was well worth his attention, and the following year he put Verrazano in charge of an American expedition, ostensibly to find a northwest passage to the orient but actually to extend France's empire to America. In 1524 the Florentine set sail, arriving in North America in February of that year. He landed probably off the coast of North Carolina, although there is some dispute about the actual spot and it may have been considerably farther either to the north or to the south. Thence he travelled northward to Newfoundland, discovering en route the Hudson river and Manhattan island and visiting Narragansett bay, which he may also have discovered. He returned to France in the same year, reaching Dieppe on July 8, and the account of his discoveries, which he wrote for the king on his arrival, is the first description we have of the northeast coast of America.

Nothing is certain of the eventual fate of Verrazano, although it is thought that he was either killed by Indians or hanged as a pirate on a later expedition to America, probably South America.

VERRES, GAIUS (*c.* 120–43 B.C.), Roman magistrate, notorious for his misgovernment of Sicily. It is not known to what *gens* he belonged. He at first supported Marius but soon went over to Sulla, who gave him land at Beneventum and secured him against punishment for embezzlement. In 80, Verres was quaestor in Asia on the staff of Cn. Cornelius Dolabella, governor of Cilicia. The governor and his subordinate plundered in concert, till in 78 Dolabella had to stand his trial at Rome and was convicted, mainly on the evidence of Verres, who thus secured a pardon for himself. In 74, by a lavish use of bribes, Verres secured the city praetorship and, as a creature of Sulla, abused his authority to further the political ends of his party. He was then sent as governor to Sicily, the richest of the Roman provinces.

The people were for the most part prosperous and contented, but under Verres the island experienced more misery and desolation than during the time of the first Punic or the recent servile wars. The corn-growers and the revenue collectors were ruined by taxation and the cancelling of contracts; temples and private houses were robbed of their works of art; and the rights of Roman citizens were disregarded. Verres returned to Rome in 70, and in the same year, at the request of the Sicilians, Cicero prosecuted him. Verres was defended by the most eminent of Roman advocates, Q. Hortensius. The court was composed exclusively of senators, some of whom might have been his personal friends. But the presiding judge, M'. Acilius Glabrio, was not corruptible. Verres tried to get the trial postponed till 69 when his friend Metellus would be the presiding judge, but in August Cicero opened the case.

The effect of the first brief speech was so overwhelming that Hortensius refused to reply and recommended his client to leave the country. He went to Massilia and lived there till 43, when he was proscribed by Antony, the reason alleged being his refusal to surrender some of his art treasures which Antony coveted.

Verres may not have been so black as he is painted by Cicero, on whose speeches we depend entirely for our knowledge of him, but there can hardly be a doubt that he stood pre-eminent among the worst specimens of Roman provincial governors. Of the seven Verrine orations, only two were actually delivered. The remaining five were compiled from the depositions of witnesses and published after the flight of Verres.

VERRILL, ADDISON EMERY (1839–1926), U.S. zoologist, was born in Greenwood, Me., Feb. 9, 1839. He attended Harvard university, graduating from the Lawrence Scientific school of that institution in 1862. From 1860 to 1864 he worked as assistant to Louis Agassiz and in the latter year was named professor of zoology at Yale university. In 1865 he became curator of the Peabody zoological museum at Yale, in 1870 instructor in geology at the Sheffield Scientific school and in 1868 nonresident professor of comparative anatomy and entomology at the University of Wisconsin. From 1871 to 1887 he served as assistant in charge of scientific explorations by the U.S. Commission of Fish and Fisheries and in that post was responsible for important technical improvements in the equipment used for the collection of marine specimens and for the discovery of a number of marine invertebrates, of which he made a valuable collection. Until the year of his death he continued his studies of invertebrates, particularly of those which inhabit water, and his investigations took him along both coasts of North America, as well as to South and Central America and Hawaii. He found and described many hundreds of previously undiscovered specimens of marine life, and the collection he made for the Peabody museum is an important one.

Of his more than 300 papers, many have become standard references, particularly his *Report on the Invertebrate Animals of Vineyard Sound and Adjacent Waters* (1873) and his monographs on the coelenterates of the Canadian Arctic. He was also the author of a number of works on the Bermuda islands, which were the source of much valuable information. He died Dec. 10, 1926, in Santa Barbara, Calif.

His son, ALPHEUS HYATT VERRILL (1871–), was born in New Haven, Conn., July 23, 1871. He studied with his father and at Yale university. In 1899 he made the first of his many expeditions to South and Central America, where he undertook extensive archaeological excavations. These resulted in two important discoveries: in Santo Domingo of *Solenodon paradoxus,* a species of insectivorous mammal long thought to be extinct; and in Panamá of traces of a prehistoric civilization the existence of which was previously unknown. He is the author of numerous books, most of them about various phases of the countries in which he travelled and many of them for boys.

VERRIO, ANTONIO (1639–1707), Italian painter, was born at Lecce, in the Neapolitan province of Terra di Otranto. In 1660 at Naples he executed a large fresco work "Christ Healing the Sick," for the Jesuit college. He subsequently went to France where at Toulouse he painted an altarpiece for the Carmelites. He was invited to England by Charles II and employed in the decorating of Windsor castle. Little of his work is now extant. He was a rapid painter, fertile in invention and best at covering large surfaces in decorative frescoes. Charles II named him "master gardener," gave him a lodge in Hyde Park and paid him lavishly. He was employed by James II on Cardinal Wolsey's Tombhouse. He painted James and several of his courtiers in the hospital at Christ Church, London and also executed a number of decorative frescoes at St. Bartholomew's hospital. He was later employed by Lord Exeter at Burleigh and painted the large staircase at Hampton court for King William. He was very successful but his work was often criticized by his contemporaries for gaudy colours, bad drawing and senseless composition. He died at Hampton Court on June 17, 1707.

VERRIUS FLACCUS, MARCUS (*c.* 10 B.C.), Roman grammarian and teacher, flourished under Augustus and Tiberius. He was a freedman, and his manumitter has been identified with Verrius Flaccus, an authority on pontifical law; but for chronological reasons the name of Veranius Flaccus, a writer on augury, has been suggested (Teuffel-Schwabe, *Hist. of Roman Lit.* 199, 4). He was summoned to court to bring up Gaius and Lucius, the grandsons of Augustus. He removed there with his whole school, and his salary was greatly increased on the condition that he took no fresh pupils. He died at an advanced age during the reign of Tiberius (Suetonius, *De Grammaticis,* 17), and a statue in his honour was erected at Praeneste, in a marble recess, with inscriptions from his *Fasti.* Flaccus was also a distinguished philologist and antiquarian investigator. For his most important work (*De Verborum Significatu*) *see* FESTUS, SEXTUS POMPEIUS. Of the calendar of Roman festivals (*Fasti Praenestini*) engraved on marble and set up in the forum at Praeneste, some fragments were discovered (1771) at some distance from the town itself in a Christian building of later date, and some consular *fasti* in the forum itself (1778). Two new fragments were subsequently added.

Other lost works of Flaccus were: *De Orthographia: De Obscuris Catonis;* an elucidation of obscurities in the writings of the elder Cato; *Saturnus,* dealing with questions of Roman ritual; *Rerum memoria dignarum libri,* an encyclopaedic work much used by Pliny the elder; *Res Etruscae,* probably on augury.

VERROCCHIO, ANDREA DEL (1435–1488), Italian goldsmith, sculptor and painter, was born at Florence. He was the son of Michele di Francesco de' Cioni, and took his name from his master, the goldsmith Giuliano Verrocchi. As a teacher he occupies an important position from the fact that Leonardo da Vinci and Lorenzo di Credi worked for many years in his *bottéga* as pupils and assistants.

Only one existing painting can be attributed by Vasari to Verrocchio, the celebrated "Baptism of Christ," originally painted for the monks of Vallombrosa, and now in the Uffizi, Florence. The figures of Christ and the Baptist are executed with great vigour but are rather hard and angular in style. The two angels are of a much more graceful cast; the face of one is of especial beauty, and Vasari asserts that this head was painted by the young Leonardo. Other pictures from Verrocchio's *bottéga* probably exist, as, for example, two in the National Gallery of London formerly attributed to Ant. Pollaiuolo—"Tobias and the Angel" (No. 781) and the very lovely "Madonna and Angels" (No. 296), both very brilliant and jewel-like in colour. This exquisite painting may possibly have been painted from Verrocchio's design by Lorenzo di Credi while he was under the immediate influence of his wonderful fellow-pupil, Da Vinci.

In examining Verrocchio's work as a sculptor we are on surer ground. One of Verrocchio's earliest sculptures is the bronze "David" in the Bargello, Florence (1469). In 1472 he completed the fine tomb of Giovanni and Piero de' Medici, in the first sacristy of San Lorenzo at Florence. This consists of a great porphyry sarcophagus enriched with magnificent acanthus foliage in bronze. Above it is a graceful open bronze grill, made like a network of cordage. The charming bronze putto with dolphin now in the court of the Palazzo Vecchio at Florence was intended for the villa Medici at Careggi. In 1474 Verrocchio began the monument to Cardinal Forteguerra in the cathedral of Pistoia. The kneeling figure of the cardinal was never completed and now lies in a room of La Sapienza, but the whole design is shown in what is probably Verrocchio's original clay sketch now in the South Kensington. The actual execution of this work as designed by Verrocchio was entrusted to an assistant, the Florentine Lorenzetto. Somewhere between 1475 and 1480 is the terra-cotta relief of the Madonna and Child from S. Maria Nuova, now in the Bargello, a genuine standard work. In 1480 Verrocchio completed one of the reliefs of the magnificent silver altar-frontal of the Florentine baptistery, that representing the "Beheading of St. John." Verrocchio's other works in the precious metals are now lost, but Vasari records that he made many elaborate pieces of plate and jewellery, such as morses for copes, as well as a series of silver statues of the Apostles for the pope's chapel in the Vatican. Between 1478 and 1480 he was occupied, in making the bronze group of the "Unbelief of St. Thomas," which still stands in one of the external niches of Or San Michele (Florence). He received 800 florins for these two figures, which are more remarkable for the excellence of their technique than for their sculpturesque beauty. The attitudes are rather rigid and the faces hard in expression. Verrocchio's most imposing work was the colossal bronze equestrian statue of the Venetian general Bartolommeo Colleoni, which stands in the piazza of SS. Giovanni e Paolo at Venice. Verrocchio received the order for this statue in 1485 but had only completed the model when he died in 1488. In spite of his request that the casting should be entrusted to his pupil Lorenzo di Credi, the work was given to Alessandro Leopardi by the Venetian senate. The statue was gilt and was unveiled in 1496[1]. There appears to be no doubt that the model was completed by Verrocchio himself, and that nothing more than its reproduction should be attributed to Leopardi, who, however, set his own name alone on the saddle girth.

This is one of the noblest equestrian statues in the world. The horse is designed with wonderful nobility and spirit, and the easy pose of the great general, combining perfect balance with absolute ease and security in the saddle, is a marvel of sculpturesque ability. Most remarkable skill is shown by the way in which Verrocchio has exaggerated the strongly marked features of the general, so that nothing of its powerful effect is lost by the lofty position of the head.

According to Vasari, Verrocchio was one of the first sculptors who made a practical use of casts from living and dead subjects. He is said also to have produced plastic works in terra-cotta, wood and in wax decorated with colour.

As a sculptor his chief pupil was Francesco di Simone. Another pupil was Agnolo di Polo (Paolo), who worked chiefly in terra cotta.

Verrocchio died in Venice in 1488 and was buried in the church of St. Ambrogio in Florence.

See also Hans Mackowsky, "Verrocchio" (1901), *Künster Monographien,* No. 52; M. Cruttwell, *Verrocchio* (1904); M. Reymond, *Verrocchio* (1906).

VERSAILLES, a town of northern France, capital of the department of Seine-et-Oise, 12 mi. by road W.S.W. of Paris, with which it is connected by rail and tram. Pop. (1936) 72,203. Versailles owes its existence to the palace built by Louis XIV. It stands 460 ft. above the sea, and the fresh healthy air and nearness to the capital attract many residents. The three avenues of St. Cloud, Paris and Sceaux converge in the Place d'Armes. Between them stand the former stables of the palace, later occupied by the artillery and engineers. To the south lies the quarter of Satory, the oldest part of Versailles, with the cathedral of St. Louis, and to the north the new quarter, with the church of Notre-Dame.

The Palace.—To the west of the Place d'Armes a gilded iron

[1]*See* Gaye, *Cart. ined.* i., p. 367.

gate and a stone balustrade mark off the great court of the palace. In this court stand statues of Richelieu, Condé, Du Guesclin and other famous Frenchmen. At the highest point there is an equestrian statue in bronze of Louis XIV. To the right and left of this stretch the long wings of the palace, while behind extend the Cour Royale and beyond it the smaller Cour de Marbre, to the north, south and west of which rise the central buildings. To the north the Chapel Court and to the south the Princes Court, with vaulted passages leading to the gardens, separate the side from the central buildings. The palace chapel (1696–1710), the roof of which can be seen from afar rising above the rest of the building, was the last important work of J. Hardouin-Mansart.

The north wing contains galleries and halls of historical pictures and sculptures, and other great apartments, the most famous of which historically is the theatre built under Louis XV. where was held the banquet to the Gardes du Corps, the toasts at which provoked riots that drove Louis XVI. from Versailles. Here the National Assembly met from the 10th of March 1871 till the proclamation of the constitution in 1875, and the Senate from the 8th of March 1876 till the return of the two chambers to Paris in 1879. The central buildings include the former dauphin's apartments and many others on the ground floor and fine state-rooms on the first floor with the great "Galerie des Glaces" (1678) overlooking the park. The hall of Hercules was till 1710 the upper half of the old chapel famed for its associations with Bossuet, Massillon and Bourdaloue. The queen's apartments and the rooms of Louis XIV. are on this floor. The Oeil de Boeuf, named from its oval window, was the anteroom where the courtiers waited till the king rose. It leads to the bedroom in which Louis XIV. died, after using it from 1701, and which Louis XV. occupied from 1722 to 1738. In the south wing of the palace, on the ground-floor, is the Gallery of the Republic and the First Empire. In the south wing is also the room where the Chamber of Deputies met from 1876 till 1879, and where the Congress has since sat to revise the constitution voted at Versailles in 1875 and to elect the president of the republic. The first floor is almost entirely occupied by the Battle Gallery. In the window openings are the names of soldiers killed while fighting for France, with the names of the battles in which they fell, and there are more than eighty busts of princes, admirals, constables, marshals and celebrated warriors who met a similar death. Another room is given up to exhibits connected with the events of 1830 and the accession of Louis Philippe.

The Gardens.—The gardens of Versailles were planned by André Le Nôtre. The ground falls away on every side from a terrace adorned with ornamental basins, statues and bronze groups. Westwards from the palace extends a broad avenue, planted with large trees, and having along its centre the grass of the "Tapis Vert"; it is continued by the Grand Canal, 200 ft. wide and 1 m. long. On the south of the terrace two splendid staircases lead past the Orangery to the Swiss Lake, beyond which is the wood of Satory. On the north an avenue, with twenty-two groups of three children, each group holding a marble basin from which a jet of water rises, slopes gently down to the Basin of Neptune, remarkable for its fine sculptures and abundant water. The Orangery (built in 1685 by Mansart) is the finest piece of architecture at Versailles; the central gallery is 508 ft. long and 42 wide, and each of the side galleries is 375 ft. long. There are 1,200 orange trees, one of which is said to date from 1421, and 300 other kinds of trees.

The alleys of the parks are ornamented with statues, vases and regularly cut yews, and bordered by hedges surrounding the shrubberies. The Grand Canal under Louis XIV. was covered with Venetian gondolas and other boats. Around the Tapis Vert are numerous groves, the most remarkable being the Ballroom or Rockery, with a waterfall; the Queen's Shrubbery, the scene of the intrigue of the diamond necklace; that of the Colonnade, the King's Shrubbery, the Grove of Apollo, and the basin of Enceladus.

Among the chief attractions of Versailles are the fountains and waterworks made by Louis XIV in imitation of those he had seen at Fouquet's château of Vaux. Owing to the scarcity of water at Versailles, the works at Marly-le-Roi were constructed in order to bring water from the Seine; but part of the supply thus obtained was diverted to the newly erected château of Marly. Vast sums of money were spent and many lives lost in an attempt to bring water from the Eure, but the work was stopped by the war of 1688. At last the waters of the plateau between Versailles and Rambouillet were collected and led by channels (total length 98 m.) to the gardens, the soil of which covers innumerable pipes, vaults and aqueducts.

The Trianons.—Beyond the present park, but within that of Louis XIV., are the two Trianons. The Grand Trianon was originally erected as a retreat for Louis XIV. in 1670, but in 1687 Mansart built a new palace on its site. Louis XV., after establishing a botanic garden, made Gabriel build in 1766 the small pavilion of the Petit Trianon. It was a favourite residence of Marie Antoinette, who had a garden laid out in the English style, with rustic villas in which the ladies of the court led a mimic peasant-life. The Grand Trianon contains a museum of state carriages, old harness, etc.

The Town.—The church of Notre-Dame, built by Mansart, and the cathedral of St. Louis, built by his grandson, are uninteresting. The celebrated tennis-court (Jeu de Paume) is now used as a museum. The palace of the prefecture, built during the Second Empire, was a residence of the president of the republic from 1871 to 1879. The military hospital formerly accommodated 2,000 people in the service of the palace. A school of horticulture was founded in 1874, attached to an excellent garden, near the Swiss Lake.

Versailles is the seat of a bishop, a prefect and a court of assizes and has tribunals of first instance and of commerce, a board of trade arbitrators, a chamber of commerce and a branch of the Bank of France, and, among its educational establishments, lycées and training colleges for both sexes and a technical school. It is an important garrison town and has a school of military engineering and artillery. Distilling, boot and shoe making and market gardening are carried on.

History.—Louis XIII often hunted in the woods of Versailles, and built a small pavilion at the corner of what is now the rue de la Pompe and the avenue of St. Cloud. In 1627 he entrusted Jacques Lemercier with the plan of a château. In 1661 Louis Levau made some additions which were further developed by him in 1668. In 1678 Mansart took over the work, the Galerie des Glaces, the chapel and the two wings being due to him. In 1682 Louis XIV took up his residence in the château. Till his time the town was represented by a few houses to the south of the present Place d'Armes; but land was given to the lords of the court and new houses sprang up, chiefly in the north quarter. Under Louis XV the parish of St. Louis was formed to the south for the increasing population, and new streets were built to the north on the meadows of Clagny. Under Louis XVI the town extended to the east and received a municipality; in 1802 it gave its name to a bishopric. In 1783 the armistice preliminary to the treaty of peace between Great Britain and the United States was signed at Versailles. The states-general met here on the 5th of May 1789, and on the 20th of June took the solemn oath in the Tennis Court by which they bound themselves not to separate till they had given France a constitution. Napoleon neglected, and Louis XVIII and Charles X merely kept up, Versailles, but Louis Philippe made great alterations, some of which were later altered back to the original designs, partly with the help of a large gift from the United States. In 1870 and 1871 the town was the headquarters of the German army besieging Paris, and in the Galerie des Glaces William I of Prussia was crowned German emperor in 1871. After the peace Versailles was the seat of the French national assembly while the commune was triumphant in Paris, and of the two chambers till 1879, being declared the official capital of France. After World War I the treaty between the Allied Powers and Germany was signed in the Galerie des Glaces.

See A. P. Gille, *Versailles et les deux Trianons*, with illustrations by M. Lambert (Tours, 1899, 1900); P. de Nolhac, *La Création de Versailles* (Versailles, 1901); J. E. Farmer, *Versailles and the Court under Louis XIV* (New York, 1905).

VERSAILLES, TREATY OF, the treaty of peace that was signed at the close of World War I by the representatives of the Allied and Associated powers and of Germany at Versailles, Fr., on June 28, 1919, and was brought into force by the exchange of ratifications on Jan. 10, 1920. The original intention had been that it should be only one part of a general and inclusive treaty making settlement with Austria, Hungary, Bulgaria and Turkey as well as with Germany; in that case, it would have been comparable to the treaty of Vienna in 1815, which was, in fact, an "omnibus treaty." But the delays in dealing with the smaller states, particularly Hungary and Turkey, not only separated the German treaty from the others, but caused it to be the first to be signed and the first to come into force, just as it was the first in importance.

I. NEGOTIATIONS BEFORE THE ARMISTICE

On Oct. 4, 1918 the German government requested the president of the United States to bring about the immediate conclusion of a general armistice as a preliminary to the restoration of peace and declared its acceptance of the fourteen points formulated by him on Jan. 8, 1918. After lengthy negotiations with Germany, President Wilson communicated its request to the Allied governments and inquired whether they were willing to grant an armistice and to make peace on the basis of the fourteen points. The Allies accepted the proposal, but made two reservations: (1) they excluded the "freedom of the seas" (Point 2), and (2) they demanded that "compensation will be made by Germany for all damage done to the civilian population of the Allies and their property by the aggression of Germany by land, by sea, and from the air." These conditions were communicated to the German government by President Wilson on Nov. 5, 1918. The German government made no reply in writing to these terms, but in fact accepted them by getting in touch with Marshal Foch, asking for an armistice, and accepting the conditions set forth by the marshal. Thus the note of Nov. 5 (the "Lansing note") became a kind of contract between Germany on the one hand and the Allied and Associated powers on the other. The exact meaning of the language concerning reparation was, however, obscured by the insertion in the armistice of a reservation, which was accepted by Germany, to the effect that "any subsequent concessions and claims by the Allies and the United States remain unaffected" (art. 19).

The course of the negotiations leading to the treaty of Versailles is related in the article PARIS, CONFERENCE OF. Here the treaty is analyzed and reviewed in the light of its 20 years' history (1919–1939).

II. ANALYSIS OF THE TREATY

Part I. The Covenant.—Part I deals with the covenant of the League of Nations (*see* COVENANT). The covenant united all its signatories in a league guaranteeing their territorial independence and integrity (art. 10); according to President Wilson, this was the "heart" of the matter. The entrance of Germany into the league was deprecated at the time by some of the Allies and did not take place until after the signature of the agreements of Locarno on Dec. 1, 1925 and their ratification in 1926. The most important power granted to the league was the supervision of mandated territories (art. 22), by which the government of the former German colonies, after having been assigned to various mandatory powers, was subject to supervision by a permanent mandates commission. This was appointed by the league and inspected the annual reports of the mandatory powers on the territory committed to their charge. Other duties of the league were to formulate plans for the reduction of armaments (art. 8) and to supervise the trade in arms and ammunition with backward countries (art. 23). There were also provisions for international co-operation in labour questions (art. 23) and for international control of health and disease (art. 25); in the 20 years that followed, these responsibilities of the league were widely and successfully extended.

The most important obligation of the covenant was found in articles 12–16, by which members of the league bound themselves not to "go to war in disregard of its covenants" until three months after an award of arbitration or a report by the council of the league; article 16 provided for the application of economic "sanctions" against a member who resorted to war in disregard of its covenants. These articles of the covenant were put to the test, unsuccessfully, against Japan in Manchuria in 1931–33 and against Italy in Ethiopia in 1935–36.

The machinery through which the league functioned consisted of a council and an assembly. The council was to have five members, the United States, France, Great Britain, Italy and Japan being permanent members (in order to give the great powers a majority). The failure of the United States to join the league upset this plan, and ultimately the number of seats held by the smaller powers was increased to ten, of which three were "semi-permanent"; these seats were filled by the assembly. Germany entered the league in 1926 and occupied a permanent seat until its withdrawal from the league in 1933. Japan withdrew from the league in 1933, and Italy in 1937. The soviet union entered the league in 1934 and occupied a permanent seat until its expulsion in 1939. The assembly consisted of representatives of all member states, and was a kind of international parliament.

Two institutions connected with, but actually separated from, the league were the Permanent Court of International Justice (provided for in art. 14 and functioning since 1921) and the International Labour office (provided for in art. 23 and 387–427 and functioning since 1919).

Other duties of the league, assigned to it by other articles of the treaty of Versailles and affecting Germany, were the governance of the Saar basin and the Free City of Danzig, the supervision of German disarmament after the dissolution of the inter-Allied naval and military commissions in 1925, and the supervision of the racial and religious Minorities' treaties which were signed as part of the general settlement of 1919–20.

Parts II and III. Territorial Dispositions.—(*a*) *Western Frontier.*—As a result of the war, Germany lost territory in the west, north and east, and had its influence greatly weakened beyond its own borders. Belgium, which ceased to be a neutral state (art. 31), acquired from Germany the frontier districts of Moresnet, Eupen and Malmedy (art. 32–34) as compensation for damage resulting from the German occupation. Luxembourg ceased to be a neutral state and to form part of the German *Zollverein* (art. 40); later it entered into an economic union with Belgium. The Saar basin, a rich mining area vainly claimed by France, was placed under the control of the league, which governed it by an international commission, and its coal mines were ceded to France as compensation for the destruction of coal mines in northern France by the German army (art. 45–50). At the end of 15 years a plebiscite was to be taken, whereby the inhabitants would vote as to their preference for (1) the existing international regime, (2) union with France, (3) union with Germany. In 1935 the Saar voted to return to Germany. Finally, Alsace and Lorraine were ceded by Germany to France (art. 51–79) "to redress the wrong done by Germany in 1871." France thus gained nearly 2,000,000 inhabitants, great strategic advantages, and valuable economic resources, particularly the iron fields of Lorraine.

The left bank of the Rhine and the right bank to a line drawn 50 km. to the east of the Rhine were demilitarized. Fortifications were to be dismantled, and no permanent works for manoeuvre or mobilization were to be permitted (art. 42–43). Violation of these articles by Germany was to be regarded as "a hostile act" (art. 44). The articles were violated by Germany in March 1936 when German troops reoccupied the Rhineland—and the signatories of the treaty contented themselves with a verbal protest.

(*b*) *Northern Frontier.*—In the north Germany lost northern Schleswig to Denmark as the result of a plebiscite held in two zones (art. 109–114). The northern zone voted for return to Denmark, the southern or Flensburg zone elected for Germany. Thus Denmark finally received that plebiscite which Bismarck had promised in 1866 (art. 3, treaty of Nikolsburg) but which Ger-

many never allowed to be held.

(*c*) *Eastern Frontier.*—Beginning at the Baltic, Germany ceded to Poland West Prussia and most of the province of Poznan (art. 87); this meant that a "corridor," as the Germans called it, was run between Pomerania and East Prussia and separated the latter province from the main body of the German reich. On the other hand, the territory was historically Polish (*i.e.* before the partitions of Poland) and was inhabited by a Polish majority. No provision of the treaty caused so much animosity and resentment as this arrangement, which, it should be noted, accorded with President Wilson's 13th point for giving Poland "a free and secure access to the sea." The territory ceded did not, however, include Danzig, a purely German town, which was established as a free city under the sovereignty of the league (art. 100–108). In East Prussia plebiscites were provided for in the Allenstein and Marienwerder districts (art. 94–98), where there was a mixture of Germans and Poles; both plebiscites went in favour of Germany (1920). The city and hinterland of Memel were ceded to the principal Allies (art. 99), who in 1924 awarded the territory to Lithuania. Further south, a plebiscite was provided for in upper Silesia (art. 88), where the population was partly German, partly Polish. This resulted (1921) in a majority for Germany, but inasmuch as the treaty clearly implied a partition of the territory, the League of Nations—at the request of the Allies and Germany—rendered a decision by which the southern half of the area—including valuable mines—passed to Poland, the upper half returning to Germany. Less than one-third of the population ceded by Germany to Poland and Lithuania were German. Provision was made (art. 91) by which Germans who did not wish to become Polish nationals might opt for German nationality and leave Poland.

Altogether, Germany ceded to the various powers about 25,000 sq.mi. of territory and nearly 6,000,000 inhabitants. This loss was, however, probably less serious than the loss of iron ore (65% in Lorraine and Luxembourg), coal (45% in the Saar and Silesia), zinc (72%), lead (57%) and potash (Alsace).

Part IV. German Rights and Interests Outside Germany.—Germany ceded all its oversea colonies to the principal Allied and Associated powers (art. 119), who distributed them to various mandatories. In Africa the Cameroons and Togoland were divided between France and Great Britain, and East Africa between Great Britain and Belgium; South-West Africa was awarded to the Union of South Africa. These territories contained some 18,000 Germans and more than 12,000,000 natives. In the Pacific Germany lost the Marshall Islands to Japan, New Guinea to Australia, Samoa to New Zealand, and Nauru to the British Empire. It also renounced outright to Japan the province of Shantung (art. 156–158), which Japan returned to China in 1923. In addition to these cessions of territory, Germany lost all its state property, movable and immovable, in its colonies and was obliged to cancel all its treaty rights, capitulations, and concessions in China, Siam, Liberia, Egypt, and Morocco. The property and stations of German missionaries were to be handed over to trustees, and individual missionaries were to be controlled or expelled at the will of the mandatory (art. 438).

Part V. Military, Naval and Air Clauses.—"In order to render possible the initiation of a general limitation of the armaments of all nations," Germany agreed to reduce its army to 100,000 men, with stores of guns, ammunition, etc. in proportion. Beyond this figure all existing munitions were to be surrendered and destroyed and the manufacture of munitions closely restricted; the importation of munitions of war was prohibited (art. 159–170). Conscription was abolished, and Germany was required to adopt a system of voluntary enlistment of at least 12 years for the men and 25 years for officers. Military training outside the army was forbidden and the existence of a general staff prohibited (art. 173–179).

The naval clauses were equally severe, for the German navy was restricted to 6 battleships of an antiquated type, 6 cruisers, 12 destroyers, and 12 torpedo boats (art. 181), and submarines were forbidden. For purposes of replacement no ship was to be built in excess of 10,000 tons. Other ships of the German navy were to be handed over to the Allies (art. 185). The personnel was to be recruited in the same manner as the army and was limited to a total of 15,000 men (art. 183). Naval works and fortifications within 50 km. of the coast were to be demolished. The fortifications of Heligoland were to be dismantled.

The air clauses (art. 198-202) were the most drastic of all, for they absolutely prohibited all naval and military air forces and called for the destruction of all air matériel. Inter-Allied commissions of control were provided for each arm of the service and functioned until 1925, when their work was taken over by the League of Nations. This supervision was never fully effective and gradually ceased to be exercised; there was no restraint when Herr Hitler decided on the rearmament of Germany in 1935.

Part VI. Prisoners of War and Graves.—This section provided for the return of prisoners of war and for the upkeep and maintenance of graves.

Part VII. Penalties.—William II, "formerly German emperor," was arraigned "for a supreme offence against international morality and the sanctity of treaties" (art. 227), although in 1914 war was a legal procedure and had not been renounced as an "instrument of national policy" (to use the language of the Briand-Kellogg pact of 1928). The principal Allied Powers proposed to try the former emperor, but the Netherlands government, in whose territory he had taken refuge, refused to surrender him, and nothing came of the project.

There were further provisions (art. 228-230) for the punishment before military tribunals of the allies of Germans "accused of having committed acts in violation of the laws and customs of war." Eventually a list of more than 100 such criminals was drawn up and their extradition was demanded of Germany. On account of the excitement produced in Germany, the demand was not insisted upon; instead, the Allies agreed to about a dozen being tried in Germany by Germans, and when a few had been convicted and given mild sentences, the Allies decided to drop the matter. In 1925 Field Marshal Hindenburg, himself a "war criminal," was elected president of the German reich without any Allied protest.

Part VIII. Reparation.—This was perhaps the most important section of the treaty, for it produced bitter controversy almost from the beginning and was much affected by outside and popular influences. In the pre-Armistice agreement of Nov. 5, 1918 (*see* above, I), Germany had undertaken to make compensation for "all damage done to the civilian population of the Allies and property by the aggression of Germany by land, by sea, and from the air." In the treaty this obligation was rephrased thus (art. 231): "The Allied and Associated Governments affirm and Germany accepts the responsibility of Germany and her allies for causing all the loss and damage to which the Allied and Associated Governments and their nationals have been subjected as a consequence of the war imposed upon them by the aggression of Germany and her allies." Although the Germans interpreted this clause to imply that Germany was solely responsible for the war, the intention of the Allies was, as has been disclosed by a study of the records of the peace conference, merely to reaffirm the obligation assumed by Germany when it signed the armistice. The fact that the same language is used, *mutatis mutandis,* in the treaties with Austria, Hungary and Bulgaria adds further proof. In the definition (art. 232) of the categories of loss and damage under which Germany was liable, however, pensions to military persons and separation allowances to civilians were included, which seems clearly contrary to the definition laid down in the note of Nov. 5, 1918 (but may possibly be justified by the reservation in the Armistice that subsequent claims remained unaffected; *see* above, Part I). A memorandum justifying the inclusion of these items was prepared by Gen. Smuts of South Africa, but its argument has not been generally accepted.

There was sharp disagreement among the Allies as to how much Germany could pay on account of reparation. The most realistic British experts placed the figure at something like £2,000,000,000 or $10,000,000,000, and the Americans at £3,000,000,000 or $15,000,000,000; some sanguine British and French estimates ranged as high as £20,000,000,000 or $100,000,000,000

(in 1871 Germany imposed an indemnity of $1,000,000,000 on France). As no sum could be agreed upon, a clever scheme was adopted of postponing the fixing of the amount until more data about the damage done was available and passions had cooled down. A reparation commission was established with extensive powers, which was to assess the German obligation not later than May 1, 1921 (art. 233); in the meantime, Germany was to make certain preliminary payments in kind and in gold (£1,000,000,000 or $5,000,000,000), which would tide over the immediate needs of the Allies. The commission was to be composed of representatives of the United States, France, Great Britain and Italy, and a fifth member from Japan, Belgium or Yugoslavia, according to the claims being considered; it was to give Germany "a just opportunity to be heard," but was not bound to accept the German argument. It was expected that the United States would become a kind of arbiter between conflicting claims and that the commission would be able to reduce the demands on Germany to a reasonable figure. But the failure of the United States to ratify the treaty reduced the commission to four; ordinarily France and Belgium voted together against Britain and Italy; France, as the country which had suffered the greatest devastation, held the presidency of the commission and in this capacity possessed a casting vote in case of a tie (art. 437). In consequence, France and Belgium were able to outvote Britain and Italy and often did so. On April 28, 1921 the commission determined the debt of Germany to be approximately $33,000,000,000, in addition to the war debt of Belgium which Germany had assumed as "a consequence of the violation of the treaty of 1839" (art. 232); this was more than twice the American estimate of Germany's "capacity to pay," and about one-half of this sum was accounted for by the inclusion of pensions and separation allowances. It should be noted, however, that in their counterproposals to the treaty, the Germans offered to pay 100,000,000,000 gold marks, or approximately $25,000,000,000.

Although Germany's obligations were reckoned in gold marks, the actual payments had to be made largely in kind, and the treaty contained elaborate provisions for the transfer by Germany to the Allies of various commodities (art. 236 and annexes). They included the replacement by German ships, on the basis of "ton for ton and class for class," of Allied vessels sunk by German submarines. Great Britain received most under this head. France obtained large deliveries of coal and coal derivatives; Belgium received much livestock. Germany had also to furnish much material for the restoration of the devastated regions, and to renounce numerous ocean cables.

Since German resistance to the payment of reparation was to be expected, the treaty provided that the Allies might employ "economic and financial prohibitions and reprisals and in general such other measures as the respective governments may determine to be necessary" and that Germany was not to regard them as "acts of war." From the beginning Germany protested that the terms were not only impossible of execution but were contrary to the pre-Armistice agreement. The French, for their part, insisted that Germany could pay if it wished to or were forced to pay, and they tried to insist on the letter of the treaty. British opinion took a middle ground and opposed pressing Germany to the point where payment would really "hurt." In the United States there was much confusion of thought, for many persons who advocated reducing the burden on Germany were insistent that the Allies should pay their "war debts" to the United States. Ultimately it became clear that the colossal sums involved in reparation could not be transferred from one country to another without seriously upsetting the internal economy of both. The history of the reparation question from 1920 to 1932 is discussed in the article REPARATIONS AND THE DAWES PLAN.

Part IX. Financial Clauses.—This section was largely technical, dealing with the order of priority of German payments, the meeting of special debts from special assets, currency questions, and the like, and was closely connected with the reparation clauses. The powers to which German territory was ceded had to assume a portion of the German debt as it stood at the outbreak of the war (art. 254), but "inasmuch as in 1871 Germany refused to undertake any portion of the burden of the French debt," France was exempted from any obligation in respect of recovered Alsace-Lorraine (art. 255). The powers which assumed mandates of the former German colonies were also exempted from taking over the debts of those colonies (art. 257).

Part X. Economic Clauses.—Sec. I (art. 264–275) dealt with the restoration of commercial relations. The most important provision was that securing "most favoured nation" treatment from Germany for five years without reciprocity (art. 267). France obtained the exemption from customs duties of products of Alsace-Lorraine for five years (art. 268). Sec. II (art. 282–295) dealt with the revival of treaties which had been nullified by the war.

Secs. III-VIII (art. 296–312) provided for the collection of debts and the regulation of various property rights and interests, contracts, patents, insurance, etc. In the liquidation of German property in foreign countries the principle was adopted of giving the Allies power to confiscate the private property of German nationals and of crediting the sums obtained to the amount paid as reparation by the German government (art. 297); Germans whose property was thus taken were left to collect compensation from their government. This departure from long-established practice was of course challenged by the Germans and was sometimes criticized in Allied countries as "socialistic." The Allies justified their position by saying that "all available means" must be used to meet Germany's obligations and that they themselves had taken over the foreign property of their own nationals. A considerable sum was obtained by this device.

Part XI. Aerial Navigation.—This provided for full liberty of passage and facilities for Allied aircraft flying over Germany until Jan. 1, 1923, unless Germany had been previously admitted to the League of Nations (art. 313–320).

Part XII. Port, Waterways and Railways.—This was a highly technical section. Its aim was to secure international control over rivers which flowed through more than one country—a rather striking development of the doctrine as to international rivers laid down at Vienna in 1815. There was a natural desire, however, to provide access to the sea for countries like Switzerland and Czechoslovakia, which were landlocked but were the sources of rivers running to the sea. International commissions were accordingly set up to control the Rhine, Elbe, Oder, Niemen (Nemunas) and Danube rivers, with the result that Germany was left in a minority position as regards three rivers regarded as essentially German, the Rhine, the Elbe and the Oder. The Kiel canal was in effect internationalized so as to give freedom of access to all vessels of whatever country at peace with Germany (art. 380); the canal was, however, left under German administration. Access to the sea was provided for Czechoslovakia by the establishment of free zones in the harbours of Hamburg and Stettin. Certain clauses governing international transport through Germany were of a temporary nature and were subsequently replaced by the decisions of an international transport conference held at Barcelona in 1921 under the auspices of the League of Nations. This section of the treaty was denounced by Germany in Nov. 1936. Several powers protested individually against this unilateral action, but to no effect.

Part XIII. Labour.—This section created an International Labour Organization as the instrument to carry out art. 23a of the covenant of the League of Nations, by which the members undertook "to endeavour to secure and maintain fair and humane conditions of labour for men, women and children, both in their own countries and in all countries to which their commercial and industrial relations extend." Three representatives of labour took part in the formulation of the plan: Samuel Gompers of the United States, George N. Barnes of Great Britain and Albert Thomas of France, the last-named of whom became the head of the International Labour office. The office was established at Geneva, side by side, but not identical with, the secretariat of the League of Nations; though an integral part of the league, its character and organs were autonomous. Its governing body consisted at first of 24 members, 12 representing governments, 6 elected by employers' delegates to the general conference, 6 by

workers' delegates. Later the number was increased to 32, in the same proportion, with the proviso that 8 of the government members must represent Canada, France, Great Britain, India, Italy, Japan, the soviet union and the United States, thus insuring adequate representation to the states of greatest industrial importance. The general conference, which meets annually, consists of 4 delegates from each member state, 2 chosen by the government, 1 by employers, 1 by labour. The conference acts by recommendations, and the governments are pledged to submit such recommendations to their respective competent authorities, who then decide what action, if any, to take. All members of the league are automatically members of the International Labour Organization. Germany was admitted in 1919, long before it joined the league; when it left the league in 1933, it left the labour organization also. Japan and Italy, however, continued in the organization after they had resigned from the league. In 1934 the United States joined the organization without joining the league. In 1939 there were 57 member states.

As a result of the defeat of France in 1940, the International Labour office was transferred to Montreal, Can. For the work of the office, *see* the article INTERNATIONAL LABOUR ORGANIZATON, THE.

Part XIV. Guarantees.—In addition to the provisions for the demilitarization of the Rhineland (*see* above Parts II and III), a military occupation by Allied troops was also provided for (art. 428). The whole of this area, together with bridgeheads across the Rhine, was to be occupied for 15 years from the coming into force of the treaty (Jan. 10, 1920); if, however, Germany "faithfully carried out" the terms of the treaty, the bridgehead and zone of Cologne was to be evacuated in 5 years, that of Coblenz in 10, and that of Mainz in 15 (art. 429). Because of suspicion that Germany was evading the military clauses, the evacuation of the Cologne zone was postponed from Jan. to Dec. 1925. In June 1930 both the Coblenz and the Mainz zones were evacuated as part of a general settlement with Germany (*see* REPARATIONS AND THE DAWES PLAN).

There was also a sweeping provision (art. 430) that if any time during the occupation or after the expiration of the 15-year period the reparation commission found Germany not observing its obligations with regard to reparation, the whole or part of the areas evacuated would be immediately reoccupied. It seems doubtful whether this article justified the action taken by the Allies in 1921 when they occupied areas in Germany east of the bridgeheads. Whether it justified the occupation of the Ruhr by France and Belgium in 1923 was warmly disputed by the British government on the one hand and by the French and Belgian governments on the other. As a guarantee for the settlement of the eastern frontier of Germany, Germany was required to abrogate the treaty of Brest-Litovsk and other agreements made with the soviet government and to withdraw its troops in the east within its new frontiers when the Allies "shall think the moment suitable" (art. 433).

Part XV. Miscellaneous Provisions.—This consists of a number of miscellaneous and technical matters which were accidentally omitted elsewhere The most important was the recognition that the free zones of upper Savoy and Gex, lying between France and Switzerland, established in 1815 were "no longer consistent with present conditions" and that it was "for France and Switzerland to come to an agreement" for modification (art. 435). Switzerland, however, resisted the proposals of France for modification, and its position was sustained by the Permanent Court of International Justice in 1932.

The treaty was drawn up in English and French, and the texts in both languages were authentic; part of the misunderstanding of art. 231 in Germany was due to a faulty German translation.

III. ESTIMATE

The treaty of Versailles, from the moment that its text was published, was bitterly criticized by the German government and the German people and by many people in other lands. The first complaint was that the treaty had been "dictated," not merely in the sense that it had been imposed on a defeated enemy (which is the usual result of a lost war), but that no opportunity had been allowed for verbal negotiations between vanquished and victors. This was true, and the Allies may have blundered psychologically in refusing to meet the Germans for personal negotiations; it may be doubted, however, whether this procedure would have resulted in any large modification of the treaty.

Secondly, the Germans contended that the treaty was not in harmony with the fourteen points, although the pre-Armistice agreement provided that they should form the basis of peace. There was some truth in this contention. Point 3 calling for "the removal, as far as possible, of all economic barriers and the establishment of an equality of trade condition" was certainly not observed, although the restrictions imposed on Germany were avowedly temporary. The provisions of Part V of the treaty relating to German disarmament were far from fulfilling the promise of Point 4 for "adequate guarantees given and taken that national armaments will be reduced to the lowest point consistent with domestic safety," although they marked a step in that direction. The "free, open-minded, and absolutely impartial adjustment of all colonial claims" demanded in Point 5 was certainly not satisfied, even though the adoption of the mandate system was somewhat less selfish than outright annexation. Also, on various points of detail, it could be maintained that the treaty failed to observe that "impartial justice" which President Wilson talked of so often in his speeches of 1918, subsequent to that in which he laid down the fourteen points. On the other hand, the territorial clauses of the treaty were substantially in accord with Points 7 (Belgium), 8 (Alsace-Lorraine) and 13 (Poland); even the cession of Eupen and Malmedy to Belgium could be justified by the necessity of compensating that country for damages done by the German army of occupation. Germany was not made an original member of the League of Nations, as it was perhaps entitled to expect under Point 14, but at least it was assured that in due course it would be admitted. The treaty, then, was not a complete realization of the fourteen points, so far as they concerned Germany, but neither was it the complete travesty of them so often represented.

The third German complaint, and the one that really mattered, was that the treaty demanded intolerable sacrifices of Germany and that it could not be carried out without wrecking the economic life of the country. What the Germans really meant, although they did not put it in so many words, was that the treaty would make it impossible to restore the standard of living which had existed in 1914. No doubt the various items of loss and obligation, when assembled together, made the treaty as a whole appear much more crushing and severe than they did to the numerous committees which worked them out separately, and apparently the treaty in its definitive form was not reviewed by the Big Four from the point of view of its cumulative effect on the Germans. On the other hand, President Wilson, Georges Clemenceau, and David Lloyd George were under such strong popular pressure not to make a lenient peace that they would not have dared to reduce the German burden in any large measure. The Germans, for their part, made the mistake of challenging almost every article of the draft treaty, instead of concentrating on a few fundamental issues, with the result that their objections were regarded as largely factious and only a few concessions were made. Apart, however, from such considerations, it is now clear, more than 20 years later (1942), that the Germans greatly exaggerated the probable effects of the treaty on their economic position. A competent American authority, by no means unfriendly to Germany, has shown that the burden of taxation in Germany after 1919 was only a quarter as heavy as the burden in Britain, only half as heavy as in France or Canada. Furthermore, Germany's claim that it was ruined by reparation was not justified, for the total amount paid by Germany between 1920 and 1931 (when the Hoover moratorium was proclaimed) amounted to 21,585,000,000 gold marks, and it borrowed more than twice that amount in the United States alone and then defaulted on most of those loans. What ruined the German

economy was the four years of war, during which the German government floated loans to the amount of 98,000,000,000 marks (or four times the amount paid in reparations), the total cost of the war to Germany was about $100,000,000,000 (or 20 times the amount paid in reparations). It may well be the verdict of history that although Germany lost the war in a military sense and was then forced to yield certain territories, she won the peace in an economic sense.

Even if the harshest view be taken of the treaty of Versailles, the fact remains that no other great diplomatic instrument has ever been so speedily modified, revised, or altered. Part I was modified to admit Germany to the League of Nations. Part V was torn up unilaterally by Germany when she began to rearm. Part VII went largely by default. Part VIII was repeatedly whittled away and finally abandoned. Parts X, XI were modified or abandoned in large measure. Part XII was denounced by Germany. Part XIV, the section on guarantees, the crux of the treaty, was abandoned by the Allies five years ahead of schedule. Except as regards Parts V and XII, these concessions were made to Germany *before* the advent of Adolf Hitler to power. Hitler's denunciations of Parts V and XII evoked only faint and futile protests.

Thus, in 1938, only Parts II, III and IV of the treaty remained; these concerned the territorial settlements of 1919. In the light of events after 1938, it seems fair to say that the real German grievance against the treaty of Versailles was not so much the burden of reparation or the so-called "war guilt" clause (art. 231) as the loss of territory in Europe and elsewhere and that the German acceptance of the fourteen points in 1918 was not sincere. By the *Anschluss* of Austria in March 1938 (forbidden by art. 80), the partition of Czechoslovakia in Sept. 1938, and the occupation of Bohemia and Moravia in March 1939 (contrary to art. 81), the seizure of Memel in March 1939 (contrary to art. 99), Germany largely destroyed the political structure of eastern Europe as erected by the treaty of Versailles. The last step was to make war on Poland on Sept. 1, 1939.

Whereas Germany complained that the treaty was too severe, French opinion always considered the treaty inadequate for the defense of France and Clemenceau was defeated for the presidency of the republic in 1920 because he had made too weak a settlement. The events of 1940, culminating in the overrunning of France by German armies, proved the correctness of the French contentions in 1919. Curiously enough, when France, in the years following the negotiation of the treaty, tried to enforce it against Germany, it was not supported by its associates who had compelled it to accept the treaty against its better judgment, the United States retiring altogether from European politics, Great Britain and Italy constantly demanding that France make concessions to Germany. It is true that the treaty of Versailles failed to bring peace, order and prosperity to Europe; it is also true that the treaty was never fully applied. Rigorous enforcement of the treaty might have convinced Germany not only that it had lost the war, but also that war did not pay. Once the Allies began not to enforce the treaty and to modify it, they lost all chance of reconciling Germany to its provisions and encouraged it to nullify them. It is only from that point of view that the treaty of Versailles can be considered the cause of the war of 1939.

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VERS DE SOCIÉTÉ, a term for social or familiar poetry, originally borrowed from the French, which came to rank as an English expression. The use of the phrase as an English one is first met at the opening of the 19th century, and it is to be observed that the English meaning is not wholly equivalent to that of the French original. The prince of the French graceful trifers was the Abbé de Chaulieu (1639–1720), of whom it was said that he made verses solely for the amusement of his friends, without the smallest intention of seeing them in print.

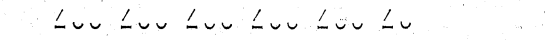
An enormous collection of *vers de société* was brought together by Titon du Tillet (1676–1762), in his *Parnasse françois,* where those who are curious about the subject may observe to satiety how ingenious and trifling these artificial verses of the French 18th century could be. The fashion for them followed upon the decline of interest in rondeaux, ballades and villanelles, and Chaulieu himself had not a little to do with throwing these ingenuities out of fashion. Of the writers of *vers de société* in France, J. B. Rousseau had the most poetical faculty.

If in England the expression *vers de société* carries with it more literary dignity, this is mainly due to the genius of one man—Matthew Prior. Prior's *Poems on Several Occasions,* collected in 1709, presents us with some of the earliest entirely characteristic specimens, and with some of the best. Here the poet consciously, and openly, resigns the pretension of high effort and an appeal to Parnassus. He is paying a visit at Burghley House, where the conversation turns on the merits and adventures of Fleetwood Shepherd; Prior then and there throws off, in extremely graceful verse, a piece appropriate to the occasion. He addresses it, and he dates it (May 14, 1689); and this is a typical example of *vers de société.* It will be seen that Prior, who learned much from his residence in the heart of the French world of fashion between 1711 and 1715, treats very much the same subjects as did Chaulieu and La Fare, but he does so with more force of style and dignity of imagination. As the 18th century progressed, the example of Prior was often followed by English poets, and the *vers de société* tended to merge with the epistle and the epigram. Swift, however, when he was neither coarse nor frigid, sometimes achieved a genuine success, as in the admirable verses on his own death. The odes of Ambrose Philips (1671–1749), addressed by name to various private persons, and, most happily, to children, were not understood in his own age, but possess some of the most fortunate characteristics of pure *vers de société.* In his "Welcome from Greece," a study in *ottava rima,* Gay produced a masterpiece in this delicate class, but most of his easy writings belong to a different category. Nothing of peculiar importance detains us until we reach Cowper, whose poems for particular occasions, such as those on "Mrs. Throckmorton's Bullfinch" and "The Distressed Travellers," are models of the poetic use of actual circumstances treated with an agreeable levity, or an artful *naïveté.* In a later age Byron, who excelled in so many departments of poetry, was an occasional writer of brilliant *vers de société,* such as the epistle "Huzza, Hodgson," but to find a direct successor to Prior it is necessary to pass Henry Luttrell (1765–1851) and W. R. Spencer (1769–1834), and come down to Winthrop M. Praed (1802–39). A certain character was given to English *vers de société* by Hood and Barham, but the former was too much addicted to a play upon words and the latter was too boisterous to be considered as direct continuers of the tradition of Prior. That tradition, however, was revived by Frederick Locker, afterwards Locker-Lampson (1821–95), whose *London Lyrics,* first printed in 1857 and constantly modified until 1893, is in some respects a typical example of pure *vers de société.* Numerous others attempted to carry on the tradition in English. Superior to all of them was Austin Dobson (1840–1921), who was, however, more than a writer of *vers de société.*

VERSE, the name given to an assemblage of words so placed together as to produce a metrical effect. The art of making, and the science of analysing, such verses is known as versification. According to Max Müller, there is an analogy between *versus* and the Sanskrit term, *vritta,* which is the name given by the ancient grammarians of India to the rule determining the value of the quantity in Vedic poetry. A verse is a series of rhythmical syllables, divided by pauses, and destined to occupy a single line.

Greek Metre.—The chief principle in ancient verse was quantity, *i.e.,* the amount of time involved in expressing a syllable. Accordingly, the two basal types which lie at the foundation of classical metre are "longs" and "shorts." The convention was that a long syllable was equal to two short ones: accordingly there was a real truth in calling the succession of such "feet" metre, for the length, or weight, of the syllables forming them could be, and was, measured. In Greek verse, there might be an *ictus* (stress), which fell upon the long syllable, but it could only be a regulating element, and accent was always a secondary element in the construction of Greek metre. There are naturally only two movements, the quick and the slow. Thus we have the anapest (⏑⏑–) and the dactyl (–⏑⏑), which are equal, and differ only as regards the position of their parts. After these follow two feet which must be considered as in their essence non-metrical as it is only in combination with others that they can become metrical. These are the spondee (––) and the pyrrhic (⏑⏑). Of more essential character are the iambic (⏑–) and the trochee (–⏑). Besides these definite types, the ingenuity of formalists has invented an almost infinite number of other "feet." It is, perhaps, necessary to mention some of the principal of these, although they are, in the majority of cases, purely arbitrary. In the rapid measures we find the tribrach (⏑⏑⏑), the molossus (–––), the amphibrach (⏑–⏑), the amphimacer (–⏑–), the bacchius (⏑––) and the antibacchius (––⏑). There is a foot of four syllables, the choriamb (–⏑⏑–) and one of five, the dochmiac (⏑––⏑–).

Of the metres of the ancients, by far the most often employed, and no doubt the oldest, was the dactylic hexameter, a combination of six feet, five successive dactyls interchangeable except in the fifth foot with spondees and a spondee or trochee:—



This was known to the ancients as "epic" verse, in contrast to the various lyrical measures. The poetry of Homer is the typical example of the use of the epic hexameter, and the character of the Homeric saga led to the fashion by which the dactylic hexameter, whatever its subject, was styled "heroic metre." The earliest epics, doubtless, were chanted to the accompaniment of a stringed instrument, marking the pulsation of the verse ἔπη.

We pass, by a natural transition, to the pentameter, which was used with the hexameter, to produce the effect which was early called elegiac, and its form shows the appropriateness of this custom:—

"Cynthia | prima fu- | it, || Cynthia | finis e- | rit."

A hexameter, full of energy and exaltation, followed by a descending and melancholy pentameter, had an immediate tendency to take a complete form, and this is the origin of the stanza. Such a distich was called an elegy, ἐλεγεῖον, as specially suitable to an ἔλεγος or lamentation. It is difficult to say with certainty whether the distich so composed was essential as an accompaniment to flute-music in the earliest times, or how soon there came to be written purely literary elegies towards which the melody stood in a secondary or ornamental relation.

Iambic metre was, next to the dactylic hexameter, the form of verse most frequently employed by the poets of Greek antiquity. It was not far removed from prose; it gave a writer opportunity for expressing popular thoughts in a manner which simple men could appreciate, being close to their own unsophisticated speech. In particular, it presented itself as a heaven-made instrument for the talent of Euripides.

It was not, however, until the invention of the lyric proper, whether individual to the poet, or choral, that the full richness of possible rhythms became obvious to the Greeks. The lyric inspiration came originally from the island of Lesbos, and it passed down through the Asiatic archipelago before it reached the mainland of Greece. The Lesbians cultivated an ode-poetry, the enchanting beauty of which can still be realized in measure from what remains to us of the writings of Sappho and Alcaeus. There is a stanza known as the Sapphic and another known as the Alcaic.

The name of Stesichorus of Himera points to the belief of antiquity that he was the earliest poet who gave form to the choral song; he must have been called the "choir-setter" because he arranged and wrote for choirs semi-epic verse of a new kind, "made up of halves of the epic hexameter, interspersed with short variations—epitrites, anapaests or mere syncopae—just enough to break the dactylic swing, to make the verse lyrical" (Gilbert Murray). But it appears to be to Arion that the artistic form of the dithyramb is due. Pindar gathered the various inventions together, and exercised his genius upon them all.

After the happy event of the Persian War, Athens became the centre of literary activity in Greece, and here the great school of drama developed itself, using for its vehicle, in dialogue, monologue and chorus, nearly all the metres which earlier ages and distant provinces had invented. The verse-form which the dramatists preferred to use was almost exclusively the iambic trimeter, a form which adapted itself equally well to tragedy and to comedy. Aeschylus employed for his choruses a great number of lyric measures, which Sophocles and Euripides reduced and regulated. With the age of the dramatists the creative power of the Greeks in versification came to an end, and the revival of poetic enthusiasm in the Alexandrian age brought with it no talent for fresh metrical inventions.

Latin Metre.—Very little is known about the verse-forms of the original inhabitants of Italy, before the introduction of Greek influences. The earliest use of poetry as a national art in Italy is to be judged by inscriptions in what is called the Saturnian metre. The introduction of Greek dramatic metre marks the start of regular poetry among the Latins, which was due, not to men of Roman birth, but to poets of Greek extraction or inhabiting the Greek-speaking provinces of Italy. These writers, bearing the stamp of a widely recognized cultivation, threw the old national verse back into oblivion. Latin verse, then, began in a free but loyal modification of the principles of Greek verse. Plautus was particularly ambitious and skilful in this work, and, aided by a native genius for metre, he laid down the basis of Latin dramatic versification. Terence was a feebler and at the same time a more timid metrist. In satire, the iambic and trochaic measures were carefully adapted by Ennius and Lucilius. The dactylic hexameter followed, and Ennius, in all matters of verse a daring innovator, directly imitated in his *Annales* the epic measure of the Greeks. To him also is attributed the introduction of the elegiac distich. The dactylic hexameter was forthwith adopted as the leading metre of the Roman poets, and the basis upon which all future versification was to be erected was firmly laid down before the death of Ennius in 169 B.C. Lucilius followed, but perhaps with some tendency to retrogression, for the Latin critics seem to have looked upon his metre as wanting both in melody and elasticity. Lucretius, on the other hand, made a further advance on the labours of Ennius, in his study of the hexameter. Lest, however, this great form of verse should take too exclusive a place in the imagination of the Romans, a younger generation began to imitate the lyrical measures of the Greeks with remarkable success. These poets left the rigid school of Ennius, and sought to emulate the Alexandrians of their own age: we see the result in the lyric measures used so gracefully and with such brilliant ease by Catullus. The versification of the Romans reached its highest point of polish in the Augustan age, in the writings of Tibullus, Propertius, Virgil and Ovid. Horace in his odes and epodes was not content with the soft Alexandrian models, but aimed at achieving more vigorous effects by an imitation of the older Greek models.

Modern Versification.—The main distinction between

classical and modern versification consists in the substitution of stress for quantity on the basis of metre, corresponding to a change of enunciation which set in in the late classical period. A syllable, in modern verse, is heavy or light, according as it is stressed or unstressed.

The prosodies of Provence, France, Italy and Spain were derived from popular accentual Latin verse by a slow and intangible transition. Versification, deprived of all the regulated principles of rhythmical art, received in return the ornament of rhyme, without which the weak rhythm itself would practically have disappeared. A new species of rhythm, depending on the varieties of mood, was introduced, and stanzaic forms of great elaboration and beauty were invented. The normal line is of ten or eight syllables: the alexandrine of 12 appears later. In Provençal and early French the position of the caesura in each line was fixed by strict rules; in Italian these were relaxed. Dante, in the *De Vulgari Eloquentia,* gives very minute, although somewhat obscure, accounts of the essence and invention of stanzaic form (*cobla* in Provençal), in which the Romance poetries excelled from the first. The stanza was a group of lines formed on a regular and recurrent arrangement of rhymes. It was natural that the poets of Provence should carry to an extreme the invention of stanzaic forms, for their language was extravagantly rich in rhymes. They invented complicated poetic structures of stanza within stanza, and the *canzo* as written by the great troubadours is a marvel of ingenuity such as could scarcely be repeated in any other language.

In French poetry, successive masters corrected the national versification and drew closer round it the network of rules and principles. Immutable rules were laid down by Malherbe, and by Boileau in his *Art Poétique* (1674), and for more than a century they were implicitly followed by all writers of verse. It was the genius of Victor Hugo which first enfranchised the prosody of France, not by rebelling against the rules, but by widening their scope in all directions, and by asserting that, in spite of its limitations, French verse was a living thing.

In very early times the inhabitants of the Germanic countries developed a prosodical system which owed nothing whatever to classical sources. The finest examples of this Teutonic verse are found in Icelandic and in Anglo-Saxon. The line consisted of two sections, each containing two strongly stressed syllables, and of these four syllables three (or at least two) were alliterated. In all ancient Teutonic verse three severe and consistent rules can be observed, viz., that the section, the strong accentuation, and above all the alliteration must be preserved. We find this to be the case in High and Low German, Icelandic, Anglo-Saxon, and in the revived alliterative English poetry of the 14th century, such as "Piers Plowman."

English Metre.—The first writer in whom there has been discovered a distinct rebellion against the methods of Anglo-Saxon versification is St. Godric, who died in 1170 Only three brief fragments of his poetry have been preserved, but there is no doubt that they show, for the first time, a regular composition in feet. A quotation will show the value of St. Godric's invention:—

"Saintë | Nicholaes, | Godes | druth,
Tymbre us | fairë | sconë | hus,
At thy | burth, | at thy | bare,
Saintë | Nicholaes, | bring uswel thare."

From this difficult stanza down to the metres of modern English the transition seems gradual and direct, while the tradition of Anglo-Saxon alliterative prosody is abruptly broken. There is still more definition of feet in the *Poema Morale* (*c.* 1200). The *Ormulum,* which belongs to the early part of the 13th century, is monotonously regular. A further advance was made about 50 years later in *Genesis and Exodus,* of which Saintsbury has said that "it contains more of the kernel of English prosody, properly so called, than any [other] single poem before Spenser." The phenomenon which we meet with in all these earliest attempts at purely English verse is the unconscious determination of writers, who had no views about prosody, to work the varying stresses of English with the kind of regularity which they heard in French and Latin.

Between 1210 and 1340 not one English poem of importance is known to have been written in the old alliterative measure of the Anglo-Saxons But at the latter date there set in a singular reaction in favour of alliteration, a movement which culminated, after producing some beautiful romances, in the satires of Langland. Those writers, and they were many, who preserved foot-scansion and rhyme, during this alliterative reaction, became ever closer students of contemporary French verse, and in the favourite octosyllabic metre "the uncompromising adoption of the French, or syllabically uniform, system is the first thing noticeable" (Saintsbury). This tendency of Middle English metre culminates in the work of John Gower, which is singularly polished in its rhyming octosyllabics, although unquestionably nerveless still, and inelastic.

It is, however, to Chaucer that we turn for far greater contributions to English verse. He it was who first, with full consciousness of power as an artist, adopted the use of elaborate stanzas, always in following of the French; he it was who first gained freedom of sound by a variation of pause, and by an alternation of trochaic and iambic movement. It is the lack of these arts which keeps Gower and his predecessors so stiff. In particular Chaucer, in his first period, invented rime-royal, a stanzaic form (in seven decasyllabic lines, rhymed *a b a b b c c*), peculiarly English in character, which was dominant in our literature for more than 200 years; it was used in the long romance of *Troilus and Creseide,* where English metre for the first time displays its beauty to the full. It seems to have been originally called riding-rhyme, the name by which Gascoigne describes it (1575).

Throughout the 15th and early 16th centuries there began to arise the popular ballads. The introduction of the loose, elastic ballad-quatrain, with its melodious tendency to refrain, was a matter of great importance in the metamorphosis of British verse. The degenerate forms employed by the English 15th-century poets in attempting more regular prosody were in some measure corrected by the greater exactitude of the Scotch writers, particularly of Dunbar, who was by far the most accomplished metrist between Chaucer and Spenser. But Wyatt (1503–42) was the great pioneer. He introduced, from France and Italy, the prosodical principles of the Renaissance—order and coherency, concentration and definition of sound—and that although his own powers in metre were far from being highly developed. He and his more gifted disciple Surrey introduced into English verse the sonnet (not of the pure Italian type, but as a quatorzain with a final couplet) as well as other short lyric forms. To Surrey, moreover, we owe the introduction from Italian of blank verse.

With the heroic couplet, with blank verse, and with a variety of short lyric stanzaic measures, the equipment of British verse might now be said to be complete. For the moment, however, towards the middle of the 16th century, all these excellent metres seemed to be abandoned in favour of an awkward couplet of 14 feet. It was to break up this nerveless measure that the remarkable reforms of the close of the century were made, and the discoveries of Wyatt and Surrey were brought, long after their deaths, into general practice. In drama, the doggerel of an earlier age retired before a blank verse, which was at first entirely pedestrian and mechanical, but struck out variety and music in the hands of Marlowe and Shakespeare. But the central magician was Spenser, in whom there arose a master of pure verse whose range and skill were greater than those of any previous writer of English, and before whom Chaucer himself must withdraw. His great work was that of solidification and emancipation, but he also created a noble form which bears his name, that Spenserian stanza of nine lines closing with an alexandrine, which lends itself in the hands of great poets, and great poets only, to magnificent narrative effects.

It was at this moment that a final attempt was made to disestablish the whole scheme of English metre, and to substitute for it unrhymed classic measures. In the year 1579 this heresy was powerful at Cambridge, and a vigorous attempt was made to include Spenser himself among its votaries. It failed, and with this failure it may be said that all the essential questions connected with English poetry were settled. (E. G.; X.)

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VERTEBRATA, one of the main subdivisions in use for the animal kingdom, including such familiar animal types as mammals (including man), birds, reptiles, amphibians, fish, along with such less familiar types as lampreys and hagfish (Cyclostomata, *q.v.*). The name is not precisely equivalent to Chordata: the latter name is used to include in addition to typical vertebrates, the Tunicata (*q.v.*), which are universally accepted as degenerate relations of the vertebrates, *Amphioxus*, and also certain other types such as *Balanoglossus* (*q.v.*) and *Pterobranchia* (*q.v.*) whose genetic affinity with the Vertebrata is more doubtful. The phylum is marked off from all others by a plan of bodily structure peculiar to itself, including (1) an axial supporting skeleton traversing the body longitudinally in the mesial plane, (2) a muscular system consisting primarily of a series of paired blocks situated to right and left of the axial skeleton, and (3) the concentration of the central nervous system and the main blood-vessels in longitudinal trunks in the region of the mesial plane, the nervous system dorsal to, and the great vessels, as well as the other main organs of the body, ventral to the axial skeleton.

The axial skeleton in its primitive condition, as seen in one of the lower types or as a temporary phase in the embryos of the higher, consists of a stiff rod, the notochord. In the more typical vertebrates this continuous notochord is replaced in the trunk by the vertebral column, giving increased flexibility combined with more efficient support, and in the head by a cartilaginous or bony case, the skull, enclosing the brain.

The vertebrates are usually provided with two pairs of appendages, anterior and posterior, in the form of fins in fishes, limbs in land vertebrates. Both are liable to loss and to great modification in adaptation to particular habits. The vertebrates probably originally lacked paired appendages, as the earliest known forms, the extinct ostracoderms, did not have them.

The vertebrate body is clothed with a separable skin which usually develops protective structures such as scales, feathers, hair.

The muscular system beneath the skin is fundamentally composed of a paired series of muscle blocks or myotomes along the body axis. This arrangement, obvious in lower vertebrates and the embryos of the higher ones, is obscured in the adults of the latter by the spreading of the limb musculature. The segmental condition of the musculature imposes a segmental structure upon some other systems, especially the vertebral column, and nervous, circulatory and urogenital systems.

The nervous system is characterized by a very high degree of cephalization, *i.e.*, concentration of nervous tissue in the head to form a highly developed brain, correlated with the three pairs of sense organs characteristic of the vertebrate head—the olfactory sacs, the eyes (peculiar in that their nervous tissue is part of the brain wall) and the ears, which combine the function of equilibration subserved by the semicircular canals and the function of hearing. In the trunk the nervous system takes the form of a thick-walled tube, the spinal cord, from which arise paired nerves at segmental intervals. The central nervous system of vertebrates differs from that of invertebrates in being hollow.

The vertebrates are coelomate animals, *i.e.*, their viscera are suspended by means of mesenteries in cavities lined by peritoneum. In lower vertebrates the coelom is divided into the pericardial cavity containing the heart and the pleuro-peritoneal cavity containing the other viscera. In mammals the latter cavity is subdivided by the diaphragm into the pleural cavities containing the lungs and the abdominal cavity for the remaining organs.

The distinctive feature of the digestive system is the pharynx, which in lower vertebrates and the embryos of the higher ones is perforated by a series of elongated openings, the gill slits, whose walls in lower aquatic vertebrates bear gills and through which a respiratory water current passes. In the tissue between successive gill slits are found skeletal components, known as gill arches, which served originally to anchor the respiratory muscles. The vertebrates originally lacked jaws, as shown by the jawless ostracoderms, but early in vertebrate history the first pair of gill arches became modified to form the jaws. The remaining gill arches persist in land vertebrates in very altered and reduced form, contributing to the cartilages of the larynx and to the middle ear bones. In most vertebrates the digestive tract terminates in a chamber, the cloaca, that also receives the urogenital ducts. The final opening or anus was probably originally at the posterior end but tends to be displaced forward and ventrally.

The respiratory system consists of gills in the lower aquatic vertebrates, of lungs in the higher ones, including those which, like whales and seals, have secondarily taken up aquatic habits. Lungs are believed to be homologous with the swim bladder of fishes.

The circulatory system is characterized by the large ventral heart and the curved aortic arches passing from the heart between the gill slits. These aortic arches, associated with aquatic respiration, become modified in air-breathing vertebrates. Other features of the vertebrate circulation are a main dorsal artery or aorta running the body length, and two portal circulations (capillary systems) interposed in the venous system, one in the kidneys, the other in the liver.

There is a close association of urinary and genital systems, in that the genital ducts were originally kidney ducts. The pair of kidneys is composed of uriniferous tubules originally segmentally arranged. The sexes are nearly always separate. In aquatic forms, laying of eggs in water suffices, but better protection of the embryo is needed in land-living forms; hence the enclosure of the egg in a shell in reptiles and birds and finally the habit of internal incubation in mammals.

The vertebrates are classifiable into fish and fish-like forms with or without fins, and the limbed vertebrates or tetrapods. The chief living groups of the former are the Cyclostomata, or lampreys, without jaws or paired fins; the Elasmobranchii, including the sharks and rays; the Holocephali or chimaeras; the Crossopterygii or lobe-finned fishes, nearly all extinct; the Dipnoi or lung fishes; and the Actinopterygii or ray-finned fishes, including all common fishes. Existing tetrapods form four classes: amphibians, reptiles, birds and mammals. Palaeontological evidence strongly indicates the origin of reptiles and amphibians from crossopterygian fishes and of birds and mammals separately from reptiles. The annelid theory of vertebrate origin is now largely discarded and a relationship to echinoderms is currently accepted. (*See* FISHES; SELACHIANS; AMPHIBIA; REPTILES; BIRDS; ORNITHOLOGY; MAMMALIA; etc.)

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VERTEBRATE EMBRYOLOGY. The science of embryology (*q.v.*) had its first beginnings in the study of the Vertebrata (*q.v.*), the group that includes those forms of life whose eggs and breeding habits naturally first attracted attention, and even today the mass of known embryological detail relating to vertebrates far exceeds that relating to any other phylum. Further there is no phylum of the animal kingdom which shows in so varying degrees the modifying influence of such factors as amount of yolk in the egg, external environmental conditions, etc.

The vertebrate animal, like most other animals, begins its existence as a single cell, the *zygote* or fertilized egg, formed by the fusion of two gametes, derived one from each parent. The

zygote possesses in itself all the specific peculiarities of the complete individual of its species. To human observation, however, the zygotes of different animals do not exhibit any of the peculiarities differentiating the adults. Such peculiarities as they do present are in such comparatively trivial characters as size, shape, colour. Otherwise each zygote is to all appearance simply a typical cell with cytoplasm and nucleus. The superficial differences have to do mainly with adaptive features enabling the young individual to remain for a more or less prolonged period within the shelter of an egg shell. This is rendered possible in the first instance by the zygote possessing in its cytoplasm a store of *yolk*—highly concentrated food material—which provides it with subsistence. The greater the amount of this yolk capital stored away in the zygote, the greater its size: there is a rough proportion between size of egg and quantity of yolk. Thus in *Amphioxus* the zygote has a very minute trace of yolk in its cytoplasm and its diameter is about 0.1 mm.; in the extinct bird *Aepyornis* of Madagascar, judging from the size of the shell, the zygote may have been as much as 160 mm. in diameter.

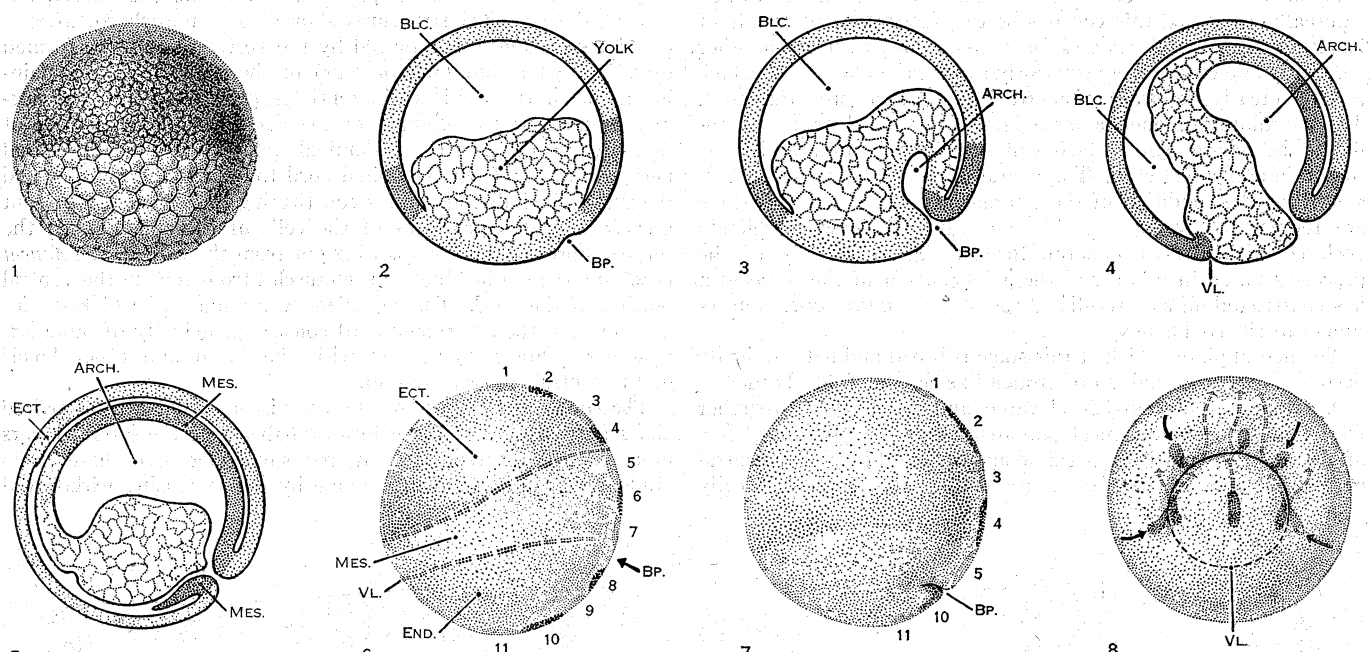
In the Mammalia of the most ancient type (Monotremata, *q.v.*), which still lay their eggs, these are large and richly yolked (*Echidna* 3.5 mm., *Ornithorhynchus* 2.5 mm.), and the young pass through the early development within the egg shell.

In the ordinary modern mammal, on the other hand, the egg is not laid in the ordinary sense. The zygote is retained within the uterus and there proceeds with its development, absorbing such nourishment as it requires from the mother. The store of yolk, no longer necessary, has disappeared and the zygote has reverted to the small size of from 0.1 mm. to 0.3 mm. in diameter.

Embryology of a Typical Vertebrate.—The basic features of vertebrate development can best be illustrated by an account of the transformations of the salamander embryo during the earlier formative stages. The first step following fertilization is the cleavage, by cell division, of the egg into a greatly increased number of smaller cells, together constituting the spherical *blastula* (fig. 1). The latter develops a cavity, the *blastocoele,* which is eccentrically situated because of the large amount of nutritive yolk stored in the cells composing the lower half of the embryo (fig. 2). There now ensues a remarkable process termed *gastrulation,* during which the primitive gut cavity and the germ layers are established. The first indication of the onset of gastrulation is the appearance of a small transverse indentation on the surface of the embryo below the equator (fig. 2). This groove is called the *blastopore,* and the tissue bordering it above, its *dorsal lip. Lateral* and *ventral lips* are formed as the groove extends to become crescentic and finally circular in form (figs. 7 and 8).

Meanwhile the original pocket formed beneath the overhanging dorsal lip has pushed deeper internally, where it gradually displaces the blastocoele and expands to form the primitive gut cavity, or *archenteron* (figs. 3 to 5). The understanding of the manner in which the archenteron is established is due largely to the classical studies of Walther Vogt. Fig. 6 represents a blastula on which a meridional series of closely spaced spots have been "painted" by the application of harmless dyes. As gastrulation proceeds the spots nearest the blastopore gradually disappear from view, until at the stage shown in fig. 7 all of the tissue lying between marks No. 5 and 10 has moved into the interior, where dissection shows it to form the roof and floor of the gut cavity. Before the latter is finally completed, at the close of gastrulation, all of the tissue below mark No. 4 moves in to share in its formation.

This inrolling of surface material, although initiated first at the dorsal lip and proceeding here most actively, takes place around the entire circumference of the blastopore as the lateral and ventral lips are formed. By applying spots of colour at various points on the blastula, Vogt was able to map out the portions of the blastula which are thus tucked into the interior, and to foretell what these invaginated materials will form after they have reached their new position. Some of this information is represented in fig. 6, showing the blastula in surface view just before the onset of gastrulation. Except for the area labelled



(1) ADAPTED FROM R. G. HARRISON (UNPUBLISHED); (2-5) ADAPTED FROM HAMBURGER AND MAYER; (6, 7) REDRAWN AND MODIFIED FROM FIG. 3, A AND C, WALTHER VOGT, "ARCHIV FÜR ENTWICKLUNGSMECHANIK DER ORGANISMEN," VOL. 120 (1929); (8) ADAPTED FROM HAMBURGER, "LABORATORY MANUAL OF EXPERIMENTAL EMBRYOLOGY" (UNIVERSITY OF CHICAGO PRESS)

Fig. 1.—Salamander embryo in blastula stage of development. Note differences in cell-size and pigmentation between upper and lower hemispheres. Figs. 2 to 5.—Sagittal sections of young embryo at successive stages during gastrulation, showing invagination of mesoderm (heavily stippled) and endoderm to form the primitive gut cavity. (*arch.*, archenteron; *blc.*, blastocele; *bp.*, blastopore; *ect.*, ectoderm; *end.*, endoderm; *mes.*, mesoderm; *vl.*, ventral lip.) Fig. 6.—An embryo (blastula stage) bearing a meridional series of marks applied to the surface tissue by means of vital dyes. *bp.*, point where blastopore will shortly appear. The line demarcating the endoderm (*end.*) and mesoderm (*mes.*) coincides with the position where the future lateral and ventral lips (*vl.*) of the blastopore will appear. Fig. 7.—Same embryo as in fig. 6, after invagination of surface tissue has begun. Fig. 8.—Ventral view of embryo in gastrula stage, showing the inrolling of surface tissue along the dorsal and lateral lips of the blastopore. Solid arrows indicate direction of past movements and stippled arrows the direction of future movements after the marked tissue has moved to the interior of the embryo. The tissues invaginating at the outer and inner margins of the crescentic blastopore groove are mesoderm and endoderm, respectively. Later, as indicated by the dotted line, the blastopore groove completely encircles the endoderm. It is at the ventral blastopore lip (*vl.*) thus formed that the ventral mesoderm of the embryo is finally invaginated (*see* figs. 4 and 5).

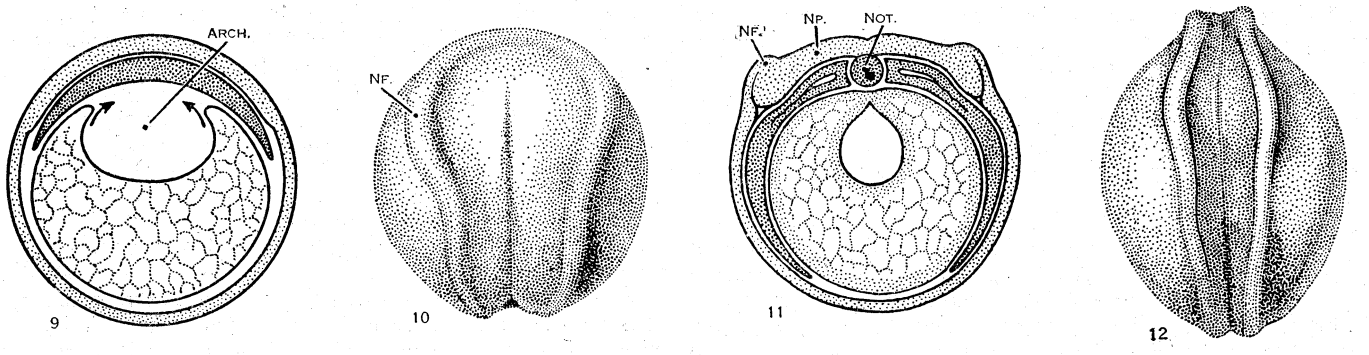


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Fig. 9.—Transverse section of embryo in advanced stage of gastrulation. The roof of the gut cavity (*arch.*) is formed by the mesoderm. Later the lateral margins of the endoderm will grow upward (note arrows) and fuse to form an intestinal tube lined entirely with endoderm (*see* **fig. 11**). **Fig. 10.**—Dorsal view of embryo showing primordium of central nervous system. The tissue bordered by the horseshoe-shaped ridge will later form the brain and spinal cord. *nf.*, neural fold. **Fig. 11.**—Transverse section of embryo at stage shown in fig. 10. *nf.*, neural fold; *np.*, neural plate; *not.*, notochord. **Fig. 12.**—Showing the beginning closure of the neural folds to form the tubular central nervous system. Compare with fig. 10.

ectoderm, all of the surface tissue passes to the interior, where the regions marked *mesoderm* and *endoderm* constitute the germ layers bearing these names. Meanwhile the ectoderm undergoes a process of stretching or expansion which enables it to envelop entirely the two internal germ layers.

The diagram in fig. 9 shows the relationships of all three layers as seen in a transverse section of the embryo toward the completion of gastrulation. The mesoderm, which has invaginated at the dorsal and lateral lips (fig. 8), forms an arched mantle roofing the archenteron and extending ventrally on either side between the ectoderm and endoderm. Its original continuity with the endoderm along the line labelled *vl.* in fig. 6 has become interrupted during the process of invagination. The lateral margins of the trough-like endoderm are seen to be pushing upwards (note arrows) and will later meet to form the definitive roof of the alimentary tube.

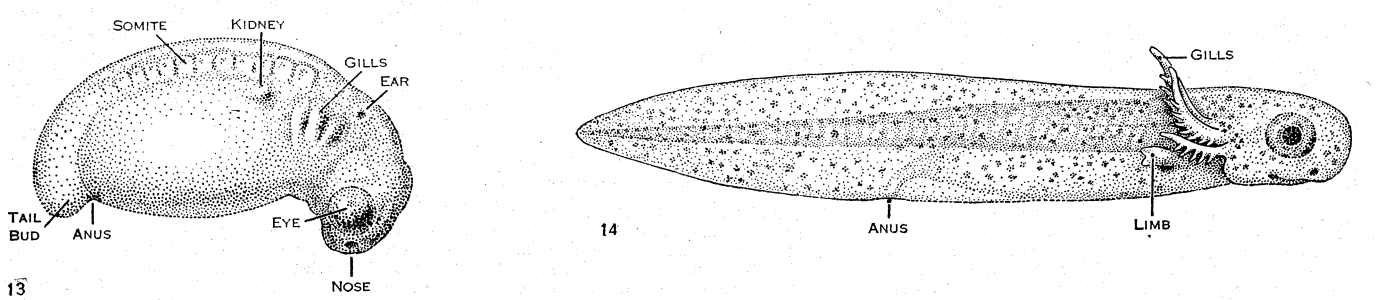
First, however, attention may be called to an important development which now ensues in the dorsal ectoderm. As viewed externally (fig. 10), this consists of the appearance of a pair of longitudinal ridges, the *neural folds,* continuous with one another anteriorly and converging posteriorly toward the blastopore, which is now greatly reduced in aperture and constitutes the anus. The neural folds bound a large horseshoe-shaped area of ectoderm, the *neural plate,* which will subsequently differentiate as the brain and spinal cord. The neural plate in transverse section, as well as the condition of the internal germ layers at this stage are represented in fig. 11. The gut cavity is now completely enclosed within the endoderm, through fusion dorsally of the processes noted in fig. 9, and the axial portion of the mesoderm has constricted off as a rod-like structure, the *notochord,* or forerunner of the backbone.

The neural plate, which at this stage is broad and flat, gradually becomes narrower and more trough-like as the folds bordering it laterally become further elevated and move closer together (fig. 12). They finally meet and fuse along the mid-dorsal line of the embryo, and it is in this manner that the tubular central nervous system of the vertebrate embryo is characteristically formed. The anterior portion of the tube later differentiates as the brain and the remainder as the spinal cord.

Following closure of the neural folds and the increasing elongation of the embryo one can begin to recognize the emergence of several organ primordia (fig. 13). The eye is visible as a bulge on the side of the head, and immediately below it is a depression in the epidermis which will later form the nasal passage communicating with the mouth cavity. The pit noted higher on the head subsequently sinks to the interior and differentiates as the membranous labyrinth (semicircular canals, etc.) of the internal ear. Elevated ridges mark the beginning outgrowth of the external *gills,* and further back the embryonic kidney, or *pronephros,* is becoming visible as a swelling beneath the skin. The dorsal portion of the mesoderm has become divided by transverse furrows into a number of segments, or *somites,* visible through the semitransparent skin.

The internal relationships at this stage are seen in fig. 15, which will also serve as a basis for indicating the subsequent fate of the principal structures shown. The notochord, after a transitory existence, is replaced by the vertebral column, formed by adjacent portions (*sclerotomes*) of the somites. The remaining tissue of the somites differentiates principally into the segmented muscles (*myotomes*) of the back, and, by a process of downgrowth, those of the abdominal wall. Meanwhile the spinal nerves grow out from the spinal cord to supply the muscles and the skin. The individual fibres constituting these nerves represent greatly elongated processes of the cells of the spinal cord; the sensory fibres to the skin growing out from the cells of the *neural crest,* and the motor fibres to the muscles from cells in the ventral portion of the cord. The so-called "white-matter" which gradually envelops the embryonic cord consists principally of innumerable nerve fibres connecting with the brain and other levels of the central nervous system.

The *coelom,* or cavity housing the viscera, originates as paired clefts formed by a splitting into two sheets of the lateral layers of unsegmented mesoderm. At first small (fig. 16), these clefts gradually expand, as room is made by the increasing withdrawal



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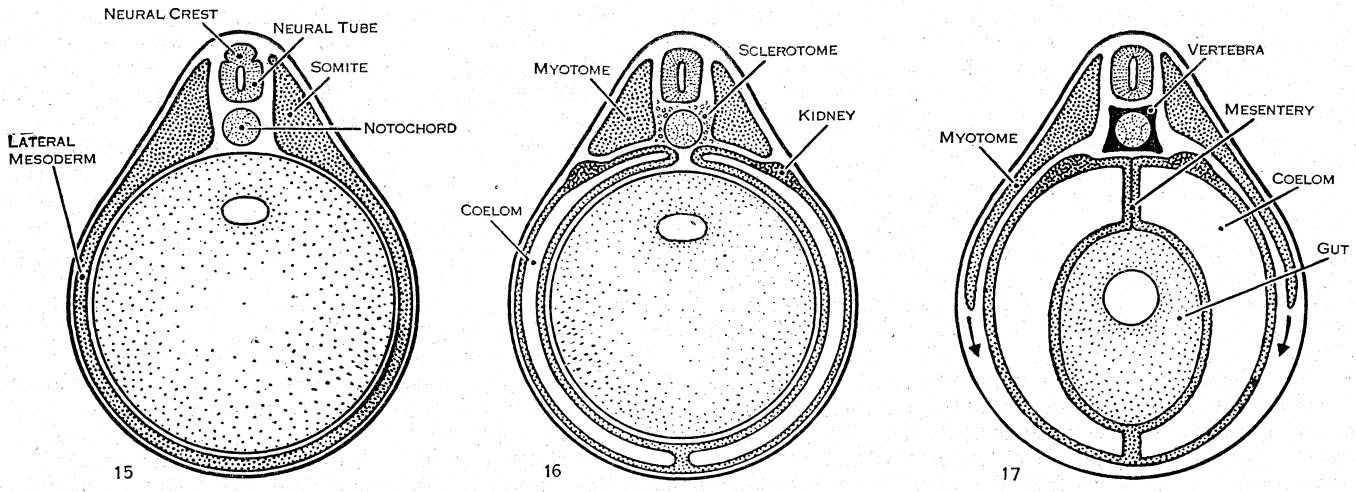
(13, 14, ADAPTED FROM R. G HARRISON (UNPUBLISHED)

Fig. 13.—Embryo at stage of development when various organ primordia first appear. The mouth opening, which forms as a secondary perforation, does not break through until considerably later. **Fig. 14.**—Young larva (tadpole) at stage of hatching from protective jellylike membranes in which the embryos develop. Note that the fore limb has as yet only two digits. The small dark spots scattered in the skin are the pigment cells (chromatophores).



(15) COURTESY V. C. TWITTY; (16, 17) ADAPTED FROM HYMAN, "COMPARATIVE VERTEBRATE ANATOMY" (UNIVERSITY OF CHICAGO PRESS)

Figs. 15, 16 and 17.—Diagrams illustrating the formation of the coelom, mesenteries, musculature of the body wall (myotomes), and the vertebral column. The aggregations of cells labelled *sclerotome* in Fig. 16 are budded off from the somites and later (fig. 17) form the vertebral column. The *neural crest* (fig. 15), in addition to forming the nerves (not shown) to the skin, gives rise to wandering cells which differentiate into chromatophores (*see* fig. 14).

of yolk from the wall of the gut into the blood stream, and eventually the medial sheets from each side meet to form the *mesentery* supporting the intestine (fig. 17). It is during this period of coelom formation that the myotomes grow ventrally beneath the skin to complete the musculature of the body wall.

In its broad outlines the preceding account of the early development of the salamander is applicable to vertebrates in general. For example, if we ignore the inevitable differences imposed by variations in the amount of yolk stored in the egg, the processes of cleavage, gastrulation, coelom formation, etc., are remarkably similar in such widely related vertebrates as the amphibians, fish and birds. One of the most notable differences between the embryos of the lower and higher vertebrates is the development by the latter of the extra-embryonic membranes, an innovation essential to embryos developing within a shell on land (reptiles and birds), and inherited and adapted by the mammal for uterine life.

The remainder of the article will be devoted to special accounts of the development of the various *organ systems*.

The Skin.—The skin of vertebrates is formed by the ectoderm, with a backing of tough connective tissue traversed in all directions by fine intercellular fibres and constituting the dermis. In all members of the group the epidermis, by cell multiplication, loses its original condition of being only one cell thick. In fish numerous epidermal cells become glandular and secret slime. From the lungfish upwards, local aggregations of these cells form definite flask-shaped glands, opening by minute pores on the body surface. These epidermal glands undergo specialization in various directions—salivary glands, poison glands, sweat glands, milk glands, etc. In terrestrial vertebrates the superficial ectoderm cells become converted into keratin, forming a horny layer which obstructs evaporation, and these horny cells are shed from time to time as loose scurf, as coherent flakes, or as a continuous slough (*e.g.*, snakes). In reptiles they form a hard layer, covering underlying bony plates in tortoise shell or the surface of the head in reptiles generally, or forming, with a dense backing of connective tissue, the scales of ordinary reptiles. Innumerable special developments of the horny layer occur, some of which will be found described in other articles: such are claws, feathers, hair, hoofs, rhinoceros horn, whalebone, etc.

The Nervous System.—In most of the more primitive holoblastic vertebrates the brain first becomes differentiated into an anterior cerebrum and a posterior rhombencephalon, demarcated from one another by an upward fold of the brain floor. Of these the former becomes later differentiated into the thalamencephalon in front and the mesencephalon behind. The cerebral hemispheres, which in the higher mammals assume great importance, seem to arise primitively as paired outward bulgings of the side wall of the brain towards its front end—related to the sense of smell. The main part of the thalamencephalon undergoes thickening of its side walls (optic thalamus) while its roof becomes for the most part degenerate, forming a thin membrane in intimate contact with a network of blood vessels (choroid plexus) lying immediately outside it. At its hind end an outgrowth—the pineal body—develops which may remain a simple club-shaped or tubular structure, but in several cases becomes differentiated into two portions, the anterior of which (parapineal) develops into an eye (*Sphenodon*, various lizards).

In front of the fold of the brain floor already alluded to, the floor of the thalamencephalon dips down as the infundibulum, and this becomes in the course of development closely associated with an independent structure—the pituitary body. In the more typical vertebrates the two become inextricably involved with one another and it is customary to speak of the nervous part of the pituitary body. The pituitary ingrowth of the ectoderm is typically a hollow pocket and in the surviving crossopterygians it retains this form through life, forming a gland which opens into the buccal cavity. In those vertebrates in which yolk is present at the site of its formation, the pituitary ingrowth is, as in other such cases, solid, developing its cavity secondarily.

The *organs of special sense* arise as localized developments of the ectoderm. In the case of the olfactory organ and the auditory organ, the rudiment shows first as a localized thickening of the ectoderm, which then, through extension in area, becomes involuted below the surface of the skin as a saucer-like depression. Finally, the opening to the exterior becoming gradually constricted, the organ assumes the form of a more or less completely closed vesicle. In the case of the olfactory organ the closure is never complete, the function, that of chemical testing of the surrounding medium, necessitating free communication between its cavity, in the lining of which the sensory cells develop, and the outside. In the majority of vertebrates however partial closure takes place, to divide the opening into two—one at each end of the organ—and so render possible the drawing in of a current of the external medium through the organ. The first vertebrates that have this power of "sniffing" are the lungfishes and the origin of the arrangement which makes this possible is well seen in *Protopterus*, where the opening of the olfactory organ narrows, except at its two ends, so as to form a slit. The edges of the slit then undergo fusion and the original single opening is now represented by two separate openings a considerable distance apart. As the anterior boundary of the buccal cavity becomes delimited, one, the anterior or external naris, is left outside and the other, posterior or internal naris, is enclosed within the buccal cavity, perforating its roof. In terrestrial vertebrates in general the olfactory organ becomes similarly provided with external and internal nares, though the process of development shows various modifications in detail.

The early stages of development of the otocyst or rudiment of the auditory organ are similar to those of the olfactory organ, but the reduction of the external opening goes further: in fact in all vertebrates except elasmobranchs, it becomes completely closed. The peculiar feature which distinguishes the vertebrate is that the usually pyriform otocyst of early stages undergoes a complicated process of modelling, whereby its wall comes to project into three hollow ridges situated in planes perpendicular to one another. The basal or attached portion of each of these becoming obliterated except at its two ends, the ridge is converted into an arched tube—the semicircular canal—opening at each end into the cavity of the otocyst and filled, like the rest of the otocyst, with watery endolymph. In all except the most archaic vertebrates, the otocyst undergoes a still further process of modelling whereby its lower portion (saccule), which develops a special pocket-like outgrowth devoted to the sense of hearing, becomes more or less completely constricted off from the upper portion or utricle, carrying the semicircular canals.

The vertebrate eye differs from the other sense-organs in that its main portion—that containing the actual sensory cells—is developed, not from the external ectoderm, but from the involuted portion of the ectoderm which forms the brain. In a typical case, as in a bird embryo, the optic rudiment consists in its earliest stage simply of the lateral portion of the wall of the thalamencephalon, which here extends outwards on each side so as to give the brain a T-shape. As development proceeds the optic rudiment becomes narrowed at its base to form the optic stalk, which later will become the optic nerve. The distal dilated portion gives rise to the retina, while the region of external ectoderm in contact with its outer end gives rise to the lens. In a typical case, *e.g.*, a bird, the lens is at first simply a slight thickening of the ectoderm, but this soon sinks inwards to form a saucer-shaped depression of the surface, which, by a gradual narrowing of its opening, becomes converted into a closed vesicle. The deep wall of this becomes greatly thickened, its individual cells becoming tall and columnar, and gradually takes on the form of a biconvex lens, the outer wall forming a thin layer of epithelium covering its outer surface. As development goes on the cells of the lens become keratinized and transparent.

Meanwhile the original optic rudiment is undergoing differentiation. Its distal portion next the lens becomes involuted within the proximal portion, so that the whole rudiment now takes the form of a double-walled optic cup the mouth of which is blocked by the lens. The inner wall of the cup increases much in thickness and gradually assumes the immense complexity characteristic of the functional retina, of which the most striking peculiarity is that the visual cells are situated on its deep face, the sensory rods facing not towards the lens but away from it—so that rays of light have to traverse the whole thickness of the retina, which is therefore necessarily transparent. On the other hand, the nerve-fibres which pass from the retina to the brain emerge from the retina on its face next the lens, instead of from its deep face as one would expect. This extraordinary reversal of the vertebral retina is at once explained by the method of its development, the deep surface carrying the rods having been originally, before the involution of the brain rudiment took place, part of the outer surface of the head. The outer layer of the optic cup undergoes none of the complicated histogenesis seen in the retina. It persists as a single layer of polygonal cells within which there is deposition of granules of dark melanin pigment. They constitute what is termed the pigment layer of the retina.

The ectodermal lens and retina, which constitute the essential optical part of the eye, become ensheathed during development by a thick coating of connective tissue or mesenchyme. This, in its outer layers, becomes condensed into the tough protective wall of the eyeball, the part between the lens and the surface of the head becoming clear and transparent (cornea) while the remainder becomes white and opaque (sclerotic). Between the sclerotic and the pigment layer of the retina there is a rich development of blood spaces and of dark melanin, which gives its characteristic appearance to the choroid.

Alimentary Canal.—The alimentary canal of the vertebrate is in its early stages closed anteriorly, the mouth being a secondary perforation. As in many other animals, the portion of external surface in the region of the mouth becomes involuted to form the lining of the buccal cavity, so that the protective and glandular functions of the skin extend inwards into the first portion of the alimentary canal. The buccal cavity of the vertebrate is therefore morphologically a stomodaeum. For a time, in many vertebrate embryos, the stomodaeal involution remains isolated from the rest of the alimentary canal by a thin partition, covered on its buccal face by ectoderm, on its enteric face by endoderm. This partition eventually ruptures and disappears, although in *Amphioxus* it remains distinctly visible as the velum, perforated in its centre by a circular opening.

The most important features to note in the buccal cavity of the vertebrate are the organs in its lining which have been brought in from their original position on the outer surface of the head. Among these are glands which become of special importance in terrestrial vertebrates, where their watery secretion serves to keep moist the buccal lining, and in certain cases play a preliminary part in the digestive process, as the salivary glands. Still more conspicuous however are the placoid scales, which, in the primitive elasmobranch scattered all over the outer surface of the body, are also recognizable in the buccal lining. Around the margin of the jaw a series of these placoid scales become specially enlarged, forming the teeth of the adult. The embryology of the elasmobranch then demonstrates that the teeth of vertebrates are vestiges of the placoid scales on the surface of the body.

The buccal cavity is continued into the pharynx, characterized in all vertebrates by the development of (1) the gill clefts or pouches and (2) the thyroid. The gill clefts, normally six in number, arise as pocket-like extensions of the pharyngeal wall (visceral pouches), which at their tips undergo fusion with the external ectoderm and open to the exterior, the original visceral pouch becoming thus converted into a visceral cleft, lined with endoderm except towards its outer end, where the lining is ectodermal. The cleft lining, in view of its respiratory function, undergoes increase of area by growing out into folds (respiratory lamellae) and develops a rich blood supply.

Visceral cleft I develops in all gnathostomes characteristic differences from the others. In elasmobranchs its respiratory lamellae are reduced to the vestigial pseudobranch on its anterior wall, its function being, as in crossopterygians and sturgeons, that of a mere passage for the water of respiration. In Dipnoi its outer ectodermal end forms a sensory organ (organ of Pinkus) embedded in the side of the head. In these and in all terrestrial vertebrates, it has lost its communication with the exterior. In anurous amphibians and in all amniotes it expands towards its outer end into a wide tympanic cavity lying immediately under the skin so as to allow a wide flat area of the latter to vibrate freely (tympanic membrane or eardrum). The pharyngeal portion of the cleft remains as the narrow Eustachian tube, providing a means of keeping the air pressure equal on the two sides of the eardrum.

While the presence of pharyngeal visceral clefts constitutes one of the most striking vertebrate characteristics, the evidence of comparative anatomy clearly indicates that the series of clefts is undergoing a gradual process of reduction. This is shown by the diminishing number of clefts present in the series *Amphioxus*—cyclostomes (up to 14 in *Bdellostoma*)—Gnathostomata. Embryology shows us this process of reduction actually at work. In various elasmobranch embryos vestigial pouches appear behind those which actually develop into clefts. In teleosts the vestigial spiracular rudiment flattens out while its pseudobranch remains visible on the inner surface of the operculum, thus appearing in the adult as if it belonged to visceral cleft II. The operculum of fishes above elasmobranchs is simply the exaggerated valvular flap formed by the outer edge of visceral arch II (hyoid) which grows back to cover the visceral clefts further back in the series.

The thyroid, an equally characteristic development of the vertebrate pharynx, arises as a mid-ventral downgrowth of the pharyngeal floor about the level of the hyoid arch. This rudiment, arising either as a hollow pouch or as a solid structure which

develops a cavity secondarily, soon becomes isolated from the pharynx as a closed vesicle, and this in turn becomes subdivided into a multitude of little spherical sacs of endoderm separated by mesenchyme, in which there arises a rich network of blood spaces. The endodermal epithelium is glandular, producing a clear colloid secretion which distends the numerous rounded vesicles. In its later development the thyroid differs in different vertebrates. It may, as in teleostean fishes, become diffuse and no longer recognizable as a compact organ, while in tetrapods it retains its compact form but becomes more or less completely separated into a right and left lobe. The clue to the evolutionary history of the thyroid is given by the embryology of the lamprey (*Petromyzon*), in the larva of which it is recognizable as an endostyle, an organ known also in *Amphioxus* and Tunicates.

The *lung,* a characteristic feature in the main groups of Vertebrata above the elasmobranchs, arises normally from a rudiment very similar to that of the thyroid, only situated further back, about the hinder limit of the pharynx. Normally unpaired at first, the rudiment soon divides into right and left branches. In simple urodeles each lung remains a thin-walled membranous sac, but in other tetrapods increase in area of the endodermal respiratory lining is brought about by its bulging out into more and more complicated recesses, culminating in large reptiles and in mammals in a spongy texture. In birds, the endoderm-lined cavities of the lung become converted into fine tubular channels (air capillaries) interwoven with the blood capillaries and constituting the most highly evolved respiratory organ known. To enable it to function, a bellows-like arrangement is formed by pocket-like outgrowths of the lung wall which become greatly dilated and constitute the air sacs. Portions of these grow out into the substance of the bones, replacing the bone marrow, while others extending in among the muscles of flight provide a mechanism whereby air is automatically passed in and out through the air capillaries during flight.

The post-pharyngeal portion of the alimentary canal forms the digestive tube and in different vertebrates undergoes varying degrees of differentiation into distinct parts. The great glands of the intestine arise in the embryo as pocket-like diverticula of its wall. The pancreas is peculiar in that it arises normally from three distinct diverticula—a pair situated ventrally in the neighbourhood of the bile duct, and the third dorsal. The pancreas of the adult is formed by the fusion of these three rudiments and it may retain (birds) all three openings to the intestine, *i.e.,* three distinct pancreatic ducts.

Coelomic Organs.—The *coelom* or body cavity becomes normally subdivided into a smaller pericardiac and a larger peritoneal cavity. In some of the more archaic vertebrates, *e.g.,* elasmobranchs, the two cavities remain continuous through a narrow pericardioperitoneal canal.

The loss of the primitive coelomic segmentation has brought with it characteristic modifications in the development of the archinephros or series of nephridial tubes.

It is a normal characteristic of the embryo of metamerically segmented animals that the head end, with its special nerve centres and sense organs, develops first, the process of development spreading slowly tailwards, and this principle applies to the nephridial tubes as to other organs. The disappearance of the coelomic septa in the Vertebrata has however eliminated the necessity of each segment having its independent pair of drainage tubes. There has accordingly come about a loss of the serial regularity in the development of the nephridial tubes and these tend to develop in three successive batches, known as pronephros, mesonephros and metanephros. Of these the pronephros is the functional kidney in the early stages of those vertebrates in which these stages are free-living (larval). Where, on the other hand, early development is embryonic, it no longer becomes a functional organ, the excretory products presumably passing away by diffusion from the extensive network of blood vessels on the surface of the yolk. The pronephros is purely larval: eventually it atrophies, a pair of its nephrostomes however persisting in greatly enlarged form, at least in selachians, as the ostia of the oviducts. The excretory function is now carried out by the series of tubules extending back to the region of the cloaca and termed the opisthonephros. In the fishes and amphibians, this constitutes the kidney of the adult, though already in many of these, *e.g.,* elasmobranchs and urodeles, there is seen a tendency for the excretory function to become concentrated in the hind portion of the opisthonephros, its front portion remaining small and serving for the transmission of the spermatozoa. This condition foreshadows that of the Amniota in which the opisthonephros has become completely divided into mesonephros and metanephros. The former, representing the greater part of the opisthonephros, acts as the functional kidney during embryonic life but later becomes purely reproductive, forming the epididymis attached to the testis. The metanephros—the extreme hind end of the opisthonephros, in which the tubules become greatly increased in size and number—alone forms the kidney of the adult amniote.

The renal organs of vertebrates present many other features of embryological interest. In various of the more archaic types the rudiments of the first pronephric tubules, in the form of little outgrowths of the somatic mesoderm, bend backwards at their outer ends and become joined together, forming in this way the rudiment of a longitudinal duct (archinephric duct) which gradually extends back, receiving the successive tubules which undergo fusion with it, and eventually opens into the cloaca. This opening of the tubules into a longitudinal duct instead of directly to the exterior constitutes one of the striking differences between the Vertebrata and the Annelida.

In elasmobranch fishes the archinephric duct becomes split longitudinally into two—a Müllerian duct, into which opens the persistent pronephric nephrostome, and a Wolffian duct, into which open the tubules of the opisthonephros. Functionally, the former becomes the oviduct. In the Amniota the functional tubules of the metanephros open into a third duct—the ureter—while the Wolffian duct now functions exclusively as a vas deferens or male genital duct.

The *gonads*—ovaries or testes—develop from a pair of elongated ridges, the genital ridges, which arise just mesial to the kidneys. In the female, the reproductive cells (eggs or macrogametes) are still shed into the coelom, finding an exit through the Müllerian ducts. In the male, however, the testis is shut off as an isolated chamber into the cavity of which the reproductive cells (spermatozoa or microgametes) are shed. They eventually reach the vas deferens by way of fine tubular channels (vasa efferentia), which arise in the embryo as outgrowths from the wall of certain of the Malpighian bodies.

The mesenchyme cells, distributing themselves through the body of the embryo, settle down into spongy connective tissue which forms a support and backing to the various developments of ectoderm and endodern. As development proceeds, special tracts take on special characters—fatty tissue, tendon, ligament and so on—but there are two developments of the mesenchyme which are of special importance. These are the vascular and the skeletal systems.

Vascular System.—The blood vessels originate from condensations of mesenchyme cells which hollow out into channels containing the watery tissue fluid which bathes all of the cells of the embryo. The corpuscles may arise either *in situ,* by differentiation of the central cells of the original mesenchyme aggregations, or may enter the blood stream from special centres of proliferation. The latter include, especially in later developmental stages, the liver, bone marrow and lymphatic glands.

The detailed study of the later development of the blood system shows that it provides one of the most interesting chapters in vertebrate embryology. The fundamental plan is seen to be that of two main longitudinal blood vessels, one ventral to the alimentary canal, in which the blood runs forwards, and one dorsal (dorsal aorta), in which the blood streams in a tailward direction, these two longitudinal vessels being connected by a series of hoop-like aortic arches, situated between the gill clefts, in which the blood passes from the ventral vessel to the dorsal. The vertebrate heart consists of the portion of the ventral vessel immediately behind the pharynx, in which contraction of the vessel wall, elsewhere comparatively inconspicuous, becomes greatly exaggerated

and occurs rhythmically throughout life.

The *heart or cardiac tube* is that part of the ventral vessel which is contained within the pericardiac chamber. At first straight, its rapid increase in length, combined with the fact that it is fixed at each end where it traverses the pericardiac wall, causes it to assume a characteristic S-shaped curvature. As may be well seen in the embryo of a fowl during the third day of incubation, waves of contraction pass forward along the cardiac tube, propelling the blood in its interior forward towards the aortic arches. As development proceeds the originally uniform cardiac tube becomes at intervals relatively enlarged to form a series of four dilatations, demarcated from one another by relatively less dilated portions. These four dilatations become the sinus venosus, atrium, ventricle and conus arteriosus. With this morphological change in diameter comes a physiological change in that the originally uniform wave of contraction becomes replaced by serial contractions of each chamber in turn. As development proceeds further, the four chambers become compacted together and the original tubular shape of the heart is completely lost. The pumping activity of the heart becoming more and more concentrated in the ventricle, the muscular wall of this part becomes much more highly developed than that of the others.

To secure that the blood stream flows in the proper direction a valvular apparatus becomes developed in the interior of the heart and this, in its earliest stages, takes the form of longitudinal ridge-like thickenings of the inner layer of the heart wall. These are best seen in the conus arteriosus, where they are normally four in number and where they are jammed together when the conus contracts, obliterating its cavity and so preventing any backward suction when the ventricle dilates. These endocardiac ridges, dependent for their efficiency upon physiological activity, become in such relatively archaic vertebrates as elasmobranchs and ganoids converted into a purely mechanical apparatus which works automatically, each ridge becoming segmented into a row of valves shaped like watch pockets, with their openings directed toward the head. These flatten against the wall when the blood streams forward, but open out and occlude the cavity by their edges coming in contact the moment the blood tends to regurgitate. In the air-breathing vertebrates from lungfish upwards, the conus with its valvular apparatus undergoes an extraordinarily interesting series of evolutionary changes. In the lungfish the conus is relatively long and is bent into a characteristic Z-form. Along its interior run the four endocardiac ridges. Two of these, the right and the left, project as thin blade-like structures more than halfway across the lumen, their free edges overlapping so that they subdivide the cavity into two portions, one dorsal and one ventral. The two cavities are continued forward into the ventral aorta by a horizontal partition which extends as far forward as the level of aortic arch V where it merges into the roof of the ventral aorta. Aortic arches V and VI take origin from the dorsal or pulmonary cavity, while the remaining aortic arches spring from the continuation forward of the ventral cavity. The atrioventricular portion of the heart also has its cavity divided, in this case by a vertical septum projecting forward from its posterior wall. This septum is incomplete, not extending completely across the atrioventricular cavity except when the wall of this part of the heart is contracted. Owing to the peculiar flexure of the conus, its incomplete septum—horizontal at its front end—becomes at its ventricular end vertical and in line with the atrioventricular septum. The result is that, in the contracted condition of the ventricle, the right half of its cavity is continuous with the right half of the cavity of the conus and this cavity, owing to the peculiar flexure, ends off at its headward end by being dorsal, *i.e.,* continuous with the pulmonary cavity of the ventral aorta. Correspondingly the left ventricular cavity is continued through the conus to the ventral or systemic cavity of the ventral aorta.

In the tetrapods the conus develops endocardiac ridges similar to those seen in lungfish, but the conus has now greatly shrunken in length, with the result, owing to its ends being fixed, that the Z-flexure is drawn out and replaced by a spiral twist. Further, in the Amniota, the two prominent ridges, which in the lungfish merely overlap, undergo complete fusion, so that the cavity of the conus, as of the ventral aorta, becomes divided completely into pulmonary and systemic cavities, continuous respectively with the right and left ventricles, which also become completely separated during development. In the higher Amniota the septum so formed in the conus becomes itself split, so that the conus comes to be represented by two separate vessels, pulmonary and systemic, spirally twisted round one another.

Of all features in the development of the blood system of vertebrates, perhaps the most interesting is that the great arteries of the higher amniotes repeat in the course of their development the series of aortic arches between the visceral clefts. Although the bird or human being will never use its gill clefts for breathing, yet it shows for a time the typical piscine arrangement of aortic arches. As development proceeds, large tracts of this primitive scheme disappear while others persist and become straightened out into the great arteries of the adult.

The *venous system* of the vertebrate shows also many features of interest in its embryology. Perhaps the most important of these is that the venous system of the higher vertebrates shows for a time in the embryo the same main trunks—duct of Cuvier, anterior and posterior cardinal veins—as those of an adult fish. The main new development in the venous system of tetrapods, the inferior or posterior vena cava, presents the striking peculiarity that it has a double origin in the embryo, its anterior portion being associated with the liver and its posterior portion with the posterior cardinal veins. This points to the posterior vena cava having originated in evolution from an arrangement similar to that of modern dipnoans, where the anterior end of the opisthonephros is fused with the tip of the liver, thus rendering possible the direct passage of blood from kidneys to heart through the liver substance.

The Skeletal System.—The vertebrae are formed from cells of the segmented mesoderm (somites), and differentiate first as paired cartilaginous rudiments of the neural and haemal arches, two pairs of each in the lower types within the length of a single muscle segment. In two of the more archaic groups, Elasmobranchii and Dipnoi, cartilage cells from the arch-rudiment burrow through the primary sheath and colonize the secondary sheath of the notochord. The notochord thus becomes enclosed in a cylinder of cartilage, which in the elasmobranch becomes segmented into vertebral centra, each carrying two pairs of neural and of haemal arches. In other vertebrates this invasion of the secondary sheath by cartilage cells does not take place, and the centra arise outside the primary sheath by expansion of the bases of the arches. In the head region traces of cartilaginous vertebrae can be traced in various archaic vertebrates as far forward as the tip of the infundibulum, the hinder region of the cranium representing a part of the axial skeleton in which the vertebral segmentation has disappeared and the neural canal become greatly enlarged in correlation with the expansion of the central nervous system to form the brain. The olfactory organ and the otocyst each becomes enclosed in a capsule of cartilage and these become incorporated in the complete cranium. The anterior portion of the cartilaginous cranium, including the capsule of the olfactory organ, has been demonstrated to arise in large part from the cranial neural crest (see fig. 15). Most of the cartilaginous visceral skeleton has a similar origin. The principal elements of the limb skeleton are also preformed in cartilage. Later the cartilaginous skeleton of the embryo is largely replaced in the adults of most vertebrates by bony tissue.

In addition to those portions of the skeleton already mentioned, which appear first in cartilaginous form, there are many elements which develop directly into bone from membranous concentrations of mesenchyme. In the typical mammal these are confined principally to the skull, but in lower types such as the turtle, and in many extinct forms, they are often abundant in other portions of the body as variously sized plates situated in the deeper part of the skin. These are believed to have evolved from enlarged or compound dermal scales. In the elasmobranch, the placoid scales of the skin extend into the buccal cavity, where some of them enlarge to form the teeth. In other lower vertebrates, embryology

demonstrates that the bones which underlie the base of the cartilaginous cranium and reinforce it are formed of originally separate denticles, which become united into a continuous plate by the spreading out and fusion of their basal portions. This origin through fusion of small scale-like elements is no longer evident in the embryonic development of the homologous dermal bones of the higher vertebrates, including man.

Adaptations to Environment.—In certain cases the environment and the young individual's relations to it present no special peculiarities. The young crossopterygian or lungfish or urodele leads a normal kind of aquatic existence and the strikingly uniform type of *larva* in these three relatively archaic vertebrates suggests strongly that it repeats an early stage of vertebrate evolution. In most vertebrates, however, development is either embryonic or secondarily larval. In elasmobranchs, in teleosts and in reptiles and birds, the early stages are passed within the shelter of egg envelopes and this involves the modifications associated with the storing up of a supply of yolk—modifications which still persist in cases such as the majority of teleosts, where a larval mode of development is re-acquired. Embryonic development is seen in its highest expression in the terrestrial vertebrates and these, in addition to the immense exaggeration of the ventral part of the endoderm to store up yolk (*yolk sac*), show two other striking peculiarities: (1) the body of the embryo becomes enclosed in a water jacket (*amnion*) in which it floats suspended and is thus protected from the sudden jars incidental to a terrestrial existence, and (2) the allantois (the pouch-like outgrowth from the hinder end of the alimentary canal which in the amphibian functions as a urinary bladder) becomes precociously enlarged and, spreading around the inner surface of the egg shell, constitutes the breathing organ during a large part of embryonic life. In ordinary mammals the allantois has developed a new function, that of absorbing nourishment from the uterine wall, and in correlation with this, the supply of yolk, which in the reptilian egg was so conspicuous, has now disappeared almost entirely.

BIBLIOGRAPHY.—*The Embryology of the Chick* (1929), and *The Embryology of the Pig* (1931), both by B. M. Patten, present clear and well illustrated accounts of the development of the animals specified in the titles. L. B. Arey's *Developmental Anatomy* (1941) stresses mammalian and human embryology, and includes illustrated descriptions of many of the commoner developmental anomalies.

(J. G. K.; V. C. T.)

VERTICAL, the direction of the line of action of gravity, as determined by the plumb-line. *The angle of the vertical* is the angle between the direction of the plumb-line and the direction towards the earth's centre (*see* GEODESY).

VERTIGO: *see* MÉNIERE'S DISEASE; SEA-SICKNESS.

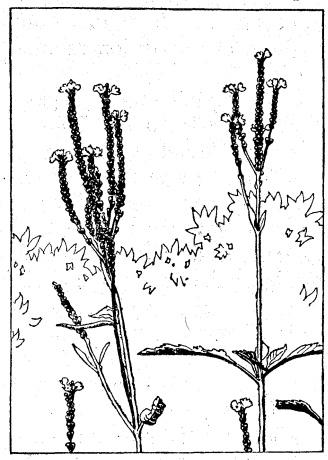
VERTUE, GEORGE (1684–1756), English engraver and antiquary, was born in St. Martin's-in-the-Fields, London, in 1684. At the age of 13 he was apprenticed to an heraldic engraver, a Frenchman, who failed in three or four years. Vertue then studied drawing at home, and afterwards worked for seven years as an engraver under Michael Vandergucht. His plate of Archbishop Tillotson, after Kneller, commissioned by Lord Somers, established his reputation as an engraver; and he was soon in an excellent practice, engraving portraits after Dahl, Richardson, Jervas and Gibson. In portraiture alone he executed over 500 plates. In 1717 he was made engraver to the Society of Antiquaries. He died on July 24, 1756, and was buried in Westminster Abbey.

Vertue's forty volumes of memoranda on the history of British art were purchased by Horace Walpole, and form the basis of that author's *Anecdotes of Painting in England,* including an account of Vertue's life and a catalogue of his engravings.

VERTUMNUS, in Roman cult, the god of the changing year (Lat. *vortumnus,* changing) with its seasons, its flowers and its fruits, probably of Italian origin. In legend, he has the power of assuming any shape he pleases, which enables him to win the love of Pomona (*q.v.*). His shrine and statue (*see* the description in Propertius iv. 2) were in the Vicus Tuscus, and from his connexion with this busy street he was regarded as having a special interest in trade and barter. At another sanctuary on the slope of the Aventine, sacrifice was offered to him every year on Aug. 13.

VERULAMIUM, a Romano-British town situated in the territory of the Catuvellauni, close to the modern St. Albans (Hertfordshire). Before the Roman conquest it was the capital of Tasciovanus, Prince of the Catuvellauni, who issued coins inscribed with the name of the place, and of his son, Cunobelin; afterwards it received the dignity of a *municipium* (implying municipal status and Roman citizenship). Tacitus tells us that the town was burnt by Boadicea (*q.v.*), in A.D. 60 or 61, but it again rose to prosperity. The visit of Germanus to the tomb of S. Alban shows that it was still inhabited in 429. Its site is still easily recognizable. Its walls of flint rubble survive in stately fragments, and enclose an area of 200 acres. Of the internal buildings little is known. A theatre was excavated in 1847, and parts of the forum were opened by Mr. William Page in 1898; both indicate a civilized and cultivated town. The complete uncovering of the site was planned in 1910 but abandoned. (*Royal Comm. on Hist. Monuments, Inventory of Herts.* [1910], pp. 3, 190; *Victoria County Hist. Herts.* IV. [1914].)

VERVAIN (*Verbena officinalis*), a plant of the family Verbenaceae (*q.v.*), native to Europe and Asia, common in the south of England, and naturalized across the continent of North America. It is a smooth slender annual, 1 to 3 ft. high, with opposite, deeply incised leaves and numerous very slender spikes of purplish or white flowers. To the vervain, which was held in superstitious veneration by the ancient peoples of Great Britain, were ascribed remarkable medicinal virtues, which, however, are now wholly discredited. In the United States the name vervain is applied to several native species of *Verbena,* as the white vervain (*V. urticifolia*), the blue vervain (*V. hastata*), the hoary vervain (*V. stricta*), the bracted vervain (*V. bracteosa*), and the spreading vervain (*V. prostrata*). Most of these inter-hybridize.



BY COURTESY OF THE WILD FLOWER PRESERVATION SOCIETY

BLUE VERVAIN (VERBENA HASTATA)

VERVET, a Central and South African monkey, *Cercopithecus aethiops pygerythrus.* It is allied to the grivet (*q.v.*), but distinguished by the presence of a rusty patch at the root of the tail and by the black chin, hands and feet.

VERVIERS, a town, province of Liége, Belgium, on the main line from Liége to Aix-la-Chapelle and Cologne. Pop. (est. 1939) 42,357. It is on the Vesdre, which flows into the Ourthe a few miles before its junction with the Meuse; and the water of that river is supposed to be especially good for dyeing purposes.

VERWEY, ALBERT (1865–1937), Dutch man of letters, was one of the leading figures of the revival of Dutch literature, called "The movement of 1880." He helped to found and from 1884–89 was one of the editors of the *Nieuwe Gids;* from 1894–1904 of the *Tweemaandelijksch Tijdschrift* and *De XXe Eeuw,* and from 1905–19 of *De Beweging.* In 1924 Verwey was appointed professor of Dutch literature in the University of Leyden. His anthology with commentaries of *Nederlandsche Dichters behalve Vondel* (1893, etc.) and his essay on *Potgieter* and his circle, *Het Testament van Potgieter* (1908) are works of lasting value. Verwey, who held an honorary doctor's degree from the University of Groningen, translated into Dutch Shelley's *A Defence of Poetry,* Sidney's *An Apology for Poetry* (1891) and Shelley's *Alastor* (1922). In 1885 he issued an article on *The Sonnet and the Sonnets of Shakespeare.*

He has published several volumes including *Inleiding tot de nieuwe Nederlandsche dicht Kunst, 1880–1900* (1914); *Proza* (1911 etc.); *De Maker* (1924) and *Rondom mijn Werk, 1890–1923* (1925).

See M. Uyldert, *Albert Verwey* (1908).

VESICA PISCIS, in architecture, the term given to a pointed oval panel formed by two equal intersecting circular

curves; a common form given to a panel in which the figure of Christ is represented. It is employed in mediaeval seals, especially those of bishops as well as those of numerous monastic establishments.

VESNIC, MILENKO (1862–1921), Serbian diplomatist, was born a Turkish subject in what was then the Sanjak of Novi Pazar, Feb. 13, 1862, but made his way to Belgrade, where he was educated. After studying law he took his doctorate in Munich. He entered the Serbian diplomatic service in 1891, but soon left it for journalism and teaching. In 1893 he entered parliament and was for a short time minister of education in the Gruijic cabinet. In 1899 he and other Radical leaders were falsely charged with complicity in the attempt on King Milan's life, and Vesnic was sentenced to two years' imprisonment. After a year he was pardoned, resumed his professorship, and in 1901 became minister in Rome. In 1904 he was appointed minister in Paris, a post which he held, with short intervals of political work, until his death. He was one of the delegates sent by King Peter to negotiate the peace of London in 1913, and in 1919 was delegate of the new Yugoslav state at the peace conference. In 1920 Vesnic, who remained a Radical, became the head of a coalition cabinet. He died in Paris May 15, 1921.

VESOUL, a town of eastern France, capital of the department of Haute-Saône, 236 mi. E.S.E. of Paris on the Eastern railway to Belfort. Pop. (1936) 11,755. Vesoul is of ancient origin, but in existing records is first mentioned in the 9th century. Originally a fief of the church of Besançon, it passed to the house of Burgundy, becoming, in the 13th century, capital of the bailiwick of Amont. The castle was destroyed in the 17th century. The town suffered much during the wars of religion and the Thirty Years' War. Vesoul belonged temporarily to France after the death of Charles the Bold, duke of Burgundy; was returned to the empire when Charles VIII, king of France, broke off his marriage with the daughter of Maximilian, king of the Romans; and again became part of France under Louis XIV after the peace of Nijmwegen in 1678. Vesoul stands between the river Durgeon and the isolated vine-clad hill of La Motte (1,263 ft.), crowned by a votive chapel which in 1855 replaced the old fortification. The 13th- and 15th-century walls of the town still exist on its northern side.

VESPASIAN, in full TITUS FLAVIUS VESPASIANUS, Roman emperor A.D. 70–79, was born on Nov. 18, A.D. 9, in the Sabine country near Reate. His father was a tax-collector and money-lender on a small scale; his mother was the sister of a senator. After having served with the army in Thrace and been quaestor in Crete and Cyrene, Vespasian rose to be aedile and praetor, having meanwhile married Flavia Domitilla, the daughter of a Roman knight, by whom he had two sons, Titus and Domitian, afterwards emperors. Having already served in Germany, in the years 43 and 44, in the reign of Claudius, he distinguished himself in command of the 2nd legion in Britain under Aulus Plautius. He reduced Vectis (Isle of Wight) and penetrated to the borders of Somersetshire. In 51 he was for a brief space consul; in 63 he went as governor to Africa, where, according to Tacitus (ii, 97), his rule was "infamous and odious"; according to Suetonius (*Vesp.* 4), "upright and highly honourable." He went with Nero's suite to Greece, and in 66 was appointed to conduct the war in Judaea.

On the first of July, 69, while he was at Caesarea, he was proclaimed emperor, first by the army in Egypt, and then by his troops in Judaea. The legions of the East at once took the customary oath of allegiance. Nevertheless, Vitellius, the occupant of the throne, had on his side the veteran legions of Gaul and Germany, Rome's best troops. But the feeling in Vespasian's favour quickly gathered strength, and the armies of Moesia, Pannonia and Illyricum soon declared for him, and made him in fact master of half of the Roman world. They entered Italy on the northeast under the leadership of Antonius Primus, defeated the army of Vitellius at Bedriacum (or Betriacum), sacked Cremona and advanced on Rome, which they entered after furious fighting, in which the Capitol was destroyed by fire. The new emperor received the tidings of his rival's defeat and death at Alexandria, whence he at once forwarded supplies of corn to Rome, which were urgently needed, along with an edict or a declaration of policy, in which he gave assurance of an entire reversal of the laws of Nero, especially those relating to treason.

Leaving the war in Judaea to his son Titus, he arrived at Rome in 70. He at once devoted his energies to repairing the evils caused by civil war. He restored discipline in the army, which under Vitellius had become utterly demoralized, and, with the co-operation of the senate, put the government and the finances on a sound footing. He renewed old taxes and instituted new, increased the tribute of the provinces, and kept a watchful eye upon the treasury officials. By his own example of simplicity of life, he put to shame the luxury and extravagance of the Roman nobles and initiated in many respects a marked improvement in the general tone of society. By taking over the censorship, the last of the republican magistracies, he gained complete control over the entry to the senate. He altered the constitution of the praetorian guard, in which only Italians, formed into nine cohorts, were enrolled, while Italians seem to have been excluded from the legions; he tended to assimilate the auxiliaries to the legions in personnel. The time-expired men, when they went back to their homes, he made use of to promote the urbanization and Romanization of the more backward and unorganized provinces. In 70 a formidable rising in Gaul, headed by Claudius Civilis, was suppressed and the German frontier made secure; the Jewish War was brought to a close by Titus's capture of Jerusalem, and in the following year, after the joint triumph of Vespasian and Titus, the temple of Janus was closed, and the Roman world had rest for the remaining nine years of Vespasian's reign. In 78 Agricola went to Britain, and both extended and consolidated the Roman dominion in that province, pushing his arms into north Wales and the Isle of Anglesey. In the following year Vespasian died, on June 23.

The "avarice" of Tacitus and Suetonius seems to have been an enlightened economy, which, in the disordered state of the Roman finances, was an absolute necessity. Vespasian could be liberal when he chose, as Quintilian's pension shows. Pliny's great work, the *Natural History,* was written during Vespasian's reign and dedicated to his son Titus. Of the philosophers who encouraged conspiracy by republican theorizing only one, Helvidius Priscus, was put to death, and he had affronted the emperor by studied insults. "I will not kill a dog that barks at me," were words honestly expressing the temper of Vespasian.

Much money was spent on public works and the restoration and beautifying of Rome—a new forum, the splendid temple of peace, the public baths and the vast Colosseum being begun under Vespasian. The roads and aqueducts were repaired, and the limits of the *pomerium* extended.

The most important of his changes in the provinces was the reorganization of the eastern provinces, whereby Judaea became a province of its own, Syria absorbed the vassal kingdom of Commagene and had its legionary forces strengthened and centred at Samosata, and Cappadocia and lesser Armenia were absorbed in Galatia, whose governor also was given legionary troops to hold the upper river, stationed at Melitene; second to this comes the annexation of the *agri decumates,* the first step to cutting out the salient in the Rhine-Danube frontier. Mention may be made of his extension of Latin rights to Baetica.

To the last, Vespasian was a blunt soldier, with strength of character, and with a steady purpose to establish good order and secure the prosperity and welfare of his subjects. In his habits he was punctual and regular, transacting his business early in the morning, and enjoying his siesta after a drive. He was free in his conversation, and his humour was apt to take the form of rather coarse jokes. There is something very characteristic in the exclamation he is said to have uttered in his last illness, "An emperor ought to die standing."

See Tacitus, *Histories;* Suetonius, *Vespasian;* Dio Cassius lxvi; Merivale, *Hist. of the Romans under the Empire,* chs. 57–60; H. Schiller, *Geschichte der römischen Kaiserzeit,* i, pt. 2; B. W. Henderson, *Civil War and Rebellion in the Roman Empire,* A.D. *69–70* (1908); *Five Roman Emperors* (1927); M. I. Rostovtseff, *Social and Economic History of the Roman Empire* (1926).

VESPERS, in the Roman Catholic liturgy, the seventh of the eight "hours" which make up the daily office. (*See* BREVIARY.)

VESPERS, SICILIAN, the revolution of the Sicilians against Angevin domination, so called because it broke out at the hour of Vespers on Easter Tuesday 1282. The government of Charles I. of Anjou (*q.v.*) was highly oppressive, and the people of Sicily were strongly attached to the house of Hohenstaufen. The actual outbreak was a purely unpremeditated popular movement. Charles at that time was making preparations for an attack on the East Roman empire, and heavily taxing the Sicilians in order to meet his expenses. Peter III. king of Aragon, wishing to assert the claims to Sicily which he possessed in right of his wife Constanza daughter of Manfred (*q.v.*), was negotiating with the enemies of Charles, when the people of Sicily, goaded beyond endurance, rose unexpectedly against their rulers. On March 31, 1282 a riot broke out in a church near Palermo, in consequence, according to tradition, of the insults of a French soldier towards a Sicilian woman, and a general massacre of the French began. The rising spread to the city, where a republic was proclaimed, and then through the rest of the island; thousands of French men, women and children were butchered (there may be some exaggeration in the wholesale character of the slaughter), and by the end of April the whole of Sicily was in the hands of the rebels. Charles at once led an expedition against the Sicilians and besieged Messina. The island was saved from re-conquest by the intervention of Peter of Aragon, but this intervention changed the character of the movement, and the free communes which had been proclaimed throughout the island had to submit to royal authority and a revived feudalism. Peter, having reached Palermo in Sept. 1282, accepted the Sicilian crown, and declared war on Charles. *See* SICILY; NAPLES.

BIBLIOGRAPHY.—The standard work on the subject is Michele Amari's *Guerra del Vespro* (2 vols. 8th ed., Florence, 1876), which is based on a study of the original authorities, but is too strongly prejudiced against the French; *cf.* L. Cadier's *Essai sur l'administration du royaume de Sicile par Charles I. et Charles II. d'Anjou* (fasc. 59 of the *Bibliothèque des écoles françaises de Rome et d'Athènes,* 1891). *See* also A. de Saint-Priest, *Histoire de la conquête de Naples par Charles d'Anjou* (1847–49); A. Cappelli's preface to the "Leggenda di Messer Giovanni da Procida," in *Miscellanea di opuscoli inediti o rari dei secoli XIV. XV.* (Turin, 1861); F. Lanzani, *Storia dei communi d'Italia,* lib. v. ch. 3 (Milan, 1882).

VESPUCCI, AMERIGO (1451–1512), merchant and adventurer, who gave his name of *Amerigo* to the new world as *America,* was born at Florence on March 9, 1451. His father, Nastagio (Anastasio) Vespucci, was a notary, and his uncle, Fra Giorgio Antonio Vespucci, to whom he owed his education, was a scholarly Dominican and a friend of Savonarola. Amerigo was placed as a clerk in the great commercial house of the Medici, then the ruling family in Florence. A letter of Dec. 30, 1492, shows that he was then in Seville; and till Jan. 12, 1496, he seems to have usually resided in Spain, especially at Seville and Cadiz, probably as an agent of the Medici. In December 1495, on the death of a Florentine merchant, Giannetto Berardi, established at Seville, who had fitted out the second expedition of Columbus in 1493, and had also undertaken to fit out 12 ships for the king of Spain (April 9, 1495), Vespucci was commissioned to complete the contract. As Ferdinand recalled the monopoly conceded to Columbus (this order of April 10, 1495, was cancelled on June 2, 1497), "private" exploring now had an opportunity, and adventurers of all kinds were able to leave Spain for the West. Vespucci claims to have sailed with one of these "free-lance" expeditions from Cadiz on May 10, 1497. Touching at Grand Canary on the way, the four vessels he accompanied, going 37 days on a west-south-west course, and making 1,000 leagues, are said to have reached a supposed continental coast in 16° N., 70° W. from Grand Canary (June 16, 1497). This should have brought them into the Pacific. They sailed along the coast, says Vespucci, for 80 leagues to the province of Parias (or Lariab), and then 870 leagues more, always to the north-west, to the "finest harbour in the world," which from this description should be in British Columbia or thereabouts, thence 100 leagues more to north and north-east, to the islands of the people called "Iti," from which they returned to Spain, reaching Cadiz in October 1498. Still following Vespucci's own statement, he, in May 1499, started on a second voyage in a fleet of three ships under Alonzo de Ojeda (Hojeda). Sailing south-west over 500 leagues they crossed the ocean in 44 days finding land in 5° S. Thence, encountering various adventures, they worked up to 15° N., and returned to Spain by way of Antiglia (Española, San Domingo), reaching Cadiz in Sept. 1500.

Entering the service of Dom Manuel of Portugal, Vespucci claims to have taken part in a third American expedition, which left Lisbon in May 1501. Vespucci has given two accounts of this alleged third voyage, differing in many details, especially dates and distances. From Portugal he declares that he sailed to Bezeguiche (Cape Verde), and thence south-west for 700 leagues, reaching the American coast in 5° S. on the 7th (or 17th) of August. Thence eastward for 300 (150) leagues, and south and west to 52° S. (or 73° 30′; in his own words, "13° from the antarctic pole," *i.e.,* well into the antarctic continent). He returned, he adds, by Sierra Leone (June 10), and the Azores (end of July), to Lisbon (Sept. 7, 1502). His second Portuguese (and fourth and last American) voyage, as alleged by him, was destined for Malacca, which he supposed to be in 33° S. (really in 2° 14′ N.). Starting from Lisbon on May 10, 1503, with a fleet of six ships, and reaching Bahia by way of Fernando Noronha (?), Vespucci declares that he built a fort at a harbour in 18° S., and thence returned to Lisbon (June 18, 1504). In Feb. 1505, being again in Spain, he visited Christopher Columbus, who entrusted to him a letter for his son Diego. On April 24, 1505, Vespucci received Spanish letters of naturalization; and in 1508 was appointed *piloto mayor* or chief pilot of Spain, an office which he held till his death, at Seville, on Feb. 22, 1512.

If his own account had been trustworthy, it would have followed that Vespucci reached the mainland of America eight days before John Cabot (June 16 against June 24, 1497). But Vespucci's own statement of his exploring achievements hardly carries conviction. This statement is contained (i.) in his letter written from Lisbon (March or April 1503) to Lorenzo Piero Francesco di Medici, the head of the firm under which his business career had been mostly spent, describing the alleged Portuguese voyage of March 1501–Sept. 1502. The original Italian text is lost, but we possess the Latin translation by "Jocundus interpreter," perhaps the Giocondo who brought his invitation to Portugal in 1501. This letter was printed (in some nine editions) soon after it was written, the first two issues (*Mundus Novus* and *Epistola Albericii de Novo Mundo*), without place or date, appearing before 1504, the third, of 1504 (*Mundus Novus*), at Augsburg. Two very early Paris editions are also known, and one Strâsbourg (*De Ora Antarctica*) 1505, edited by E. Ringmann. It was also included in the *Paesi novamente retrovati* of 1507 (Vicenza) under the title of *Novo Mondo da Alb. Vesputio.* The connection of the new world with Vespucci, thus expressed, is derived from the argument of this first letter, that it was right to call Amerigo's discovery a new world, because it had not been seen before by any one. This prepared the way for the American name soon given to the continent. (ii.) In Vespucci's letter, also written from Portugal (September 1504), and probably addressed to his old schoolfellow Piero Soderini, gonfaloniere of Florence 1502–12. From the Italian original (of which four printed copies still exist, without place or date, but probably before 1507) a French version was made, and from the latter a Latin translation, published at St. Dié in Lorraine in April 1507, and immediately made use of in the *Cosmographiae Introductio* (St. Dié, 1507) of Martin Waldseemüller (Hylacomylus), professor of cosmography in St. Dié university. Here we have perhaps the first suggestion in a printed book that the newly discovered fourth part of the world should be called "America, because Americus discovered it."

Since Alexander von Humboldt discussed the subject in his *Examen critique de l'historie de la géographie du nouveau continent* (1837), vol. iv., the general weight of opinion (in spite of F. A. de Varnhagen, *Amerigo Vespucci, son caractère, ses écrits . . . sa vie . . . ,* Lima, 1865, and other pro-Vespuccian works) has been that Vespucci did not make the 1497 voyage, and that he had no share in the first discovery of the American continent.

See also R. H. Major, *Prince Henry the Navigator* (1868), pp. 367–388; F. A. de Varnhagen, *Le Premier voyage de Amerigo Vespucci* (Vienna, 1869); *Nouvelles recherches sur les derniers voyages du navigateur florentin* (Vienna, 1869); *Ainda Amerigo Vespucci Novos*

Estudos (Vienna, 1874); Luigi Hugues, *Il terzo viaggio di A. Vespucci* (Florence, 1878); "Alcune Considerazioni sul Primo Viaggio di A. Vespucci," in the *Bollettino* of the Italian Geographical Society, series ii. vol. x., pp. 248–263, 367–380 (Rome, 1885); "Il Quarto Viaggio di A. Vespucci," in the same *Bollettino*, year xx., vol. xxiii., pp. 532–554 (Rome, 1886); "Sul nome 'America'" in the same *Bollettino*, series iii. vol. i., pp. 404–427, 515–530 (Rome, 1888), and an earlier study under the same title (Turin, 1886); "Sopra due lettere di A. Vespucci," in the same, series iii. vol. iv., pp. 849–872, 929–951 (Rome, 1891); *Narrative and Critical History of America*, edited by Justin Winsor, vol. ii., pp. 129–186 (1886); *The Letters of A. Vespucci* (translation, etc., by Clements R. Markham, Hakluyt Society, 1894); H. Harrisse, *A. Vespuccius* (London, 1895); Jos. Fischer and F. R. von Weiser, *The Oldest Map with the Name America* . . . (Innsbruck, 1903); B. H. Soulsby in the *Journal of the Royal Geographical Society* (Feb. 1902), pp. 201–209; H. Vignaud, *A. Vespucci* (1917); A. Magnaghi, *A. Vespucci* (1926). (C. R. B.)

VESSEL (O. Fr. *vaissel*, from a rare Latin word *vascellum*, diminutive of *vas*, vase, urn), a word of somewhat wide application for many objects, the meaning common to them being capacity to hold or contain something. Thus it is a general term for any utensil capable of containing liquids, and for those tubular structures in anatomy, such as the arteries, veins or lymphatics, which contain, secrete or circulate the blood or lymph. Organs or structures which are largely supplied with vessels are said to be "vascular" (Latin *vasculum*, another diminute of *vas*). Vessel (as in French) is also a general term for all craft larger than a rowing boat capable of floating on water. The word is also familiar in Biblical phraseology in the figurative sense of a person regarded as the recipient of some Divine dispensation, *e.g.* a "chosen vessel," or as one into which something is infused or poured, as a "vessel of wrath." (*See* also DRINKING VESSELS.)

VESTA, the Roman hearth-goddess. The name is etymologically identical with Hestia (*q.v.*), but the Roman cult is nearer the primitive conditions. In an early community fire was hard to make, and therefore it was desirable that at least one fire should be kept always burning. This duty would naturally devolve upon the chief or king, and the actual maintenance of the fire would usually fall to his young daughters, since slaves, if he had any, would hardly be trusted with a duty considered holy, he and his sons would be out most of the day, and his wife would be busy with housework. Much of the actual preparation of food would also fall upon the daughters, as soon as they were old enough, for a Roman housewife in early days might not grind corn or cook food for her husband (Plutarch, *quaest. Rom.*, 85). Hence we get, in early historical times, besides the private cult of Vesta and the *di penates* (*q.v.*) in every household, a public cult of a sacred royal hearth, never allowed to go out, tended by girls (Virgines Vestales) whose service begins when they are from six to ten years old (Gellius, i. 12, 1), and lasts originally for five years (Dion. Hal., i. 76, 3), *i.e.*, till they are old enough for marriage, or at least betrothal. The earliest cult of this kind was supposed to be that at Lavinium; the most famous was at Rome.

In Republican times, the *pontifex maximus* took the place of the king for many sacred purposes. The Vestals, whose number was six, and whose term of service had now been lengthened to 30 years, were in his charge, being freed from the *potestas* of their own fathers. They must, when chosen, be of the required age, free-born of free-born and respectable parents (although later, daughters of freedmen were eligible), having both parents alive (*patrimae et matrimae*), and free from physical and mental defects. The *pontifex* took the candidate by the hand, pronouncing a formula of admission to the sacred office; her hair was cut and the cuttings hung on a certain tree; she was dressed in an ancient costume, identical with that of a bride. From this it does not follow that she was the wife of either fire-god or king (Klausen, Frazer, Wissowa), but rather that the bride's dress was that of a virgin. If a Vestal let the fire go out she was beaten. On such occasions, and also apparently once a year, when it was solemnly extinguished and re-lighted at the New Year (March 1), the fire was re-kindled by friction of wood (the use of a burning-glass, Plut., *Numa.* 9, if Roman at all, is certainly a late innovation). If found guilty of unchastity, she was subjected to an ordeal which amounted to a horrible form of capital punishment; she was shut up with a little food in an underground cell, which was covered over with earth. The Vestals' duties, besides the tending of the fire, comprised the fetching of water from a sacred spring (Vesta would have no water from the city mains), the preparation of sacred food-stuffs (*muries*, or brine, and *mola salsa*, coarse meal mixed with salt) for ritual purposes; also the custody of various holy objects, said to include the Palladium (*q.v.*) in the *penus Vestae* or store-chamber of the shrine of Vesta, which was so holy that no one but a Vestal might enter it. They took part in ceremonies of various kinds, besides Vesta's own elaborate daily ritual. Further, the privileges accorded to the Vestals, and especially those which were extended to their senior, the Virgo Maxima, were those of princesses.

The shrine of Vesta stood in the Forum, near the Regia, or palace of the kings. It was not technically a *templum* but a round structure, a stone imitation of the primitive "bee-hive" hut. When Augustus became *pontifex maximus*, he built a second shrine of Vesta on the Palatine and handed over the Regia to the Vestals. They also had for their quarters the splendid Atrium Vestae, between the shrine and the Velia. Their cult continued in great honour throughout the empire, until the abolition of pagan worship by the Christian emperors. Gratian confiscated the Atrium Vestae in 382. Considerable ruins of both it and the shrine are still to be seen; the former contains numerous statues (all late) of Vestals. The shrine contained no statue, the eternal fire serving instead. Images of Vesta of any kind are rare; when shown in art she is represented as a woman fully draped, sometimes accompanied by an ass.

Her festival, the Vestalia, was on June 9; thereafter, until June 15, the shrine was closed for the annual ceremonial cleansing. This period was deemed highly unlucky.

Allied deities were the very old pair of fire-gods, Cacus and Caca, probably belonging to the Palatine settlement, and the later Fornax, spirit of the baker's oven (hence Vesta's association with the ass, which turns the mill; bakers in early Rome were also millers).

BIBLIOGRAPHY.—Besides the literature given under HESTIA, *see* A. Wissowa, *Religion u. Kultus*, and in Roscher, art. VESTA; these give numerous references to earlier literature; J. G. Frazer, *Golden Bough*, ii., p. 195 ff.; H. J. Rose, *Primitive Culture in Italy*, p. 81 ff., and in *Mnemosyne* (1925), p. 410 ff. (H. J. R.)

VESTERÅS: *see* VÄSTERÅS.

VESTINI, an ancient Sabine tribe which occupied the eastern and northern bank of the Aternus in central Italy. It entered into the Roman alliance, retaining its own independence, in 304 B.C., and issuing coins of its own in the following century. A northerly section round Amiternum near the passes into Sabine country probably received the Caerite franchise soon after. The local dialect, which belongs to the north Oscan group, survived certainly to the middle of the 2nd century B.C. (*see* the inscriptions cited below) and probably until the Social War. The oldest Latin inscriptions of the district are *C.I.L.* ix. 3,521, from Furfo with Sullan alphabet, and 3,574, which cannot be earlier than 100 B.C. (*see* LATIN LANGUAGE). The Latin first spoken by the Vestini was not that of Rome, but that of their neighbours the Marsi and Aequi (*qq.v.*). The inscription of Scoppito shows that at the time at which it was written the upper Aternus valley must be counted Vestine, not Sabine, in point of dialect.

BIBLIOGRAPHY.—*See* PAELIGNI and SABINI, and for the inscriptions and further details, R. S. Conway, *Italic Dialects*, pp. 258 et seq.

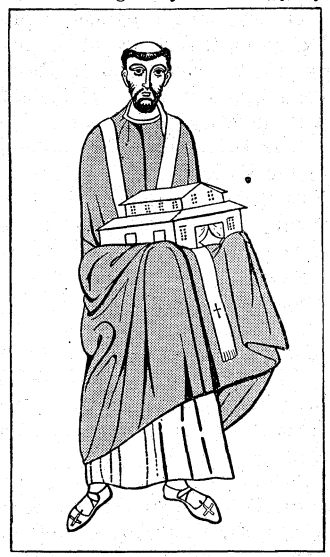
VESTMENTS, ceremonial garments worn by priests and others in performing the offices of religion. Ecclesiastical vestments, to which this article is confined, are the special articles of costume worn by the officers of the Christian Church "at all times of their ministration," as distinct from the "clerical costume" worn in everyday life. Ecclesiastical vestments may be divided into two categories: (1) liturgical, (2) non-liturgical. Liturgical vestments are again divided, under the completed rules of the Catholic Church, into three classes: (1) Those worn only at the celebration of mass—chasuble, maniple, pontifical shoes and

gloves, *pallium;* (2) those never worn at mass, but at other liturgical functions—surplice and cope; (3) those used at both—alb, amice, stole, dalmatic, tunicle. Non-liturgical vestments are those —*e.g.,* cappa magna, rochet—which have no sacred character, have come into use from motives of convenience or as ensigns of dignity, and are worn at secular as well as ecclesiastical functions.

Origin of Ecclesiastical Vestments.—The liturgical vestments of the church are not, as was once supposed, borrowed from the sacerdotal ornaments of the Jewish ritual, but were developed out of the articles of dress worn by all and sundry under the Roman empire.

Thus in the 37th of the so-called "canons of Hippolytus" we read: "As often as the bishops would partake of the Mysteries, the presbyters and deacons shall gather round him clad in white, quite particularly clean clothes, more beautiful than those of the rest of the people."

When, in the year 258, St. Cyprian was led to martyrdom, he wore (*see* Braun, *Die liturgische Gewandung,* 1907, p. 65) an under tunic (*linea*), an upper tunic (*tunica dalmatica*) and mantle (*lacerna, byrrus*). This was the ordinary type of the civil costume of the time. The *tunica,* a loose sack-like tunic with a hole for the head, was the innermost garment worn by all classes of Roman citizens under the republic and empire. The tunica was originally of white wool, but in the 3rd century it began to be made of linen, and from the 4th century was always of linen. About the 6th century the long *tunica alba* (white tunic) went out of fashion in civil life, but it was retained in the services of the Church and developed into the various forms of the liturgical alb (*q.v.*) and surplice (*q.v.*). The *tunica dalmatica* was a long, sleeved upper tunic, originating, as its name implies, in Dalmatia, and first becoming fashionable at Rome in the 2nd century; it is the origin of the liturgical dalmatic and tunicle (*see* Dalmatic). Another over-dress of the Romans was the *paenula,* a cloak akin to the *poncho* of the modern Spaniards and Spanish Americans, *i.e.,* a large piece of stuff with a hole for the head to go through, hanging in ample folds round the body. This was originally worn only by slaves, soldiers and other people of low degree; in the 3rd century, however, it was adopted by fashionable people as a convenient riding or travelling cloak; and finally, by the sumptuary law decreed by the emperor Theodosius in 382, it was prescribed as the proper everyday dress of senators, instead of the military chlamys, the toga being reserved for state occasions. This was the origin of the principal liturgical vestment, the chasuble (*q.v.*).



FROM BRAUN, "DIE LITURGISCHE GEWANDUNG IM OCCIDENT UND ORIENT" (HERDEN, FREIBURG IM BREISGAU)

FIG. 1.—VESTMENTS OF POPE HONORIUS (D. 638), FROM A MOSAIC IN S. AGNESE IN ROME

As late as the 6th century these garments were common both to the clergy and laity, and, so far as their character was concerned, were used both in the liturgy and in everyday life. Meanwhile, however, a certain development had taken place. By the 4th century the garments worn at liturgical functions had been separated from those in ordinary use, though still identical in form. It is in the 4th century, too, that the first distinctive vestment makes its appearance, the *omophorion* worn by all bishops in the East; in the 5th century we find this in use at Rome under the name of *pallium* (*q.v.*), as the distinctive ornament of the pope (*see* fig. 1). About the same time the *orarium,* or stole (*q.v.*), becomes fixed in liturgical use. The main development and definition of the ecclesiastical vestments, however, took place between the 6th and 9th centuries. The secular fashions altered with changes of taste; but the Church retained the dress with the other traditions of the Roman empire. At Rome, especially, where the popes had succeeded to a share of the power and pretensions of the Caesars of the West, the accumulation of ecclesiastical vestments symbolized a very special dignity: in the second quarter of the 9th century the pope, when fully vested, wore a *camisia* girdled (*see* Rochet), an alb (*linea*) girdled, an amice (*anagolaium*), a tunicle (*dalmatica minor*), a dalmatic (*dalmatica major*), stole (*orarium*), chasuble (*planeta*) and pallium. With the exception of the pallium, this was also the costume of the Roman deacons. By this time, moreover, the liturgical character of the vestments was so completely established that they were no longer worn instead of, but over, the ordinary dress.

Hitherto the example of the Roman Church had exercised no exclusive determining influence on ritual development even in the West. The popes had, from time to time, sent the pallium or the dalmatic—specifically Roman vestments—as gifts of honour to various distinguished prelates; Britain, converted by a Roman mission, had adopted the Roman use, and English missionaries had carried this into the newly Christianized parts of Germany; but the great Churches of Spain and Gaul preserved their own traditions in vestments as in other matters. From the 9th century onwards, however, after the revival of the Roman empire by Charlemagne, this was changed; everywhere in the West the Roman use ousted the regional uses.

The process of assimilation, however, was by no means one-sided. If Spain and Gaul borrowed from Rome, they also exercised a reciprocal influence on the Roman use; it is interesting to note, in this connection, that of the names of the liturgical vestments a very large proportion are not of Roman origin, and that the non-Roman names tended to supersede the Roman in Rome itself. Apart from the archiepiscopal pallium, the Churches of Spain and Gaul had need to borrow from Rome only the dalmatic, maniple and liturgical shoes.

The period between the 9th and the 13th centuries is that of the final development of the liturgical vestments in the West. In the 9th century appeared the pontifical gloves; in the 10th, the mitre; in the 11th, the use of liturgical shoes and stockings was reserved for cardinals and bishops. By the 12th century, mitre and gloves were worn by all bishops.

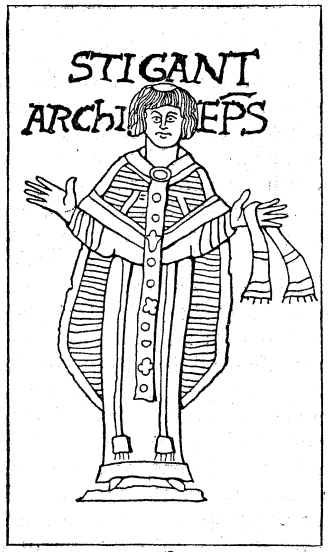
In an age when, with the feudal organization of society, even everyday costume was becoming a uniform, symbolizing the exact status of the wearer, it was natural that in the Church the official vestments should undergo a similar process. With this process, which was practically completed in the 11th century, doctrinal developments had little or nothing to do, though from the 9th century onwards liturgiologists were busy expounding the mystic symbolism of garments which hitherto had for the most part no symbolism whatever. Yet in view of later controversies, the changes made during this period, notably in the vestments connected with the mass, are not without significance. Hitherto the chasuble had been worn indifferently by all ministers at the eucharist, even by the acolytes; it had been worn also at processions and other non-liturgical functions; it was now exalted into the mass vestment *par excellence.* New vestments took the place, on less solemn occasions, of those hallowed by association with the holy sacrifice; thus the processional cope (*q.v.*) appeared in the 11th century and the surplice (*q.v.*) in the 12th. A change, too, came over the general character of vestments. Up to the 9th century these had been very plain; what splendour they had was due to their material and the ample folds of their draperies. But from this time onwards they tend to become more and more elaborately decorated with embroidery and jeweller's work (see, *e.g.,* the articles Chasuble and Cope).

Very significant, too, is the parting of the ways in the development of liturgical vestments in the East and West. During the first centuries both branches of the Church had used vestments substantially the same, developed from common originals; the alb, chasuble, stole and pallium were the equivalents of the *stichárion, phenailion, orárion* and *omophorion.* While, however, between the 9th and 13th centuries, the Western Church was adding largely to her store of vestments, that of the East increased her list by but three, the *encheirion, epimanikia* (*see* Maniple) and the *sakkos* (*see* Dalmatic).

In the Western Church, though considerable alterations continued to be made in the shape and decoration of the liturgical vestments, and in this respect various Churches developed different traditions, the definition of their use was established by the close of the 13th century and still continues in force. Before discussing the changes made in the Reformed Churches, due to the doctrinal developments of the 16th century, we may therefore give here a list of the vestments now worn by the various orders of clergy in the Roman Catholic Church and the Oriental Churches.

Roman Catholic Church.—As the sacrifice of the mass is the central mystery of the Catholic faith, the vestments worn by the priest when celebrating mass are the most important. The cassock (*q.v.*), which must always be worn under the vestments, is not itself a liturgical garment. Over this the priest, robing for mass, puts on the amice, alb, girdle (*cingulum*), maniple, stole and chasuble. Taking the other orders downwards: deacons wear amice, alb, girdle, maniple, stole and dalmatic; subdeacons, amice, alb, girdle, maniple and tunicle; the vestment proper to the minor orders, formerly the alb, is now the surplice or cotta. (The stole and maniple alone are symbolical of order, *i.e.*, of the relation to the sacrifice of the mass.) Bishops, as belonging to the order of priesthood with completed powers, wear the same vestments as the priests, with the addition of the pectoral cross, the pontifical gloves and ring; liturgical sandals and stockings; a tunicle and dalmatic worn over the stole and under the chasuble, and the mitre (*see* fig. 3). Archbishops, on solemn occasions, wear the pallium over the chasuble (*see* fig. 2). Bishops also carry a pastoral staff (*q.v.*) as a symbol of their pastoral office. Finally, the pope, when celebrating mass, wears the same vestments as an ordinary bishop, with addition of the subcinctorium (*see* ALB), and *orale* or *fanone* (*see* AMICE). It should be noted that the *liturgical* head-dress of the pope is the mitre, not the tiara, which is the symbol of his supreme office and jurisdiction (*see* TIARA).

Of the liturgical vestments not immediately or exclusively associated with the sacrifice of the mass the most conspicuous are the cope and surplice. The biretta, too, though not in its origin or in some of its uses a liturgical vestment, has developed a distinctly liturgical character (*see* BIRETTA). Besides the strictly liturgical vestments there are also numerous articles of costume worn at choir services, in processions, or on ceremonial occasions in everyday life, which have no sacral character; such are the almuce (*q.v.*), the *cappa* and *mozzetta* (*see* COPE), the rochet (*q.v.*), the *pileolus*, a skull-cap, worn also sometimes under mitre and tiara. These are generally ensigns of dignity; their form and use vary in different churches, and they often represent special privileges conferred by the popes, *e.g.*, the *cappa* of the Lateran basilica worn by the canons of Westminster cathedral, or the almuce worn, by concession of Pope Pius IX., by the members of the Sistine choir.



FROM FOWKE, "BAYEUX TAPESTRY" (BELL & SONS)

FIG. 2.—VESTMENTS OF STIGAND, ARCHBISHOP OF CANTERBURY (1052–1070); FROM THE BAYEUX TAPESTRY

Oriental Churches.—As already stated, the vestments of the great historical Churches of the East are derived from the same Graeco-Roman originals as those of the West, but in contradistinction to the latter they have remained practically stereotyped, both in character and number, for a thousand years; in the East, however, even more than in the West the tendency to gorgeous ornamentation has prevailed.

An Orthodox bishop, vested for the holy liturgy, wears over his cassock: (1) the *sticharion* or alb (*q.v.*); (2) the *epitrachelion* or stole (*q.v.*); (3) the *zone*, a narrow stuff girdle clasped behind, which holds together the two vestments above named; (4) the *epimanikia*, liturgical cuffs, corresponding, possibly, to the pontifical gloves of the West; (5) the *epigonation*, a stiff lozenge-shaped piece of stuff hanging at the right side by a piece of riband from the girdle or attached to the *sakkos*, the equivalent of the Western maniple (*q.v.*); (6) the *sakkos*, like the Western dalmatic (*q.v.*), worn instead of the *phainolion*, or chasuble; (7) the *omophorion*, the equivalent of the Western pallium (*q.v.*). Besides these, the bishop wears a pectoral cross (*engkolpion*) and a medal containing a relic (*panagia*). He also has a mitre (*q.v.*), and carries a crozier (*dikanikion*), a rather short staff ending in two curved branches with serpents' heads, with a cross between them.

FROM BRAUN, "DIE LITURGISCHE GEWANDUNG IM OCCIDENT UND ORIENT" (HERDER, FREIBURG IM BREISGAU)

FIG. 3.—VESTMENTS OF THE MONUMENTAL FIGURE OF BISHOP JOHANNES OF LÜBECK (D. 1350) IN LÜBECK CATHEDRAL, GERMANY

The vestments of a priest are the sticharion, epitrachelion, girdle, epimanikia and phainolion (*see* CHASUBLE). He wears all these vestments only at the celebration of the eucharist and on other very solemn occasions; at other ministrations he wears only the epitrachelion and phainolion over his cassock. A dignitary in priest's orders is distinguished by wearing the epigonation; and in Russia the use of the mitre is sometimes conceded to distinguished priests by the tsar. The deacon wears the sticharion, without a girdle, the epimanikia, and the orarion (*see* STOLE) hanging over his left shoulder. The lesser orders wear a shorter sticharion and an orarion wound round it.

On less solemn occasions bishops wear the *mandyas*, a cope-like garment fastened at the lower corners as well as at the neck, and the *kalimaukion*, a tall, brimless hat, with a veil hanging down behind, and in place of the *dikanikion* they carry a short staff with an ivory cross-piece.

The Liturgical Colours.—In another respect the vestments of the Eastern differ from those of the Western Church. In the East there is no sequence of liturgical colours; the vestments are usually white or red, and stiff with gold embroidery. In the West the custom, long universal, of marking the seasons of the ecclesiastical year and the more prominent fasts and festivals by the colour of the vestments of clergy and altar, dates, approximately, from the 12th century, certain rules being laid down by Pope Innocent III., *c.* 1200, which are still those of the Roman Church.

According to the rubric of the Roman Missal (*tit.* xviii.) the liturgical colours are five: white, red, green, violet, black. The following is a list of the occasions to which the various colours are appropriated:—

White.—Christmas to octave of Epiphany, Trinity Sunday, all festivals of Christ (except those of the Passion), of the Blessed Virgin, the Holy Angels and Confessors, holy virgins and women (not martyrs), nativity of St. John the Baptist, festivals of the chains of St. Peter and of his see (*cathedra Petri*), Conversion of St. Paul, All Saints, consecration of churches and altars, anniversary of election and coronation of popes, and of election and consecration of bishops. White is also worn during the octaves of these festivals, on ordinary days (for which no special colour is provided) between Easter and Whitsuntide, at certain special masses connected with the saints falling under the above category and at bridal masses. White is also the colour proper to sacramental processions, and generally to all devotions connected with the exposition of the Blessed Sacrament. At baptisms the priest wears a violet stole during the first part of the service, *i.e.*, the exorcization, then changes it for a white one. White is worn at the funerals of children.

Red.—Saturday before Whit Sunday, Whit Sunday and its

octave; all festivals in commemoration of the sufferings of Christ, *i.e.*, festival of the instruments of the Passion, of the Precious Blood, of the invention and elevation of the Cross; all festivals of apostles, except those above noted; festivals of martyrs; masses for a papal election; the Feast of the Holy Innocents, when it falls on a Sunday (violet if on a week-day), and its octave (always red). In England red vestments are worn at the mass (of the Holy Spirit) attended by the Roman Catholic judges and barristers at the opening of term, the so-called "Red Mass."

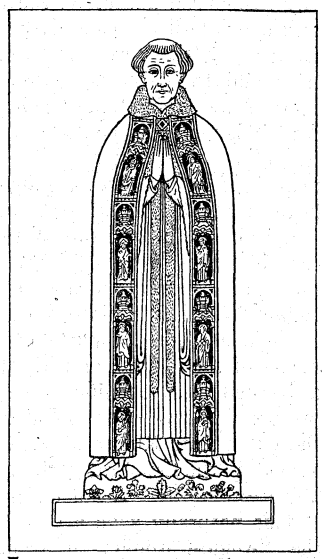


FIG. 4.—VESTMENTS OF DR. HENRY SEVER (D. 1471), FROM A BRASS IN THE CHAPEL OF MERTON COLLEGE, OXFORD, SHOWING SURPLICE, ALMUCE, AND COPE

Green.—From the octave of Epiphany to Septuagesima, and between Trinity and Advent, except festivals and their octaves and Ember days.

Violet.—Advent; the days between Septuagesima and Maundy Thursday; vigils that fall on fast days, and Ember days, except the vigil before Whit Sunday (red) and the Ember days in Whitsun week (red). Violet vestments are also worn on days of intercession, at votive masses of the Passion, at certain other masses of a pronouncedly intercessory and penitential character, at intercessory processions, at the blessing of candles on Candlemas Day, and at the blessing of the baptismal water. A violet stole is worn by the priest when giving absolution after confession, and when administering extreme unction.

Black.—Masses for the dead and funeral ceremonies of adults; the mass of the presanctified on Good Friday.

In the Anglican Church, where the liturgical colours have been revived, these generally follow the Roman use. Some churches, however, have adopted the colours of the use of Salisbury (Sarum), which was in force before the Reformation throughout the province of Canterbury.

Benediction of Vestments.—In the Roman Catholic Church the amice, alb, girdle, stole, maniple, chasuble must be solemnly blessed by the bishop or his delegate, the prayers and other forms to be observed being set forth in the *Pontificale* (*see* BENEDICTION). Other vestments—*e.g.*, dalmatic, tunicle, surplice—are sometimes blessed when used in connection with the sacrifice of the mass, but there is no definite rule on the subject.

Mystic Meaning of Vestments.—The origin of the vestments was in course of time forgotten, and they began to develop a symbolic meaning. The earliest record of any attempt to interpret this symbolism that we possess is, so far as the West is concerned, the short exposition in the *Explicatio Missae* of Germanus, bishop of Paris (d. 576), the earliest of any elaboration that of Hrabanus Maurus (d. 856). From the latter's time onward a host of liturgists took up the theme, arguing from the form, the material, the colour and the fashion of wearing the various garments to symbolical interpretations almost as numerous as the interpreters themselves. We cannot even outline here the process of selection by which the symbolic meanings now stereotyped in the Roman Pontifical were arrived at. They are now formulated in the words used by the bishop when, in ordaining to any office, he places the vestment on the ordinand with the appropriate words, *e.g.*, "Take the amice, which signifies discipline in speech," while other interpretations survive in the prayers offered by the priest when vesting, *e.g.*, with the amice, "Place on my head the helmet of salvation," etc.

Protestant Churches.—In the Protestant Churches the custom as to vestments differs widely, corresponding to a similar divergence in tradition and teaching. At the Reformation two tendencies became apparent. Luther and his followers regarded vestments as among the *adiaphora*, and in the Churches which afterwards came to be known as "Lutheran" many of the traditional vestments were retained. Calvin, on the other hand, laid stress on the principle of the utmost simplicity in public worship; at Geneva the traditional vestments were absolutely abolished, and the Genevan model was followed by the Calvinistic or "Reformed" Churches throughout Europe. The Church of England, in which the Lutheran and Calvinistic points of view struggled for the mastery, a struggle which resulted in a compromise, is separately dealt with below. At the present day the Lutheran Churches of Denmark and Scandinavia retain the use of alb and chasuble in the celebration of the eucharist (stole, amice, girdle and maniple were disused after the Reformation), and for bishops the cope and mitre. The surplice is not used, the ministers conducting the ordinary services and preaching in a black gown, of the 16th century type, with white bands or ruff. In Germany the Evangelical Church (outcome of a compromise between Lutherans and Reformed) has, in general, now discarded the old vestments. In isolated instances (*e.g.*, at Leipzig) the surplice is still worn; but the pastors now usually wear a barret cap, a black gown of the type worn by Luther himself, and white bands. In Prussia the superintendents now wear pectoral crosses (instituted by the emperor William II.). In the "Reformed" Churches the minister wears the black "Geneva" gown with bands. It is to be noted, however, that this use has been largely discontinued in the modern "Free" Churches. On the other hand, some of these have in recent times adopted the surplice, and in one at least (the "Irvingite" or Catholic Apostolic Church) the traditional Catholic vestments have been largely revived.

Anglican Church.—In the matter of the vestments the Reformation in England passed through several stages. Under Henry VIII. no alterations were made. In the first Prayer Book of Edward VI. (1549) the Lutheran example seems to have been followed: the priest at Holy Communion is directed to wear "a white alb plain with a vestment or cope," while the assisting priests or deacons are to wear "albs with tunicles." Elsewhere there are directions for the wearing of surplice and hood at choir services in cathedrals and collegiate churches, and bishops are directed to wear, besides a rochet, a surplice or alb, and a cope or vestment, with a pastoral staff borne either by themselves or their chaplains. Of the amice, girdle, maniple and stole there is no word; and, in view of the practice of the "Lutheran" Churches, it appears that these vestments were to be disused.

FIG. 5.—VESTMENTS OF CRANLEY, ARCHBISHOP OF DUBLIN (D. 1417), FROM A BRASS IN NEW COLLEGE CHAPEL, OXFORD, SHOWING MITRE, AMICE, CHASUBLE, MANIPLE, DALMATIC, TUNICLE, STOLE, ALB, GLOVES AND CALIGAE, AND WEARING THE PALLIUM OVER THE CHASUBLE

The intention of the framers of this book, among whom was Bishop Ridley, was to substitute the Holy Communion for the Mass considered as a sacrifice. It was soon found, however, that the conservative clergy took advantage of the retention of so much of the old liturgy to celebrate it as "a verie masse." To guard against this the second Prayer Book of Edward VI., in addition to changing the order of the prayer of consecration, prescribed as the sole vestment of the minister the surplice, which had never been associated with the sacrifice of the mass, but had been for many centuries the vestment proper to the administration of the sacraments (*see* SURPLICE). This book was, of course, suppressed during the reaction of Queen Mary's reign, but in 1559, after the accession of Elizabeth, parliament once more adopted it, and passed the Act of Uniformity, which made its use obligatory on all.

The Ornaments Rubric.—In the Prayer Book of 1559 no

explicit directions were given as to the vestments to be worn. It is probable that the queen, from motives of policy as well as personal tastes, wished to preserve as far as possible the outward forms of the "old religion." However this may be, the Act of Uniformity, prefixed to the new Prayer Book, ended with a section directing that the ornaments of the Church and of the ministers thereof were to be "retained and had in use" as they were "by authority of Parliament in the second year of the reign of King Edward VI., until other order shall be therein taken by the authority of the Queen's Majesty, with the advice of the Commissioners appointed and authorized under the Great Seal of England, or of the Metropolitan." The rubric in the Prayer Book itself, apparently inserted by the Privy Council without the authority of parliament, ran: ". . . the minister at the time of the Communion, and at other times of his administration, shall use etc. . . . according to the Act of Parliament at the beginning of this book." The wording of the "Ornaments rubric" in the Prayer Book as revised in 1662, and still in use, was taken directly from the last section of the Act of Uniformity.

FROM DRUITT, "COSTUME ON BRASSES" (MORING)

FIG. 6.—VESTMENTS OF ANGLICAN PRIEST IN CASSOCK, SURPLICE, AND NARROW BLACK SCARF, FROM A BRASS OF WILLIAM DYE (D. 1567) AT WESTERHAM, KENT

This ambiguous procedure lies at the root of the troubles which have since distracted the Church of England. The second year of Edward VI. is now admitted to mean the first Prayer Book, which authorized, not indeed all the Mass vestments, but at least the most conspicuous of them. Yet nothing is historically clearer than the fact that these vestments were not retained. If they continued anywhere in use after 1559, it was not for long.

Whatever the letter of the law under the rubric, the Protestant bishops and the commissioners made short work of such "popish stuff" as chasubles, albs and the like. As for copes, in some places they were ordered to be worn, and were worn at the Holy Communion, while elsewhere they were burned.

The difficulty seems to have been not to suppress the chasuble, of the use of which after 1559 not a single authoritative instance has been adduced, but to save the surplice, which the more zealous Puritans looked on with scarcely less disfavour. At last, in 1565, Queen Elizabeth determined to secure uniformity. The result was the issue in 1566 by the archbishop of the statutory *Advertisements,* which fixed the vestments of the clergy as follows: (1) In the ministration of the Holy Communion in cathedral and collegiate churches, the principal minister to wear a cope, with gospeller and epistoler agreeably; at all other prayers to be said at the Communion table, to use no copes but surplices; (2) the dean and prebendaries to wear surplice and hood; (3) every minister saying public prayers, or ministering the sacraments, to wear "a comely surplice with sleeves." For 300 years these directions (confirmed by the canons of 1603) governed the use of the Church of England in the matter of vestments, though the cope came to be worn only on occasions of high ceremony.

With the growth of the "Oxford" or "Tractarian" movement, from 1830 onward, there came a change. The revival of high sacramental doctrine and of the belief in the Sacrifice of the Mass (which was ingeniously distinguished from the "sacrifices of masses" denounced in the XXXIX. Articles) naturally led to a movement to revive the use of the vestments which symbolized these doctrines. Opposition was naturally aroused; the law was appealed to; and the judicial committee of the Privy Council (*Hebbert* v. *Purchas,* 1870, and *Ridsdale* v. *Clifton,* 1877) decided that the *Advertisements* of 1566 were the "other order" contemplated in Elizabeth's Act of Uniformity, and that from this time the cope and surplice were the only vestments legal in the Church of England. In the course of their judgment their lordships pointed out that the *Advertisements* had been accepted as authoritative by the canons of 1603 (canons 24 and 58), and argued convincingly that the revisers of the Prayer Book in 1662, in restoring the rubric of 1559, had no idea of legalizing any vestments other than those in customary use under the *Advertisements* and the canons.

This judgment was far from settling the question. The "ritualistic" clergy refused to obey it, on the ground that it was not delivered by a spiritual court; and, in the absence of any generally recognized authority, the clergy did what was right in their own eyes, until in place of the old ideal expressed in the Acts of Uniformity, there were almost as many "uses" as parishes, doctrine and the vestments which symbolized it varying through every shade from Rome to Geneva. Thirty years after the Ridsdale judgment the confusion had become so great that it was felt that something must be done to restore at least a semblance of unity, the dominant opinion being that this could best be done by sanctifying with some sort of authority the parochial uses which had grown up. To this end convocation appointed a subcommittee of five bishops to investigate the matter. Their report "On the Ornaments of the Church and its Ministers"—a learned and ingenious document—was presented in 1908. It concluded that under the Ornaments Rubric the vestments prescribed in the first Prayer Book of Edward VI. are permitted, if not enjoined.

FIG. 7.—VESTMENTS OF ARCHBISHOP OF GREEK ORTHODOX CHURCH IN FULL ROBES

This naturally gave a great impetus to the "Anglo-Catholic" movement, which was now favoured by many, if not most, of the bishops; but nothing could be done to give the revived practices legal validity so long as the Church continued to be effectively under the control of Parliament. The situation in this respect was altered by the so-called Enabling Act of 1919, which gave to the Church powers of self-government, measures passed by the Convocations and the newly established Church Assembly being subject only to the veto of parliament. Early in 1927 an alternative Prayer Book, drawn up by a committee of bishops and intended, among other things, to regularize practices of doubtful legality under the old book, was adopted by both Convocations and by the Church Assembly. The rubric in this alternative book (the old Prayer Book still being retained alongside of it) directs that the minister at the Holy Communion is to wear either a surplice with stole or scarf, or "an alb plain with a vestment or cope." The last direction, borrowed from the first Prayer Book of Edward VI., is not explained, and "an alb plain" therefore seems to mean without amice, maniple and girdle, the stole being admitted by implication. The alternative Prayer Book was submitted to Parliament in 1928 but was rejected by the House of Commons.

BIBLIOGRAPHY.—Father Joseph Braun's *Die Liturgische Gewandung* (Freiburg-im-Breisgau, 1907) is a monument of careful and painstaking research. *See* also Mgr. L. Duchesne's *Origines du culte chrétien* (1903), and especially C. Rohault de Fleury's *La Messe* (1883–89). *See* also F. X. Kraus, *Realencyklopädie der christlichen Altertümer* (Freiburg.-i.-B. 1882, 1886); Smith and Cheetham, *Dict. of Christian Antiquities* (ed. 1893) and *The Catholic Encyclopedia* (1907 onwards).

For the vestment question in the Church of England *see* the report of the sub-committee of Convocation on *The Ornaments of the Church and its Ministers* (1908); *Hierurgia Anglicana,* documents and extracts illustrative of the ceremonial of the Anglican Church after the Reformation, new ed. revised and enlarged by Vernon Staley (1902–3); J. T. Tomlinson, *The Prayer Book, Articles and Homilies* (1897), a polemical work from the Protestant point of view, but scholarly and based on a mass of contemporary authorities to which references are given; the bishop of Exeter, *The Ornaments Rubric* (1901), a pamphlet. For the legal aspect of the question *see* G. J. Talbot, *Modern Decisions on Ritual* (1894). (W. A. P.)

VESTRIS, LUCIA ELIZABETH (1797–1856), English actress, was born in London in Jan. 1797, the daughter of Gaetano Stefano Bartolozzi (1757–1821) and granddaughter of Francesco

Bartolozzi, the engraver. In 1813 she married Auguste Armand Vestris, who deserted her four years later. Madame Vestris had made her first appearance in Italian opera in the title-rôle of Peter Winter's *Il ratto di Proserpina* at the King's theatre in 1815. She had an immediate success in both London and Paris, where she played Camille to Talma's Horace in *Horace*. Her first hit in English was at Drury Lane in James Cobb's (1756–1818) *Siege of Belgrade* (1820). She was particularly a favourite in "breeches parts," like Cherubino in the *Marriage of Figaro*, and in *Don Giovanni*. In 1831 she became lessee of the Olympic theatre, and began the presentation of a series of burlesques and extravaganzas for which she made this house famous. She married Charles James Mathews (*q.v.*) in 1838, accompanying him to America and aiding him in his subsequent managerial ventures. She died in London on Aug. 8, 1856.

See C. E. Pearce, *Madame Vestris and her Times* (1923).

VESUVIUS, a volcano rising from the eastern margin of the Bay of Naples in Italy, about 7 m. E.S.E. of Naples. The height of the mountain varies from time to time within limits of several hundred feet, but averages about 4,000 ft. above sea-level (in June 1900, 4,275 ft., but after the eruption of 1906 3,668 ft.). Vesuvius consists of two distinct portions. On the northern side a lofty semicircular cliff, reaching a height of 3,858 ft., half encircles the present active cone, and descends in long slopes to the plains. This precipice, Monte Somma, forms the wall of a vastly greater prehistoric crater.

At the beginning of the Christian era, and for many previous centuries, no eruption had been known. Strabo, however, detected the probable volcanic origin of the cone and drew attention to its fire-eaten rocks. The sides of the mountain were richly cultivated, as they are still, the vineyards being of extraordinary fertility. Pompeian wine jars are frequently marked with the name *Vesuvinum* (*vinum*). (The wine is now known as *Lacrima Christi.*) On the barren summit lay a wide flat depression, walled by rugged rock festooned with wild vines. The present crater-wall of Monte Somma is doubtless a relic of that time. It was in this lofty rock-girt hollow that the gladiator Spartacus was besieged by the praetor Claudius Pulcher (73 B.C.): he escaped by twisting ropes of vine branches and descending through unguarded fissures in the crater-rim. A painting discovered when excavating in Pompeii in 1879 represents Vesuvius before the eruption (*Notizie degli scavi,* 1880, pl. vii.).

After centuries of quiescence the volcanic energy began again to manifest itself in a succession of earthquakes, which spread alarm through Campania. For some sixteen years after 63 these convulsions did much damage to the surrounding towns. On Aug. 24, 79, the earthquakes, which had been growing more violent, culminated in a tremendous explosion of Vesuvius. A contemporary account of this event has been preserved in two letters of the younger Pliny (Epist. vi. 16, 20) to the historian Tacitus. He was staying at Misenum with his uncle, the elder Pliny, who was in command of the fleet. The latter set out on the afternoon of the 24th to attempt to rescue people at Herculaneum, but came too late, and went to Stabiae, where he spent the night, and died the following morning, suffocated by the poisonous fumes. Three towns are known to have been destroyed—Herculaneum at the western base of the volcano, Pompeii on the south-east side, and Stabiae, which was situated farther south on the site of the modern Castellamare.

For nearly fifteen hundred years after the catastrophe of 79 Vesuvius remained in a condition of less activity. Occasional eruptions are mentioned, in A.D. 202, 472, 512, 685, 993, 1036, 1049, 1139. At length, after a series of earthquakes lasting for six months and gradually increasing in violence, the volcano burst into renewed paroxysmal activity on Dec. 16, 1631. Though the inhabitants had been warned by the earlier convulsions of the mountain, so swiftly did destruction come upon them that 18,000 are said to have lost their lives.

Since this great convulsion, which emptied the crater, Vesuvius has never again relapsed into a condition of total quiescence. At intervals, varying from a few weeks or months to a few years, it has broken out into eruption, sometimes emitting only steam, dust and scoriae, but frequently also streams of lava. The years 1766–67, 1779, 1794, 1822, 1872, 1906 and 1929 were marked by special activity. The extensive eruption of 1906 completely altered the conformation and aspect of the cone, considerably reducing its height.

The modern cone of the mountain has been built up by successive discharges of lava and fragmentary materials round a vent of eruption, which lies a little south of the centre of the prehistoric crater. The southern segment of the ancient cone, answering to the semicircular wall of Somma on the north side, has been almost concealed, but is still traceable among the younger accumulations. The numerous deep ravines which indented the sides of the prehistoric volcano, and still form a marked feature on the outer slopes of Somma, have on the south side served as channels to guide the currents of lava from the younger cone. On one of the ridges between these radiating valleys an observatory for watching the progress of the volcano was established by the Neapolitan government (1844), and is now a national institution. A continuous record of each phase in the volcanic changes has been taken, and some progress has been made in the study of the phenomena of Vesuvius, and in prognosticating the occurrence and probable intensity of eruptions. The foot of the cone is reached from Naples by electric railway, and thence a wire-rope railway (opened in 1880) carries visitors to within 150 yd. of the mouth of the crater.

See John Phillips, *Vesuvius* (1869); *Pompei e la Regione Sotterrata dal Vesuvio nell' Anno 79* (Naples, 1879); L. Palmieri, *Il Vesuvio e la sua Storia* (Milan, 1880); H. J. Johnstone-Lavis, "The Geology of Monte Somma and Vesuvius" (1884), in *Quart. Journ. Geol. Soc.* vol. xl. p. 85; J. L. Lobley, *Mount Vesuvius* (London, 1889); F. Furchheim, *Bibliografia del Vesuvio* (Naples, 1897); T. McK. Hughes, "Herculaneum," in *Proc. Camb. Antiq. Soc.* No. xlviii. p. 25 (Cambridge, 1908); A. Lacroix, *Étude minéralogique des produits silicatés de l'éruption du Vésuve 1906* (1907); K. Burkhalter, *Aus dem Reiche des Vesuves* (Steffisburg, 1908); F. Zambonini, *Mineralogia Vesuviana* (Naples, 1910); F. A. Perrett, *The Vesuvius Eruption of 1906* (Washington, 1924). (A. GEI.; T. A.)

VETCH, the English name for *Vicia* spp., also known as tares, a leguminous annual with trailing or climbing stems, compound leaves with five or more pairs of leaflets, reddish-purple, bluish-white, white and yellow flowers borne singly, in multiples and in racemes in the leaf-axis and the pods containing from two to ten smooth usually vari-coloured seeds. The wild form, sometimes regarded as a distinct species of *V. angustifolia,* is common in dry soils. There are two races of the cultivated vetch, winter and spring; the former, a hardy form, resistant to cold, has smoother, more cylindrical pods with smaller seeds than the spring varieties. The name vetch is applied to other species of the genus *Vicia*. *Vicia ervilia,* bitter vetch, and *V. sylvatica,* wood vetch, are British plants. Another British plant, *Hippocrepis,* is known as horseshoe vetch owing to the breaking of the pod into several horseshoe-shaped joints. *Anthyllis vulneraria* is kidneyvetch, a herb with heads of usually yellow flowers, found on dry banks. *Astragalus,* another genus of Leguminosae, is known as milkvetch; species of *Coronilla* are known as crownvetch. Vetches are a valuable forage crop indigenous to Great Britain and other parts of Europe. They are adapted to a wide range of soil conditions, and are generally used in combination with grass and clover, beginning with the first cutting of the latter in May, taking the winter vetches in June, recurring to the Italian rye grass or clover as the second cutting is ready, and afterwards bringing the spring vetches into use. Each crop of vetch can thus be utilized when in its best condition for cattle food. In the U.S., vetches are most extensively grown in the Pacific coast area in Washington, Oregon and California, and in the Great Lakes area in Washington, Indiana, Ohio and New York. In the latter region hairy vetch (*V. villosa*) is used almost exclusively, while in the former region common vetch (*V. sativa*) is more frequently planted. Hairy vetch is chiefly grown for green manure and seed crop. Common vetch, while widely grown as a soil improving crop, is used in western Oregon and Washington for hay, seed, silage, pasture and green feed. In general the cultural practices with vetches are similar to those in European countries with the exception that most seedings of common

vetch or spring vetch are made in the fall. Winter killing seldom occurs. Like other legumes, vetches require the presence of certain symbiotic bacteria for their successful development; in planting vetch on lands for the first time such bacteria must be supplied by artificial inoculation. Besides hairy and common vetch, several other species are grown to a limited extent, as Hungarian (*V. pannonica*) and purple vetch (*V. atropurpurea*) in the Pacific states and monantha (*V. monantha*) in the gulf states.

In the 20th century, demands for vetch seed, particularly hairy, expanded materially in the southern states, primarily for cover crop and green manure purposes. Domestic production in the Pacific northwest states has supplied most of the seed, with the tonnage reaching a high of 40,000,000 lb. a year. Previous to domestic U.S. production, heavy imports occurred from central and north Europe. Common and Hungarian vetch have also been used extensively in the south. Purple vetch is used mostly in California for green manure. Vetches have long been esteemed as a supplementary green food for summer feeding but have been extensively cultivated also for the purposes of ensilage. Although a certain proportion of the vetch acreage must be cultivated for seed production, the crop is not commonly grown for its grain, but is generally cut in the flowering or early-seeding stage for the purposes first mentioned. Sometimes, however, vetches are grown in association with rye for early spring grazing—though earliness of growth in spring is not one of the special features of the vetch plant. Grown in association with oats they form a useful mixture for silage, hay or green fodder.

There are two types of the common vetch (*Vicia sativa*), viz., the winter and summer sorts. The botanical distinctions between the two varieties are not very pronounced, and in practice greater reliance must be placed on the parentage of the seed than on its name. When winter vetches are required, it is important to obtain seed from a crop that had been sown in the autumn. Vetches are adapted to a wide range of soils, but yield the greatest bulk of forage on land of the heavier and more moist class. The crop is usually grown without yard manure, but where this is available the vetch can make good use of it. In the absence of dung, a complete mixture of artificial manures should be given where the soil is in poor physical condition and low in fertility.

Even when intended for seed production, vetches are commonly grown in association with another crop that will afford mechanical support. For ensilage, typical mixtures for autumn sowing are 2 bu. of tares and ½ bu. of rye per acre; and 2 bu. of tares, ½ bu. of beans and ½ bu. of winter oats. These are for light and heavy land respectively. On rich land, however, lighter seedings of tares are required to avoid lodging, the difference being made up by increased quantities of beans and oats. The vetches grown in Great Britain are put to a variety of uses. About 15% of the area is cut for hay, about 60% is cut for green fodder or silage, and about 25% is harvested ripe for the seed. A certain amount of green fodder and hay is sold to horse and cow owners in towns, but this trade declined sharply with the reduction in the number of horses and of town dairies, and is now small. Of the seed, only about 5,000 tons per annum are placed on the market, 70% of the produce being used for seed purposes or for feeding to stock on farms. That sold is usually bought for poultry and pigeon mixtures. (H. A. SCH.)

VETERANS' ADMINISTRATION. The Veterans' administration is an independent establishment of the United States government, created by executive order No. 5398, dated July 21, 1930, issued under authority of an act approved July 3, 1930 (46 Stat.L. 1016). The president, by this order, transferred to the Veterans' administration the duties and personnel of the bureau of pensions, the national home for disabled volunteer soldiers and the United States Veterans' bureau. By executive order No. 5476 of Nov. 4, 1930, effective Dec. 1, 1930, there were transferred from the war department to the Veterans' administration the duties and personnel pertaining to the furnishing of trusses and artificial limbs to former members of the military and naval services.

This was the major step in concentrating the administration of veterans' benefits, as such, in one agency. The first step in that direction of major importance was the establishment of the former Veterans' bureau. The United States Veterans' bureau was established on Aug. 9, 1921, by Public No. 47, 67th congress. Previous to that date, compensation and insurance had been administered by the former bureau of war risk insurance in the treasury department; medical and hospital services had been administered by the United States public health service, also in the treasury department, but an entirely distinct organization having functions other than the care of disabled veterans; rehabilitation had been administered by the Federal Board for Vocational Education, an independent bureau which had been charged with fostering vocational education in public schools throughout the United States and also the rehabilitation of persons disabled in industry.

The Veterans' administration, under the administrator of veterans' affairs, maintains a central office in Washington, D.C., and more than 100 field stations including hospitals, regional offices and soldiers' homes. Claims for all benefits for veterans and their dependents administered by the Veterans' administration are subject to appeal to the Board of Veterans' Appeals in Washington, D.C.

Early History.—The system of benefits for veterans of the United States is said to have been originally based upon the precedents and experiences of the English and American colonial governments. The first national soldiers' relief measure in England was enacted in the parliamentary session of 1592–93 (35 Elizabeth, Ch. 4.). The preamble of this act recited "that such as have since the 25th day of March, 1588, adventured their lives and lost their limbs or disabled their bodies, or shall hereafter adventure their lives, lose their limbs, or disable their bodies, in defense and service of Her Majesty and the State, should at their return be relieved and rewarded to the end that they may reap the fruit of their good deservings, and others may be encouraged to perform the like endeavours."

The English colonies in America, following the custom of the mother country, introduced pension systems for disabled veterans almost at the beginning of the colonization. The pilgrims at Plymouth as early as 1636 enacted a law that any man who should be sent forth as a soldier and returned maimed should be maintained competently by the colony during life.

At the outbreak of the Revolutionary War, action was taken by several of the colonies. The first national law was passed on Aug. 26, 1776, promising half pay for life in case of loss of limb or disability sufficient to interfere with earning a living. The basic purpose of this law was to encourage enlistments in the Revolutionary army and to prevent desertions and resignations from the army at critical times. The Continental congress, however, had no funds, so the law was in effect a recommendation to the states. The first United States congress enacted a law (1 Stat. at L., 95, approved Sept. 29, 1789) which provided that "the military pensions which have been granted and paid by the states respectively . . . shall be continued and paid by the United States, ..."

Principal Benefits for Veterans and Their Dependents.—The nature and extent of the benefits granted to veterans and their dependents are changed by law from time to time. Early in the history of the United States, they included land grants, homestead privileges, domiciliary care and pensions, but the benefits subsequent to World War I are chiefly of four kinds, namely: (1) Monetary benefits such as compensation and pensions for disabled veterans and for dependents of deceased veterans; retirement pay for disabled officers; and insurance; (2) medical treatment, hospital and domiciliary care for discharged veterans; (3) burial and funeral expenses; and (4) vocational rehabilitation and other federal aid for readjustment in civilian life (Publics No. 16 and 346, 78th congress).

Compensation or Pension.—Compensation is a term used to describe monetary benefits payable on account of service connected death or disability resulting from service in World War I. Corresponding benefits payable on account of service other than in World War I are termed "pensions." The latter term is also used to describe (1) monetary benefits for age, or for disability not related to service, including such disability benefits payable to veterans of World War I; and (2) monetary benefits to dependents of such deceased veterans.

With the outbreak of World War I the Allied governments found themselves confronted with an antiquated system of pensions and all of them had to devise a new program of relief. Soon after the entry of the United States into World War I, members of congress and public-spirited citizens who had made a study of workmen's compensation legislation and the subject of veterans' relief met in conference for the purpose of devising a system of governmental relief of proper proportions which would reflect an intelligent appreciation of the problem, in keeping with the modern attitude and current conditions.

The plan finally agreed upon and enacted into law provided that payments of compensation should be based upon the reduction in earning capacity resulting from the service disability, ratings to be based as far as practicable upon the average reduction in earning capacity resulting from such injuries in civil occupations, and not upon the impairment of earning capacity in each individual case, so that there would be no reduction in the rate of compensation for individual success in overcoming the handicap of a permanent injury.

A pension is also payable to veterans of all prior wars or of the regular establishment for service disabilities, the rates being fixed by law. Veterans of all wars who served for a specified period may also receive a pension without regard to the service origin of their disabilities if the conditions of entitlement set forth in the law are met.

Similar basic principles are applicable in awarding compensation or pension to specified dependents of deceased veterans.

The total amount paid to veterans and the dependents of veterans as compensation or pension from the founding of the United States to Dec. 31, 1943, was $15,664,828,887.30.

Emergency Officers' Retirement Pay.—On May 24, 1928, a law was enacted which provided, among other things, that all persons who have served as officers of the army, navy or marine corps of the United States during World War I, other than as officers of the regular army, navy or marine corps, who during such service incurred disability in line of duty, and who, within a specified period, were rated at not less than 30% permanently disabled for such disability should, upon application, be placed upon a retired list at 75% of the pay to which the applicant was entitled at the time of discharge from commissioned service, with certain exceptions. Application had to be filed within one year from date of enactment of the act. Subsequent amendments to the basic law included, among other changes, authority to extend this benefit to honourably discharged men who served during World War I as provisional, probationary or temporary officers of the military or naval forces or of the coast guard, and extended the time for filing claim in combat disability cases.

Reserve officers called to active duty and officers appointed in the army of the United States during World War II, meeting the requirements of the army regulations pertaining to retirement of officers of the regular establishment are retired by the war department, certified by the war department to the Veterans' administration, and their retired pay equal to 75% of their base pay is paid by the Veterans' administration, out of the pension appropriation.

Insurance.—The same principle underlying the granting of war risk insurance in World War I governed the granting of National Service Life insurance, namely, restoring the insurability of persons in service while exposed to the extra hazard of military and naval service, thereby affording them the opportunity, voluntarily, to secure greater protection for their dependents in the event of death than is provided under existing compensation and pension laws.

Application for this insurance may be made by any man or woman in the active service of the army, navy, marine corps or coast guard. Such persons may apply for not less than $1,000 and not more than $10,000 insurance which is payable, in case of death of the insured, to the beneficiary or beneficiaries of record or to the beneficiary or beneficiaries entitled under the law.

Gratuitous insurance is provided in those cases in which the person in service died or became totally disabled, or was captured or isolated by the enemy prior to April 20, 1942, and had less than $5,000 of insurance in effect. In such cases the law provides that government insurance to an aggregate of $5,000 shall be deemed to be granted.

Insurance Protection under the Soldiers' and Sailors' Civil Relief Act.—Any person in the active service during World War II having a commercial life insurance policy or policies meeting the requirements of the applicable law, upon application, may secure for the period of military service and for two years after separation from service, protection against lapse for the nonpayment of premiums on an amount not to exceed $10,000. Insurance premiums and interest thereon are guaranteed by the United States but if the amount so guaranteed is not paid to the insurer by the insured prior to the expiration of the period of protection, the amount then due will be treated by the insurer as a policy loan and if at the expiration of the period of protection the cash value is less than the amount then due, the policy will terminate and the United States will pay to the insurer the difference between such amount and the cash surrender value. The amount paid to the insurer by the United States will become a debt due to the United States by the insured. Premiums are guaranteed at the annual rate due on the policy and interest is at the rate provided by the policy for policy loans.

Medical and Hospital Treatment and Domiciliary Care.—In considering the general scope of veterans' legislation, it is the opinion of those persons experienced in veterans' problems that the greatest benefit afforded to veterans is that of hospitalization in modern scientific hospitals where the highest type of medical care is afforded. Hospitalization and domiciliary care are extended to veterans of all wars, priority being given to those suffering with disabilities of service origin. The same benefits are also available to veterans of the regular establishment if discharged for a disability incurred in line of duty, or if in receipt of a pension for a service disability. A veteran may also receive outpatient treatment for a service connected condition at a facility or regional office; or he may be treated therefor in his home if he is unable to travel.

Burial and Funeral Expenses.—Within the limitations of the applicable law, the Veterans' administration will assume the actual cost (not to exceed $100) of burial, funeral and transportation of the body of a veteran to the place of burial. When the death occurs in a Veterans' administration facility within the continental limits of the United States, payments are authorized for the actual cost (not to exceed $100) of burial and funeral and for the transportation of the body to the place of burial within the continental limits of the United States. A United States flag is furnished for the purpose of draping the casket of a veteran of any war or a person discharged from the United States army, navy, marine corps or coast guard who served one enlistment or for disability incurred in line of duty. After the burial, the flag is presented to the next of kin. If a flag is not furnished for the funeral, it may be issued to the nearest relative of a person who died in service in World War II.

Rehabilitation of War-Disabled Veterans.—Rehabilitation comprehends restoring a disabled person to his best possible mental and physical condition, and aiding him in preparing for and securing employment. In addition to the facilities for providing hospitalization, domiciliary care and medical treatment for disabled veterans there was enacted on March 24, 1943, a law designated Public No. 16, 78th congress, which authorized the administrator of veterans' affairs to provide vocational rehabilitation training to any person who served at any time during World War II, who (1) was discharged from service under conditions other than dishonourable; (2) has a disability incurred in or aggravated by such service for which pension is payable, or would be but for the receipt of retirement pay; and (3) is in need of vocational rehabilitation to overcome the handicap of such disability.

The law stipulates that no course of training shall extend beyond four years and provides for the maintenance and support of the individual veteran through increased pension during his training period, with additional allowances for specified dependents. The Veterans' administration is authorized to defray the entire expense of all training arrangements made.

Servicemen's Readjustment Act of 1944.—This law, popularly called the "G. I. Bill of Rights," provides federal aid for readjustment in civilian life for returning World War II veterans. It makes veterans' benefits available in general to any veteran of World War II discharged under conditions other than dishonourable after service of 90 days or more, or discharged by reason of an injury or disability incurred in line of duty.

Educational aid for a one-year course is available to every eligible veteran, without regard to his age when he entered service. A veteran is entitled to education or training beyond one year upon satisfactory completion of the first year, provided his education was interrupted by entrance into service. If he was not over 25 years of age when he entered service, interruption of education is presumed. Education or training must be pursued in an approved educational or training institution, must begin not later than two years after discharge or the end of the war (whichever is later), and the additional course beyond one year may not exceed the length of time in active service after Sept. 16, 1940 and before the end of the war, not including time spent in any one of the three service academies, or in a course in the Army Specialized Training program or Navy College Training program, which course was a continuation of a civilian course and which was pursued to completion. No course of education may exceed four years. The Veterans' administration will pay to the school tuition fees, not exceeding $500 per school year, and to the veteran a subsistence allowance of $50 per month if he has no dependents, or $75 per month if there are dependents. Application may be made to any approved educational or training institution or to any office of the Veterans' administration.

The Veterans' administration is not empowered to make loans to World War II veterans but is authorized to guarantee, under certain conditions, a loan or loans for the purchase of homes, farms or business property, repairs, additions, stock, machinery, equipment, etc. The aggregate amount which may be guaranteed shall not exceed $2,000. The government will pay the interest for the first year on the amount guaranteed. Application may be made to a bank or other financial institution, or information may be secured through any office of the Veterans' administration.

If a veteran of World War II is unemployed within two years after discharge or the termination of the war, whichever is later, he may be entitled to a readjustment allowance of $20 per week, while unemployed, under conditions specified by the law. This allowance may not be paid for more than 52 weeks of unemployment. An adjusted amount is paid during partial unemployment. A veteran who is self-employed for profit is eligible for a readjustment allowance if his net earnings are less than $100 for the previous calendar month,

the amount of the allowance being the difference between his net earnings and $100.

Full information may be secured from the Veterans' administration, any office of the United States Employment service, or any State Unemployment Compensation agency.

Aid in securing employment for veterans is implemented by the establishment of a Veterans' Placement Service board consisting of the administrator of Veterans' Affairs, the director of the Selective Service system, and the administrator in charge of the United States Employment service. This board shall determine all matters of policy relating to the administration of the Veterans' Employment service.

(F. T. Hi.)

VETERANS OF FOREIGN WARS. The Veterans of Foreign Wars of the United States, chartered by act of congress, in 1936, is a nonpartisan, nonsectarian, nonprofit organization composed exclusively of campaign medal service veterans of the army, navy, marine corps and coast guard.

The origin of the organization is traced to three national societies of overseas veterans formed in 1899; the American Veterans of Foreign Service, Columbus, O.; the Colorado Society of the Army in the Philippines, Denver, Colo.; the American Veterans of Foreign Service, Altoona, Pa. These organizations were merged in 1913 to become a single association known as the Veterans of Foreign Wars of the United States. The organization is unique among veteran societies because its existence is not limited by the lives of veterans of one particular war or campaign. With eligibility based on campaign medal service, it is destined to exist as long as Americans in military service are called upon to leave the continental limits of the United States in time of war.

The aims and activities of the organization, crystallized in the phrase "To honor the dead by helping the living," are constantly keyed to these threefold objectives: (1) The welfare of disabled veterans and their dependents; (2) care of the widows and orphans of veterans; (3) preservation of the basic principles of Americanism as expressed in the Bill of Rights.

To promulgate the first two of these purposes the organization advocates the fundamental principle that the federal government is primarily responsible for the welfare of the nation's veterans and their dependents. To promote the preservation of Americanism principles, the organization strives to contribute to the national welfare in every way that will impress the average American with his citizenship responsibilities as well as his privileges. This work is accomplished through various channels which include youth activities, observance of patriotic anniversaries, instruction in American history and traditions for noncitizens, community service, etc.

A minimum of 25 overseas veterans is required before charters are granted to local chapters known as "Posts." Since 1913, these units have been formed in communities throughout the United States, Alaska, Hawaii and the Canal Zone.

As of Jan. 1, 1944, approximately 3,600 "Posts" were functioning actively. Delegates representing the individual "Posts" compose the voting strength of the annual National Encampment when the policies for the ensuing year are adopted and officers are elected.

The national headquarters, in Kansas City, Mo., directs the functions of the National Service bureau and the National Legislative office, in Washington, D.C., and the rehabilitation experts who are employed by the national organization to administer the Service and Welfare program of the organization in all of the 48 states.

Important phases of the veteran welfare objectives deal with rehabilitation, employment, hospitalization, pension and compensation. To further assist widows and orphans, the organization maintains the V.F.W. National Home, Eaton Rapids, Mich., (founded in 1925) where dependents in this category are provided with food, shelter, clothing and education without cost.

(B. Y.)

VETERINARY SCIENCE, the branch of knowledge that deals with the anatomy of domesticated animals, their physiology and racial characteristics, their breeding, feeding and hygienic management; the pathology and treatment of their diseases and injuries; the improvement of stock; their relations to man with regard to inter-communicable maladies and to his use of their flesh and products. Here the subject is considered in relation to medicine; other aspects are treated under special headings. (*See* Horse, Dog, etc.; Anthrax, Canine Distemper, Glanders, etc.; Slaughter-House and Abattoir; and the comparative anatomy sections of separate anatomical articles.)

History.—The veterinary art in its modern development dates from the establishment of the veterinary school of Lyons in 1761. Schools were established in London in 1791; Edinburgh, 1823; Glasgow, 1863; Dublin, 1900; and Liverpool 1904 (transfer of a second Edinburgh school founded in 1873).

The profession was first organized in Great Britain by the foundation in 1844 of the Royal College of Veterinary Surgeons. This body regulates the examinations of students who must be trained in an affiliated veterinary college, appoints examiners, and admits as members of the college all who pass the qualifying examinations. There is thus only one portal into the veterinary profession. The Royal college keeps the statutory register of veterinary surgeons, has power to remove the names of members convicted of misdemeanours or of conduct disgraceful in a professional respect, and to prosecute unregistered persons who use a title stating that they are specially qualified to practise (Veterinary Surgeons act, 1881). The recognized course of instruction covers a period of four years after the passing of an approved examination in general education, and leads to the diploma of M.R.C.V.S. Possession of this diploma is essential for commissioned rank in the royal army veterinary corps and for appointment as government veterinary officers in Great Britain and in the dominions.

The Royal college also grants the postgraduate diploma of fellow, after presentation of a thesis of sufficient merit and the passing of a special examination. The college diploma in veterinary state medicine is awarded after nine months' postgraduate study in epizootiology, veterinary bacteriology, and protozoology, veterinary hygiene and toxicology, chemistry, meat inspection, dairy and milk inspection, administration and reporting. The universities of London, Edinburgh and Liverpool grant degrees in veterinary science (bachelor, master and doctor); the course is usually taken with that for the qualifying diploma but occupies five years. The degree in itself does not confer a licence to practise or entitle to registration. Liverpool university grants a postgraduate diploma in veterinary hygiene, and Manchester university a diploma in veterinary state medicine.

The veterinarian is in Great Britain legally debarred from treating certain diseases, *e.g.*, pleuro-pneumonia of cattle, rinderpest, glanders, epizootic lymphangitis, sheep-pox, rabies and foot and mouth disease. The Diseases of Animals acts, 1894–1925, and the orders made thereunder provide for notification of the above-named diseases.

The orders also provide for the notification of anthrax, parasitic mange of horses, sheep-scab, swine fever and certain forms of tuberculosis. Diagnosis of suspected disease by veterinary inspectors is followed by segregation, and destruction of diseased and in-contact animals where necessary with suitable compensation. Many markets and farms, and all ports, are systematically inspected and all importation of animals controlled. The ministry of agriculture and fisheries has a staff of veterinary inspectors for this work and for the investigation of other animal diseases.

Local authorities in Great Britain and Ireland employ veterinary officers, either whole-time or part-time, for meat and milk inspection and to carry out the statutory duties of the authority for the eradication of contagious disease.

Research institutes have been established in London, Cambridge, Edinburgh, Weybridge and elsewhere, for the investigation of animal diseases and for the preparation of vaccines and sera for their prevention or treatment. Similar institutes have been created in many of the dominions and colonies.

In the United States courses leading to the degree of Doctor of Veterinary Science require three years and in the best colleges four years, the requirements for admission being a high-school education or its equivalent. Most of the state universities have veterinary colleges in connection with their schools of agriculture and some of them give a six-year combined course leading to degrees in both agriculture and veterinary medicine. The American Veterinary Medical association holds a place comparable to that of the Royal College of Veterinary Surgeons in Great Britain and exercises an influence on the setting of standards in the profession. Practitioners must be graduates of an acceptable school to gain admission. Besides the demand for private practice in rural localities, especially in connection with the growing dairy industry, the bureau of animal industries, U.S. Dept. of Agri., employs

about a thousand veterinarians as meat inspectors, quarantine agents, and in extension work. The Veterinary Corps is a division of the Medical Department of the Army. Veterinary graduates are also in demand as State Veterinarians, as teachers and government research workers.

DISEASES OF DOMESTICATED ANIMALS

Reference is made here only to some of the more important disorders other than those described in separate articles which treat of ACTINOMYCOSIS, ANTHRAX, ABORTION, CANINE DISTEMPER, FOOT-AND-MOUTH DISEASE, GLANDERS, PLEURO-PNEUMONIA, HYDROPHOBIA, RINDERPEST, SWINE FEVER. In treatment of animal patients the main object is to place them in those conditions which allow nature to operate most freely in restoring health. Fresh air, cleanliness, quiet and comfort, should be secured as far as possible.

The Horse.—*Epizootic Lymphangitis* is a chronic contagious disease, characterized by inflammation of the superficial lymphatic vessels and regional lymphatic glands. Nodular swellings appear which soften and discharge a creamy pus, with formation of ulcers. The eruptions usually appear on the limbs but may occur elsewhere, and are caused by the cryptococcus of Rivolta. Inoculation probably occurs through a wound, and lesions slowly appear. Affected animals are destroyed; they do not react to mallein, and the disease is thus distinguished from glanders.

Strangles is an acute contagious disease in which there is inflammation of the mucous membrane of the upper air passages and suppuration of lymphatic glands, usually the submaxillary, but other glands may be involved. An organism, *streptococcus equi,* is always present in the nasal discharge and in the abscess cavities, and is the probable cause, but a filterable virus has been suggested as the primary causative factor. Formerly common amongst young horses, it is becoming a rare disease under modern conditions. There is fever, catarrh, diminished appetite, languor and sore-throat; the suppurating glands become swollen and painful, and then soften and discharge pus. Recovery usually follows and immunity is acquired. Irregular or atypical forms of the disease occur, and are more dangerous. Infection takes place by inhalation and ingestion and also by inoculation or wound infection, with involvement of the associated lymph glands so that any part of the body may be affected. Widespread abscess formation is sometimes seen, due to pyaemic infection of the blood stream.

Horse-pox (*variola equina*), a rare and benign disease, spreads like cowpox, by contact, and may be transmitted to man. Lesions appear on the skin, in the hollows of the heels, on the back of the limbs, and on mucous membranes, mouth, nose, etc. Isolation, with strict cleanliness, for three weeks is advisable.

Cattle.—*Black-quarter* or *Blackleg* is a specific infection of young cattle, the causal organism being *B. chauveii.* Large crepitant swellings develop in the quarter or other parts; there is high fever, with lameness, and later, marked depression, and death occurs within two days. Immunity can, however, be conferred by vaccination with blackleg aggressin, and the disease can thus be controlled.

Mammitis, or *Garget,* of which there are acute and chronic forms, is due to a streptococcus transmitted usually in the process of milking. In acute cases the udder becomes swollen, hot and painful; in others the course is gradual, with little constitutional disturbance, the incubation period lasting for months. The milk may be scarcely altered or greatly changed and offensive. Tuberculous mastitis is of great importance and is usually chronic. Prevention depends on immediate isolation of affected animals, careful inspection, and cleanliness in housing and milking.

Milk Fever.—An intoxication associated with lactation most frequently met with in recently calved high-grade cows, but the goat, sow, bitch, mare and ewe are also susceptible. Symptoms vary widely, but usually involve the nervous system, causing excitement, spasms, paralysis, coma, and there is often marked disturbance of respiration, circulation and digestion. By inflation of the udder with filtered air or oxygen, as introduced by Schmidt of Kolding, Denmark, the mortality in this once fatal disease has been brought very low. Goats, ewes and mares respond to this treatment equally well.

Jöhne's Disease.—A chronic specific enteritis of cattle, caused by the growth in the intestinal mucous membrane and mesenteric glands of a bacillus discovered by Jöhne. It produces thickening of the bowel and interferes with food absorption; there is diarrhoea and extreme wasting. The course is long, sometimes years, and in such cases the animals are "carriers." Infection is by food contaminated with infected excreta. Early diagnosis is difficult. Suspected animals should be slaughtered; no treatment is effectual in severe cases. Some animals improve, put on weight, and again relapse. Isolation is important.

Cowpox (*variola vaccinia*), is a mild, contagious, eruptive disease of the udder and teats; the eruption at its height, when not altered by attempts at milking, shows a depressed centre, a raised silvery edge, containing lymph, and outside this a pink areola. It is transmissible to man, and affords protection against smallpox. (*See* VACCINATION.) In cows it requires little treatment.

Sheep-pox (*variola ovina*) is the most serious of all the variola of animals. It is highly infectious, and benign and malignant forms are met with. It occurs in France and southern and eastern European countries, but not in America or Australia. It is unlikely to appear in Great Britain. The virus is ultra-visible, and very resistant.

Foot-rot, a specific infectious disease of the feet in sheep, is said to be caused by the bacillus of necrosis, but this is probably a secondary invader. It is a soil disease, rare in hilly or light lands, but common on deep soils. Lameness may be severe, tissue changes marked, and the hoofs deformed. Arsenical footbaths are useful for mass treatment. Infected animals should not be introduced to sound flocks.

Tuberculosis.—An inoculable and infectious disease caused by the bacillus of Koch, of which there are three types, human, bovine and avian. No domestic animal is completely immune, but cattle, pigs and poultry are chiefly affected. In cattle, grape-like masses form in the chest and abdominal cavity, the lymphatic glands become enlarged and caseous, and diseased centres appear in the substance of the organs. The symptoms vary greatly according to the organs attacked. Cattle in apparent health may on post-mortem show extensive invasion. The tuberculin test is efficient in proving the existence of infection, but not its degree, and emaciated, heavily-affected animals may fail to react. Congenital tuberculosis is rare, post-natal infection being the rule. This fact induced Bang to advocate isolation of reactors, with pasteurization of milk, for eliminating tuberculosis from herds. Calmette has introduced a live vaccine (B.C.G.) so modified that although it confers immunity from natural infection it is not pathogenic for animals or men. "Open tuberculosis" is a term applied to advanced cases of the disease affecting the lungs, bowels, womb, and udder, or otherwise discharging bacilli and therefore dangerous, and by the Tuberculosis Order all such cases must be notified. In pigs the glands of the throat and the bones are often diseased, and in the latter case the meat is condemned. The bovine bacillus, found in meat and particularly in milk, is the cause of considerable disease, especially in children.

Poultry Diseases.—The diseases here mentioned are all highly contagious and fatal. In all cases segregation, and rigid disinfection of runs, incubators and fittings are essential.

Bacillary White Diarrhoea is the most important disease of fowls in this country, and responsible for more losses than all other diseases combined. It runs an acute course in chicks and a chronic course in adults. Chicks which survive an outbreak may become "carriers," and on reaching maturity produce eggs containing the causal agent, *B. pullorum.* The disease is mainly introduced by infected eggs, day-old chicks, or adult "carrier" fowls. "Carriers" can be detected by the agglutination test.

Coccidiosis, next in importance, is caused by the protozoan *Eimeria avium,* and attacks chicks from two to eight weeks old. The mortality varies from 20 to 90%, depending on their age.

Fowl Pox, a contagious disease due to a filter-passing virus, is characterized by eruptive lesions on the skin or its appendages, by diphtheritic membranes in the mouth, or by an oculo-nasal dis-

charge. There may be present only one of these lesions, or a combination of them, in the same bird.

Fowl Typhoid, enzootic in Wales and the bordering counties, and the cause of heavy annual losses, is a contagious septicaemia, the symptoms being pallidity of comb and a characteristic greenish yellow diarrhoea. The incubation period is about six days and death may occur within 16 days.

Gapes, due to worms in the wind-pipe causing the bird to gasp for breath, affects mainly young chicks. Gape-worm eggs passed in the bird's faeces contain larvae after ten days' time, and may hatch; infestation is caused by swallowing free larvae or eggs containing larvae. Prevention is by isolation. Turkeys frequently carry the parasite, and should not run with chickens.

Fowl Cholera, very rare in Great Britain, is caused by *B. avisepticus.* It is characterized by profuse diarrhoea and is highly fatal. The intestinal mucous membrane usually shows acute inflammation and small haemorrhages are frequently present in the heart.

Fowl Plague, due to a filter-passing virus, has an incubation period of 24 to 48 hours; treatment is useless.

Parasitology.—The small intestines of colts are frequently infested with *Ascaris equorum,* producing malnutrition and anaemia, but the large intestine is the great worm reservoir for the horse. Here the *strongyles* are found, of which both larvae and adults induce disease. The former taken in with the food, penetrate the mucous membrane, reach certain tissues and blood vessels and finally return to the bowel. *Sclerostoma tetracantha* has a similar cycle except that it does not enter the blood vessels or distant tissues. Its symptoms are emaciation, foetid diarrhoea and weakness. The egg-laying females of *Oxyuris curvula* pass from the bowel to the anal region and produce pruritus. The *bot-fly* passes its larval stage in the stomach and when the larvae are numerous may cause disease. In sheep and cattle the common fluke *Distoma hepatica* infests the liver, causing the highly fatal "liver rot." Small *stomach strongyles* produce serious effects in young cattle and lambs, with inflammation and diarrhoea, followed by death from exhaustion. In cattle, sheep and pigs small *thread-worms* induce bronchitis, husk, and pneumonia. None of these parasites multiplies inside the host; eggs and larvae pass to the exterior in the droppings or sputum, undergo certain changes, and return with the food. *Tapeworms* infest the domestic animals, particularly dogs and lambs. The larval *Hydatids,* or bladder worms, are found in various organs, brain, liver, muscles, etc., causing giddiness and paralysis. Pigs are frequently infested with *Ascaris lumbricoides,* which may cause obstruction when numerous, and may wander into the bile ducts and induce fatal jaundice. External parasites cause disease of the skin, *e.g.,* mange, scab and ring-worm in all domestic animals. Ticks and various flies are responsible for transmitting diseases due to blood parasites, *e.g.,* redwater in cattle (England), Texas fever, equine biliary fever, jaundice in dogs, surra in horses and camels, heartwater in ruminants (South Africa). Much advance has recently been made in the treatment of these diseases by organic compounds of arsenic, antimony, etc.

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(F. BU.; F. T. H.)

VETO, generally the right of preventing any act, or its actual prohibition; in public law, the constitutional right of the competent authority, or in republics of the whole people in their primary assembly, to protest against a legislative or administrative act, and to prevent wholly or temporarily, its validation or execution. *See* CONSTITUTION AND CONSTITUTIONAL LAW.

VETTER, a lake of south Sweden, 80 m. long and 18 m. in extreme breadth, 733 sq.m. in area, 390 ft. maximum depth, and an elevation above sea-level of 289 ft. It drains by the Motala river to the Baltic. Its waters are remarkably transparent and blue, its shores picturesque and steep on the east side, where the Omberg (863 ft.) rises abruptly, with furrowed flanks pierced by caves. The lake is subject to sudden storms. Its northern part is crossed from Karlsborg to Motala by the Göta canal route. At the southern end is the important manufacturing town of Jönköping, and 15 m. N. of it the picturesque island of Vising. Vadstena, 8 m. S. of Motala, with a staple industry in lace, has a convent (now a hospital) of St. Bridget (1383), a beautiful monastic church (1395–1424) and a castle of King Gustavus Vasa. At Alvastra, 16 m. S., are ruins of a Cistercian monastery (11th century).

VETULONIA, an ancient town of Etruria, Italy. It lies 1,130 ft. above sea-level, about 10 m. directly N.W. of Grosseto, on the north-east side of the hills which project from the flat Maremma and form the promontory of Castiglione. In Etruscan times there was a bay here. Silius Italicus tells us that it was hence that the Romans took their magisterial insignia (fasces, curule chair, purple toga and brazen trumpets), and it was undoubtedly one of the twelve cities of Etruria. There are remains of the acropolis walls of massive limestone, in almost horizontal course, and also of houses and a street of the Roman period.

The earliest tombs found belong to the Villanovan period (First Benacci to late Second Benacci stage). Next come transitional tombs (in some of which hut-urns are found) surrounded by a ring of stones, and a few graves which are very early Etruscan: and then a group of important palaeo-Etruscan tombs (850–700 B.C.), most of them circle graves, in which objects of very great value and interest have been found. The objects found are in the museum at Florence.

See Randall MacIver, *Villanovans and Early Etruscans* (1924).

VEVEY, a small town in the Swiss canton of Vaud, near the eastern extremity of the Lake of Geneva. Population (1941) 12,613, of whom most were French-speaking (9,634 in 1930) and Protestant.

Vevey was a Roman settlement (*Viviscus*) and later formed part of the barony of Vaud, that was held by the counts and dukes of Savoy till 1536, when it was conquered by Bern. In 1798 it was freed from Bernese rule and became part of the canton du Léman (renamed canton de Vaud in 1803) of the Helvetic Republic. Vevey is 12 mi. by rail S.E. of Lausanne, and is well served by steamers plying over the Lake of Geneva. It is the second town in point of population in the canton. It stands at the mouth of the Veveyse, and commands fine views of the mountains. The whole of the surrounding country is covered with vineyards. Every twenty years or so the *Fête des Vignerons* is held here by an ancient gild of vinedressers.

VEXILLUM, the name for a small ensign consisting of a square cloth suspended from a cross-piece fixed to a spear [Lat. dim. of *velum,* piece of cloth, sail, awning, or from *vehere, vectum,* to carry]. The *vexillum* was strictly the ensign of the maniple, as *signum* was of the cohort, but the term came to be used for all standards or ensigns other than the eagle (*aquila*) of the legion (*see* FLAG). Caesar (*B.G.* ii. 20) uses the phrase *vexillum proponere* of the red flag hoisted over the general's tent as a signal for the march or battle. The standard-bearer of the maniple was styled *vexillarius,* but by the time of the Empire *vexillum* and *vexillarius* had gained a new significance. Tacitus uses these terms frequently both of a body of soldiers serving apart from the legion under a separate standard and also with the addition of some word implying connection with a legion of those soldiers who, after serving 16 years with the legion, continued their serv-

ice, under their own *vexillum*, with the legion (*see* also COLOURS, MILITARY). The term is also used for the scarf wrapped round a bishop's pastoral staff (*see* CROZIER). Modern science has adopted the word for the web or vane of a feather of a bird and of the large upper petal of flowers, such as the pea.

VÉZELAY, a village of France, in the department of Yonne, 10 mi. W.S.W. of Avallon by road. Its population, which was over 10,000 in the middle ages, was 439 in 1936. The history of Vézelay is bound up with its Benedictine abbey, which was founded in the 9th century under the influence of the abbey of Cluny. The acquisition of the relics of St. Magdalen, soon after its foundation, began to attract crowds of pilgrims, whose presence enriched both the monks and the town which had grown up round the abbey and acknowledged its supremacy. In the 12th century the exactions of the abbot Artaud and the refusal of the monks to grant political independence to the citizens resulted in an insurrection in which the abbey was burned and the abbot murdered. During the 12th century Vézelay was the scene of the preaching of the second crusade in 1146 and of the assumption of the cross in 1190 by Richard Coeur de Lion and Philip Augustus. The influence of the abbey began to diminish in 1280. Vézelay stands on a hill on the left bank of the Cure and still preserves most of its ancient ramparts, notably the Porte Neuve, consisting of two massive towers flanking a gateway. The church of La Madeleine dates from the 12th century and was restored by Viollet-le-Duc.

VIANDEN, an ancient town in the grand duchy of Luxembourg, on the banks of the Our, close to the Prussian frontier. Pop. (1935) 1,195. It possesses one of the oldest charters in Europe, granted early in the 14th century by Philip, count of Vianden, who was the ancestor of William of Orange. The original name of Vianden was Viennensis or Vienna. The ruins of the castle stand on an eminence of the little town. Its size and importance in its prime may be gauged from the fact that the Knights' hall could accommodate 500 men-at-arms.

VIAREGGIO, a maritime town and sea-bathing resort of Tuscany, Italy, in the province of Lucca, on the Mediterranean, 13 mi. N.W. of Pisa by rail, 7 ft. above sea level. Pop. (1936) 30,384 (town), 35,594 (commune). Being sheltered by dense pine-woods on the north, it is frequented as a winter resort, and in summer by some thousands for its sea-bathing. In 1740 the population was only 300, and in 1841, 6,549. The body of Shelley was burned on the shore near Viareggio after his death by drowning in 1822. At Varignano near Viareggio is a large oil refinery.

VIATICUM, a Latin word meaning "provision for a journey" (Gr. τὰ ἐφόδια), is used by early Christian writers to denote anything that gave spiritual comfort to the dying. Ultimately it came to be restricted to the last communion given to the dying. In extreme cases the viaticum may be given to persons not fasting, and the same person may receive it frequently if his illness be prolonged. The ritual administration is that prescribed for the communion of the sick, except in the formula "Accipe, frater (soror), viaticum corporis Domini nostri Jesu Christi, qui te custodiat ab hoste maligno, et perducat in vitam aeternam. Amen." The viaticum is given before extreme unction, a reversal of the mediaeval practice due to the importance of receiving the Eucharist while the mind is still clear.

VIBORG, a town of Denmark, capital of the *amt* (county) of its name, in the district of Jutland, on Viborg lake. Pop. (1940) 18,445. The most notable building is the cathedral (1130–69, restored 1864–76). It has paintings by Joachim Skovgaard. The Black Friars' church is of the 13th century, and the museum has specimens of the stone, bronze and iron ages. The industries embrace distilleries, iron foundries and manufactures of cloth.

VIBORG, Finland: *see* VIIPURI.

VIBO VALENTIA, a city of Calabria, Italy, province of Catanzaro, on an eminence gently sloping to the Gulf of S. Eufemia, 1,575 ft. above sea level, 70 mi. N.N.E. of Reggio di Calabria by rail. Pop. (1931) 10,650 (town); 15,651 (commune). Destroyed by earthquake in 1783, under the French occupation it was rebuilt and made capital of a province. It suffered in the earthquake of 1905. The castle was built by Frederick II. The principal church contains sculptures by the Gagini of Palermo.

The city is the ancient Hipponium, first mentioned in 388 B.C., when its inhabitants were removed to Syracuse by Dionysius. Restored by the Carthaginians (379), occupied by the Bruttii (356), held by Agathocles of Syracuse (294), Hipponium ultimately became, as Vibo Valentia, a flourishing Roman colony, where a branch from Scolacium (Squillace) on the east coast road joined the Via Popilia. A harbour was made by Agathocles at Bivona on the coast. In the modern town there are some Roman remains. The town walls of the Greek city can be traced for their whole extent, about 4 mi. They are well constructed of regular blocks of stone. They belong to the end of the 5th century B.C. and are the finest monument of Greek military architecture in Calabria. Important remains of them have been brought to light, and traces of four temples. The Roman town occupied only part of the Greek site; the streets of the modern town still preserve the Roman arrangement. (T. A.)

VIBURNUM, a genus of handsome shrubs (rarely small trees) of the honeysuckle family (Caprifoliaceae, *q.v.*), comprising about 120 species, found in temperate and subtropical regions, especially in eastern Asia and North America, many of which are planted for ornament. They are usually upright, rather large shrubs with opposite, simple, medium-sized leaves and numerous flowers, mostly in large umbel-like clusters, the marginal flowers sometimes enlarged and sterile. The fruit is a drupe, often highly coloured, with a single, usually flattened stone. Two species are found in Great Britain: *V. lantana* (wayfaring-tree), found widely also in Europe and Asia, and naturalized in the eastern United States; and *V. opulus* (cranberry tree), indigenous to Europe and Asia. The common snowball of the gardens is a floral variant of the latter. (*See* GUELDER ROSE.) In the United States and Canada some 15 species occur, several of which are widely distributed. Four species attain the size of small trees: *V. lentago* (nanny-berry), *V. prunifolium* (black haw), *V. rufidulum* (Southern black haw) and *V. obovatum* (small viburnum). Well-known shrubby species are *V. trilobum* (high cranberry), *V. alnifolium* (hobblebush), *V. dentatum* (arrow-wood), and *V. acerifolium* (dockmackie). Besides the foregoing many other species are cultivated for their ornament, and several American species yield medicines. One of the finest cultivated sorts is *V. carlesi* of Korea, grown in America both outdoors and forced in the greenhouse by florists for winter bloom.

VICAR, a title, more especially ecclesiastical, describing various officials acting in some special way for a superior. Cicero uses *vicarius* to describe an under-slave kept by another slave as part of his private property. The *vicarius* was an important official in the reorganized empire of Diocletian. It remained as a title of secular officials in the middle ages, being applied to persons appointed by the Roman emperor to judge cases in distant parts of the empire or to wield power in certain districts or, in the absence of the emperor, over all the empire. In the early middle ages the term was applied to representatives of a count administering justice for him in the country or small towns and dealing with unimportant cases, levying taxes, etc. Monasteries and religious houses often employed a vicar to answer to their feudal lords for those of their lands which did not pass into mortmain.

The title of "vicar of Jesus Christ," borne by the popes, was introduced as their special designation during the 8th century, in place of the older style of "vicar of St. Peter" (or *vicarius principis apostolorum*).

All bishops were looked upon as in some sort vicars of the pope, but the title *vicarius sedis apostolicae* came especially to be applied as an alternative to *legatus sedis apostolicae* to describe papal legates to whom in certain places the pope delegated a portion of his authority. Pope Benedict XIV tells us in his treatise *De synodo dioecesana* that the pope often names vicars-apostolic for the government of a particular diocese because the episcopal see is vacant or, being filled, the titular bishop cannot fulfil his functions. The Roman Catholic Church in England was governed by vicars-apostolic from 1685 until 1850, when Pope Pius IX re-established the hierarchy. Vicars-apostolic at the present day are nearly always titular bishops taking their titles from places not

acknowledging allegiance to the Roman Catholic Church.

Sometimes the pope appointed a neighbouring bishop as the vicar of a church which happened to be without a pastor. A special vicar was appointed by the pope to superintend the spiritual affairs of Rome and its suburbs, to visit its churches, monasteries, etc., and to correct abuses. It became early a custom for the prebendaries and canons of a cathedral to employ "priest-vicars" or "vicars-choral" as their substitutes when it was their turn as hebdomadary to sing High Mass and conduct divine office. In the English Church these priest-vicars remain in the cathedrals of the old foundations as beneficed clergy on the foundation; in the cathedrals of the new foundation they are paid by the chapters. "Lay vicars" also were and are employed to sing those parts of the office which can be sung by laymen. The incumbent of a parish where the tithes are impropriate is entitled vicar.

In the Anglican Church a vicar-general is employed by the archbishop of Canterbury and some other bishops to assist in such matters as ecclesiastical visitations. In the Roman Catholic Church bishops sometimes appoint lesser vicars to exercise a more limited authority over a limited district. They are called "vicars-forane" or rural deans. They are entrusted especially with the surveillance of the parish priests and other priests of their districts, and with matters of ecclesiastical discipline. They are charged especially with the care of sick priests and in case of death with the celebration of their funerals and the charge of their vacant parishes. In canon law priests doing work in place of the parish priest are called vicars. Thus in France the *curé* or head priest in a parish church is assisted by several *vicaires*.

See Du Cange, *Glossarium mediae et infiniae Latinitatis,* ed. L. Favre (Niort, 1883, etc.); Migne, *Encyclopédie théologique,* series i. vol. 10 (Droit Canon); Comte de Mas Latrie, *Trésor de chronologie* (Paris, 1889); and Sir R. J. Phillimore, *Ecclesiastical Law of the Church of England* (2nd ed. 1895).

VICENTE, GIL (*c.* 1465–1536?), sometimes called the Portuguese Shakespeare, was born in the latter part of the reign of King Alphonso V. The first half of his life is vague. He was of humble birth and almost certainly spent his boyhood in some mountain village of the north of Portugal. He was perhaps apprenticed later to his father or uncle, Martim Vicente, goldsmith of Guimarães, and first came to the court at Evora, with many other provincials, on the occasion of the marriage of King João II.'s young son and heir to a daughter of the Catholic king in 1490. His work as goldsmith attracted the attention of Queen Lianor, and after the death of her son in 1491, and her husband four years later and the accession of her brother Manuel, Vicente retained her favour. It was at her request that he contributed (in 1509) a few verses to a poetical contest printed in the *Cancioneiro Geral* (1516). On the evening of June 7, 1502, the day after the birth of King Manuel's heir, the future João III., Vicente with a few others, dressed as herdsmen, entered the queen's chamber and recited a rustic monologue of 114 lines in Spanish. This primitive *Auto da Visitaçam* pleased Queen Lianor, and for the following Christmas Vicente had ready a longer but equally simple *Auto Pastoril Castelhano.*

For the next 34 years he was a kind of poet laureate, accompanying the court from Lisbon to Almeirim, Thomar, Coimbra or Evora and staging his plays to celebrate great events and the solemn occasions of Christmas, Easter and Maundy Thursday. The departure of a Portuguese fleet on the expedition against Azamor in 1513 turned his attention to more national themes, and in the *Exhortação da Guerra* (1513) and *Auto da Fama* (1515), inspired by the splendid victories of Albuquerque in the East, he wrote fervent patriotic verse which still stirs the hearts of his countrymen. Vicente's first wife, Branca Bezerra, may have died at about this time, and it seems that he was a widower when in 1514 he produced the charming *Comedia do Viuvo.*

His career as goldsmith kept pace with his growing success as dramatist. In 1509 he was appointed overseer of works in gold and silver at Thomar and elsewhere; in 1512 he was elected to the Lisbon Guild of Goldsmiths, and in Oct. 1513 he became one of their four representatives on the Lisbon town council. On Feb. 4 of this year he was appointed master of the Lisbon mint, a post which he resigned on Aug. 6, 1517, in favour of Diogo Rodriguez, whose sister Melicia he married, perhaps in the same year. After the death of King Manuel in 1521 and of Queen Lianor four years later, Vicente frequently complains of poverty, but he received various pensions in the new reign; his accomplished daughter Paula won the favour of Princess Maria (1521–77); and he enjoyed the personal friendship of King João III.

On the occasion of the departure by sea of King Manuel's daughter Beatriz to wed the duke of Savoy in Aug. 1521, Vicente's *Cortes de Jupiter* was acted in a large room "adorned with tapestry of gold," a fact chronicled by his friend, the poet Resende. The *Fragoa de Amor* (1524) was also written for a court occasion, the betrothal of King João III. to the sister of the Emperor Charles V. In the *Auto Pastoril Portugues* (1523), the farce *O Juiz da Beira* (1525), the *Tragi-comedia da Serra da Estrella* (1527) and the satirical *O Clerigo da Beira* (1529–30) he returned to the people, to the peasants and shepherds of the Beira mountain country which he knew so intimately.

He devoted himself more and more to the stage and multiplied himself in answer to the critics of Sá de Miranda's school. In 1526 came the *Templo de Apolo,* followed in rapid succession by the biblical play *Sumario da Historia de Deus,* the *Nao de Amores,* the *Divisa da Cidade de Coimbra,* and the *Farsa dos Almocreves.* These last three plays, with the *Serra da Estrella,* were all produced before the court in 1527 at Lisbon and Coimbra. On the other hand the *Auto da Festa* appears to have been acted in a private house at Evora. The elaborate *Auto da Feira* (1528), with its living popular types, contains some exceedingly caustic satire against Rome (personified on the stage): "You remit the sins of the whole world and forget to shrive yourself." It must be remembered that this was not a question of religion but of national politics: the relations of the devout João III. with the Vatican were often as troubled as those of his equally pious and even more regalist nephew Philip II. of Spain.

Vicente was now over 60, but he retained his vigour and versatility. The brilliant scenes of two of his last plays, the *Romagem de Agravados* (1533) and the *Floresta de Enganos* (1536), are loosely put together, and may well be earlier work; but the lyrical power of the *Triunfo do Inverno* (1529) and the long, compact *Amadis de Gaula* (1532) prove that his hand had lost none of its cunning and that his mind remained alert and young. The *Auto da Mofina Mendes* (1534), partly a religious allegory, partly a version of "Pierrette et son pot au lait," shows his old lightness of touch and penetrating charm. The *Auto da Lusitania,* which was acted in the presence of the court in 1532, may with some plausibility be identified with the *Caça de Segredos* at which Vicente tells us he was at work in 1525. It was the last of his plays to be staged at Lisbon in his lifetime; in Lent of 1534, by request of the abbess of the neighbouring convent of Odivelas, he produced there his religious *Auto da Cananea,* but the remainder of his plays were acted before the king and court at Evora; and it was probably at Evora that Vicente died in the year of his last play (1536).

Vicente's 44 plays admirably reflect the tragi-comedy of his age of change and upheaval in all its splendour and its squalor. Eleven are written exclusively in Spanish, 14 in Portuguese; the rest are bilingual; scraps of church or medical or law Latin, of French and Italian, of the dialect or slang of peasants, gipsies, sailors, fairies and devils frequently occur. His drama may be divided into religious plays, foreshadowing the Calderon *autos,* court plays, pastoral plays, popular farces and romantic comedy. They were often elaborately staged: a ship was rowed on the scene, or a tower opened to display some splendid allegory; here too he forestalled the later Spanish drama.

The various plays of the years 1513–19, composed when he was about 50, show Vicente at the height of his genius. He possessed a genuine comic vein, an incomparable lyric gift, and the power of seizing touches of life or literature and transforming them into something new by the magic of his phrase and his satiric force, under which lay a strong moral and patriotic purpose.

A far-sighted patriot and imperialist, and intensely national, he was also a devout son of the church; but he belonged to the more

outspoken days before the Reformation, and his satire of priests and of the abuses of Rome was frank and merciless; so that when in 1531 one of his plays, the *Jubileu de Amores* (which some critics would identify with the *Auto da Feira*) was acted at Brussels, the papal nuncio, Cardinal Aleandro, who was present, felt "as if I were in mid-Saxony listening to Luther or in the horrors of the sack of Rome." As a lyric poet Vicente is first seen at his best in the wonderful poems of the *Auto da Sibila Cassandra* (1513?) in Spanish. This poet, who goes to the very heart of the Portuguese people, can as a lyric poet occasionally rival and even excel Camões, who, as Prof. W. P. Ker remarked, is "less of a miracle than Vicente" and owed more to the Renaissance. Vicente was over 50 when Sá de Miranda brought the new forms and metres from Italy; in their rivalry Vicente remained faithful to the indigenous octosyllabic verse. He had to meet growing criticism, and, in answer to the taunts of pedants, borrowed from Gomez Manrique the proverb, "Better an ass that carries me than a horse that throws me," and, building on it the *Farsa de Ines Pereira,* turned the tables on the "men of good learning."

It is Vicente's originality that he is an artist of the Renaissance untainted by its pedantry. He is at once the most imitative and the most original of poets; we continually find him working up his borrowed material, like gold in the hands of an artist of genius, into concrete figures; and his rapidly sketched portraits of peasant, priest and courtier will last as long as literature. Even in his rudest plays, and when the execution is at its roughest, his bold plastic genius makes itself felt. His plays are rich in folklore, and in his love of all that was popular and indigenous he seized on the essential and eternal elements of art. His knowledge of the French language was small, the influence of France came to him through Spain, and his *Barcas* were inspired by the Spanish version of the Dance of Death. The Spanish influence is always strong in this most national poet; he even quotes from the Book of Job, not direct but through Garci Sanchez de Badajoz. He had studied very carefully the work of the early Spanish playwrights Gomez Manrique and Encina, although he soon surpassed them. No other country produced so inspired a dramatic poet before the second half of the 16th century. Actor, stage-manager and author, Vicente was also goldsmith and musician; he wrote the settings for some of his own lyrics, delightful popular *romances* and *cossantes* interspersed in his plays, which often end and open with a song, and are sometimes, as in the *Auto da Alma,* one long lyric.

Vicente is no exception to the general rule that Portuguese literature is mainly lyrical, in prose and verse; but in his many-sidedness he delineated life in its various aspects with the skill of a master, and he is the true forerunner of writers so different as Molière, Lope de Vega, Calderon and Shakespeare.

BIBLIOGRAPHY.—The only collected editions of Vicente's plays, a few of which were printed separately in his lifetime (seven of these were placed on the Portuguese Index of 1551), are the folios of Lisbon (1562 and 1586); the 3 vols. of Hamburg (1834) and Lisbon (1852); and the modern edition by Dr. Mendes dos Remedios (3 vols., Coimbra, 1907–14). The critical edition of the 1562 text prepared by Mme. Michaëlis de Vasconcellos immediately before her death has not yet seen the light. The only English translations are A. F. G. Bell, *Lyrics of Gil Vicente* (1914; 3rd ed. 1921) and *Four Plays of Gil Vicente* (1920). *See* E. Prestage, "The Portuguese Drama in the 16th Century; Gil Vicente," in the *Manchester Quarterly* (July and Oct. 1897); M. Menéndez y Pelayo, *Antología de Poetas Líricos,* vol. vii.; T. Braga, *Gil Vicente e as origens do theatro nacional* (Porto, 1898); J. I. de Brito Rebello, *Gil Vicente* (1902 and 1912); C. Michaëlis de Vasconcellos, *Notas Vicentinas,* 4 vols. (Coimbra, 1912–22); A. Braamcamp Freire, *Vida e Obras de Gil Vicente* (Porto, 1919); and A. F. G. Bell, *Gil Vicente* (1921). For a fuller bibliography see *Four Plays of Gil Vicente* (1920). A new Vicente play, the *Auto da Festa,* was published from his library in 1906 by the Conde de Sabugosa. (A. B.)

VICENZA (anc. *Vicetia*), a town and episcopal see of Venetia, Italy, capital of the province of Vicenza, 42 m. W. of Venice by rail, 131 ft. above sea-level. Pop. (1901) 32,200 (town); 47,558 (commune); (1936) 48,279 (town), 69,379 (commune). It lies at the northern base of the Monti Berici, on both sides of the Bacchiglione, at its confluence with the Retrone. It was surrounded by 13th century walls, now mostly demolished. The town has many fine buildings by Andrea Palladio (*q.v.*). The best is the basilica, one of the finest works of the Renaissance, of which Palladio himself said that it might stand comparison with any similar work of antiquity, replacing the exterior of the Palazzo della Ragione, a Gothic building (1444–1477), which the colonnades of the basilica entirely enclose. Begun in 1549, it was finished in 1614. Close by is the Torre di Piazza (12th–15th cent.) 270 ft. high, and here are also the Loggia del Capitanio, by Palladio (1571) and the long Lombardesque Monte di Pietà (16th cent.). He also designed many of the fine palaces which give Vicenza its individuality; only two, the Porto Barbaran and Chiericati palaces (the latter containing the picture gallery), have two orders of architecture, the rest having a heavy rustica basis with only one order above it. Many palaces attributed to him are really the work of Scamozzi (the architect of the fine Palazzo del Municipio, 1588) and others of his successors. The famous Teatro Olimpico begun by him, but finished in 1583, is a remarkable attempt to construct a theatre in the ancient style, and the stage, with the representation of streets ascending at the back, is curious. The Italian Gothic cathedral (mainly 13th cent.), consists of a nave with eight chapels on each side, and a very high Renaissance domed choir. The churches of S. Lorenzo (1280–1344) and S. Corona (1260–1300), both of brick, are better examples of Gothic; both contain interesting works of art—the latter a very fine "Baptism of Christ," by Giovanni Bellini. The church of SS. Felice e Fortunato was restored in 975, but has been much altered, and was transformed in 1613. The portal is of 1154, and the Lombardesque square brick tower of 1166. Under it lies a mosaic pavement with the names of the donors, belonging to the original church of the Lombard period (?). Of the Palladian villas in the neighbourhood, La Rotonda, 1½ m. S.E., is a square building with Ionic colonnades and a central dome which has been more than once copied in England and France. Near by is the Villa Valmarana, with fine frescoes by G. B. Tiepolo (1737), and the new Piazzale della Vittoria, behind which is the baroque church of Monte Berico, with good works of art, from which porticoes lead down to the tower. Vicenza also has palaces in the Venetian Gothic style.

The ancient *Vicetia* was of less importance than Verona and Patavium. It was for some time during the middle ages an independent republic, but was subdued by the Venetians in 1405. Towards the end of the 15th century it became the seat of a school of painting strongly influenced by Mantegna, of which the principal representatives were Bartolomeo Montagna, its founder, his son Benedetto Montagna, more important as an engraver, Giovanni Speranza and Giovanni Buonconsiglio. Andrea Palladio (1518–1580) was a native of Vicenza, as was also a contemporary, Vincenzo Scamozzi (1552–1616), who was largely dependent on him, but is better known for his work on architecture (*Architettura universale,* 1615). Palladio inaugurated a school of followers who continued to erect similar buildings in Vicenza even down to the French Revolution. Other natives of Vicenza were Giangiorgio Trissino (1478–1553) (*see* ITALIAN LITERATURE; PALLADIO), Antonio Pigafetta (1491–1534) and Antonio Fogazzaro (1842–1911) (*q.v.*). (T. A.)

See G. Pettina, *Vicenza* (Bergamo, 1905).

VICKERS LIMITED. This is one of the greatest companies engaged in the trades of shipbuilding, engineering, manufacture of armaments (including aircraft) and production of steel.

The business was originated in 1828 when Edward Vickers and his father-in-law, George Naylor, went into partnership and started crucible steel rolling mills at Millsands in Sheffield and Wadsley under the style of Naylor, Vickers and Company. By 1863 the heavy business of the firm had developed to such an extent that the old establishment at Millsands had to be abandoned and the River Don works at Sheffield were constructed. These works are now known as "Vickers Works" and are owned by English Steel Corporation Limited, of which company mention is made below. On April 17, 1867 the partnership was converted into a limited company under the title of Vickers Sons & Co. Limited. In 1897 the company acquired the shipbuilding yard and engineering works of the Naval Construction and Armaments Co. Limited at Barrow-in-Furness and the Maxim Nordenfelt Guns and Ammuni-

tion Co. Limited. In that year the name of the company was changed to Vickers Sons & Maxim Limited.

The name was again changed in 1911 to the present title of Vickers Limited. In 1919 Vickers acquired control of the rolling stock manufacturers, Metropolitan Carriage Wagon and Finance Co. Limited, and in 1929 the latter company took over the railway carriage business of Cammell Laird & Co., Limited. The capital of the Metropolitan Co. (now known as Metropolitan-Cammell Carriage & Wagon Co. Limited) was held in 1939 jointly by Vickers Limited and Cammell Laird & Co. Limited. In 1928 Vickers and Sir W. G. Armstrong Whitworth & Co. Limited amalgamated their armament, main shipbuilding, steel and certain commercial interests and transferred these interests to a new company formed for that purpose and called Vickers-Armstrongs Limited. Vickers owned in 1939 the whole of the share capital of the last-named company. In 1929 Vickers, Vickers-Armstrongs and Cammell Laird decided to concentrate their steel interests and formed English Steel Corporation Limited.

Vickers-Armstrongs held in 1939 the controlling interests in this company.

From £155,000 in 1867 the issued capital of Vickers Limited had in 1926 reached £20,679,290 and in that year was written down to £12,468,968 by reducing each £1 share to 6/8d. In 1936, however, part of the reduction was restored by writing up the nominal value of the ordinary stock units to the 1939 figure of 10/– each.

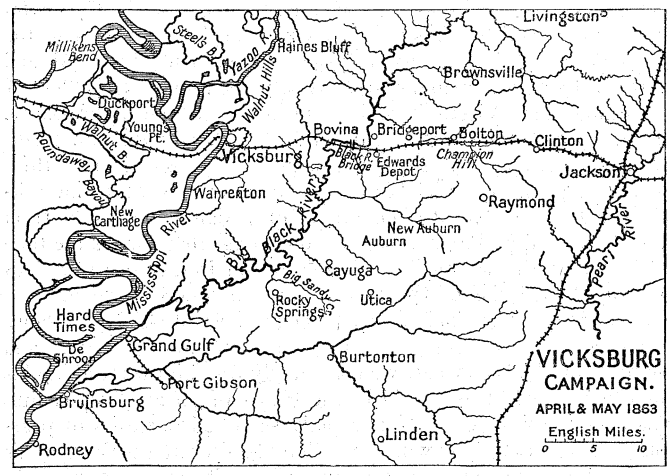
(L. C. M.; X.)

VICKSBURG, a city of western Mississippi, U.S.A., on the Mississippi river, at the mouth of the Yazoo, about midway between Memphis and New Orleans; the county seat of Warren county. It is on federal highways 61 and 80 and is served by the Illinois Central system and river steamers and barges. A bridge across the Mississippi at this point carries railway, vehicular and pedestrian traffic. The city is built on a high bluff, rising 350 ft. above sea level. Pop. was 18,072 in 1920 (51% Negroes); 22,943 in 1930; and 24,460 in 1940 by the federal census.

On the landward side the city is completely surrounded by the Vicksburg National Military park (1,443 ac.), and beyond the northern end of the park, fronting on the river, is one of the largest and most beautiful of the national cemeteries, containing 16,653 graves of Union soldiers, of which 12,912 are marked "unknown." The park includes the battle lines of the opposed armies during the investment of Vicksburg, May 18 to July 4, 1863 (*see* below), and all the fighting ground between them. About 900 bronze markers tell the story, and three observation towers afford comprehensive panoramas of the field. There are 15 state memorials, scores of statues and busts of Union and Confederate commanders, and on Oct. 13, 1927, a bronze statue of Jefferson Davis (by Henry H. Kitson) was unveiled, and presented by the state of Mississippi to the United States. The U.S. Waterways Experiment station for flood control was built there in 1929. Vicksburg is an important cotton and hardwood lumber market. It has railroad and machine shops, lumber mills, cottonseed oil mills, oil refineries, and factories manufacturing boxes, veneer, hoops, staves, boat oars and work clothing. The factory output in 1937 was valued at $3,913,135. The city has a commission form of government.

Early in the 18th century the French built Ft. St. Peter near the site of Vicksburg, and on Jan. 2, 1730, its garrison was massacred by the Yazoo Indians. In 1790 the Spaniards erected Ft. Nogales, which was taken by U.S. troops in 1798 and renamed McHenry. The first permanent settlement was made about 1814 by the Rev. Newitt Vick (d. 1819), a Methodist preacher, and in accordance with his will a town was laid out in 1824. It was incorporated in 1825 and chartered as a city in 1836.

The Campaign of 1862 to 1863.—Vicksburg is historically famous as being the centre of interest of one of the most important campaigns of the American Civil War. The command of the Mississippi, which would imply the severance of the Confederacy into two halves, and also the reopening of free commercial navigation from St. Louis to the sea, was one of the principal objects of the Western armies of the Union from the time that they began their southward advance from Illinois, Missouri and Kentucky in Feb. 1862. A series of victories in the spring and summer carried them as far as the line Memphis–Corinth, but in the autumn they came to a standstill and were called upon to repulse the counter-advance of the Southern armies. The Federals were accompanied by a flotilla of thinly armoured but powerful gunboats which had been built on the upper Mississippi in the autumn of 1861, and had co-operated with the army at Fort



Donelson, Shiloh and Island No. 10, besides winning a victory on the water at Memphis.

At the same time a squadron of sea-going vessels under Flag-officer Farragut had forced the defences of New Orleans (*q.v.*) and, accompanied by a very small military force, had steamed up the great river. On reaching Vicksburg the heavy vessels again forced their way past the batteries, but they had to deal, no longer with low-sited fortifications, but with inconspicuous earthworks on bluffs far above the river-level, and they failed to make any impression. Farragut then returned to New Orleans. From Helena to Port Hudson the Confederates maintained complete control of the Mississippi, the improvised fortresses of Vicksburg, Port Hudson and Arkansas Post (near the mouth of Arkansas river) being the framework of the defence. It was to be the task of Grant's army around Corinth and the flotilla at Memphis to break up this system of defences, and, by joining hands with Farragut and clearing the whole course of the Mississippi, to cut the Confederacy in half.

The long and painful operations by which this was achieved group themselves into four episodes: (*a*) the Grenada expedition of Grant's force, (*b*) the river column under McClernand and Sherman, (*c*) the operations in the bayoux, and (*d*) the final "overland" campaign from Grand Gulf. The country in which these operations took place divides itself sharply into two zones; the upland east of the Mississippi below Vicksburg and east of the Yazoo above, and the levels west of this line, which are a maze of bayoux, backwaters and side channels, the intervening land being kept dry near the river itself by artificial banks (levees) but elsewhere swampy. At Vicksburg, it is important to observe, the bluffs trend away from the Mississippi to follow the course of the Yazoo, rejoining the great river at Memphis. Thus there are two obvious lines of advance for the Northern army, on the upland (Memphis and Grand Junction on Grenada–Jackson), and downstream through the bayou country (Memphis–Helena–Vicksburg). The main army of the defenders, who were commanded by General Pemberton, between Vicksburg and Jackson and Grenada, could front either north against an advance by Grenada or west along the bluffs above and below Vicksburg.

The first advance was made at the end of Nov. 1862 by two columns from Grand Junction and Memphis on Grenada. The Confederates in the field, greatly outnumbered, fell back without fighting. But Grant's line of supply was one long single-line, ill-equipped railway through Grand Junction to Columbus, and the opposing cavalry under Van Dorn swept round his flank and, by destroying one of his principal magazines (at Holly Springs), without further effort compelled the abandonment of the advance.

Grant then sent Sherman with the flotilla and some 30,000 men to attack Vicksburg from the water-side, while he himself should deal with the Confederate field army on the high ground. But the scheme broke down completely when Van Dorn cut Grant's line of supply, and the Confederate army was free to turn on Sherman. The latter, ignorant of Grant's retreat, attacked the Yazoo bluffs above Vicksburg (battle of Chickasaw Bayou) on Dec. 29; but a large portion of Pemberton's field army had arrived to help the Vicksburg garrison, and the Federals were easily repulsed with a loss of 2,000 men. General McClernand now appeared and took the command out of Sherman's hands, informing him at the same time of Grant's retreat. Sherman thereupon proposed, before attempting fresh operations against Vicksburg, to clear the country behind them by destroying the Confederate garrison at Arkansas Post. This expedition was completely successful: at a cost of about 1,000 men the fort and its 5,000 defenders were captured on Jan. 11, 1863.

Retreating from the upland, Grant sailed down the river and joined McClernand and Sherman at Milliken's Bend at the beginning of February, and assumed command of the three corps (XIII., McClernand; XV., Sherman; XVII., McPherson) available. He had already imagined the daring solution of his most difficult problem which he afterwards put into execution, but for the present he tried a series of less risky expedients to reach the high ground beyond Pemberton's flanks, without, indeed, much confidence in their success, yet desirous in these unhealthy flats of keeping up the spirits of his army by active work, and of avoiding, at a crisis in the fortunes of the war, any appearance of discouragement. Three such attempts were made in all, with the co-operation of the flotilla under Rear Admiral David D. Porter. First, Grant endeavoured to cut a canal across the bend of the Mississippi opposite Vicksburg, hoping thus to isolate the fortress, to gain a water connection with the lower river, and to land an army on the bluffs beyond Pemberton's left flank. This was unsuccessful. Next he tried to make a practicable channel from the Mississippi to the upper Yazoo, and so to turn Pemberton's right, but the Confederates, warned in time, constructed a fort at the point where Grant's advance emerged from the bayoux. Lastly, an advance through a maze of creeks (Steele's Bayou expedition), towards the middle Yazoo and Haines's Bluff, encountered the enemy, not on the bluffs, but in the low-lying woods and islands, and these so harassed and delayed the progress of the expedition that Grant recalled it. Shortly afterwards Grant determined on the manoeuvre in rear of Vicksburg which established his reputation. The troops marched overland from Milliken's Bend to Hard Times, and on April 16 and 22 Porter's gunboats and the transports ran past the Vicksburg batteries. All this, which involved careful arrangement and hard work, was done by April 24. General Banks, with a Union army from New Orleans, was now advancing up the river to invest Port Hudson, and by way of diverting attention from the Mississippi, a cavalry brigade under Benjamin Grierson rode from La Grange to Baton Rouge (600 mi. in 16 days), destroying railways and magazines and cutting the telegraph wires *en route*. Sherman's XV corps, too, made vigorous demonstrations at Haines's Bluff, and in the confusion and uncertainty Pemberton was at a loss.

Foiled at Grand Gulf on April 29, on the 30th McClernand and the XIII corps crossed the Mississippi 6 mi. below Grand Gulf, followed by McPherson. The nearest Confederate brigades, attempting to oppose the advance at Port Gibson, were driven back. Grant had now deliberately placed himself in the middle of the enemy at the risk of being unable to obtain further supplies for his forces, since the river route between Milliken's Bend and Hard Times, curving around the enemy's flank, was exposed to the shore batteries. But his resolute purpose outweighed all textbook strategy. Having crossed the Mississippi, he collected wheeled transport for five days' rations, and on Sherman's arrival cut loose from his base altogether (May 7). Free to move, he aimed north from the Big Black river, so as to interpose between the Confederate forces at Vicksburg and those at Jackson. A fight took place at Raymond on May 12, and Jackson was captured just in time to forestall the arrival of reinforcements for Pemberton under General Joseph E. Johnston. The latter, being in supreme command of the Confederates, ordered Pemberton to come out of Vicksburg and attack Grant. But Pemberton did not do so until it was too late. On May 16 Grant, with all his forces well in hand, defeated him in the battle of Champion Hill with a loss of nearly 2,500 men, and sharply pursuing him drove him into Vicksburg. By May 18 Vicksburg and Pemberton's army in it was invested by land and water. Grant promptly assaulted his works, but was repulsed with loss (May 19); the assault was repeated on May 22 with the same result, and Grant found himself compelled to resort to a blockade. Reinforcements were hurried up from all quarters. Johnston's force (east of Jackson) was held off by a covering corps under Blair (afterwards under Sherman), and though another unsuccessful assault was made on June 25, resistance was almost at an end. On July 4, the day after, far away in Pennsylvania, the great battle of Gettysburg had closed with Lee's defeat, the garrison of Vicksburg, 29,000 strong, surrendered.

See J. H. Wilson, "A Staff Officer's Journal of the Vicksburg Campaign," *Mil. Serv. Inst. Journ.*, vol. xliii., p. 93–109, 261–275 (1908); and W. L. Livermore, "The Vicksburg Campaign," *Mil. Hist. Soc. of Mass.*, vol. ix., p. 538–571 (Boston, 1912). For a personal side light, *see* U. S. Grant, "Letter to his Father on the Capture of Vicksburg, 1863," *Amer. Hist. Rev.*, vol. xii., p. 109 (Lancaster, Pa. 1906).

VICO, GIOVANNI BATTISTA (1668–1744), Italian jurist and philosopher, was born at Naples on June 23, 1668, and in 1697 became professor of rhetoric at the university there. Meanwhile he had acted as tutor to the nephews of the bishop of Ischia, G. B. Rocca, at the castle of Vatolla, near Cilento, in the province of Salerno. There he passed nine studious years, chiefly devoted to classical reading, Plato and Tacitus being his favourite authors, because "the former described the ideal man, and the latter man as he really is." Two authors exercised a weighty influence on his mind—Francis Bacon and Grotius. He was no follower of their ideas, indeed often opposed to them; but he was stimulated by Bacon to investigate certain great problems of history and philosophy, while Grotius led him to philosophic jurisprudence. In 1708 he published his *De ratione studiorum*, in 1710 *De antiquissima Italorum sapientia*, in 1720 *De universi iuris uno principio et fine uno*, and in 1721 *De constantia iurisprudentis*. He failed to secure the university chair of jurisprudence which he had hoped these works would secure for him. His great work, *Principii d'una scienza nuova* appeared in 1725 (2nd ed. 1730, which is practically a new work). In 1735 Charles III. of Naples made Vico historiographer-royal, with a yearly stipend of 100 ducats. Soon after his mind began to give way, but during frequent intervals of lucidity he made new corrections in his great work, of which a third edition appeared in 1744, prefaced by a letter of dedication to Cardinal Trojano Acquaviva. He died on Jan. 20, 1744, and was buried in the church of the Gerolimini.

Vico is perhaps the greatest name in the Neapolitan tradition of jurisprudence. His aim was the relation of the history of law to that of the human mind, and the problem with which he was faced is stated in its final form in the *Scienza Nuova*. The question is—if the principle of justice be one and immutable, how are the varying codes to be accounted for? His solution is offered in his *Universal Law* (*Diritto universale*).

Law, he held, emanates from the conscience of mankind, and participates in the changes of the human mind. The reasons for its changes, therefore, must be sought in the general history of human development. The primitive sentiment of justice is unconscious and instinctive, and expresses itself in religious forms of a concrete nature, mankind being at this stage incapable of abstract ideas (*cf.* Vinogradoff, *History of Jurisprudence*). These give place to abstract formula, and these in turn to the direct manifestation of the philosophic principles of law. Thus the history of Roman Law, for instance, can be divided into three parts, the divine, the heroic and the human, corresponding to the three main phases of general Roman history. Thus in the varying aspects of law Vico found the expression of a single fundamental principle.

This theory seems to have originated in his study of Roman law, which Vico saw as a continuous progress from the primitive

law of the XII. Tables to the universal and flexible *jus gentium*. This conception he generalized into a complete philosophy of history. The history of humanity he sees as a process of development from "poetic wisdom," the impersonal, religious, instinctive ideas of primitive society to "occult wisdom," which turns divinely implanted ideas into conscious philosophical wisdom. Like most discoverers of a system, however, Vico carried it further than it would go. His *law of cycles*, the "eternal ideal history, invariably followed by all nations," which is the expression of this theory, seeks to reduce the whole course of history to conformity with this threefold succession of phases, divine, heroic and human, which he sees exemplified in government, language, literature, jurisprudence and civilization.

See Vico's autobiography in the *Scienza Nuova*, and Sir J. Ferrari's introduction to his edition of the works of Vico (6 vols., Milan, 1835–37) and the more complete edition, including translation by Pomodoro of the Latin works (Naples, 8 vols., 1858–69). A complete bibliography was prepared by B. Croce, *Bibliographia Vichiana* (Naples, 1904). *See* also Cantoni, *Vico* (Turin, 1867); R. Flint, *Vico* ("Philosophical Classics," 1885); B. Croce, many articles in various Italian reviews and *La filosofia di Giambattista Vico* (Bari, 1911).

VICTOR, the name taken by three popes and two antipopes.

VICTOR I. was bishop of Rome from about 190 to 198. He submitted to the opinion of the episcopate in the various parts of Christendom the divergence between the Easter usage of Rome and that of the bishops of Asia. The bishops, particularly St. Irenaeus of Lyons, declared themselves in favour of the usage of Rome, but refused to associate themselves with the excommunication pronounced by Victor against their Asiatic colleagues.

VICTOR II., the successor of Leo IX., was consecrated in St. Peter's, Rome, on April 13, 1055. His father was a Swabian baron, Count Hartwig von Calw, and his own baptismal name was Gebhard. At the instance of Gebhard, bishop of Regensburg, uncle of the emperor Henry III., he had been appointed while still a young man to the see of Eichstädt; in this position his great talents soon enabled him to render important services to Henry, whose chief adviser he ultimately became. His nomination to the papacy by Henry, at Mainz, in September 1054, was made at the instance of a Roman deputation headed by Hildebrand, whose policy doubtless was to detach from the imperial interest one of its ablest supporters. In June 1055 Victor met the emperor at Florence, and held a council, which anew condemned clerical marriages, simony and the alienation of the estates of the church. In the following year he was summoned to Germany to the side of the emperor, and was with him when he died at Botfeld in the Harz on Oct. 5, 1056. As guardian of Henry's infant son, and adviser of the empress Agnes, Victor now wielded enormous power, which he began to use with much tact for the maintenance of peace throughout the empire and for strengthening the papacy against the aggressions of the barons. He died shortly after his return to Italy, at Arezzo, on July 28, 1057. His successor was Stephen IX. (X.)

VICTOR III. (Dauferius Epifani), pope from May 24, 1086 to Sept. 16, 1087, was the successor of Gregory VII. He was a son of Landolfo V., prince of Benevento, and was born in 1027. After studying in various monasteries he became provost of St. Benedict at Capua, and in 1055 obtained permission from Victor II. to enter the cloister at Monte Cassino, changing his name to Desiderius. He succeeded Stephen IX. as abbot in 1057, and his rule marks the golden age of that celebrated monastery; he promoted literary activity, and established an important school of mosaic. Desiderius was created cardinal priest of Sta. Cecilia by Nicholas II. in 1059, and as papal vicar in south Italy conducted frequent negotiations between the Normans and the pope. Among the four men suggested by Gregory VII. on his deathbed as most worthy to succeed him was Desiderius, who was favoured by the cardinals because of his great learning, his connection with the Normans and his diplomatic ability. The abbot, however, declined the papal crown, and the year 1085 passed without an election. The cardinals at length proclaimed him pope against his will on May 24, 1086, but he was driven from Rome by imperialists before his consecration was complete, and, laying aside the papal insignia at Terracina, he retired to his beloved monastery. As vicar of the Holy See he convened a synod at Capua on March 7, 1087, resumed the papal insignia on the 21st of March, and received tardy consecration at Rome on the 9th of May. Owing to the presence of the antipope, Clement III. (Guibert of Ravenna), who had powerful partisans, his stay at Rome was brief. He sent an army to Tunis, which defeated the Saracens and compelled the sultan to pay tribute to the papal see. In August 1087 he held a synod at Benevento, which renewed the excommunication of Guibert; banned Archbishop Hugo of Lyons and Abbot Richard of Marseilles as schismatics; and confirmed the prohibition of lay investiture. Falling ill at the synod, Vicar returned to Monte Cassino, where he died on Sept. 16, 1087. His successor was Urban II.

Victor III., while abbot of Monte Cassino contributed personally to the literary activity of the monastery. He wrote *Dialogi de miraculis S. Benedicti*, which, along with his *Epistolae*, are in J. P. Migne, *Patrol. Lat.* vol. 149, and an account of the miracles of Leo IX. (in *Acta Sanctorum*, 19th of April). The chief sources for his life are the "Chronica monasterii Casinensis," in the *Mon. Germ. hist. Script.* vii., and the Vitae in J. P. Migne, *Patrol. Lat.* vol. 149, and in J. M. Watterich, *Pontif. Roman. Vitae* (1862).

See J. Langen, *Geschichte der römischen Kirche von Gregor VII. bis Innocenz III.* (Bonn, 1893); F. Gregorovius, *Rome in the Middle Ages*, vol. 4, trans. by Mrs. G. W. Hamilton (London, 1900–02); K. J. von Hefele, *Conciliengeschichte* (2nd ed., 1873–90), vol. 5; Hirsch, "Desiderius von Monte Cassino als Papst Victor III.," in *Forschungen zur deutschen Geschichte*, vol. 7 (Göttingen, 1867); H. H. Milman, *History of Latin Christianity*, vol. 3 (repub., 1899).

VICTOR IV. was a title taken by two antipopes. (1) Gregorio Conti, cardinal priest of Santi Dodici Apostoli, was chosen by a party opposed to Innocent II. in succession to the antipope Anacletus II., on March 15, 1138, but through the influence of Bernard of Clairvaux he was induced to make his submission on the 29th of May. (2) Octavian, count of Tusculum and cardinal deacon of St. Nicola in carcere Tulliano, the Ghibelline antipope, was elected at Rome on Sept. 7, 1159, in opposition to Alexander III., and supported by the emperor Frederick Barbarossa. Consecrated at Farfa on the 4th of October, Victor was the first of the series of antipopes supported by Frederick against Alexander III. Though the excommunication of Frederick by Alexander in March 1160 made only a slight impression in Germany, this pope was nevertheless able to gain the support of the rest of western Europe, because since the days of Hildebrand the power of the pope over the church in the various countries had increased so greatly that the kings of France and of England could not view with indifference a revival of such imperial control of the papacy as had been exercised by the emperor Henry III. He died at Lucca on April 20, 1164 and was succeeded by the antipope Paschal III. (1164–1168).

See M. Meyer, *Die Wahl Alexanders III. und Victors IV. 1159* (Göttingen, 1871); and A. Hauck, *Kirchengeschichte Deutschlands* Band iv. (1922). (C. H. H.)

VICTOR, SEXTUS AURELIUS, prefect of Pannonia about 360 (Amm. Marc. xxi. 10), possibly the same as the consul (jointly with Valentinian) in 373 and as the prefect of the city who is mentioned in an inscription of the time of Theodosius. Four small historical works have been ascribed to him on more or less doubtful grounds—(1) *Origo Gentis Romanae*, (2) *De Viribus Illustribus Romae*, (3) *De Caesaribus*, (4) *De Vita et Moribus Imperatorum Romanorum excerpta ex Libris Sex. Aur. Victoris*. The four have generally been published together under the name *Historia Romana*, but the fourth is a *réchauffé* of the third.

The first edition of all four was that of A. Schottus (8vo, Antwerp, 1579). A good modern edition of the *De Caesaribus* is by F. Pichlmayr (Munich, 1892).

VICTOR AMADEUS II. (1666–1732), duke of Savoy and first king of Sardinia, was the son of Duke Charles Emmanuel II. and Jeanne de Savoie-Nemours. Born at Turin, he lost his father in 1675, and spent his youth under the regency of his mother, known as "Madama Reale" (madame royale), an able but ambitious and overbearing woman. He assumed the reigns of government at the age of sixteen, and married Princess Anne, daughter of Philip of Orleans and Henrietta of England, and niece of Louis XIV., king of France. His first sign of independence was his visit to Venice in 1687, where he met Prince Eugène of Savoy

and other personages, without consulting Louis. Louis now tried to precipitate hostilities by demanding his participation in a second expedition against the Waldensians. The duke unwillingly complied, but when the French entered Piedmont and demanded the cession of the fortresses of Turin and Verrua, he refused, and while still professing to negotiate with Louis, joined the league of Austria, Spain and Venice. War was declared in 1690, but at the battle of Staffarda (Aug. 18, 1691), Victor was defeated by the French. A treaty with France was signed in 1696, and Victor appointed generalissimo of the Franco-Piedmontese forces in Italy operating against the imperialists. By the treaty of Ryswick (1697) a general peace was concluded.

On the outbreak of the war of the Spanish Succession in 1700 the duke was again on the French side, but the insolence of Louis and of Philip V. of Spain towards him induced him, at the end of the two years for which he had bound himself to them, to go over to the imperialists (1704). After some successes the French were completely defeated by Victor and Prince Eugène (1706). By the peace of Utrecht (1713) the Powers conferred the kingdom of Sicily on Victor Amadeus, whose government proved efficient and at first popular. But after a brief stay in the island he returned to Piedmont and left his new possessions to a viceroy; when the Quadruple Alliance decreed in 1718 that Sicily should be restored to Spain, Victor was unable to offer any opposition, and had to content himself with receiving Sardinia in exchange.

The last years of Victor Amadeus's life were saddened by domestic troubles. After his wife's death, he married the Contessa di San Sebastiano, abdicated the crown and retired to Chambéry to end his days (1730). But his second wife, an ambitious *intrigante,* induced him to return to Turin and attempt to revoke his abdication. This led to a quarrel with his son, Charles Emmanuel III., who arrested his father and confined him at Rivoli and later at Moncalieri; there Victor died on Oct. 31, 1732.

Victor Amadeus, not only won for his country a high place in the council of nations, but he doubled its revenues and increased its prosperity and industries.

See D. Carutti, *Storia del Regno di Vittorio Amedeo II.* (Turin, 1856); and E. Parri, *Vittorio Amedio II. ed Eugenio di Savoia* (Milan, 1888); C. A. Garufi, *Rapporte diplomatici tra Filippo V. e Vittorio Amedeo di Savoia . . . 1712–1720* (Palermo, 1914). The Marchesa Vitelleschi's work, *The Romance of Savoy* (2 vols., London, 1905), is based on original authorities, and is the most complete monograph on the subject.

VICTOR EMMANUEL II. (1820–1878), king of Sardinia and first king of Italy, was born at Turin on March 14, 1820, and was the son of Charles Albert, prince of Savoy-Carignano. Brought up in the bigoted and chilling atmosphere of the Piedmontese court, he received a rigid military and religious training, but little intellectual education. In 1842 he married Adelaide, daughter of the Austrian Archduke Rainer. Victor Emmanuel played no part in politics during his father's lifetime, but took an active interest in military matters. When the war with Austria broke out in 1848, he was delighted at the prospect of distinguishing himself, and was given the command of a division. At Goito he was slightly wounded and displayed great bravery, and after Custozza defended the rearguard to the last (July 25, 1848). After the defeat at Novara on March 23, Charles Albert, having rejected the peace terms offered by the Austrian field-marshal Radetzky, abdicated in favour of his son. Victor Emmanuel was received by Radetzky with every sign of respect and the field-marshal offered not only to waive the claim that Austria should occupy a part of Piedmont, but to give him an extension of territory, provided he revoked the new Piedmontese constitution granted by Charles Albert in March 1848, and substituted the old blue Piedmontese flag for the Italian tricolour, which savoured too much of revolution. But the young king rejected the offer, and had to agree to the temporary Austrian occupation of part of his territories and of half the citadel of Alessandria, to disband his Lombard, Polish and Hungarian volunteers, and to withdraw his fleet from the Adriatic; but he secured an amnesty for all the Lombards compromised in the recent revolution, having even threatened to go to war again if it were not granted. It was the maintenance of the constitution in the face of the overwhelming tide of reaction that established his position as the champion of Italian freedom and earned him the sobriquet of *Rè Galantuomo* (the honest king). But the task entrusted to him was a most difficult one. Parliament having rejected the peace treaty, the king dissolved the assembly; in the famous proclamation from Moncalieri he appealed to the people's loyalty, and the new Chamber ratified the treaty (Jan. 9, 1850). This same year, Cavour (*q.v.*) was appointed minister of agriculture in D'Azeglio's cabinet, and in 1852 became prime minister.

In having Cavour as his chief adviser Victor Emmanuel was most fortunate, and but for that statesman's astounding diplomatic genius the liberation of Italy would have been impossible. The years from 1850 to 1859 were devoted to restoring the shattered finances of Sardinia, reorganizing the army and modernizing the antiquated institutions of the kingdom. Among other reforms the abolition of the *foro ecclesiastico* (privileged ecclesiastical courts) brought down a storm of hostility from the Church both on the king and on Cavour, but both remained firm in sustaining the prerogatives of the civil power. When the Crimean War broke out, the king strongly supported Cavour in the proposal that Sardinia should join France and England against Russia so as to secure a place in the councils of the great powers and establish a claim on them for eventual assistance in Italian affairs (1854). In 1855, while the allied troops were still in the East, Victor Emmanuel visited Paris and London, where he was warmly welcomed by the Emperor Napoleon III. and by Queen Victoria, as well as by the peoples of the two countries.

Victor Emmanuel's object now was the expulsion of the Austrians from Italy and the expansion of Sardinia into a North Italian kingdom, but he did not regard the idea of Italian unity as coming within the sphere of practical politics for the time being, although a movement to that end was already beginning to gain ground. With this end in view he entered into communication with some of the conspirators, especially with La Farina, the leader of the *Società Nazionale,* and even communicated with Mazzini and the republicans. In 1859 Cavour's diplomacy succeeded in drawing Napoleon III. into an alliance against Austria, although the king had to agree to the cession of Savoy and possibly of Nice and to the marriage of his daughter Clothilde to the emperor's cousin Prince Napoleon. These conditions were very painful to him, but he was always ready to sacrifice his own personal feelings for the good of his country. He had an interview with Garibaldi and appointed him commander of the newly raised volunteer corps, the *Cacciatori delle Alpi.* Even then Napoleon would not decide on immediate hostilities, and it required all Cavour's genius to bring him to the point and lead Austria into a declaration of war (April 1859). Although the Franco-Sardinian forces were successful in the field, Napoleon, fearing an attack by Prussia and disliking the idea of a too powerful Italian kingdom on the frontiers of France, insisted on making peace with Austria, while Venetia still remained to be freed. Victor Emmanuel, realizing that he could not continue the campaign alone, agreed to the armistice of Villafranca. When Cavour heard the news he hurried to the king's headquarters at Monzambano, and in violent, almost disrespectful language implored him to continue the campaign at all hazards. But the king on this occasion showed great political insight and saw that by adopting the heroic course proposed by the latter he ran the risk of finding Napoleon on the side of the enemy, whereas by waiting all might be gained. Cavour resigned office, and by the peace of Zürich (Nov. 10, 1859) Austria ceded Lombardy to Sardinia, but retained Venetia; the central Italian princes who had been deposed by the revolution were to be reinstated, and Italy formed into a confederation of independent states. But this solution was most unacceptable to Italian public opinion, and both the king and Cavour determined to assist the people in preventing its realization, and consequently entered into relations with the revolutionary governments of Tuscany, the duchies and of Romagna. As a result of the events of 1859–60, those provinces were all annexed to Piedmont, and when Garibaldi decided on the Sicilian expedition Victor Emmanuel secretly assisted him. He had considerable influence over Garibaldi, who, although in

theory a republican, was greatly attached to the bluff soldier-king. When Garibaldi having conquered Sicily was determined to invade the mainland possessions of Francis II. of Naples, Victor Emmanuel, foreseeing international difficulties, wrote to the chief of the red shirts asking him not to cross the straits; but Garibaldi, although acting throughout in the name of his majesty, refused to obey and continued his victorious march, for he knew that the king's letter was dictated by diplomatic considerations rather than by his own personal desire. Then, on Cavour's advice, King Victor decided to participate himself in the occupation of Neapolitan territory, lest Garibaldi's doubtful entourage should proclaim the republic or create anarchy. When he accepted the annexation of Romagna offered by the inhabitants themselves the pope excommunicated him, but, although a devout Catholic, he continued in his course undeterred by ecclesiastical thunders, and led his army in person through the Papal States, occupying the Marches and Umbria, to Naples. On Oct. 29 he met Garibaldi, who handed over his conquests to the king. On Feb. 18, 1861, the parliament proclaimed him king of united Italy.

The next few years were occupied with preparations for the liberation of Venice, and the king corresponded with Mazzini, Klapka, Türr and other conspirators against Austria in Venetia itself, Hungary, Poland and elsewhere, keeping his activity secret even from his own ministers. The alliance with Prussia and the war with Austria of 1866, although fortune did not favour Italian arms, added Venetia to his dominions.

The Roman question yet remained unsolved, for Napoleon, although he had assisted Piedmont in 1859 and had reluctantly consented to the annexation of the central and southern provinces, and of part of the Papal States, would not permit Rome to be occupied, lest he should lose the support of the French clericals, and maintained a French garrison there to protect the pope. When war with Prussia appeared imminent Victor Emmanuel was anxious to assist the man who had helped him to expel the Austrians from Italy, but he could not do so unless Napoleon gave him a free hand in Rome. This the emperor refused to do until it was too late. Even after the first French defeats the chivalrous king, in spite of the advice of his more prudent councillors, wished to go to the rescue, and asked Thiers, the French representative who was imploring him for help, if with 100,000 Italian troops France could be saved, but Thiers could give no such assurance and Italy remained neutral. On Sept. 20, 1870, the French troops having been withdrawn, the Italian army entered Rome, and on July 2, 1871, Victor Emmanuel made his solemn entry into the Eternal City, which then became the capital of Italy.

The pope refused to recognize the new kingdom even before the occupation of Rome and the latter event rendered relations between church and state for many years extremely delicate. The king himself was anxious to be reconciled with the Vatican, but the pope, or rather his entourage, rejected all overtures, and the two sovereigns dwelt side by side in Rome until death without ever meeting. Victor Emmanuel devoted himself to his duties as a constitutional king with great conscientiousness, but he took more interest in foreign than in domestic politics and contributed not a little to improving Italy's international position. On Jan. 9, 1878, Victor Emmanuel died of fever in Rome, and was buried in the Pantheon.

Bluff, hearty, good-natured and simple in his habits, he always had a high idea of his own kingly dignity, and his really statesmanlike qualities often surprised foreign diplomats, who were deceived by his homely exterior. As a soldier he was very brave, but he did not show great qualities as a military leader. He had a great weakness for female society, and kept several mistresses; one of them, the beautiful Rosa Vercellone, he created Countess Mirafiori e Fontanafredda and married morganatically in 1869; she bore him one son.

BIBLIOGRAPHY.—Beside the general works on Italy and Savoy, *see* V. Bersezio, *Il Regno di Vittorio Emanuele II.* (Turin, 1869); G. Massari, *La vita ed il Regno di Vittorio Emanuele II.* (Milan, 1878); N. Bianchi, *Storia della Diplomazia Europea in Italia* (Turin, 1865); *Il Carteggio Cavour Nigra 1858–61* (Bologne, 1926); C. S. Forester, *Victor Emmanuel II.* (1927). (L. V.)

VICTOR EMMANUEL III (1869–), king of Italy, son of King Humbert I and Margherita of Savoy-Genoa, was born at Naples on Nov. 11, 1869. He entered the army and soon after attaining his majority, was appointed to the command of the Florence Army Corps, and in 1896 to that of the Naples Army Corps. His formal accession to the throne took place on Aug. 9 and 11, 1900, after the assassination of his father (July 29).

When in 1915 Italy declared war on Austria, the king at once went to the war zone, remaining there until the armistice, appointing his uncle Ferdinand, duke of Genoa, regent of the kingdom to act in his stead. At the front he lived in a most unassuming manner at the "Villa Italia" near Udine, and after Caporetto near Padua, constantly visiting the trenches and the most exposed positions, as well as the military hospitals, and leading to a very large extent the life of the soldiers. Although nominally commander-in-chief he never interfered with the conduct of operations, or in the matter of appointments.

After Caporetto he multiplied his activities a thousand-fold, and his proclamation of Nov. 19, 1917, sounded like a trumpet-call to the whole people. After the armistice, King Victor Emmanuel returned to Rome on Nov. 14, 1918.

On the night preceding the fascist "march on Rome" (Oct. 28, 1922) the cabinet had decided unanimously to proclaim martial law, of which Marshal Badoglio said in those days that the simple fact of its proclamation would have been sufficient to disperse at once the rabble of the so-called "march." The prime minister, Facta, went with the decree at midnight to the villa Savoia, out of Rome, to have it signed by the king. At two in the morning back he went with the decree not signed by the king. Official fascist propagandists wrote later on that the king had "nobly" refused to sign. Others, the first of whom was Count Sforza in his *Makers of Modern Europe*, asserted that Facta had accepted reluctantly the decision of the cabinet; that he had been induced by Mussolini into believing that a new Facta-Mussolini cabinet might be formed; and that he secretly suggested that the king not sign the decree. The fact is that the king's rule had always been to obey the prime minister in any political matters. He went too far with this rule under fascism, because he signed and welcomed, or feigned to welcome, decrees which violated his oath as a constitutional king, as when he ratified the complete suppression of the freedom of the press, the suppression of the chamber of deputies, etc. Under Mussolini's rule, the king's prerogatives existed nominally but not in fact, so that by the time of World War II he was taking a small part indeed in the Italian affairs of state. On June 5, 1944, the day after the Allies entered Rome, he named his son, Crown Prince Humbert, lieutenant general of the realm, relinquishing all power for himself but retaining his title of king. On May 9, 1946, he abdicated in favour of Humbert in an effort to save the House of Savoy and departed into exile in Egypt. On June 2, 1946, however, the Italian people voted to end the monarchy and to set up a republic.

Victor Emmanuel married Princess Elena Petrovich-Niegosh, daughter of the first and last king of Montenegro; she bore him four daughters: Yolanda Margherita (June 1, 1901), Mafalda (Nov. 19, 1902), Giovanna (Nov. 13, 1907) and Maria (Dec. 26, 1914); and a son and heir, Humbert, prince of Piedmont (Sept. 15, 1904). Princess Yolanda was married on April 9, 1923, to Captain Count Giorgio Calvi of Bergolo, and Mafalda on Sept. 23, 1925, to Prince Philip of Hessen.

See L. Morandi, *Come fu educato Vittorio Emmanuele III* (1901); and B. Astoni and P. Rost, *Il Re alla guerra* (1918). (L. V.; X.)

VICTORIA, queen of the United Kingdom of Great Britain and Ireland, empress of India (1819–1901), only child of Edward, duke of Kent, fourth son of King George III., and of Princess Victoria Mary Louisa of Saxe-Coburg-Gotha (widow of Prince Emich Karl of Leiningen, by whom she already had two children), was born at Kensington Palace on May 24, 1819. The circumstances leading up to her birth were somewhat peculiar. In 1817 Princess Charlotte, the daughter of the Prince Regent, had died in childbirth, and her death removed the only legitimate offspring of the 13 sons and daughters of George III. In order to remedy this defect three of the sons, the dukes of Clarence, Kent and

Cambridge, all of them well advanced in middle life, married in 1818. The two children of the duke of Clarence died in infancy: the duke of Cambridge had a son, also duke of Cambridge (1819–1904), Victoria's only first cousin, and for nearly 40 years commander-in-chief of the British army; but since the duke of Cambridge was younger than the duke of Kent, Victoria, christened Alexandrina Victoria, became heir to the throne.

Victoria never knew her father, for he died when she was eight months old, but his place was filled, in so far as any man could fill it, by her mother's brother, the admirable and sagacious Leopold (1790–1865). Leopold had been the husband of Princess Charlotte, and thus prospective prince consort of England. He continued to reside in the country, at Claremont, until, in 1831, he was accepted as the first king of the Belgians. The widowed mother trusted him as her best adviser, and he was responsible for the general character of the princess's education. After his removal to Belgium Victoria and Leopold carried on a close and affectionate correspondence throughout the 34 remaining years of their joint lives. After her accession (1837) the niece tactfully eluded and quickly terminated the uncle's attempts to control British policy behind the backs of the British cabinet. None the less, though she could not accept him as an extra-constitutional adviser, Victoria found, in correspondence with her uncle, a delightful outlet for her private and unofficial feelings; only to him, for example, could she speak of Palmerston and Russell as "those two dreadful old men." On his death she recorded in her Journal that he had been "ever as a father" to her.

The young princess's home was Kensington Palace, though she stayed at times with her uncle at Claremont, and frequently travelled on the Continent with her mother. Her half-sister Feodore was her nursery companion, and remained her friend until her death in 1872. When Victoria was five an admirable governess was found for her in the person of Fraülein (afterwards the Baroness) Lehzen, a native of Coburg. Louise Lehzen won the whole-hearted devotion of the princess and was the principal personal influence in her life down to her accession, at the age of 18, quite eclipsing the influence of her mother, the duchess of Kent. Victoria's relations with her mother (who lived until 1861) may be described as correct, and usually friendly, but no more. Hers is an elusive, pathetic figure. Her influence was of a negative character, yet not for that reason unimportant. She felt an intense aversion towards her uncles, George IV. and the duke of Clarence, subsequently William IV., and the feeling was fully reciprocated. Thus the little princess grew up in almost complete isolation from the surviving members of her father's family, and her accession was, as it were, the beginning of a new dynasty. With a Coburg mother, a Coburg guardian-uncle, a Coburg governess (and subsequently a Coburg husband), she always thought of herself as a member of the House of Coburg rather than the House of Hanover, a feeling which expressed itself in her disapproval of the name "George," when chosen for the grandson who was to be George V.

Victoria's upbringing and education could easily be criticized by modern standards. Until she became queen she never slept a night away from her mother's room, and she was not allowed to converse with any grown-up person, friend, tutor, or servant, without the duchess of Kent or Lehzen being present. Most will agree, however, that the education, whatever its intrinsic merits, had excellent results. Leopold considered that his niece should be kept as long as possible from a knowledge of her position; so Victoria was 12 years old before a carefully arranged history lesson revealed to her that she was to be queen. When she realized the destiny in store for her, her first words were "I will be good." Very shortly afterwards she began the detailed and highly characteristic Journal which was continued throughout her life. Selections from it, down to 1885, are included in the volumes of the Queen's *Letters*.

Accession.—William IV. died in the early hours of June 20, 1837, and the archbishop of Canterbury and the lord chamberlain, hastening with the news of the king's death to Kensington, were received by Victoria in her dressing-gown at 5 A.M. In the morning the privy council assembled at Kensington, and the usual oaths were administered to the queen by the lord chancellor. The grace and dignity of Victoria's demeanour on this occasion made an immense impression on all present. Romantic sentiment was very much in fashion, and the accession of the girl-queen carried an almost instinctive conviction to her subjects that a new, and much better, epoch in the long history of English monarchy had begun.

An important and welcome result of the accession of a female sovereign was the separation of the crowns of Great Britain and Hanover, the latter passing to William IV.'s next surviving brother, the deservedly unpopular duke of Cumberland. The separation of the two crowns was indeed even more important than could be realized at the time. Thirty years later Prussia, under Bismarck's guidance, annexed the Hanoverian kingdom. It is impossible to estimate the complications that would have arisen if the Hanoverian crown had still belonged to the British sovereign.

Melbourne.—The young queen entered with intense zest upon her new freedom, her new interests and her new duties. "I have," she wrote, "*so many* communications from the Ministers, and from me to them, and I get so many papers to sign every day, that I have always a *very great* deal to do. I *delight* in this work." After 18 years of seclusion, zealously supervised by the duchess and Lehzen, with scarcely any male society except Uncle Leopold and sundry tutors, it was a delight to do business with the great men of the land. But all other great men were eclipsed in her eyes by her prime minister, Lord Melbourne. The story of that romantic friendship has often been told. The queen had necessarily much to learn about the elements of domestic and foreign policy, and the art and tact of Melbourne made such lessons a pleasure. But the statesman's unlimited influence was not in all respects wisely used. Himself the leader of the Whig party, he surrounded the queen with Whig ladies, and allowed her to become an enthusiastic partizan of the Whig party. The duchess of Kent had been rigorously excluded from all share in the queen's political duties. A spiteful rivalry arose between the ladies of the duchess and of the queen, culminating in baseless accusations of immoral conduct against Lady Flora Hastings, a maid of honour to the duchess of Kent. Before the first year of the reign was over the queen's court, had, temporarily, sunk low in the esteem of high society, and it is impossible to believe that Melbourne could not, with more vigilance, have prevented these scandals. The loyalty of the nation as a whole, however, was probably unimpaired, and the coronation ceremony, on June 28, 1838, with the royal procession through the streets of London, provided an impressive demonstration of that loyalty.

In May 1839 Lord Melbourne resigned, and Sir Robert Peel, the Conservative leader, stipulated that the mistress of the robes and the ladies of the bedchamber appointed by his predecessor should be removed. The queen refused. Lord Melbourne urged her to give way, but he could not undo in a minute the results of his own work, and, when Peel had refused to take office with the ladies unchanged, Melbourne very weakly consented to resume office. The next few months witnessed Chartist riots and demonstrations more extensive than any before or afterwards, and denunciation of the queen's conduct was a popular item in Chartist propaganda.

In certain other respects the queen's manner of life during these first years of her reign was in marked contrast with what was to follow. She preferred the gaiety of the town to the peace of the country, delighted in social festivities and late hours, and even rebuked those whose judgments of others seemed to her over-strict and puritanical. Long afterwards she wrote to Mr. Theodore Martin, the author of the *Life of the Prince Consort*:—"The Queen's letters between '37 and '40 are *not* pleasing, and indeed rather painful to herself. It was the least sensible and satisfactory time in her whole life. . . . That life of mere amusement, flattery, excitement, and mere politics, had a bad effect on her *naturally* simple and serious nature. But *all* changed after '40."

1840–1861

Marriage.—It had long been Leopold's design that Victoria should marry his nephew Prince Albert, son of the duke of Saxe-Coburg-Gotha. Albert, who was the same age as Victoria, had visited her before her accession, and had since been carefully coached for his prospective career by Baron Stockmar. Stockmar was one of the most important and least conspicuous figures of 19th century history. Originally a doctor of medicine, he had long been the intimate adviser of Leopold, and he was now to be transferred to the service of Albert. He was very able, with an ambition which found its sole satisfaction in securing the greatness of his successive masters. It has been said with little exaggeration that Albert was "Stockmar's creation," and one may add that Victoria as revealed from 1840 onwards was the creation of Albert. During the Melbourne ascendancy the queen had rather alarmingly declared that she did not see why she should ever marry, but when Albert arrived on a visit in Oct. 1839, Victoria capitulated at once, and the engagement was announced. The marriage was solemnized on Feb. 10, 1840, the queen being dressed entirely in articles of British manufacture.

The task confronting Albert as husband of the British queen was no simple one. His position was virtually without precedent, for Queen Anne's husband had been content with his nonentity, Queen Elizabeth had not married, and Queen Mary had married the ruler of a foreign country who only occasionally visited her. Moreover Albert's character was not of a kind to recommend him either to the British aristocracy or to the nation. He was stiff and shy, studious, laborious, pedantic and exact, entirely indifferent to "sport." At first the queen herself was the greatest of his difficulties, for in spite of her personal devotion she was determined to exclude him as rigorously from political affairs as she had already excluded her mother. Melbourne was her sole partner in public life; Lehzen, the promoted governess, was supreme over the royal household; nothing apparently remained for Albert but to be the father of her children. But, with Stockmar at his elbow, he made his way. Melbourne was dismissed by the general election of 1841. Victoria's prejudice against Peel gave Albert his opportunity, and he negotiated a satisfactory compromise on the "Bedchamber" question. Peel, with his earnest middle-class temperament, was to Albert a comparatively congenial spirit, and Victoria soon learnt to like him. Albert became the queen's partner in politics, and, being her superior in intellect and knowledge, became inevitably her master and guide. Lehzen returned to her native Germany. Meantime the queen had become a mother. The "Victorian Age" had begun in earnest.

It will be convenient to summarize at once the growth of the royal family. The Princess Royal (the "Vicky" of the *Letters*) was born in November 1840; in 1858 she married the crown prince of Prussia and was the mother of the Emperor William II. The prince of Wales (Edward VII.) was born in 1841. There followed Princess Alice, afterwards grand duchess of Hesse, 1843; Prince Alfred, afterwards duke of Edinburgh and duke of Saxe-Coburg-Gotha, 1844; Princess Helena (Princess Christian), 1846; Princess Louise (duchess of Argyll), 1848; Prince Arthur (duke of Connaught), 1850; Prince Leopold (duke of Albany), 1853; Princess Beatrice (Princess Henry of Battenberg), 1857. The queen's first grandchild was born in 1859 and her first great-grandchild in 1879. There were 37 great-grandchildren alive at the time of her death.

The growing cares and joys of family life combined with the influence of Albert to produce a complete change in the queen's habits. Gone was the love of idle splendour and "mere amusement." The early 'forties were the "hungry 'forties," and Victoria expressed to Peel a desire to cut down the expenses of the court in order to give more of her income to charity. Sir Robert discouraged an impulse which seemed to him all too human. "I am afraid the people would only say," he replied, "that Your Majesty was returning them change for their pounds in halfpence." A sovereign, he said, must do all things in order, not seeking praise for doing one particular thing well, but striving to be an example in all respects, even in the giving of dinner-parties. The dinner-parties of the royal pair were indeed a conspicuous example of decorum, but the guests found them stiff and by no means amusing. At the same time it should be said that the young queen's dignity and discretion made a great impression upon the royal visitors from abroad. Among such in the first ten years of her married life were Frederick William IV. of Prussia, Louis-Philippe of France, and the Tsar Nicholas I.

Osborne and Balmoral.—In June 1842 the queen made her first railway journey (though railways had been in use for some 12 years), travelling from Windsor to Paddington. The Master of the Horse, whose business it was to provide for the queen's journeys, was much put out by this innovation. He visited the station and inspected the engine several hours before it was due to start; and when the journey was about to begin the queen's coachman insisted on mounting the engine and presiding over its manipulation. It is said that his scarlet livery got so much soiled on the journey that he did not insist upon repeating the experiment. A few weeks later the queen used the railway for her first journey to Scotland. Railway travel, the most characteristic innovation of the queen's reign, made an important contribution to her happiness, for it enabled her, without losing contact with her ministers, to reside for long periods of each year in the country houses she built for herself at Osborne in the Isle of Wight, and at Balmoral in the Highlands of Scotland. Politicians sometimes complained, not without reason, of the labours and delays occasioned by the queen's addiction to these resorts, especially to the distant Balmoral; but at a later period the delays of correspondence were reduced by another innovation, the telegraph. Telegraphic communication was established between London and Balmoral in the early 'sixties. At the same time, it was usually expected that members of the Cabinet should take turns in "doing service," as Lord Palmerston called it, of residence with the queen when at Balmoral.

The estate at Osborne was purchased by Peel's advice, and the residence built, in 1846, out of the queen's savings from her income. The lease of the original (and quite small) Balmoral House was taken two years later. In 1852 the estate was bought, and the great palace in "Scotch baronial" style completed in 1855. At Balmoral her happiest days were spent. "Every year," she wrote, "my heart becomes more fixed in this dear Paradise, and so much more so now, that *all* has become my dear Albert's *own* creation, own work, own building, own laying-out;—and his great taste, and the impress of his dear hand, have been stamped everywhere." The queen held the Highlanders in more esteem than any other section of her subjects. Her favourite servant, the Highlander John Brown, was her inseparable attendant down to his death in 1883. Protestant to the core, she felt a more entire sympathy with the Presbyterian Established Church of Scotland than with the English Church. It is probable that she esteemed no English minister of religion so highly as the Scottish Presbyterian, Norman MacLeod. When he died in 1872 she wrote:—"There was in beloved Norman MacLeod such geniality with true piety, and the *strongest belief,* the largest, widest Christian love . . ." ending with the words, "he was a thorough Highlander."

The Great Exhibition of 1851 belongs to the career of Albert rather than Victoria. The old Houses of Parliament had been burnt down and the problems connected with the building of the new Houses suggested to Peel the desirability of a royal commission to consider the best means of promoting the arts and sciences. He invited Albert to preside over the commission, and its work suggested to the prince the idea of the Exhibition. That Exhibition, the first of its kind, held in the Crystal Palace erected in Hyde Park, owed everything to Albert's organizing energy. The work of the commission led to the creation of the Museum and the Science and Art Department at South Kensington, and to the founding of art schools and picture galleries all over the country.

Conflicts with Palmerston.—The fall of Peel in 1846 and the return of the Whigs brought Lord Palmerston to the Foreign Office and led to the severest struggle between the Crown and its ministers since the day when George III. had dismissed the Coalition of Fox and North in 1783. Palmerston had passed his

60th birthday and could look back on a career of high office which began ten years before the royal couple were born. Confident in his parliamentary skill and in his capacity to solve every problem of foreign policy on the spur of the moment, shrewd, bold, instinctive, casual, contemptuous of foreign potentates and diplomatic amenities, he was in every respect the antithesis of Albert. Albert distrusted Palmerston's character, disapproved of his methods, disliked his policy, and, prompted by Stockmar, disagreed with his conception of the British constitution. In the contests that ensued Victoria was the disciple of Albert, a disciple whose zeal and vehemence outran that of her husband and master; for Albert was never vehement. The fundamental issue was the interpretation of the British constitution—a constitution notoriously flexible and elusive. Lord Clarendon, after dining with the royal pair at the height of the conflict, declared that they "laboured under the curious mistake that the Foreign Office was their peculiar department, and that they had the right to control, if not to direct, the foreign policy of England."

It is impossible here to follow the struggle through all its phases. Suffice it to say that the royal pair secured an ally in the prime minister, Lord John Russell, himself, for Palmerston often treated his colleagues as casually as he treated the sovereign, and took important decisions and sent off important despatches without consulting either the one or the other. In 1850 the queen delivered a kind of ultimatum in the form of a memorandum drawn up for her use by Stockmar. "With reference to the conversation about Lord Palmerston which the queen had with Lord John Russell the other day, and Lord Palmerston's disavowal that he ever intended any disrespect to her by the various neglects of which she has had so long and so often to complain, she thinks it right, in order to avoid any mistakes for the future, to explain what it is she expects from the foreign secretary. She requires: (1) That he will distinctly state what he proposes in a given case, in order that the queen may know as distinctly to what she has given her royal sanction; (2) Having once given her sanction to a measure, that it be not arbitrarily altered or modified by the minister." Lord Palmerston accepted the rebuke with apparent meekness, but his conduct continued unchanged. At the end of 1851 he expressed to the French ambassador, without having consulted either Russell or the queen, his approval of Napoleon's *coup d'état*. Russell immediately dismissed him and used the occasion to make public the queen's memorandum quoted above. But in a few months Palmerston secured his "tit for tat" by overthrowing Russell's administration.

It was unfortunate for Victoria and Albert that Palmerston was the most popular statesman in the country. At the beginning of 1854, when the country was visibly drifting into the Crimean War, it was announced that Palmerston (at that date home secretary in Aberdeen's coalition Government) had resigned office. At once an extraordinary storm of popular fury burst forth against the royal pair whose machinations, it was supposed, guided by the hidden hand of the alien Stockmar, had brought about the downfall of the one statesman in whom the nation felt confidence. There were rumours that both the queen and the prince had been committed to the Tower. "Thousands of people," wrote Albert to Stockmar, "surrounded the Tower to see the Queen and me brought to it." It was supposed that Albert was in the pay of the Russians. Palmerston's resignation was, however, withdrawn, and the gross absurdity of the charges brought against the prince, coupled with the unmistakable patriotism of his conduct throughout the war, produced a marked revival of royalist sentiment. The queen personally superintended the committees of ladies who organized relief for the wounded, and eagerly seconded the efforts of Florence Nightingale; she visited crippled soldiers in the hospitals, and instituted the Victoria Cross. The alliance with France led to a visit from the French emperor, whom the queen found very attractive, and in 1856 the visit was returned, this being the first occasion that a British sovereign had visited Paris since the coronation of Henry VI. in the days of Joan of Arc.

The Crimean War made Palmerston prime minister, and he retained the office, with one short interval, until his death in 1865. From 1859 onwards Russell was foreign secretary and his conduct was not found much more satisfactory than that of Palmerston. Palmerston and Russell supported, while Victoria and Albert disliked, the actions of Cavour and Garibaldi which led to the union of Italy. In 1861 the American Civil War broke out. A vessel of the "Northern" navy improperly arrested two "Southern" envoys on a British steamer, and a typically unwise and peremptory despatch of Russell's might have involved Great Britain in an unforgivable war with Lincoln's Government, had not Albert secured its alteration. It was the last act of his life. His health had long been unsatisfactory and his spirits depressed. His constitution, never robust, was undermined by overwork and political adversity. At the end of 1861 he was smitten with what was probably typhoid fever and died on Dec. 14.

1862–1901

Widowhood.—Victoria was only 42 at the date of her tragic bereavement; 39 years of life remained to her, nearly half her life, and much more than half her reign. The queen's life during her long widowhood lacks the variety of the earlier years; crowded with events it may in a sense be said to be, but those events are the political history of the nation and empire over which Victoria was called to rule, and it is no easy task to disentangle biography from history. Yet it is on this latter part of the queen's life that a judgment of her character and statesmanship should be principally founded. Until her marriage she had been little more than a child; during her married life she had accepted wholeheartedly the guidance of her adored husband; after 1861 she stood alone and, ably as she was served by a succession of devoted secretaries, her conception of her duties and her policy was her own. "I am *determined*," she wrote to her uncle Leopold, "that *no one* person—may *he* be ever so good or ever so devoted among my servants—is to lead or guide or dictate *to me*. I know *how he* would disapprove of it. . . . Though miserably weak and utterly shattered, my spirit rises when I think *any* wish or plan of his is to be touched or changed, or I am to be *made to do* anything."

There were many, and among them both the editor of the *Times* and the prime minister, Lord Palmerston, who assumed that the prince of Wales, who was already somewhat older than his mother had been at her accession, would be admitted, either at once or by degrees, to a partnership with the queen like that which her husband had enjoyed. But Victoria would have none of it. Though she groaned under the labours of her self-imposed isolation, and expressed again and again a longing for a release from them by death, she rigidly excluded her heir from all share in her political duties, and maintained that exclusion to the end. Perhaps if "Bertie" (as he was always called in the family) had been more like Albert, her decision might have been otherwise, and the lives of both mother and son, we cannot doubt, would have been happier. But the prince was of a Hanoverian rather than a Coburg type. He had not proved amenable to the education so carefully provided for him. He might have ideas of his own, and Victoria was determined that the royal policy should continue to be Albert's and that she alone knew what that policy would be.

It is impossible to exaggerate the grief of the widowed queen. Other women have loved their husbands as dearly, but not all, nor perhaps many, of these have experienced so long and so poignantly what Tennyson, Victoria's favourite poet, called "sorrow's crown of sorrow," the continued overshadowing of the present by the never-forgotten brightness of the past. The queen's mourning, alike in form and in fact, was indefinitely prolonged. Never again would she, to the end of her days, take up her residence in London. Only seven times, and then as a rule with much protest and complaining, did she consent to undertake the ceremonial duty of opening the parliamentary session. Up to the time of the first Jubilee the public and spectacular functions of royalty remained almost entirely in abeyance, except in so far as they could be, and were, performed by the prince and princess of Wales. It was inevitable that this should cause dissatisfaction. There were suggestions, in the 'sixties, that the queen should abdicate in favour of her son. In the early 'seventies two rising politicians, Joseph Chamberlain and Sir Charles Dilke, were

reputed to be "republicans," and the queen's failure to use her large income for what was supposed to be its proper purpose, was acrimoniously criticised. Victoria bitterly resented such complaints. Her physicians agreed that her health could not stand the strain of public ceremonies, and she held that she was discharging with unremitting industry the essential, as distinct from the ornamental, duties of her office. The modern notion that politics should be left to politicians had never been accepted by even the most lethargic of her predecessors, and it certainly found no favour with Victoria.

The Constitutional Monarch.—In his treatise on *The English Constitution* (published 1865) Bagehot said that the sovereign had, in relation to his ministers, three rights—the right to be consulted, the right to encourage, and the right to warn; and, he adds, a sovereign of great sense and sagacity would want no others. "He would find that his having no others would enable him to use these with singular effect." If the sovereign disapproved of the minister's policy "he might not always turn his course, but he would always trouble his mind. In the course of a long reign a sagacious king would acquire an experience with which few ministers could contend." Moreover the sovereign's position must give him imponderable advantages in any conflict of opinion with his ministers. For there is a "divinity which doth hedge a king," and the minister, as Bagehot quaintly puts it, "cannot argue on his knees."

Victoria had learnt from her husband and her uncle Leopold to have a low opinion of the intelligence, industry and patriotism of politicians in general and English politicians in particular. She conceived it to be her duty to do all that lay within her power to save her people—for were they not *her* people?—from the disasters into which their elected representatives were only too likely to lead them. She exercised to the full her "right to be consulted." Again and again, as we turn the pages of the *Letters of Queen Victoria* (*1862–85*), we find ministers reprimanded for making decisions without first submitting them to the queen. The ministers humbly apologise, plead haste, or accident, or suggest that the decision in question had in fact already been in principle approved, and promise not to offend again,—a promise seldom fulfilled, it would appear. The duties of ministers in this respect were indeed not easy, for in politics, especially foreign policy which was the queen's principal interest, speed is often an essential ingredient of efficiency, and the queen's absence at Balmoral or Osborne (she spent about four months of every year at each of these residences) made royal consultation difficult. In her exercise of "the right to encourage," the queen was more sparing, though she gave generous commendation where she felt that commendation was deserved; but only an exceptional statesman—a Disraeli for example—won that affectionate confidence which the queen gave so readily to all her leading soldiers and to some of her representatives abroad, Lord Odo Russell, for example, when ambassador at Berlin, and Lord Lytton when Viceroy of India. The third of the rights enumerated by Bagehot, "the right to warn" was exercised without any intermission whatever. Again and again the queen exerted all her resources to secure a reversal of the policy adopted by her ministers. In small matters often and in great matters sometimes she succeeded. But when she found that no warnings of hers, however vehement, would avail, she remembered the limitations of her power, and officially identified herself with the policy she personally detested.

England and Germany.—For the first four years of the queen's widowhood (1862–65) Lord Palmerston, now nearly 80, was prime minister, with Russell, already past 70, as his foreign secretary, and the most embarrassing question of the day was the notorious "Schleswig-Holstein question" (*q.v.*). Roughly speaking, the question at issue was whether these two duchies, with their mainly German population, should remain subject to the king of Denmark, or become a separate state under a German prince, or be annexed by Prussia. In the English press and public there was widespread sympathy for Denmark, strengthened by the marriage, in 1863, of the prince of Wales with the charming Danish princess who was subsequently Queen Alexandra. Palmerston and Russell were strongly pro-Danish, and might well, in defiance of the views of the rest of the cabinet, have plunged the country into a disastrous war. The queen played an all-important part in restraining "those two dreadful old men." Her sympathies were with Prussia. Her eldest daughter had married the Prussian crown prince, and Albert had always held that the German States ought ultimately to be united under the Prussian monarchy. Within two months of the death of her husband she was at work, insisting on the removal of a provocative phrase from a despatch to Prussia. In her long struggle with Russell and Palmerston she was maintaining the rights of the cabinet as well as the prerogatives of the Crown, and her efforts were crowned with the success they deserved.

But the Prussia now in the ascendant was not the Prussia to which Albert had given his blessing. Bismarck was in power, and for Victoria he was henceforth and always a "terrible man." The war of 1866, when the Prussian armies engaged and defeated in six weeks the forces of Austria and all the German States, was a bitter grief to the queen, who had near relations fighting on both sides. Her personal offer of mediation before the conflict had been rudely brushed aside. In 1870 the clever camouflage of Bismarck's diplomacy and an almost instinctive distrust of the French made her once more a whole-hearted partisan of Prussia. But when the victory of Prussia had been assured the queen exerted herself to save Paris from bombardment, and Bismarck himself furnished evidence of her success, when he complained that "the petticoat sentimentality" with which Victoria had infected the Prussian royal family hampered the designs of the Prussian army. Victoria looked forward to the day when her son-in-law would succeed to the Prussian throne, dismiss Bismarck, and direct the new German empire into liberal and humane courses. But it was not to be. Bismarck's emperor lived to be 91; the crown prince reigned but 100 days (in 1888); and William II. accepted all that was worst, while rejecting most of what was wisest, in the policy of Bismarck. Only once, in 1888, did Victoria engage in direct encounter with "the terrible man." Her grand-daughter, a daughter of the German crown prince, was engaged to Prince Alexander of Battenburg (Prince of Bulgaria) and Bismarck was determined to prevent the match. Bismarck claimed a personal interview with Victoria, and the marriage had to be abandoned.

Franchise Reform.—After the death of Palmerston (1865) his successor Lord Russell revived the question of an extension of the franchise beyond the "middle-class" limits fixed in 1832. The Russell-Gladstone Bill was rejected; the Government resigned, and the Hyde Park riots followed. The queen had little or no personal interest in such questions but she had a horror of demonstrations of popular discontent, which she always feared might ultimately take a republican direction, and she took an early opportunity of writing to her new prime minister, the Conservative Lord Derby, urging him to take up the question in earnest and achieve its settlement, and promising to do all in her power to secure the co-operation of the Leaders of the Opposition. The result was the famous Second Reform Bill of 1867, so skilfully piloted through the House of Commons by Disraeli. It is probable, no doubt, that the Conservative Government would in any case have pursued a similar policy, for the same ministers had done so, unsuccessfully, in 1858. None the less the queen's action is one of many examples that could be adduced to show that she was not, in domestic affairs, a supporter of a policy of standing still. On certain domestic questions, such as Housing, she was well in advance of most of the politicians of her day, and posterity will endorse her remark that the clearance of slums was more worthy of attention than a great many of the subjects with which 19th century parliaments occupied their time.

Ireland.—The years 1867–68 were marked by the destructive outrages of the Fenians. Victoria characteristically refused to take the precautions for her personal safety which her ministers urged upon her. Both political parties turned their attention perforce to Irish grievances, and Gladstone won a decisive victory in the election of 1868 with a programme in which the main item was the disestablishment of the Irish Church. From 1868–74 he was her prime minister.

Victoria's attitude towards Ireland was much the same as that of a great many of her English subjects. She had little understanding of or sympathy with Irish grievances, and the demand for Home Rule, now beginning to be vocal in the House of Commons, she regarded as sheer disloyalty. It had been suggested that she should establish a "Balmoral" in Ireland, but the idea was repugnant to her. The Irish climate was "unhealthy," and being a bad sailor she detested the crossing. Perhaps the prince of Wales might establish a residence there? No; he would only be able to reside there very occasionally, and the upkeep of the house would not be worth its expense. On the other hand the queen was always intensely appreciative of the bravery of her Irish regiments, and their gallantry in South Africa led her to make, in 1900, a three weeks' visit to Dublin which was one of the last public actions of her life.

Gladstone and Disraeli.—The queen felt a strong repugnance towards Gladstone's policy of disestablishing and partially disendowing the Irish Protestant Church. She regarded it as a diminution of her own prerogatives and as a concession to popery, nor were her feelings assuaged by the document which Gladstone presented to her as an exposition of the measure, for she found it entirely incomprehensible. None the less she recognized that the electorate had spoken decisively, and that the bill must be passed. Her attention turned to the House of Lords. Gladstone's policy threatened to produce, for the first time since the "Great" Reform Bill, a serious conflict between the two Houses, and such a conflict she regarded as endangering the whole fabric of the constitution, and opening the way to "democracy" and republicanism; that the monarchy could survive in a completely democratized State Victoria never believed. Her chosen instrument in securing a compromise between the Houses was Archbishop Tait, and Gladstone seconded her efforts by timely concessions on the disendowment clauses.

Equally distasteful to the queen were the Army reforms of Cardwell, but here again, realizing that the reforms could not be resisted, she worked hard for their smooth passage, exerting a moderating influence on her cousin, the duke of Cambridge, who was commander-in-chief. The abolition of the system of purchase of commissions, rejected by the House of Lords, was achieved over their heads by royal warrant.

Disraeli's accession to office in 1874 opened what was for the queen a far happier period. There had been a time, in the far-off days of Corn Law Repeal, when Victoria and Albert had regarded Disraeli as the most detestable of all politicians, but as soon as Disraeli became leader of the House of Commons, in 1852, he began to obliterate those memories. "Mr. Disraeli," she had written to her uncle Leopold, "writes very curious reports to me of the proceedings of the House of Commons—much in the style of his books." It was a style that the queen came rapidly to appreciate. Disraeli's brief prime ministership in 1868 had greatly advanced him in royal favour. Never, since the death of Prince Albert, had her political duties been made so easy and so interesting. None of her prime ministers realized as Disraeli realized that, when a queen is on the throne, the successful prime minister must be a perfect courtier. No one could have surpassed Gladstone in his reverence for the throne, but that reverence expressed itself in a solemn and pompous abasement: Disraeli's homage to the throne was expressed as personal devotion to the lonely and essentially simple-minded woman who was its occupant.

The new prime minister's vigorous imperial and foreign policy was entirely congenial to the queen, who warmly applauded the acquisition of the Suez Canal shares, and welcomed the measure which conferred upon her the title of empress of India (1876), but she was by no means inclined to relax the vigilance of her control over ministerial policy. The prolonged Balkan crisis and the Russo-Turkish war of 1877–78 excited her passionate interest, and though she trusted Lord Beaconsfield (as he had now become), she had the very lowest opinion of his foreign secretary, Lord Derby (son of the former prime minister). "The Queen writes every day and telegraphs every hour," wrote Beaconsfield to his confidant, Lady Bradford. If Victoria had had her way in 1877, Great Britain would probably have undertaken another war with Russia, as unprofitable as the Crimean War.

The election of 1880 brought Gladstone back to power and ushered in what were to be the most harassing years, from a political standpoint, of the queen's reign. Her antipathy to Gladstone had been deepened by his conduct in opposition. Gladstone had denounced Beaconsfield's reckless imperial ventures in Afghanistan and South Africa and his support of the blood-stained Turk against Russia as something worse than mere errors of policy. He had held them up to reprobation as iniquitous, and the queen, identifying herself with Beaconsfield's policy, regarded Gladstone's speeches as something like personal insults to herself. Gladstone had nominally resigned the leadership of the Liberal party in 1874, and Victoria tried to avail herself of this fact to construct a Liberal administration under Granville or Hartington, from which Gladstone should be excluded; but it was impossible.

The Liberal Government of 1880–85 was one of the most unfortunate in British history; it was the Government of Majuba, the Phoenix Park murders, and the fall of Khartoum. Space does not allow us to examine the complicated and tragic record, nor is it here appropriate either to condemn or to acquit the Government on the various charges that have been brought against it. The queen's letters during these years make extremely distressing reading. She distrusted her prime minister and found little that was good in many of his colleagues. Lord Granville at the foreign office was "as weak as water"; Chamberlain was constantly uttering sentiments which, the queen held, should have excluded him from any cabinet. The "right to warn" was lavishly employed, yet it would seem, did not influence ministers. Almost inevitably a tone of peevishness and, as one might say, of "nagging" becomes more and more apparent. Even on the rare occasions when the ministers gained the queen's approval, her commendation is seasoned by the taunt that what they are now doing might well have been done before. The rôle of a constitutional monarch as Victoria understood it becomes well-nigh impossible, when the gulf between the monarch's and the ministry's policy is of more than a very moderate width, and the result is bad for all concerned; for the sovereign becomes one of the ministry's principal embarrassments, and a hypothetically bad ministry is more likely to be made worse than better by continuous royal badgering.

The Jubilee Period.—But for the queen the worst was very nearly over. After the election of 1885 Gladstone adopted a policy of Home Rule, and a section of his own party joined with the Conservatives in defeating the Home Rule Bill of 1886. Henceforth, with a brief Gladstonian interval in the early 'nineties, the Conservatives, under Salisbury, were in power. Imperialism after the queen's own heart became more and more the national mood. Before her death she saw the more deplorable of Gladstone's withdrawals reversed, with Kitchener at Khartoum and Roberts at Pretoria. A sunlit and glorious evening came to greet the end of her long laborious day. Gladstonian Liberalism was on the wane; Socialism had not yet made effective entry into politics. After the acute industrial distress of the early 'eighties a period of unprecedented material prosperity set in—the "Jubilee period." The end of a century was approaching, and the end of an age, the Victorian Age. In the Jubilees of 1887 and 1897 the queen was accepted as the worthiest symbol of a great nation and an unparalleled empire. The end came in the first month of the new century, after a brief and painless illness. It was by four years the longest reign, and by three days the longest royal life, in British history.

Church Patronage.—The queen took a keen interest in appointments to vacant bishoprics, and undoubtedly valued as highly as Queen Elizabeth had done her position as the Head of the Established Church. She was herself deeply religious and her preference was for what would now be regarded as a somewhat old-fashioned type of Protestant piety, but her views on the exercise of her patronage were well abreast of the times. The foes of the Establishment and of true religion, in her judgment, were agnosticism and the "ritualism" of the Anglo-Catholic movement; it is, she wrote to Disraeli in 1875, "of the utmost importance that really intellectual, liberal-minded, and courageous men should

be appointed." The "materialistic tendencies" of the age could not be checked by "evangelical trash." Two years later we find her writing, "Unbelief can only be met by a full recognition of the rights of reason and science." Her preference was for Broad Churchmen, and perhaps the most important ecclesiastical appointment of her reign, that of Tait to the Archbishopric of Canterbury, was her personal choice forced upon a reluctant prime minister. Her most trusted adviser in ecclesiastical matters was Dean Wellesley of Windsor, and after his death in 1882 she relied much on his successor, Dr. Randall Davidson, subsequently archbishop of Canterbury. It is characteristic of her eminent fairness of mind that she scrutinised with considerable suspicion the ecclesiastical recommendations of Disraeli, rebuking his attempts to use church preferment for the promotion of supposed Conservative interests, whereas she treated with far greater respect the recommendations of Gladstone who, whatever his political delinquencies, could never be accused of sacrificing the interests of the Church to those of his party.

The Empire.—Much might be said of the queen's pride and interest in the peoples of her far-flung empire. India was always near her heart and she encouraged her viceroys to write her long personal letters. In her later years she had a devoted Indian personal servant, and amused herself with learning the elements of Hindustani. The queen's devotion to her Indian subjects was amply appreciated and returned, alike by the chiefs and by the common people. Sir W. R. Lawrence writes (1928) in his book *The India we Served:*—"From my verandah in the early morning of Feb. 2, 1901, I saw a sight which set me thinking. I saw the greater part of Calcutta's dense population file solemnly past on their way to the great park (Maidan) to sit there all day, without food, mourning for the great Queen-Empress who had made them her children."

In 1863 we find her describing in her Journal with obvious relish the visit of certain Maori chieftains. "They all kissed my hand and behaved extremely well." On a later occasion the visitor was the redoubtable Cetewayo, and the queen's only regret was that he did not appear in his native costume, though there was apparently very little of it. In 1874 she conveyed, through her friend Dean Stanley, to Bishop Colenso of Natal, her warm approval of his championship of the rights of a native chief against the oppressive policy of the Natal Government. An amusing example of her good sense was afforded by the annexation of Fiji at the same date. Cabinet ministers agreed in finding this name "barbarous and unpleasing"; one suggested "the New Orkneys," another "Oceania," and Disraeli favoured "the Windsor Islands." Victoria held that "Fiji" was quite good enough, and Fiji it remains to this day.

The Queen's Achievement.—The essential achievement of the great queen is plain for all to see: it is massive in its simplicity. She received a crown that had been tarnished by ineptitude and vice; she wore it 63 years, and made it the symbol of private virtue and public honour. If a monarchy at once dignified and popular is of value to the nation and empire, then it was Victoria who gave back these long lost values to the crown. The achievement was one of character much more than of intellect. Opinions will differ as to the queen's political acumen, and as to the soundness of her interpretation of her duty towards her ministers. No one can question the intensity of her devotion to her duty, as wife, mother, and queen, nor the transparent honesty of her character. There are degrees of honesty even among honest men, and the queen's honesty was of the highest degree. After all, the two best things in the world, perhaps, are hard work and a happy family life, and the queen presented to her subjects a shining example of both. Her personal sympathies extended beyond her family to all her servants, and the humblest could always be the most sure of her sympathies. On occasions of mourning the queen's message was something more than royal; it was spoken from the heart of a widowed woman. When, five weeks after her husband's death, there was a bad colliery disaster at Hartley, the queen commanded her secretary to write:—"Her tenderest sympathy is with the poor widows and mothers; her own misery only makes her feel the more for them." It is but one example of many.

Perhaps a fit conclusion would be a prayer from the queen's Journal, one of many; it is dated Jan. 1, 1878. "May this year bring us peace, and may I be able to maintain strongly and stoutly the honour and dignity of my dear country! . . . God help me on in my arduous task!"

The most important authority for the queen's life is the two series of *Letters of Queen Victoria, 1837–1861* (1907), and *1862–1885* (1926–27). There is an excellent popular life by Lytton Strachey (1921) and a detailed biographical article by Sidney Lee in the *Dictionary of National Biography,* to which a full bibliography is appended.

(D. C. So.)

VICTORIA (or VITTORIA), **TOMMASSO LUDOVICO DA** (*c.* 1540–*c.* 1613), Spanish musical composer, was born probably at Avila. In 1573 he was appointed as Maestro di Cappella to the Collegium Germanicum at Rome, where he had probably been trained. Victoria left Rome in 1589, being then appointed vice-master of the Royal Chapel at Madrid, a post which he held until 1602. In 1603 he composed for the funeral of the empress Maria the greatest requiem of the Golden Age, which is his last known work, though in 1613 a contemporary speaks of him as still living. He was not ostensibly Palestrina's pupil; but Palestrina had the main influence upon his art, and alike personally and artistically the relations of the two were close. The work begun by Morales and perfected by Palestrina left no stumbling-blocks in Victoria's path and he was able from the outset to express the purity of his ideals of religious music without having to sift the good from the bad in that Flemish tradition which had entangled Palestrina's path while it enlarged his style. From Victoria's first publication in 1572 to his last requiem (the *Officium Defunctorum* of 1605) there is practically no change of style, all being pure church music of unswerving loftiness and showing no inequality except in concentration of thought. Like his countryman and predecessor Morales, he devoted himself entirely to sacred music; yet he differs from Morales, perhaps more than can be accounted for by his later date, in that his devotional spirit is impulsive rather than ascetic. He strikes the note of aspiration rather than that of renunciation.

Victoria's work is the crown of Spanish music: music which has been regarded as not constituting a special school, since it absorbed itself so thoroughly in the Rome of Palestrina. In any extensive anthology of liturgical polyphony such as the *Musica Divina* of Proske, his work stands out as impressively as Palestrina's and Lasso's; and the style, in spite of a resemblance to Palestrina which amounts to imitation, is as individual as only a successful imitator of Palestrina can be. That is to say, Victoria's individuality is strong enough to assert itself by the very act of following Palestrina's path. When he is below his best his style does not become crabbed or harsh, but over-facile and thin, though never failing in euphony. If he seldom displays an elaborate technique it is not because he conceals it, or lacks it. His mastery is unfailing, but his methods are those of direct emotional effect; and the intellectual qualities that strengthen and deepen this emotion are themselves innate and not sought out. The emotion is reasonable and lofty, not because he has trained himself to think correctly, but because he does not know that any one can think otherwise.

His works fill eight volumes in the complete edition of Breitkopf and Härtel.

(D. F. T.)

VICTORIA, a State of the Commonwealth of Australia occupying a triangular area of *c.* 87,884 sq.mi. (56,245,760 ac.) in the extreme south-east of the continent of which it forms roughly a thirty-fourth part. After Tasmania it is the smallest Australian State, and is marked off from New South Wales on the north by the river Murray from near its source to the South Australian border and by a straight boundary line drawn from The Springs, on Forest Hill near the Murray source, east-south-east to Cape Howe. On the west its border marches, along long. 140° 58′ E., with that of South Australia for some 250 m. (*i.e.,* from the Murray to Discovery bay near the mouth of the river Glenelg) and on the south a coast-line of *c.* 680 miles extends, with some marked irregularities, in an east-west direction from Discovery bay to Cape Howe (long. 150° E.) and faces Bass strait, the Southern and Pacific oceans and Tasmania. Its most northerly

portion lies in the northeast at *c.* lat. 34° S. and its coast line lies approximately along lat. 38° 30′ S. (Wilson's promontory, the most southerly point of Australia: lat. 39° 8′ S.) and in respect of size, climatic conditions and general economic development it shows certain marked resemblances to, and also significant differences from, the British Isles (*c.* 88,756 sq.mi.; *v. inf.*).

Physiography.—Geological structure and surface configuration mark out the area into four main divisions:

(*a*) A "backbone" of highlands, styled entirely misleadingly in view of its structure, the "Great Dividing range." It falls into an eastern and a western section, the line of division corresponding approximately with the Kilmore gap (*c.* 1,145 ft.), north of Melbourne. The eastern section comprises the massive but broken plateau of the Australian Alps (*q.v.*), which forms part of the main eastern highland belt of Australia. (*See* AUSTRALIA: *Geomorphology;* also NEW SOUTH WALES and TASMANIA: *Physiography.*) From its granite and basalt surfaces blunted elevations such as Mounts Cobboras (Bowen Mtns.), Feathertop, Hotham, Bogong rise to over 6,000 feet. Eastward it sinks somewhat (Mounts Howitt, Tamboritha, Buffalo, etc., over 5,000 ft.) and narrows to the Hume range which dies down to 2,000–3,000 ft. toward the Kilmore gap and the Melbourne basin (*q.v.*). These highlands (3,000–4,000 sq.mi. above 3,000 ft.), which occupy most of the eastern corner of the state, form a fine and picturesque mountain massif in which bygone rivers, working partly along north-south structural lines (*cf.* the Omeo gap, *c.* 2,800 ft., between the headwaters of the Mitta-Mitta and Tambo rivers) have excavated great wild valleys and given to Victoria a playground (*e.g.,* Mount Buffalo) which rivals the famous Kosciusko area of New South Wales. Westward from the Kilmore gap the "range," though similarly broken into spurs (*e.g.,* Mount Alexander 2,430 ft.), is much lower and forms a broad rough upland belt composed largely of ancient metamorphic, with later igneous, rocks (basalt, etc.), rarely rising above 2,000 ft. At the west extremity, just before it sinks to the western plains, lie the north-south Grampian and other ranges (Mt. William, 3,829 ft.).

(*b*) The extreme south of the state is occupied by what appear to be fragments of a parallel range, composed largely of later (Mesozoic) rocks. Subsidence in the direction of Bass strait apparently ruptured this system, admitted the sea to Port Phillip, and left the isolated hill ranges (Otway range rising to 1,900 ft.; Buln Buln [Strzelecki] range with Mt. Fatigue, 2,110 ft.) which occupy the projections on either side of it. Wilson's promontory is a semi-detached granitic mass rising to 2,350 ft.

(*c*) Between the two uplands referred to in (*a*) and (*b*) an east-west corridor-like depression stretches nearly the length of the state, from Gippsland to the western plains. In the east it is occupied and has been partly built up, by streams (Latrobe, etc.) which rise in the flanking highlands, and here also the coastal margins south of the Strzelecki range form a parallel and connected lowland. The central portion is the depressed area around Port Phillip which opens out as a broad inverted *V* from an apex near Melbourne. To the west the trough runs from about Geelong to the southwest coast (Warrnambool–Portland), and makes junction with the western plains which are the southern extremity of the river Murray basin. Fertile, sheltered and well-watered in the east, in the west these southern Victorian lowlands are paved with wide sheets of Tertiary (Oligocene–Pliocene) basalt—supporting a few small cones and some lakes—which lend to them, as to the northern fringes of Tasmania opposite, a considerable richness and economic significance.

(*d*) Between the various central plateaus and the Murray, the north and northwest of the state consists of lowlands undistinguished, except for the flattening mountain spurs along their southern margin, by any outstanding topographic features.

Coastal Features and Drainage.—Of the coastal features the most important are those of the central "water-triangle"—Port Phillip, Corio Bay, Western Port, and other forms of submergence. (*See* MELBOURNE.) Cape Otway, Wilson's promontory and Cape Howe are outstanding points in bold rocky stretches while Portland enjoys shelter from the southwest gales owing to the Cape Nelson projection. The southeast Gippsland coast is noted for its "Ninety Mile Beach" due to longshore sand drift. Through it a narrow gap at Cunninghame (Lakes Entrance) gives entrance to the long chain of lagoon-like lakes formed by the Latrobe, Macallister, Mitchell, Tambo and other streams denied free outlet to the sea. Thus is formed an interesting and beautiful district, one of the pleasure grounds of the state. The southeast streams mentioned, along with the Mitta-Mitta (125 mi.), Ovens (110 mi.), etc., on the northeast, descend steeply from the eastern highlands and have generally swift, perennial, rain and snow-fed flows capable of supplying an as yet undetermined amount of hydroelectric power.

The Murray has *c.* 1,200 mi. of its course along the Victorian boundary and, apart from rivers already mentioned, the Goulburn (280 mi.), Campaspe (100 mi.) and Loddon (155 mi.) are perhaps the most important. Of the remaining south coast streams the Glenelg (280 mi.) and the Hopkins-Mt. Emu creek (135 mi. and 170 mi.) are the longest.

Climate.—Latitude, relief and coastal extension (1 mi. of coast per 129 sq.mi. of land) give to Victoria a relatively mild, warm, and equable climate with a rainfall ranging from moderate to large. Temperatures showing ann. averages of 66°–48° F. along the coastal parts become higher and more extreme (76°–51.5° F.) in the northwest interior, and lower and more extreme (*c.* 56°–32° F.) in the eastern uplands. Thus, while hot spells are not unknown on the coasts (Melbourne: temps. of 100° F. recorded on 5–6 consecutive days), they are severer in the northwest (10 days; absolute extremes 117°–21° F.) while winter temps. below freezing and snow are normal upon the eastern heights. Rainfall, which is brought mainly by the west-east procession of southern depressions ("Antarctic lows") and to a less extent by monsoonal depressions from the north ("tropical lows"), is also markedly influenced by land elevation and coastal or interior position. Thus the southern "lows," bringing winter rain, pass mainly along the southern side of the Great Dividing range, while the tropical lows are likewise obstructed and visit chiefly the northeast of the state. Similarly while the eastern heights have falls of 50–75 in. and the Otway range *c.* 40 in., the "Mallee" in the northwest has an average of 12.6 in.

Two areas again—one a lowland strip 25–50 mi. wide extending from about Ararat southeast and east to the eastern side of Port Phillip bay and thence northeast to the Kilmore gap, the other a small area around Sale in Gippsland—are in marked rain shadows and, though flanked by areas of 25–40 in., receive under 20 in.

Apart from such irregularities rainfall in general diminishes from 40–60 in. and over along the south and in the east to 10–12 in. in the northwest of the state.

Water Supply; Mining; Power.—Except in the north and the northwest, Victoria is relatively free from the water-supply problems which confront most of the Australian states. Nevertheless the rainfall in the drier areas was sufficiently low and unreliable to cause loss in times of drought and extensive boring (1886–1906) revealed mainly either medium or poor (saline) waters or none at all. Later a large area was discovered in the "Mallee" having good sub-artesian supplies at 150–750 ft. which led to settlement along the belt now traversed by the Ouyen–Pinnaroo (South Australia) railway line. Altogether there were (1939) 330 bores in the Mallee, besides others in the Maffra (Gippsland) district. On the other hand the climate was sufficiently hot and dry, and there was enough water available, but going to waste, to stimulate water-supply and irrigation schemes, particularly in the north and northwest, on a scale large according to any standard. For this also the surface configuration was adapted—an arc of highland catchment, fairly extensive upper basins of streams which, fed with winter or perennial rains, descended with some speed and volume into broad lower valleys before debouching upon flat alluvial-floored plains. Natural hollows, lagoons and basins also assisted the construction of storage reservoirs while the rainfall and carrying capacity of the land is sufficient to justify large-scale expenditure upon additional water

supply. Earlier experience of private or semi-private enterprises (water trusts, etc.) led to the vesting of powers in the State Rivers and Water Supply commission which now controls all such works excepting those of Mildura, Melbourne, Geelong and certain municipalities, and which in addition acts for Victoria in connection with the River Murray development scheme. Apart from urban and municipal supplies, the schemes have in general two aims: (*a*) the supply of water to country areas for domestic, stock and, in one case (Coliban–Castlemaine–Bendigo), for mining purposes; (*b*) the supply of water for irrigation, the two types being naturally often associated. The irrigated areas (1939–40) covered an area of 517,903 ac., while the rural areas supplied with water for domestic and stock purposes amounted to some 23,200 sq.mi. or *c.* 27% of the whole state, and lay chiefly in the Mallee and Wimmera districts. In 1940 there was storage accommodation (reservoirs, etc.) for 1,963,200 ac.ft. (1 ac.ft.= 43,560 cu.ft.=272,250 gal. water) existing or under construction in the state, and nearly the whole of this (including a share in the Hume reservoir, *v. inf.*) is under the control of the State Rivers and Water Supply commission. The water is supplied mainly by gravitation, but along the lower (Victorian) Murray by pumping (*e.g.*, Mildura, Millewa, Red Cliffs areas), and in one case (Sugarloaf reservoir, upper Goulburn river) a hydroelectric power scheme is associated (*v. inf.*). Associated, or of a similar nature, are flood-control and drainage works (*e.g.*, west Gippsland; lower Goulburn and Loddon, covering in all *c.* 160,000 ac.).

As instances of the scope of these schemes may be mentioned the Wimmera–Mallee supply scheme, capacity *c.* 208,000 ac.ft., supplying *c.* 11,000 sq.mi. through *c.* 10,500 mi. of channels; in the northern Mallee, schemes designed to supply *c.* 2,500,000 ac. and including some 720 mi. of channels, 100 borewells and 260 excavated tanks (1,210,000 cu.yd.); the Goulburn schemes (Sugarloaf, Waranga, etc., reservoirs), 660,000 ac.ft. These supply continually increasing areas. Of the works on the Murray assigned to Victoria under the River Murray Waters act the Torrumbarry weir is completed and the great Hume reservoir above Albury (*q.v.*) (2,000,000 ac.ft.; Victorian share 1,000,000 ac.ft.) and various locks have been completed. Besides these state undertakings the Mildura Trust irrigated upward of 42,000 ac.

Mining.—This, as elsewhere in Australia, has recently improved. The principal metal produced is gold (in 1939, 156,522 oz.; £1,533,899), chiefly in the Beechworth, Bendigo and Castlemaine areas, and 6,169 men were employed in gold mining in the state in 1939. Coal has increased in importance. Black coal (Jurassic) exists in southern Gippsland, the chief being at Wonthaggi, where the state mine, working within a reserved area of 17 sq.mi. has proved reserves of 28,000,000 tons within 5 sq.mi. Output for the entire state (1939) 364,895 tons; £259,814. In addition brown coal deposits underlie *c.* 1,200 sq.mi. in central Gippsland and have an estimated average thickness of 50 ft. (750 ft. at Morwell). A total of 3,651,014 tons valued at £385,952 were mined in 1939. Reserves (actual and probable) of 40,000,000 tons of black coal and 37,000,000,000 tons of brown exist and form a practically inexhaustible source of power, the development and application of which constitutes one of the largest constructive enterprises in the commonwealth in recent times. Brown coal, machine-mined by open-cut at the two state mines at Morwell and Yallourn respectively, is supplied to a power station near by having an initial 50,000 kw., and possible 150,000 kw., capacity. From this, and from a smaller station at Newport, power is distributed through various receiving stations to Melbourne and to over 100 towns in its vicinity, in Gippsland, etc. In addition power generated at Geelong supplies towns as far west as Warrnambool, and the recently completed hydroelectric power stations on the upper Goulburn (Sugarloaf-Rubicon, etc. area) supply Murray river towns (Albury, Corowa, Echuca) and intervening areas. When completed the system, which is managed by the State Electricity commission, will supply practically the whole of south central, northeast, and central northern Victoria and is likely to effect, especially in the metropolitan area, something of a revolution as regards manufacturing industry. In addition at Yallourn is a large briquetting works (*c.* 500,000 tons annual capacity). In 1939–40, 78 electric light and power works in Victoria produced 1,389,783,000 kw.hr.

Vegetation, Timber, Settlement and Land Occupation.—A very large part of Victoria was originally covered with tree growth of some sort, the bare rock surfaces of the eastern highlands, the basalt plains of the southwest, and the heath and sandhill country in parts of the west and northwest being the chief exceptions. But much of this forest, especially in the flatter lands, has been cleared, and the nature and value of the remainder varies. The northwest is characterized by mallee (*cf.* SOUTH AUSTRALIA, WESTERN AUSTRALIA and AUSTRALIA: *Vegetation*), either as a continuous scrub, or in patches with intervening saltbush, etc., or in association with other trees (cypress-pine, etc.). In the drier parts of the north and west the forest is of the open (forested steppe) description or consists of riverside belts mainly of red (swamp or river) gum. Of forests proper the chief lie along the uplands, flanks and spurs of the Great Dividing range, in the Glenelg river basin (*c.* 3,000,000 ac.), on the southern coastal hills, and in the valleys and on the lower and middle slopes of the eastern highlands (*c.* 3,000,000 ac.). The tree types vary from district to district but are prevailingly eucalypts (*cf.* some beech forest on the Otway range, *cf.* Tasmania) which supply some 20 varieties of useful timber. The finest growths are in the east, notably in Gippsland, though much good timber in the highlands is commercially inaccessible. After long and wasteful exploitation and destruction due to bush fires, settlement and mining, the forest resources, under the State Forest commission, are being carefully husbanded and will provide a valuable and permanent asset. Some 4,860,000 ac. have been reserved, and in addition an extensive scheme of soft-wood plantation (largely *Pinus insignis* for "kraft" paper, butter and fruit packing cases, etc.) is being prosecuted (*e.g.*, in the southwest) and education in forestry is provided. Sawmilling is an important industry in the Upper Yarra (Warburton), Otway, and Gippsland areas. (*V.* also *inf. Statistical Survey: Production, Manufacturing Industries, Forestry and Fisheries, Trade, Commerce, Communications.*)

In spite of relatively large waste areas in the east and northwest, Victoria has a larger proportion of land alienated from the crown than any other Australian state. At base this is due to the favourable conditions of climate, soil and topography outlined above. It is also due to a fixed and vigorous public policy of land settlement and development, water supply, irrigation and drainage schemes being perhaps the most striking, but the active subdivision and closer settlement of large estates (*v. inf. Statistical Survey: Agriculture*) and the encouragement, through agricultural colleges (five in number), schools, etc., of improved and intensified production being equally important factors. Within natural limits Victoria has a very wide range of production, and there are few parts of its utilizable area which are physically incapable of yielding a variety of products. The great gold days have long passed and the decline in metal mining is perhaps inevitable.

The era of power development and of manufactures is only beginning, and while this will almost certainly lead to an intensification of Melbourne's predominance and to further concentration of population in the metropolitan area, it will almost as certainly stimulate rural settlement and development and help to overcome some of those difficulties which have faced land settlement in the past.

A comparison of Victoria with Great Britain (each *c.* 88,000 sq.mi.) reveals some striking similarities in general primary production, save that the "older" country, with its larger human population, has in general a higher agricultural productivity per unit area and higher densities of cattle population. But the differences are also striking, for nowhere in Great Britain are there the vineyards, irrigated areas, or even the forests which diversify and lend economic range and stability to Victoria and constitute it a well-endowed state.

Agriculture, Fruit, Vines.—The area under cultivation has

steadily increased and has more than doubled during the last 20 years (*v. inf. Statistical Survey: Agriculture*). This increase, moreover, has not been at the expense of the pastoral industry and of dairying but is due largely to the increasing application, through education, of science to methods of production. Broadly the improvements lie in the direction of fallowing, use of fertilizers, seed breeding and selection, and more skilful rotation of crops. The value of bare fallow, combined with manuring, has been effectively realized, especially in connection with wheat growing. Of the total area under crop in 1939–40 (5,002,362 ac.), more than ⅓ was under fallow and most of this was in the three main wheat-growing districts. Similarly the use of manures is almost universal. In 1939–40, 4,119,706 ac. of crops were manured with 169,092 tons of artificial fertilizer alone, and these figures do not include either the acreage fertilized with natural manures nor the considerable acreage of pasture lands top-dressed with manure. The total tonnage of artificial manure used in Victoria in 1939–40 was 340,633. The five principal arable crops are wheat, oats, barley, potatoes and hay.

Wheat.—In 1939–40 wheat occupied 56.5% of the whole area under crop. The area sown to it increased by nearly 1,000,000 acres between 1900 and 1927 and later again greatly expanded, but in 1939–40 the total acreage was only 2,827,000 as compared with 2,900,000 in 1927–28. The yield varies markedly from season to season with the rainfall and also from locality to locality. Thus averages of 18–24 bu. per ac. in the Wimmera (up to 40 bu. and over in favoured parts of the state) are matched by averages of 7–13 bu. in the Mallee, but the average for the state as a whole has steadily risen (ave., 1916–26, 14.13 bu.; *cf.* ave. for Australia, 12.41 bu.), though in severe drought it fell to 7.51 bu. (1927–28). Wheat will grow almost anywhere in Victoria where terrain favours, but 94% of the wheat lands lie in the Wimmera, Mallee and Northern divisions within a triangle bounded on the west by a line from about Mildura to Horsham, on the north by the Murray, and on the south by a line from Horsham to about Corowa. This forms part of the main Australian wheat belt and from it extensions run westward towards the South Australian border along strips marked by the lines of railway. The three divisions mentioned contain between them nearly 83% of the cultivated land in the state, the Mallee having 47%, the Wimmera 31% and the Northern 29% of their respective areas under cultivation. By far the greater part of this is utilized for producing wheat. The provision of labour-saving machinery, of railways, and of an assured water supply have helped to bring into being large-scale commercial production. In 1891–92 the Mallee, generally considered a desert, produced only 5% of the state's wheat; during the last few years it has produced, on an average, 31%, and in 1936–37 nearly 1,200,000 ac. were under cultivation in this area. The average wheat farm is 200–250 ac. The average production of wheat for the ten years ending 1939–40 was 40,380,000 bu. of high-grade grain, of which some 12,000,000 bu. are required for seed and for home consumption. The railways, driven in long parallel lines across the level lands, penetrate the wheat areas at spaced intervals and concentrate the grain upon Melbourne, whence it forms a staple export either as grain or as flour (*cf.* 1939–40, 36 flour mills; 1,054 hands, handling 19,000,000 bu. wheat yielding 404,064 tons flour valued at £4,007,867.

Other Crops.—Oats, grown to a large extent in the wheat areas but also more toward the northeast, and hay, are important subsidiary crops. The place of root crops, under the less intensive farming methods employed, is largely taken by "hay" which includes wheat, oats, lucerne, etc. Thus, 95,610 ac. sown to wheat, 804,246 ac. to oats and 304,954 ac. to lucerne and other crops in 1939–40 were cut as hay. Production of potatoes in Victoria is second only to that of Tasmania. Although the acreage sown in Victoria is somewhat greater, the yield per acre is lower. In 1939–40, 32,177 ac. yielded 87,931 tons, a yield of 2.73 tons per ac. Potatoes are grown mainly on the rich volcanic soils of the Central division (*c.* 10% of total crop), North Central (*c.* 17%), Western (*c.* 25%), and Gippsland. In these areas the rainfall also is good (25–35 in.) and there is ready access to Melbourne, the main market. Of other arable crops, maize, grown mainly (91%) in Gippsland, where relatively high temperatures and summer rainfall are available (1939–40: 18,963 ac., 381,000 bu.); onions (1939–40: 4,503 ac.) are all grown in the southern valley from about Warrnambool to Melbourne and also southeast of Melbourne (Mornington and Buln Buln); hops are also worthy of mention. At Maffra, near Sale in central Gippsland, a rising beet-sugar industry is being encouraged by a government mill and irrigation works (Macallister river) (1939–40: 4,235 ac.; 42,903 tons; 6,250 tons sugar); and steps now being taken by the commonwealth government may stimulate tobacco culture (13,000 ac. in 1932 dropping to 2,000 in 1939; producing from 7,000 to 1,000 cwt. of dry leaf grown mainly in the northeast). In the neighbourhood of Melbourne, and in the orchard areas also, large quantities of market-garden produce are grown on rich open lands, or by irrigation or under glass (Bacchus Marsh; Werribee; Hallam, etc.) (1939–40: total area market gardens 24,414 ac.). Fruit growing is widely distributed but commercial orchards exist chiefly in (*a*) the Melbourne basin, mainly to the southeast, east and north; (*b*) the irrigated Murray lands (*v. inf.*). Apples, pears and northern fruits, including small (berry) fruits, are largely grown in the south, the subtropical varieties predominating in the northern areas (*v. inf. Statistical Survey: Agriculture*).

Irrigated Areas.—(Murray River and other) (*v. sup.:* Water Supply). The area cultivated under irrigation has steadily increased, the 517,903 ac. of 1939–40 representing an increase of over 111,000 ac. upon the area in 1926–27. An increasing proportion of the space is being devoted to the intensive growing of fodder crops (several crops per season) and to dairying and stock-fattening in association therewith (1939–40: pastures 60%, lucerne 10%, sorghum and other fodders 3% of total area = *c.* 420,000 ac. in all under fodder crops). Some wheat is also grown, the high yields (40 bu. or more per ac.) compensating for relatively expensive methods. Better known, perhaps, is the fruit production of the Murray river irrigation areas, especially those subtropical varieties (apricots, peaches, oranges, etc.; grapes, raisins, currants, etc.) which are favoured by the presence of good stiff (semi-retentive) soils, ground moisture, together with dryness, warmth and sunshine at the right periods. The industry flourishes particularly in the Mildura and Shepparton areas. The relative stability of production conditions, the suitability for "small" settlers, increasing co-operation in production and marketing have steadily attracted settlers. At the same time, production far exceeds home consumption and markets abroad are therefore essential for such commodities as raisins (47,328 tons in 1939–40) and currants (10,642 tons).

Pastoral Industries; Dairying, etc.—Partly in spite of, and partly because of, the general progress in agriculture, the pastoral and dairying industries are also expanding. Victoria now takes rank with New South Wales as one of the leading dairying states of the commonwealth. The industry is carried on in the irrigation areas (*v. sup.*) but mainly in the southern plains, from east to west of the state, where low and well-watered lands, a humid climate (upward of 30 in. rainfall) and market and export facilities exist (Melbourne, Portland, Warrnambool, etc.). Cheese and butter factories are numerous and places such as Colac and Terang in the southwest, Morwell and Bairnsdale in Gippsland, Kerang and Wangaratta in the north are dairying centres. Great attention is paid to scientific education and to improved methods of production, marketing, etc. Associated is the pig-rearing industry (bacon curing, etc.) and also bee and, increasingly, poultry keeping. Cattle (for slaughter) are grazed over wide areas and fattened in the southern agricultural districts, but the industry has a mainly domestic value (*e.g.*, of the 737,260 head slaughtered in 1939, the greatest number were for home consumption). Sheep-rearing has a far wider commercial significance, Victoria being one of the leading wool and mutton producers in Australia. The total number carried has risen steadily to *c.* 20,000,000 head in 1940, and the fact that *c.* 80% of the total is comprised in flocks of 500–5,000 head is evidence of the more intensive production methods referred to (*cf.* flocks of 20,000 and upwards: 1.53%). From the rougher and wetter lands sheep have been, for physical or eco-

nomic reasons, gradually excluded and 62% of the total number are now found in the Western, Wimmera and Northern divisions (Western: 31.2%, 50,100,000 lb. wool [1936–37]; Wimmera: 14.2%, 26,000,000 lb.; Northern: 17.0%, 28,600,000 lb.). The sheep lands, in fact, stretch in a broad band from southwest to northeast across the state and form part of the great sheep belt of eastern Australia which extends into the Riverina (New South Wales, *q.v.*) and beyond. The fleeces are of good average weight (7–8 lb.) and the wool, particularly that from the western plains, is clean, long and well-coloured, and is in great demand. Of the total production (1939–40: 179,125,526 lb.) about 22,000,000 lb. was taken by the Victorian textile, etc., mills and the remainder was exported. Woollen and knitting mills are situated in Melbourne, Geelong, Castlemaine, Ballarat, Warrnambool and other centres, and the industry is steadily expanding. Mutton and lamb export is conducted on a large scale. Of 6,900,000 head slaughtered in 1940, *c.* 45% were exported frozen from 13 freezing works, total exports amounting in 1940 to 43,100,000 lb. (£2,500,000). (*V.* also *inf. Statistical Survey: Production, Pastoral and Dairying, Manufacturing Industries, Trade.*)

Manufacturing Industries; Communications; Trade; etc.—Manufacturing industries in Victoria fall into three main classes—(*a*) those closely connected with primary production: sawmilling, cheese and butter making, bacon curing, meat freezing, fruit canning, etc.; (*b*) those of a rather more developed nature but still dependent upon primary production: woollen and hosiery mills, furniture-making, power production, etc.; (*c*) those of more purely secondary character often dependent, in whole or in part, upon imported raw or semi-manufactured materials (manufacture of motor vehicles, agricultural machinery, railway rolling stock, etc.). Many of these have been referred to above (*v.* also MELBOURNE and *inf., Statistical Survey: Manufacturing Industries*). Between 1917 and 1927 the factories and workers each increased by 37%, the value of output by 90%, and the horsepower employed by 178%.

Steam is still the chief motive power, but the number of factories using electricity has increased remarkably (1939–40: *steam,* 325 factories using 493,000 h.p.; *electric,* 7,861 factories using 400,000 h.p.), and the possibilities in connection with electricity have been indicated above.

Communications.—These, as a natural consequence of the relatively small area, high productivity, and also of the energy of the people, are on the whole better developed in Victoria than in any other Australian state (*e.g.,* Victoria had, in 1939–40, 54.43 mi. of railway per 1,000 sq.mi. of territory; Tasmania 29.02; New South Wales 20.07; Australia 9.40). Apart from mountainous and barren areas, there are few parts which are not readily accessible. Areas distant more than 10 mi. from a railway hardly exist except in the east and in some few parts in the west. Roads suitable for motor traffic are widespread. Railways (*v. inf.,* Statistical Survey) are virtually all state-owned, of 5′ 3″ gauge, and fall into the following main classes: (*a*) through routes connecting Melbourne with Sydney (via Albury, where a break to the 4′ 8½″ "standard" gauge of New South Wales occurs), and with Adelaide (via Ballarat, Serviceton and Wolseley: *see* SOUTH AUSTRALIA); (*b*) east-west intra-state lines serving the "Great (Southern) Valley" and the south coast from Warrnambool to the Snowy river (Gippsland); (*c*) an impressive system of lines running roughly parallel northeast, north, but mainly northwest, draining the northern plains, the Murray valley and the wheat lands of the northwest. These lines give a striking impression of purposeful striving and reaching forward, and this indeed they do to the extent of tapping the southwestern (trans-Murray) Riverina (*q.v.*) in New South Wales; (*d*) the denser metropolitan net around Melbourne and Port Phillip bay, now electrified in its suburban units. A fifth type is visible but is not strongly developed, viz., north-south lines draining the hinterlands to their nearest convenient ports (*e.g.,* Portland, Warrnambool). Melbourne is connected with Tasmania by submarine cable.

Trade.—Some details regarding trade have already been given and a survey is afforded below. (*See Statistical Survey: Trade.*) Victoria's trade amounts in general to 27–30% of that of the commonwealth. Of its exports wool, wheat, flour and butter are the most important, particularly wool. Victorian exports go chiefly to the British Isles, the United States, India and Ceylon and New Zealand.

Shipping and Ports.—v. inf., Statistical Survey. (Note that vessels there mentioned do not include River Murray steamers.)

Population.—Statistics regarding the population of the state are given below (*see Statistical Survey*). The great preponderance of population in the metropolitan area is worthy of note. Some indications of the reasons will be found above (*see* also MELBOURNE) and the growth of manufacturing industries in this area has been referred to. Outside of Melbourne the most densely populated parts are:

(1) the surroundings of Melbourne comprised within the rim of the Melbourne basin and around the shores of Port Phillip, the latter mainly seaside and residential settlements on the east—Mordialloc (1933: 9,216), Mornington, Sorrento—and, on the west, industrial areas, as well as Geelong (pop. 39,223; *q.v.*); (2) Ballarat (*q.v.*) and Bendigo (*q.v.*) and the districts for which they serve as centres; (3) the southern coastal portions, particularly from Geelong to Warrnambool and southern and central Gippsland.

The remainder of the state is more sparsely settled, but the main belts and concentrations extend northeastward along the main overland railway line: Seymour, Benalla, Wangaratta (4,795), Albury (*q.v.*)—formerly mining, now mainly agricultural and pastoral centres—and along the Murray, irrigation settlements, *e.g.,* Mildura (6,617). The west is much more evenly and also more sparsely settled, densities continually decreasing toward the west except that, as elsewhere and in general, the railway lines mark zones of heavier population and themselves usually follow belts of better lands (*cf.* the striking instance of the Ouyen–Pinnaroo line which follows the belt of sub-surface waters). A fairly clear indication of the character of the rural settlements in Victoria will be conveyed by the general economic description given above. By far the greater number are agricultural, dairying or irrigation centres, often a combination of several types (Hamilton 5,786; Stawell 4,747; Horsham 5,273). It is noteworthy that Victoria, with *c.* 21.83 persons per sq.mi., is by far the most densely populated state of the commonwealth (*cf.* Tasmania 9.27; New South Wales 9.01; commonwealth 2.38).

Statistical Survey.—*Area and Land Occupation:* area 87,884 sq.mi. (56,245,760 ac.) 2.90% commonwealth; wholly within the temperate zone. Coastline: 680 mi.—1 mi. per 129 sq.mi. *Land Occupation* (1939): alienated 27,762,315 ac.; in process of alienation 5,379,928 ac.; held under lease or license 8,468,444 ac.; occupied by the crown 11,894,963 ac. (reservations for roads and other public purposes 7,695,269 ac.; water frontages, beds of rivers, lakes, etc., unsold land in cities, towns and boroughs 4,199,694 ac.); unoccupied 2,740,150 ac. Area under cultivation (1939–40) 7,379,200 ac.

Population (census of June 1933) 1,820,360 (males 903,399; females 916,961), which comprised 27.5% of the total for the commonwealth and produced an average density of 20.7 per sq.mi. In 1926 the birth rate was 20.84 and the death rate only 9.63 per 1,000.

Metropolitan Melbourne, covering with its suburbs 165,666 ac., had a population of 991,934 in 1933, or 54.4% of the entire state. The growth of the city was much more rapid than that of the remainder of the state. Estimated population in 1940 was 1,918,660.

Occupations (census 1933, total pop. 1,820,360); breadwinners 766,597 of whom: industrial 277,552; primary producers 151,819 (agricultural 135,699; mining and quarrying 8,866); commercial 174,189 (including 57,247 in transport and communications); professional 64,042; domestic 69,365. There were 920,728 dependents distributed among these groups.

Production (1939–40) (all figures given are net values): total £122,155,000; manufactures (added value), £74,028,000; total rural, £43,837,000 (this included agriculture £11,907,000; pastoral £16,434,000; dairying £12,333,000; poultry £3,100,000; bee-farming £63,000). Total non-rural, £4,290,000 (this included

trapping £871,000; forestry £1,109,000; fisheries, local £199,000; mines and quarries £2,111,000). Production: value per caput: total (1939–40): £64.13.0. Manufactures: £39.3.7. Total primary (the sum of rural and non-rural): £25.9.5 (agriculture £6.6.0; pastoral £8.14.0; dairying £6.10.6; poultry £1.12.10; bee-farming £0.0.8; trapping £0.9.3; forestry £0.11.9; fisheries £0.2.1.; mining £1.2.4).

Manufacturing Industries (1939–40): factories 9,215; workers 212,461; total (net) value of output £174,304,401. *Food and drink:* factories 1,471 (including butter 167; jam, etc. 29; bacon curing 18; meat freezing, etc. 9); workers 28,000; output £49,969,000. *Clothing and textiles:* 2,171 (including woollen mills 56; hosiery 231; boots, etc. 640); 63,400; £37,200,000. *Metal, machinery,* etc.: 2,497 (including engineering 395; iron and foundries 161 [1938–39]; agricultural implements 79; railway workshops 25); 54,000; £33,930,000. *Printing,* etc.: 673; 14,000; £9,883,000. *Work in wood:* 716 (including sawmills 320; joinery 199); 7,900; £6,012,196. *Heat, light, power:* 117 (including electric light 78); 2,323; £4,160,000.

Mining and Quarrying (1939): total (1939–40) £2,111,000. Stone £552,888; coal, black (364,895 tons) £259,814; brown (3,651,014 tons) £385,952; gold £1,533,899.

Agriculture (1939–40): area cultivated 7,379,767 ac. (*cf.* 1895–1905, *c.* 3,550,000 ac. [ave.]; 1905–15, 5,000,300 ac.; 1920–25, *c.* 6,900,000 ac.). Number of rural holdings: total (1929–30) 74,161; (1939–40) 72,557. Total area: (1929–30) 38,338,000 ac.; (1939–40) 40,653,000 ac. Production: wheat 2,827,000 ac. (56.5% of area cropped); 45,054,000 bu. (ave. 12–17 bu. per ac.); £8,470,000. *Hay* 1,205,000 ac.; 1,820,000 tons; £3,600,000. *Oats* 439,600 ac.; 8,280,000 bu.; £862,000. *Potatoes* 32,177 ac.; 88,000 tons; £934,000. *Vines c.* 3,000 growers; 42,600 ac.; 4,107 tons table grapes (wine 1,126,350 gal.; raisins 47,328 tons, *c.* £2,500,000; currants 10,642 tons).

Gardens and Orchards 94,000 ac. (mainly apples, pears, peaches, oranges, apricots, plums), value, including table grapes, *c.* £1,000,000. *Market gardens* £1,342,770.

Irrigation (1939–40): 517,903 ac. (increase of *c.* 70,000 ac. over average for previous five years).

Pastoral and Dairying (1940): *livestock:* horses 326,000; dairy cows 917,000; other cattle 870,000; sheep 18,251,000; pigs 297,655. Density of livestock per sq.mi. (est.): 1911, 302; 1927, 319; 1939, 235. *Production: stock slaughtered* (1940): sheep 6,980,000; cattle 400,000; pigs 422,000. *Dairying* (1940): owners 55,438; cows 917,000; butter 165,000,000 lb.; cheese, *c.* 24,000,000 lb. *Wool* (1939–40): clip 147,800,000 lb.; wool on skins *c.* 31,000,000 lb.; total wool *c.* 179,100,000 lb., £10,497,000 (1923–24—1926–27: £7,083,000–£11,444,000). Fleece (ave.) 8.86 lb.

Honey: 70,000 hives; 2,750,000 lb. honey; 35,630 lb. wax; £77,000.

Forestry and Fisheries: fisheries (1939–40): 852 boats; 1,377 men; catch *c.* £450,000. *Forests:* wooded area: 5,500,000 ac.; dedicated forests 4,860,145 ac.; sawmills (1939–40) 323; workers 4,095; Victorian timber cut 119,600,000 super ft., £981,912 (*v. sup.: Production*).

Trade, Commerce, Communications: trade (1938–39, overseas only): total £62,065,000. Excess of imports over exports £4,600,000. *Exports* £30,819,000=*c.* £16 per caput; 25% of commonwealth total: wool £9,500,000 (179,100,000 lb.); hides and skins £1,548,000; frozen meats £3,249,000; wheat £932,000 (5,000,000 bu.); flour £1,607,000 (256,000 tons); butter £3,245,000 (65,400,000 lb.). *Imports* (1926–27) £55,561,000=£32.9.2 per caput; 33.7% of commonwealth total: textiles, clothing, etc. £17,073,000; metals, machinery, motors, etc. £15,700,000; oils £3,204,500; foodstuffs £3,187,000; stationery, paper, etc. £2,707,000; rubber and leather manufactures £2,411,000; timber and worked wood £1,947,000; drugs and chemicals £1,900,000.

Shipping (1938–39, overseas and interstate): Vessels entered 2,979 with a total tonnage of 8,537,085 (188 vessels from overseas with a tonnage of 686,021; 2,243 in interstate shipping with a tonnage of 4,751,032; 548 from overseas via other Australian states with a tonnage of 3,100,032); vessels cleared 2,989, the majority in interstate shipping.

Ports (1926–27): *Melbourne:* 4,000 vessels (7,325,000 tons), of which overseas 765 (3,296,000 tons); interstate 1,770 (3,625,000 tons); local (within state) 1,466 (403,300 tons). Cargo: discharged 3,754,000 tons (1,853,000 tons overseas); shipped 1,501,300 tons (826,700 tons overseas). *Geelong:* 750 vessels (770,900 tons); cargo discharged 279,500 tons; shipped 321,000 tons. *Portland:* 108 vessels (152,000 tons); discharged 9,800 tons; shipped 44,950 tons.

Warrnambool: 150 vessels (49,000 tons); discharged 23,700 tons; shipped 4,200 tons. In 1938–39 8,600,000 tons of shipping entered Melbourne, and 837,000 tons entered Geelong. Total cargo discharged in Victoria was 4,600,000 tons.

Railways (1940): state-owned lines 4,766 mi. open. Net profit on working £1,809,274. Loss (after meeting interest charges) £396,201.

Finance: public revenue (1939–40) £29,480,781; public expenditure £29,474,520; public debt £180,549,968; (average rate of interest payable *c.* 4.91%; debt per caput [1940] £94.16.6.) Total taxation (1938–39) £35,794,096. Revenue per caput (1939–40) £15.11.11; expenditure per caput £15.11.9. Accumulated deficiency £7,953,429. Bank deposits (total, 1940) *c.* £150,000,000. Joint stock banks: assets £155,000,000; liabilities £133,000,000; deposits £131,000,000. State savings bank (1940): depositors 1,685,145; balances £67,361,000. Savings banks (state, commonwealth, school) (1940): deposits £79,145,000 (£41.11.4 per caput of population).

Social: Schools (1939): total 3,253; scholars *c.* 320,000. State 3,100; teachers *c.* 8,000; scholars 260,000; cost per scholar *c.* £13. Private 514; 2,719; 75,400.

University of Melbourne: students 4,150; receipts: £278,197; expenditure £363,996.

State Expenditure (1939–40) upon: education £3,480,832 (£1.16.10 per caput of population); charitable institutions £3,510,172; pensions, etc. £1,041,066. (O. H. T. R.; X.)

HISTORY

The first discoverer of Victoria, formerly a part of New South Wales (*q.v.*) was Captain Cook in command of H.M.S. "Endeavour," who sighted Cape Everard on April 19, 1770, a few days prior to his arrival at Botany bay. The first persons to land in Victoria were the supercargo and a portion of the crew of the merchant ship "Sydney Cove" which was wrecked at the Furneaux Islands in Bass strait on Feb. 9, 1797. In 1802, Port Phillip was discovered by Lieut. Murray, and in 1804 Lieut.-Col. Collins attempted to form a settlement there. After three months he was compelled to abandon the scheme, and to remove his party to Van Diemen's Land. In 1826 a convict establishment was attempted by the government of New South Wales at Settlement Point but it was soon abandoned. In 1834 Edward and Francis Henty, who had taken part in the original expedition to Swan river, Western Australia, and afterwards migrated to Van Diemen's Land, crossed Bass strait, established a shore whaling station at Portland bay, and formed sheep and cattle stations on the river Wannon and Wando rivulet, near the site of the present towns of Merino, Casterton and Coleraine. In 1835 a number of flock owners in Van Diemen's Land purchased through Batman from the aborigines a tract of 700,000 ac. on the shores of Port Phillip. The sale was repudiated by the British government. Batman, however, remained at Port Phillip, and commenced farming within the boundaries of the present city of Melbourne. He was followed by John Pascoe Fawkner and other settlers from Van Diemen's Land, who occupied the fertile plains of the new territory. In 1836 Captain Lonsdale was sent to Melbourne by the government of New South Wales to act as resident magistrate in Port Phillip.

The first census taken in 1838 showed that the population was 3,511, of whom 3,080 were males and 431 females. In 1841, owing to the constant immigration from Great Britain, the population had increased to 11,738. Melbourne was incorporated as a town in 1842, and was raised to the dignity of a city in 1847. The third census (which was taken in 1846) showed a population of 32,870.

The elective element was introduced into the legislative council of New South Wales in 1842, in the proportion of 24 members to 12 nominated by the Crown, and the district of Port Phillip, including Melbourne, returned six members. But the colonists were not satisfied with government from and by Sydney; an agitation in favour of separation commenced, and in 1851 Victoria was formed into a separate colony with an executive council appointed by the Crown, and a legislative council, partly elective and partly nominated, on the same lines as that of New South Wales. The population at that date was 77,435. Gold was discovered a few weeks after the colony had entered upon its separate existence, and a large number of persons were attracted to the mines, first from the neighbouring colonies and subsequently from Europe and America.

Local self-government was introduced in 1853, and the legislature found time to discuss a new constitution, which not only eliminated the nominee element from the legislature, but made the executive Government responsible to the people. The administration of the goldfields was not popular, and the miners were dissatisfied at the amount charged for permission to mine for gold, and at there being no representation for the goldfields in the local legislature. The discontent culminated at Ballarat in Dec. 1854, in riots in which there was a considerable loss of life both amongst the miners and the troops. Eventually, an export duty on gold was substituted for the licence fee, but every miner had to take out a right which enabled him to occupy a limited area of land for mining and also for residence. The new constitution was proclaimed in 1855. The crown lands were occupied by graziers, termed locally "squatters," who held them under a licence renewable annually at a low rental. These licences were very valuable, and the goodwill of a grazing farm or "run" commanded a high price. Persons who desired to acquire freehold for the purpose of tillage could only do so by purchasing the land at auction, and the local squatters, unwilling to be deprived of any portion of a valuable property, were generally willing to pay a price per acre with which no person of small means desirous of embarking upon agricultural pursuits could compete. The result was that although the population had increased in 1861 to 540,322 the area of land under crop had not grown proportionately, and Victoria was dependent upon neighbouring colonies and even more distant countries for a considerable portion of its food. A series of Land Acts was passed, the first in 1860, with the view of encouraging a class of small freeholders. The principle underlying all these laws was that residence by landowners on their farms, and their cultivation, were more important to the State than the sum realized by the sale of the land. The policy was only partially successful, and by a number of ingenious evasions a large proportion of the best land in the colony passed into the possession of the original squatters. But a sufficient proportion was purchased by small farmers to convert Victoria into a great agricultural country, and to enable it to export large quantities of farm and dairy produce.

The greater portion of the revenue was raised by the taxation through the customs of a small number of products, such as spirits, tobacco, wine, tea, coffee, etc. But an agitation arose in favour of such an adjustment of the import duties as would protect the manufactures which at that time were being commenced. A determined opposition to this policy was made by a large minority in the Assembly, and by a large majority in the Council (the "Upper House") but by degrees the democratic party triumphed. Notwithstanding these struggles the population of the colony steadily increased, and the legislature found time to pass some measures which affected the social life and the commercial position of the colonies. State aid to religion was abolished, and divorce was made comparatively easy. A system of free, compulsory and secular primary education was introduced. The import duties were increased and the transfer of land was simplified. In 1880 a fortnightly mail service via Suez between England and Melbourne was introduced, and in the following year the census showed a population of 862,346. During the same year the lengthy dispute between the two houses of parliament was brought to an end by the passage of an Act which reduced the qualifications for members and the election of the legislative council, shortened the tenure of their seats, increased the number of provinces to 14 and the number of members to 42. In 1883, a Coalition Government, in which the Liberal or Protectionist and the Conservative or Free-trade Party were represented, took office, and with some changes remained in power for seven years. During this political truce several important changes were made in the constitution. An Act for giving greater facilities for divorce was passed, and with some difficulty obtained the Royal assent. The Victorian railways were handed over to the control of three commissioners, who to a considerable extent were made independent of the Government, and the civil service was placed under the supervision of an independent board. In 1890 all the Australian colonies, including New Zealand, sent representatives to a conference at Melbourne, at which resolutions were passed in favour of the establishment of a National Australian Convention, to consider a scheme for the Federal constitution. This Convention met in Sydney in 1891 and took the first step towards federation (*see* AUSTRALIA).

In 1891 the Coalition Government resigned and a Liberal administration was formed. An Act passed in that year placed the railways again under the control of the Government. Measures of a democratic and collectivist tendency thereafter obtained the assent of the legislature. The franchise of property-holders not resident in an electorate was abolished and the principle of "one man one vote" was established. Acts were passed sanctioning old age pensions; prohibiting shops, except those selling perishable goods, from keeping open more than eight hours; compelling the proprietors to give their assistants one half-holiday every six days; preventing persons from working more than 48 hours a week; and appointing for each trade a tribunal composed of an equal number of employers and employed to fix a minimum wage.

Victoria enjoyed a large measure of prosperity during the later '80s and earlier '90s, and its financial prosperity enabled the Government to expend large sums in extending railway communication to almost every locality and to commence a system of irrigation. The soil of Victoria is on the whole more fertile than in any other state on the mainland of Australia. The rainfall is more equable than in any portion of Australia, but the northern and north-western districts are subject to droughts, and costly irrigation schemes have not proved as successful as was expected. In 1892 the prosperity of the colony was checked by a great strike which for some months affected production, but speculation in land continued for some time longer, especially in Melbourne, which at that time contained nearly half the population (500,000 out of a total of 1,140,105). In 1893 there was a collapse. The value of land declined enormously, hundreds of persons believed to be wealthy were ruined, and there was a financial panic, which caused the suspension of all the banks, with the exception of the Australasia, the Union of Australia, and the New South Wales. Most of them resumed payment; but three went into liquidation. It was some years before the normal condition of prosperity was restored, but the great resources of the colony and the energy of its people discovered new markets, and new products for them, and enabled them materially to increase the export trade. In 1908 female suffrage was instituted. Members of the legislative assembly need no property qualification and clergymen of any denominations are not allowed to be members of the legislative council or legislative assembly. Victoria was federated with all the other Australian States into the Commonwealth of Australia on Jan. 1, 1901. (*See* also AUSTRALIA.)

VICTORIA, Brazil: *see* VITÓRIA.

VICTORIA, capital of British Columbia, Canada, and principal city of Vancouver island, in the southeast corner of which it is finely situated, lat. 48° 25′ N., long. 123° 22′ W. It is on the Canadian National railway, and is the terminus of a line from Esquimalt and Nanaimo and the coast beyond. There is also a line across the Saanich peninsula. Victoria, which is a fine city with many gardens, the oldest in the province, has a splendid parliament building, the large Dominion astrophysical observatory, and a branch of the University of British Columbia. The city is a favourite tourist resort. The population was 44,068 in

1941. Pop., Greater Victoria, to include Oak Bay, Esquimalt and Saanich, is 77,580. The port, which is the fourth in Canada, is fine and well-equipped. Steamers run daily to points on the British Columbian coast, and to Australia and the east, and it is the headquarters of the Royal Canadian navy. The city is an industrial centre, the principal products being canned fish, biscuits, timber, soap, machinery, furniture, boots and clothing, bricks and cement. There is a large trade in coal, timber, canned salmon, etc. Until 1905, the headquarters of the British Pacific squadron were at Esquimalt, a fine harbour 3 mi. W. of Victoria. It has graving and dry docks, a naval college, and is defended by modern fortifications. Victoria is connected by air service with Vancouver. Victoria originated as a post and base of supply of the Hudson's Bay company.

VICTORIA, a city of Texas, U.S.A., 125 mi. S.W. of Houston, on the Guadalupe river, 28 mi. from Matagorda bay (Gulf of Mexico); the county seat of Victoria county. It is on federal highways 59, 77 and 87. It is served by the Missouri Pacific and the Southern Pacific railways. The population was 11,566 in 1940. Victoria is the trade centre of a rich agricultural region in which cotton is still the leading crop. The army maintains an advanced pursuit school with a personnel of more than 2,000 at Victoria. The Intracoastal canal from New Orleans to Corpus Christi had its inception in Victoria in 1906. Victoria was settled by the Spanish in 1824, and was incorporated as a city of the republic of Texas in 1837.

VICTORIA, LAKE, the largest lake in Africa and chief reservoir of the Nile, lying between 0° 20′ N. to 3° S. and 31° 40′ to 34° 52′ E. Among the fresh-water lakes of the world it is exceeded in size by Lake Superior only and has an area of over 26,000 sq.mi. In shape it is an irregular quadrilateral, but its shores, save on the west, are deeply indented. Its greatest length from north to south is 250 mi., its greatest breadth 200 mi. Its coast-line exceeds 2,000 mi. It fills a shallow depression in the central part of the great plateau which stretches between the western and eastern rift valleys (*see* AFRICA: *Geography*), and has an elevation of about 3,720 ft. above the sea. Its greatest ascertained depth is a little over 270 ft., and it is remarkable for the severe and sudden storms which render navigation dangerous. It contains many archipelagos, the majority being near the coast line. The lake is full of reefs, many just below the surface of the clear water. It is abundantly stocked with fish. The land surrounding the lake consists of gneiss, quartz and schistose rocks, covered with marl and red clay and in the valleys with loam.

Shores and Islands.—The shores of the lake present varied aspects. The western coast, which contains no large indentations, is, in the south, backed by precipices 300 ft. high, behind which rise downs to three times the height of the cliffs. Going north, the hills give way to papyrus and ambach swamps, which mark the delta of the Kagera. Beyond the delta the hills reappear, and increase in height, till at the northwest corner they rise some 500 ft. above the water. This western shore is marked by north to south faults which run parallel to the lake at a short distance inland. The northern coast is very deeply indented and is marked by rocky headlands jutting into the waters. This highland is narrow, and streams which rise on its northern face drain north away from the lake. On a promontory about 30 mi. east of the Katonga is Entebbe, the port and administrative centre of the Uganda Protectorate. The chief indentations on the north side are Murchison bay and Napoleon gulf. Napoleon gulf itself is deeply indented, one bay, that of Jinja, being the outlet of the Nile, the water here forcing its way over the Ripon falls through the rock-bound shore of the lake. The northeast corner of the lake is flat and bare. A narrow channel leads into Kawirondo gulf, which, with an average width of 6 mi., extends for 45 mi. to Kisumu, the terminus of the railway from the east coast of Africa. Hills dominate the south shore of the gulf and behind them is the Kasagunga range. Proceeding south the shore trends generally southwest, is marked by many deep inlets with bold bluffs and by mountains. At the southeast corner is Speke gulf, and at the southwest corner Emin Pasha gulf. Here the coast is barren and hilly, while long ridges of rock run into the lake.

Ukerewe, N. of Speke Gulf, is the largest island—almost a peninsula. Its wooded hills rise 650 ft. above the lake. It is populated with natives and some whites. At the northwest corner of the lake is the Sessi archipelago, consisting of 62 islands. The largest island in this group is Bugala. Most of these islands are forested, and some of them attain considerable elevation. Their scenery is of striking beauty. Buvuma Island is at the entrance of Napoleon gulf and there are numerous other islands, the chief being Bugaia, Lolui, Rusinga and Mfwangani. The islands are of ironstone formation overlying quartzite and crystalline schists.

Rivers.—The Kagera, the largest and most important of the lake affluents, rises east of Lake Kivu, and enters the west side of the lake just north of 1° S. It is the most remote headstream of the Nile (*q.v.*). The other rivers entering Lake Victoria from the west are the Katonga and Ruizi, both north of the Kagera. Between the Katonga and the Nile outlet, the rivers which rise close to the lake drain away northward, the watershed being the lake shore. On the northeast several streams reach the lake—notably the Sio, Nzoia and Lukos (or Yala). On the east the Mara Dabagh enters the lake between 1° and 2° S. It is, next to the Kagera, the largest of the lake tributaries. On the southern shores a number of short rivers drain into the lake. The only outlet of the lake is the Nile.

The area drained by the lake covers, with the lake itself, 92,240 sq. miles. A detailed survey was made of the lake by Sir William Garstin. (*See* British Bluebook, Egypt, 1902.)

Discovery and Exploration.—The quest for the Nile sources led to the discovery of the lake by J. H. Speke in 1858, and he named it Victoria in honour of the queen of England. In 1862 Speke and his companion, J. A. Grant, partially explored the northwest shore, leaving the lake at the Nile outlet. Great differences of opinion existed as to its size until its circumnavigation in 1874 by H. M. Stanley. The invitation sent by King Mtesa of Uganda through Stanley to the Christian missionaries led to the dispatch from England in 1876 of the Rev. C. T. Wilson, to whom we owe our first detailed knowledge of the lake. Wilson and Lieutenant Shergold Smith, R.N., made the first voyage across the lake in 1877. Smith and O'Neill, both members of the Church Missionary society, were murdered in the same year on Ukerewe Island. In 1889 Stanley further explored the lake, discovering Emin Pasha gulf, the entrance to which is masked by several islands. In 1890 the ownership of the lake was divided by Great Britain and Germany, the first degree of south latitude being taken as the boundary line. The southern portion, which fell to Germany, was visited and described by scientists of that nation. At the instance of the British foreign office a survey of the northern shores of the lake was carried out in 1899–1900 by Commander B. Whitehouse, R.N. The same officer, in 1903, undertook in agreement with the German government a survey of the southern shores. Whitehouse's work led to considerable modification of the previously accepted maps. He discovered numerous islands and bays whose existence had previously been unknown.

Before 1896 navigation was confined to Arab dhows, which traded between the south end of the lake and Uganda, and to canoes. In that year, however, a small steamer, the "Ruwenzori" was launched on the lake by a Zanzibar firm, while in 1900 a somewhat larger steamer, the "William Mackinnon," built in Glasgow and afterward taken over by the British government, made its first trip on the lake. There is now regular steamer service on the lake, weekly from Kisumu to Uganda ports and back, weekly round the lake and fortnightly between the Sessi Islands and Entebbe. The lake is connected with the coast by rail from Kisumu to Mombasa, and there is a line from Jinja northwards to Namasagali. The lake is now entirely surrounded by British territory, the southern half being in Tanganyika territory, the northern in the Uganda protectorate and a small portion of the east coast is within the confines of Kenya colony.

BIBLIOGRAPHY.—*See* NILE and UGANDA and the British Bluebook, Egypt No. 2 (1904). This report, which is mentioned above also, summarizes the information of previous travellers, whose works are quoted. In 1908 the British admiralty published a chart of the lake (scale 4 in. to the mile). *See* also E. G. Ravenstein, "The Lake-level

of the Victoria Nyanza," *Geog. Journ.* Oct. 1901; Sir H. H. Johnston, *The Uganda Protectorate* (London, 1902).

VICTORIA FALLS, rivalled only by Niagara in grandeur, from the most remarkable feature of the river Zambezi, central Africa. The falls are about midway in the course of the Zambezi in 17° 51′ S., 25° 41′ E. For a considerable distance above the falls the river flows over a level sheet of basalt, its valley bounded by low and distant sandstone hills. Its clear blue waters are dotted with numerous tree-clad islands. These islands increase in number as the river, without quickening its current, approaches the falls, whose nearness is indicated only by a veil of spray. At the spot where the Zambezi is at its widest—over 1,860 yd.—it falls abruptly over the edge of an almost vertical chasm with a mighty roar and a cloud of sun-lit spray. From 62 to 100 million gallons per minute fall over the edge.

The chasm, extending over the whole breadth of the river, is wider than Niagara, though broken, and it is more than twice the depth, a measurement varying somewhat, but attaining 420 ft. in the centre. Unlike Niagara the water does not fall into an open basin but is arrested at a distance of from 80 to 240 ft. by the opposite wall of the chasm. Both walls are of the same height, so that the falls appear to be formed by a huge crack in the bed of the river. The only outlet is a narrow channel cut in the barrier wall at a point about three-fifths from the western end of the chasm, and through this gorge, not more than 100 ft. wide, the whole volume of the river pours for 130 yd. before emerging into an enormous zigzag trough (the Grand Canyon) which conducts the river past the basalt plateau. The tremendous pressure to which the water is subjected in the confinement of the chasm causes the perpetual mist which rises over the precipice.

The fall is broken by islands on the lip of the precipice into four parts. Close to the right bank is a sloping cataract 36 yd. wide, called the Leaping Water, then beyond Boaruka Island is the Main fall in two parts, 573 and 525 yd. wide beyond which is Livingstone Island and the Rainbow falls 600 yd. wide. At both these falls the rock is sharp cut and the river maintains its level to the edge of the precipice. At the left bank of the river is the Eastern Cataract, a millrace resembling the Leaping Water. From opposite the western end of the falls to Danger point, which overlooks the entrance of the gorge, the escarpment of the chasm is covered with great trees known as the Rain forest; looking across the gorge the eastern part of the wall (the Knife Edge) is less densely wooded. At the end of the gorge the river has hollowed out a deep pool, named the Boiling Pot. It is some 500 ft. across; its surface, smooth at low water, is at floodtime troubled by slow, enormous swirls and heavy boilings. Thence the channel turns sharply westward, beginning the great zigzag mentioned. This grand and gloomy canyon is over 40 mi. long. Its almost perpendicular walls are over 400 ft. high, the level of the escarpment being that of the lip of the falls. A little below the Boiling Pot, and almost at right angles to the falls, the canyon is spanned by a bridge (completed in April 1905) which forms a link in the Cape to Cairo railway scheme. This bridge, 650 ft. long, with a main arch of 500 ft. span, is slightly below the top of the gorge. The height from low-water level to the rails is 420 ft.

The volume of water borne over the falls varies greatly, the level of the river in the canyon sinking as much as 60 ft. between the full flood of April and the end of the dry season in October. When the river is high the water rolls over the main falls in one great unbroken expanse; at low water (when alone it is possible to look into the grey depths of the great chasm) the falls are broken by crevices in the rock into numerous cascades.

The falls are in the territory of Rhodesia. They were discovered by David Livingstone on the 17th of November 1855, and by him named after Queen Victoria of England. Livingstone approached them from above and gained his first view of the falls from the island on the lip now named after him. In 1860 Livingstone, with Dr. (afterwards Sir John) Kirk, made a careful investigation of the falls, but until the opening of the railway from Bulawayo (1905) there were but few visitors. The land in the vicinity of the falls is preserved by the Rhodesian government as a public park.

BIBLIOGRAPHY.—*See* Livingstone's *Missionary Travels and Researches in South Africa* (1857) for the story of the discovery of the falls, and the *Popular Account of Dr. Livingstone's Expedition to the Zambesi and its Tributaries 1858–1864* (1894) for a fuller description of the falls and a theory as to their origin. In the *Geographical Journal* Jan. 1905, A. J. C. Molyneux on "The Physical History of the Victoria Falls," gives photographs and bibliography. Consult also "The Gorge and Basin of the Zambesi below the Victoria Falls," by G. W. Lamplugh in the *Geog. Jour.* (1908), vol. xxxi.

VICTORIA REGIA, scientific name of the giant water-lily of the Amazon, the leaves of which may be 2 metres across, with the edges turned up to a height of several centimetres. On the lower surface, the projecting ribs bear spines. The flowers are large and white, turning pinkish with age. The plant is widely cultivated and has been introduced into Java and elsewhere. The roasted fruit is eaten in Brazil. There are two other species of the genus, also South American. (*See* WATER-LILY.)

VICTORINUS, GAIUS MARIUS (4th century A.D.), Roman grammarian, rhetorician and Neoplatonic philosopher, an African by birth, lived during the reign of Constantius II. He taught rhetoric at Rome (one of his pupils being Jerome) and in his old age became a convert to Christianity. His conversion is said to have greatly influenced that of Augustine. When Julian published an edict forbidding Christians to lecture on polite literature, Victorinus closed his school. A statue was erected in his honour as a teacher in the Forum Trajanum.

The treatise *De Definitionibus* (ed. T. Stangl in *Tulliana et Mario-Victoriniana,* Munich, 1888) is probably by him and not by Boëtius, to whom it was formerly attributed. His manual of prosody, in four books, taken almost literally from the work of Aphthonius, is extant (H. Keil, *Grammatici Latini,* vi). It is doubtful whether he is the author of certain other extant treatises attributed to him which will be found in Keil. His commentary on Cicero's *De Inventione* (in Halm's *Rhetores Latini Minores,* 1863), is very diffuse, and is itself in need of commentary. His extant theological writings, which will be found in J. P. Migne, *Cursus Patrologiae Latinae,* viii, include commentaries on *Galatians, Ephesians* and *Philippians; De Trinitate contra Arium; Ad Justinum Manichaeum de Vera Carne Christi;* and a little tract, *The Evening and the Morning were one day.* The genuineness of the last two is doubtful, however, and some Christian poems under Victorinus' name are probably not his either.

See G. Geiger, *C. Marius Victorinus Afer, ein neuplatonischer Philosoph* (Metten, 1888); G. Koffmann, *De Mario Victorino philosopho Christiano* (Breslau, 1880); R. Schmid, *Marius Victorinus Rhetor und seine Beziehungen zu Augustin* (Kiel, 1895); Gore in *Dictionary of Christian Biography,* iv; M. Schanz, *Geschichte der römischen Litteratur,* iv, 1 (1904); Teuffel, *Hist. of Roman Literature* (Eng. trans., 1900), 408.

VICTOR-PERRIN, CLAUDE, DUKE OF BELLUNO (1764–1841), marshal of France, was born at La Marche (Vosges) on Dec. 7, 1764. In 1781 he entered the army as a private soldier, and after ten years' service he received his discharge and settled at Valence. Soon afterwards he joined the local volunteers, and distinguishing himself in the war on the Alpine frontier, in less than a year he had risen to the command of a battalion. He served at Toulon (1793), in the Italian campaign of 1796–97, in La Vendée, and then in Italy at Marengo. In 1802 he was governor of the colony of Louisiana for a short time, in 1803 he commanded the Batavian army, and in 1805–6 was French plenipotentiary at Copenhagen. On the outbreak of hostilities with Prussia he joined the V army corps (Marshal Lannes) as chief of the general staff. He distinguished himself at Saalfeld and Jena, and after Friedland where he commanded the I. corps Napoleon gave him the marshalate. After the peace of Tilsit he became governor of Berlin, and in 1808 he was created duke of Belluno. In the same year he was sent to Spain, where he took a prominent part in the Peninsular War (especially at Espinosa, Talavera, Barrosa and Cadiz), until his appointment in 1812 to a corps command in the invasion of Russia. Here his most important service was in protecting the retreating army at the crossing of the Beresina. He took an active part in the wars of 1813–14, till in February of the latter year he had the misfortune to arrive too late at Montereau-sur-Yonne. The result

was a scene of violent recrimination and his supersession by the emperor, who transferred his command to Gérard.

Victor now transferred his allegiance to the Bourbons, and in Dec. 1814 received from Louis XVIII. the command of the second military division. In 1815 he accompanied the king to Ghent, and on the second restoration he was made a peer of France. He was war minister in 1821–23. In 1830 he was major-general of the royal guard, and after the revolution of that year he retired altogether into private life. He died in Paris on March 1, 1841.

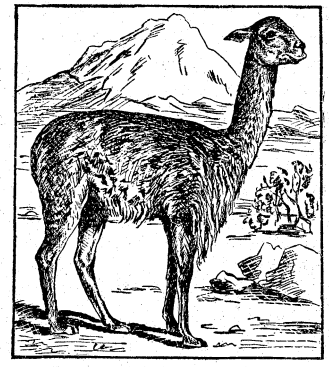
His papers for the period 1793–1800 have been published (Paris, 1846).

VICUÑA, a term applied both to a distinctive variety of wool, and also to a special kind of "finish" given to certain varieties of woollen textures. Vicuña wool is the fleece obtained from the vicuña (*q.v.*), a wild relative of the llama (*q.v.*) inhabiting the mountainous districts of Chili and Peru. This type of wool is distinguished for its remarkably long, fine, soft and lustrous character for which it is greatly prized. These properties adapt it eminently for the production of woollen and worsted textures that require a soft and full "handle" or "feel," and also for the development of a "nap."

Vicuña fabrics comprise several varieties of woollen and worsted textures, which are of the character of serge (*q.v.*), excepting that they are more supple, softer and fuller, and of a more subdued lustre than true serge textures. This is partly owing to the different character of wool employed in their manufacture, as well as to the method of finishing. Like serges, also, vicuña fabrics are usually based on the simple twill weave structures and employed as dress and costume materials and suitings.

Vicuña fabrics comprise two distinct types of textures, viz.: (1) simple structures for the lighter and medium textures suitable for women's wear, and light suitings and coatings for men's summer wear; and (2), double-cloth structures for the heavier and stronger textures suitable for men's overcoatings. This class is produced either from two-fold worsted both for warp and weft, or from two-fold worsted warp, and single worsted or woollen weft, for softer textures. One example of the latter class is woven with the 5-end venetian (double-stitch 5-end warp satin) weave, and a 10-end sateen (weft-face) back; while a second example is woven with the four-end ($\frac{2}{2}$) twill face weave, and with the plain weave on the back, which produces a relatively stronger and better wearing cloth.

To obtain the true "vicuña" handle, the routine of the finishing process is varied to suit the character of yarn employed, the weave structure and the "setting" of the fabric, *i.e.*, the number of warp and weft threads per inch in the fabric. The procedure then consists of knotting and mending; crabbing or blowing with steam, to set the fabric; scouring; milling; dyeing; washing-off; tentering; raising (wet); cutting; brushing; steaming or dewing; shrinking and pressing (rotary machine). An alternative method is to raise the cloth previous to milling. (H. N.)



CABRERA AND YEPES, MAMIFEROS SUD-AMERICANOS

VICUNA (LAMA VICUGNA)

VICUÑA or **VICUGNA,** one of the two wild South American representatives of the camel-tribe still surviving (*see* TYLOPODA). From its relative the guanaco, the vicuña (*Lama vicugna*) differs by its inferior stature, more slender build, shorter head, and the absence of bare callosities on the hind limbs. The colour is orange-red. Vicuñas live in herds on the bleak and elevated parts of the mountain range bordering the region of perpetual snow, in various parts of Peru, Ecuador, and Bolivia. Wool is highly valued for weaving.

VIDA, MARČO GIROLAMO (*c.* 1489–1566), Italian scholar and Latin poet, was born at Cremona shortly before the year 1490 and died at Alba on Sept. 27, 1566. He entered the order of the Canonici Regolari Lateranensi, and made a reputation by two Latin poems, on the *Game of Chess* and the *Silkworm*. On the strength of this he went to Rome, when Leo X. on his succession (1513) gave him a priory and set him to compose a poem on the life of Christ. This *Christiad* is his most famous work. Between 1520 and 1527 he produced another hexameter poem on the *Art of Poetry* (ed. Baldi, Würzburg, 1881). In 1532 he became bishop of Alba.

See the *Life* by Lancetti (Milan, 1840).

VIDAME, a French feudal title. The vidame (Lat. *vice-dominus*) was originally, like the avoué (*advocatus*), an official chosen by the bishop of the diocese, with the consent of the count (*see* ADVOCATE). During the Carolingian epoch, *advocatus* and *vice-dominus* were interchangeable terms; it was only in the 11th century that they became differentiated, the title of avoué being commonly reserved for nobles charged with the protection of an abbey, that of vidame for those guarding an episcopal see. In the 12th century the office of vidame, like that of avoué, had become an hereditary fief. As a title, however, it was less common and less dignified than that of avoué. The *advocati* were often great barons who added their function of protector of an abbey to their own temporal sovereignty; the vidames were usually petty nobles, who exercised their office in strict subordination to the bishop. Their chief functions were: to protect the temporalities of the see, to represent the bishop at the count's court of justice, to exercise the bishop's temporal jurisdiction in his name, and to lead the episcopal levies to war.

See A. Luchaire, *Manuel des institutions françaises* (Paris, 1892); Du Cange, *Glossarium* (ed. Niort, 1887), s. "Vice-dominus"; A. Mallet, "Étude hist. sur les avoués et les vidames," in *Position des thèses de l'École des chartes* (an. 1870–72).

VIDIN (formerly written WIDIN or WIDDIN), a fortified river-port and capital of a department in the extreme N.E. of Bulgaria; on the right bank of the Danube, near the Yugoslav frontier. Pop. (1934) 18,599, including about 3,000 Turks and 1,500 Spanish Jews—descendants of refugees who fled hither from the Inquisition in the 16th century. Vidin is an episcopal see and the headquarters of a brigade. A steam ferry connects it with Calafat, on the Rumanian bank of the Danube, and there is a branch railway to the main line Sofia-Lom. The old town, containing several mosques and synagogues and a bazaar, preserves its oriental appearance. There is a modern cathedral, a school of viticulture and a high school, besides an ancient clock-tower and the palace (*Konak*) formerly occupied by the Turkish pashas. Vidin exports cereals and fruit, and is locally celebrated for its gold and silver filigree. It has important fisheries and manufactories of spirits, beer and tobacco.

Vidin stands on the site of the Roman town of Bononia in Moesia Superior. It is a fortress of great natural strength owing to the marshes which surround it. In the 14th century it was the seat of an independent tsardom, which was overthrown by the Turks in 1396. Under the Turks it was the seat of a pashalik, which under Pasvanoglu (1794–1807) was practically independent.

VIDOCQ, FRANÇOIS EUGENE (1775–1857), French detective, was born at Arras in 1775 (or possibly 1773). After an adventurous youth he joined the French army, where he rose to be lieutenant. At Lille he was sentenced to eight years' hard labour, and sent to the galleys at Brest, whence he escaped twice but was recaptured. For the third time he escaped, and lived for some time in the company of thieves and other criminals in Paris and elsewhere, making a careful study of their methods. He then offered his services as a spy to the Paris police (1809). Eventually Vidocq was made chief of the reorganized detective department of the Paris police, with a body of ex-convicts under his immediate command. Vidocq possessed unbounded energy and a real genius for hunting down criminals. In 1827 he retired and started a paper-mill, the work-people in which were drawn entirely from ex-convicts. The venture was a failure, and in 1832 Vidocq re-entered the police service and was employed mainly in political work. Anxious to get back to his old detective post he himself foolishly organized a daring theft. His real part in the matter became known, however, and he was dismissed from service. He died in poverty. Several volumes have been published under

his name, the best known of which is *Mémoires de Vidocq* (1828). It is, however, extremely doubtful whether he wrote any of them.

See Charles Ledru, *La Vie, la mort et les derniers moments de Vidocq* (1857).

VIDYASAGAR, ISWAR CHANDRA (1820–1891), writer and social reformer of Bengal, was born at Birsinha in the Midnapur district in 1820, of a Kulin Brahman family. He was removed to Calcutta at the age of nine, was admitted into the Sanskrit College, and carried on his studies in the midst of privations and extreme poverty. In 1839 he obtained the title of *Vidyasagar* (="Ocean of learning") after passing a brilliant examination, and in 1850 was appointed head pundit of Fort William College. In 1846 appeared his first work in Bengali prose, *The Twenty-Five Tales of a Betal.* This was succeeded by his *Sakuntala,* 1855, and by his great work, *The Exile of Sita,* 1862.

As a social reformer and educationist, too, Iswar Chandra made his mark. He associated himself with Drinkwater Bethune in the cause of female education; and the management of the girls' school, called after Bethune, was entrusted to him in 1851. And when Rosomoy Datta resigned the post of secretary to the Sanskrit College of Calcutta, a new post of principal was created, and Iswar Chandra was appointed to it. He simplified the method of learning Sanskrit; and thus rendered a great service to Sanskrit learning of that ancient tongue among his countrymen. Under the education scheme of 1854 he established aided schools in Bengal. In 1858 he resigned his appointment under government. He became manager of a private college at Calcutta.

But he now turned to practical reform. He had discovered that the ancient Hindu scriptures did not enjoin perpetual widowhood, and in 1855 he startled the Hindu world by his work on the *Remarriage of Hindu Widows.* Such a work, from a learned and presumably orthodox Brahman, aroused a storm of indignation. He appealed to the British government to declare that the sons of remarried Hindu widows should be considered legitimate heirs. The act was passed in 1856, and some years after Iswar Chandra's own son was married to a widow. In the last years of his life Iswar Chandra wrote works against Hindu polygamy. He was as well known for his lavish charity and wide philanthropy as for his educational and social reforms. He received the C.I.E. in 1880. He died on July 29, 1891. (R. C. D.)

VIEBIG, CLARA (1860–), German novelist, was born on July 17, 1860, at Trier, and educated at Düsseldorf and at the Berlin high school of music. She married in 1896 Fritz Cohn, and has one son. She began by writing stories of the Eifel country, in which she was born, *Kinder der Eifel* (1897). Among the most famous of her earliest novels was *Das schlafende Heer* (1904), the scene of which is laid in German Poland; in this book there is no extenuation of the faults of either Germans or Poles. Among her other works are: *Einer Mutter Sohn* (1906), *Töchter der Hekuba* (1917), *Unter dem Freiheitsbaum* (1924), and *Die Passion* (1926).

VIEIRA, ANTONIO (1608–1697), Portuguese Jesuit, writer and orator, was born at Lisbon on Feb. 6, 1608. He went with his parents to Brazil in 1615, was educated by the Jesuits at Bahia, and entered the order, receiving the priesthood in 1635. He at once made his mark as a preacher. He was sent, in 1640, with the viceroy's son to congratulate John IV. of Portugal on his accession, and was employed on various important diplomatic missions to England, France, Holland and Italy. Vieira was full of new and progressive ideas and advocated in a series of important pamphlets the abolition of the distinction between Old and New Christians, the reform of the procedure of the inquisition, and the admission to Portugal of Jewish and foreign traders.

As a young man he had determined to serve the negro slaves and the native Indians, and on his return in 1653 he resumed his great missionary work among the Indians. He was hindered in every possible way by the Colonial authorities, and decided that the only way to ensure the success of his mission was to secure the withdrawal of the Indians from the jurisdiction of the governors and to place them under that of the Society. In 1654 he sailed to Lisbon, and there secured from the king the necessary decrees. During the next six years he organized the new control and organized the missionaries. But his enemies among the colonists, who complained that the supply of slaves had decreased, and among the other religious orders shut out from the missions, secured his exile to Portugal. King John was dead, and he had no protector against the inquisition when he was charged with heretical teaching in some of his strange books, notably in the *Clavis Prophetarum.* He was imprisoned for two years (1665–67), and on his release was prohibited from writing, teaching and preaching. On the accession of Pedro II. it was determined that he should go to Rome to procure the revision of the sentence. There Clement X. invited him to preach before the college of Cardinals, and he became confessor to Queen Christina of Sweden and a member of her literary academy. At the request of the pope he drew up a report of 200 pages on the inquisition in Portugal, with the result that after a judicial inquiry Pope Innocent XI. suspended it for five years (1676–81). Ultimately Vieira returned to Portugal with a papal bull exempting him from the jurisdiction of the grand inquisitor, and in Jan. 1681 he embarked for Brazil. He resided in Bahia and in 1687 became superior of the province. He died on July 18, 1697.

BIBLIOGRAPHY.—Vieira's writings include: *Sermoes* (Sermons) (15 vols., Lisbon, 1679–1748), and many subsequent but incomplete editions; Span., Ital., Ger. and French translations have gone through several editions, *Historia do Futuro* (Lisbon, 1718); this and the *Quinto Imperio* and the *Clavis Prophetarum* seem to be in essence one and the same book in different redactions. *Cartas* (Letters) (3 vols., Lisbon, 1735–46). *Noticias reconditas do modo de proceder a Inquisicão de Portugal com os seus presos* (Lisbon, 1821). The *Arte de Furtar* published under Vieira's name is not his. A badly edited edition of Vieira's works in 27 vols. appeared in Lisbon, 1854–58; there are unpublished mss. of his in the British Museum and Bibliothèque Nationale; and a bibliography will be found in Sommervogel, *Bibliothèque de la compagnie de Jésus,* viii. 653–85.

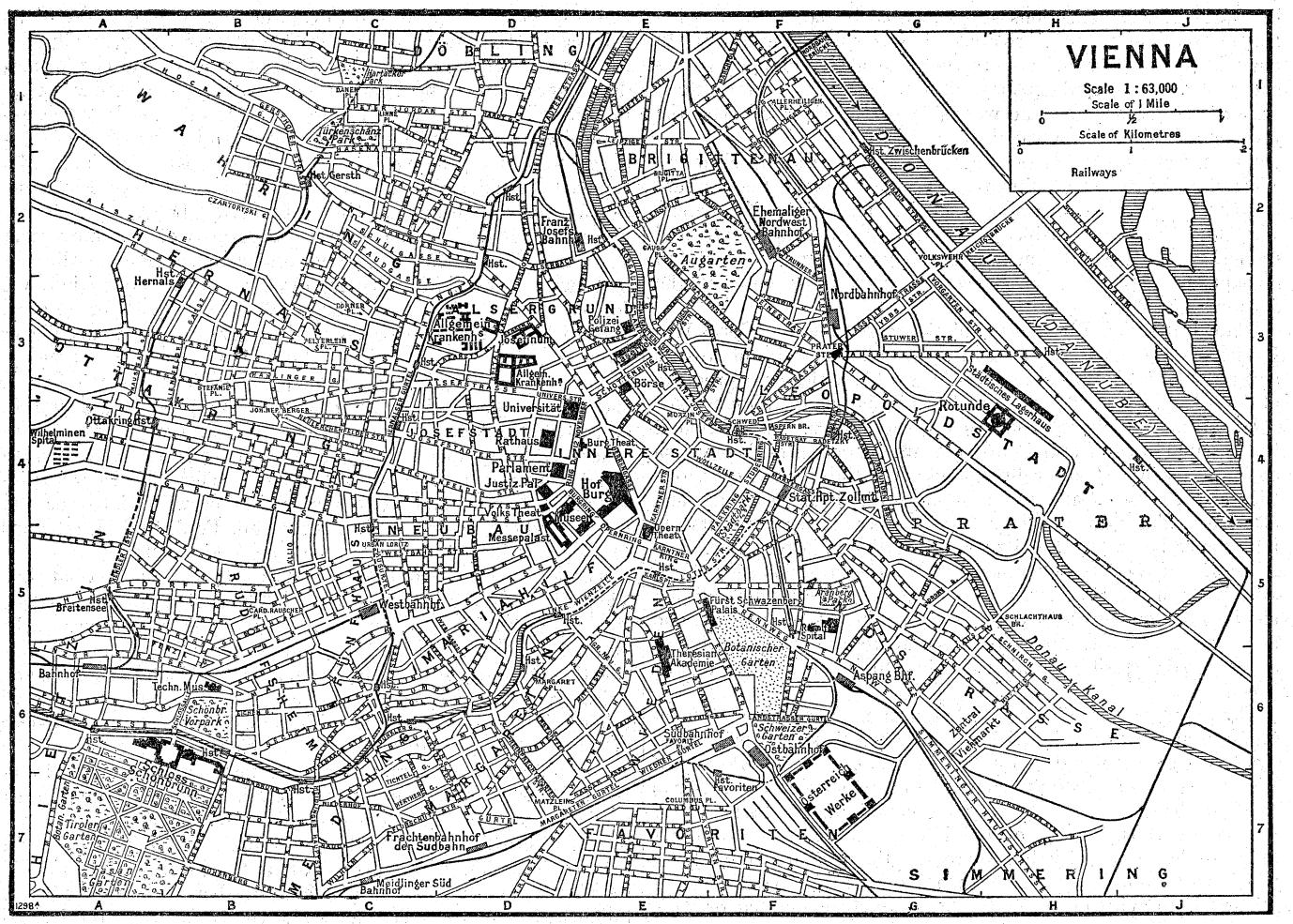
See also André de Barros, *Vida* (Lisbon, 1746), a Jesuit panegyric; D. Francisco Alexandre Lobo bishop of Vizeu, "Historical and Critical Discourse," *Obras* (Lisbon, 1849), vol. ii., a valuable study; João Francisco Lisboa, *Vida* (5th ed., Rio, 1891), he is unjust to Vieira, but may be consulted to check the next writer; Abbé E. Carel, *Vieira, sa vie et ses oeuvres* (Paris, 1879); Luiz Cabral, *Vieira, biog., caractère, éloquence* (Paris, 1900); *ibid., Vieira pregador* (2 vols., Oporto, 1901); Sotero dos Reis, *Curso de litteratura Portugueza e Brazileira,* iii. 121–244.

VIELLE, a French term, derived from Lat. *fidicula,* embracing two distinct types of instruments: (1) from the 12th to the beginning of the 15th century bowed instruments having a box-soundchest with ribs; (2) from the middle or end of the 15th century, the hurdy-gurdy (*q.v.*). The most common shape given to the earliest vielles in France was an oval, which with its modifications remained in favour until the guitar-fiddle, the Italian lyra, asserted itself as the finest type, from which also the violin was directly evolved.

VIENNA, (*Ger.* Wien) the capital of Austria, after its annexation to Germany on March 13, 1938, became the *Reichsgau* Wien in Germany. The city lies at the eastern foot of the Wiener Wald, on the right bank of the Danube within easy reach of a number of contrasted physical and economic regions.

Here many of the great routes from north to south and west to east intersect while close at hand runs the linguistic frontier between German, Slav and Magyar. From the multiplicity of these contacts Vienna acquired a cultural leadership that placed it in the forefront of European cities. Only an arm of the river, the Danube canal, passes through Vienna. The main river was developed between 1870 and 1877, and now has a quay length on the right bank of about 9 m. with accommodation in a winter harbour, Freudenau, to shelter above 500 barges of 500–700 tons cargo capacity. Navigation is possible for about 300 days per year. The new channel has an average width of 915 ft.; bordering its left bank is a free flood space about $\frac{1}{4}$ m. in width, separated by a dam from houses that stretch to the old course of the Danube.

The city is divided into 21 districts of which the Inner Town on the right bank of the Danube canal is the nucleus. The fortifications which girdled this old town were removed in 1858–60 and replaced by a magnificent boulevard—the Ringstrasse—2 m. long and 150 ft. in width, planted with four rows of trees and lined with splendid buildings and monuments. Near the centre of this inner city is the cathedral of St. Stephen, a Gothic building



dating mainly from the 14th and 15th centuries, but incorporating fragments of the original 12th century edifice, destroyed by fire 1193. Among its many impressive features may be mentioned the lofty tower (450 ft.), rebuilt in 1860–64, the catacombs, the groined ceiling, the 35 marble altars and the sarcophagus of Frederick III. This district is rich in Baroque buildings, many occupied by Government departments, banks and other commercial organizations, for it is gradually ceasing to be a residential neighbourhood; here too are situated the larger and most fashionable shops, particularly in the *Graben* thoroughfare.

South-west of the cathedral and near the Ring is the Hofburg, a huge complex of buildings of various periods and styles enclosing a number of courtyards, the oldest parts dating from the 13th century but including extensive additions since 1887. As a former imperial palace it abounds in magnificently appointed private and State apartments, numerous valuable collections and the National Library of about 1,200,000 volumes, 34,000 mss., 91,000 maps, 81,000 papyri, including the famous "Papyrus Rainer," and a large collection of musical and dramatic works. The Hofburg is separated from the Ring by handsome and spacious parks, the Hofgarten and Volksgarten. Other notable buildings in the old town include the 14th century Gothic Augustine and Maria Stiegen churches, the Minorite church of similar date and style containing a remarkable mosaic of Leonardo da Vinci's "Last Supper" by Raffaeli, the richly-frescoed Baroque churches of St. Peter (1702–13) and the university (1625–31), the Capuchin church, the 13th century Schotten church (restored 1828–83), the church of St. Ruprecht first built in 740 and the old Rathaus.

Beyond the imposing Ring and grouped around it are a number of impressive buildings and parks. Opposite the Hofburg stand the museums of natural history and art, two domed Renaissance buildings dating from 1872–81, identical in construction but separated by gardens containing the Maria Teresa monument. Adjoining the museums to the west is the palace of justice (1881) burned during riots in 1927, and the houses of parliament (1883) in modified Grecian style. Beyond these stands the new *Rathaus* (1873–83), a very large and lavishly decorated building separated from the Ring by the *Rathaus* park. This edifice is in modern Gothic style which is a striking contrast to the Classical and Renaissance styles so strongly represented in Viennese architecture. To the north stands the university, an example of Renaissance style (1873–74), even larger than the *Rathaus*. The university, the oldest German foundation (1365), has done much to raise Vienna to its high position as one of the leaders of culture amongst the European nations and its medical faculty is of world-wide reputation. The university library with 1,060,000 volumes is very well-equipped.

Other important buildings of the *Ringstrasse* include the Opera (1861–69), in French early Renaissance style. On the eastern side lies the Town park, rich in monuments. The Inner town and its immediate neighbourhood is still, unlike the older parts of most European towns, the fashionable quarter, containing the government offices and the principal hotels, the former embassies and legations, and many handsome buildings.

Across the Danube canal and between it and the main stream lie Leopoldstadt and Brigittenau, the only districts on the left bank of the canal. The former is the chief commercial quarter and is still inhabited to a great extent by Jews. Around the Ring stretches a girdle of nine inner suburbs once bound to the inner town by a second line of fortifications (1706) known as the Lines. These were razed in 1893 and a second wide boulevard (*Gürtelstrasse*) follows their course around the city.

Vienna is richly endowed in museums, picture-galleries and other marks of cultural leadership, stored with masterpieces representative of all types, masters and periods. In addition it possesses many private exhibitions of note. Every form of intellectual development, artistic, musical and scientific in all its branches, has

its representative collections supplemented by large libraries belonging to the state, city, private societies or monastic orders. In itself it is a museum of architecture and a city of open spaces and parks, amongst which may be mentioned the Prater (2,000 ac.), a wooded park on the west side of the river between the Danube and the Danube canal.

Situated at an altitude of about 550 ft. above sea-level, it has a healthy and agreeable climate. The mean annual temperature is 49·4° F and the range about 40° F. The climate is changeable but stimulating, liable to rapid falls of temperature and sudden storms especially in spring and autumn, and the rainfall amounts to 27 in. a year. Its water supply is drawn from the Alps by aqueducts.

Though it suffered loss in population and trade by World War I, Vienna gathered to itself much of the industrial life of Austria and retained a high place among the world's cities as a producer of artistic fancy goods, notably leather, jewellery, *objets d'art*, silks, clothing, millinery and other luxury goods. In addition it has manufactures of optical instruments, metal wares, heavy iron and steel machinery and rolling stock, furniture, paper, beer, textiles and chemicals and is an important publishing centre and also has a film industry. As a transit centre it recovered its old importance before 1938. The revival of the Industrial fair, electrification of the city belt railway, the transformation of palaces, even parts of the Hofburg, into offices, shops and public halls, of old imperial gardens into public parks, schemes of housing, and many other activities for ultimate social welfare are indicative of a progressive spirit somewhat foreign to popular ideas of the Viennese.

The population of Vienna numbered in 1934, 1,874,581 inhabitants on an area of 107 sq.mi., compared with the population of 2,031,498 in 1910 and 1,841,326 in 1920. The *Reichsgau* of Vienna, with an area of 471 sq.mi., had a population of 1,925,239 in 1939. Though formerly very cosmopolitan, the break up of the empire caused many of the Hungarians, Czechs and other Slavs to leave the city but increased the proportion of Jews, which rose from 9% (1910) to 11% in 1923. After Hitler's seizure of the city in 1938, the Jews largely emigrated or were exterminated.

See F. Heiderich, *Wien als Europäischer Verkehrsknotenpunkt*. "Handelsmuseum" (Vienna, 1920); Collection by Vienna University *Wien, sein Boden und seine Geschichte* (Vienna, 1924); League of Nations, *The Financial Reconstruction of Austria* (Geneva, 1926).

(W. S. L.; X.)

HISTORY

Under the name of Vindobona, Vienna was a Celtic settlement and later Roman garrison town. The Roman fortress stood on the small eminence bounded N. by the modern Salzgries, E. by the Rotenturmstrasse, S. by the Graben and W. by the Tiefer Graben. Here Marcus Aurelius is supposed to have died (A.D. 180). During the period of the Great Migrations and the succeeding centuries its traces were lost; but tradition ascribes the foundation of the St. Peter's Church to Charlemagne (A.D. 800), the Church of St. Rupprecht being older still. After the establishment of the Ostmark (*see* AUSTRIA-HUNGARY) it revived. In 1137 "Wienne" is mentioned as a "civitas."

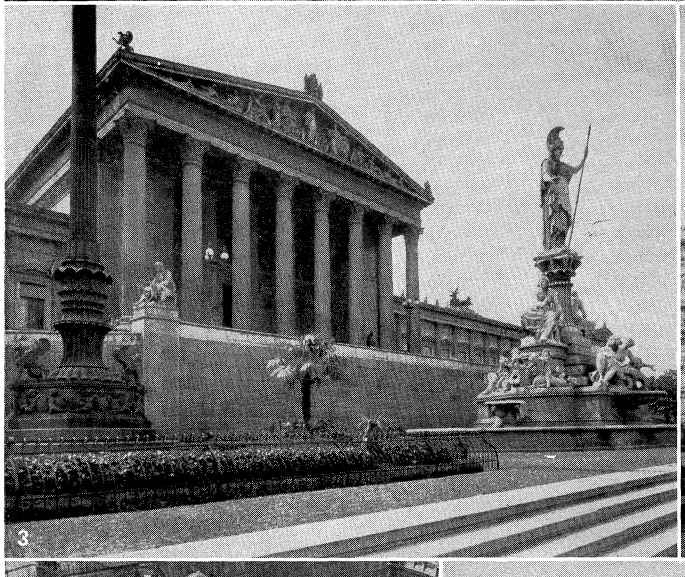
In that year Henry Jasomirgott chose it as capital of the duchy of Austria, establishing his court Am Hof outside the old walls. The cathedral (Stefanskirche) was founded in the same year; a commercial town grew up round it, and a ghetto round the present Judenplatz. Later, under the Babenberger, Vienna became an important trading centre, largely thanks to new relations between East and West established by the Crusades. It was also the centre of a brilliant court life and of an important school of lyric poetry (Walter von der Vogelweide, etc.), while the great epics of the *Niebelungen* and the *Gudrun* were composed near its walls. By the end of this period it had grown to about the size of the present Innere Stadt; many monastic orders were established here, and many churches built; although owing to the numerous fires and later rebuilding, none of these have kept their original form.

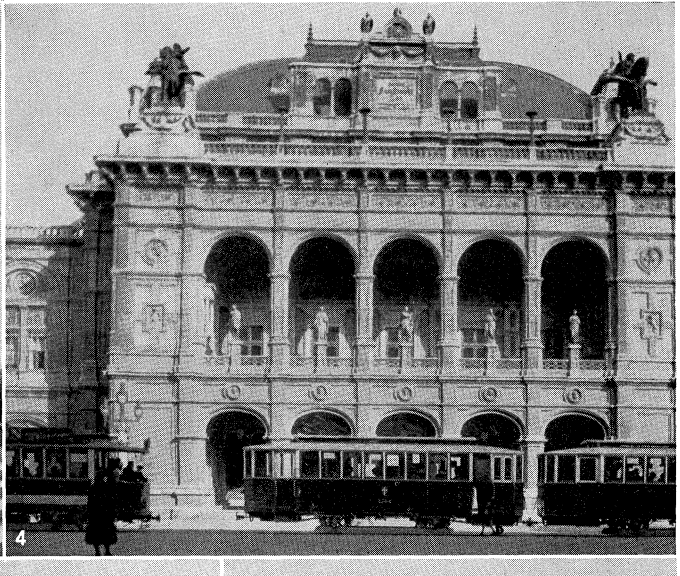
The Habsburg Rule.—The first Habsburg to enter Vienna as ruler, Albert, came into immediate conflict with the city, which he invested and forced to capitulate, annulling many of its privileges. The era of the earlier Habsburgs was generally unfortunate; the plague, the visitations of robbers and condottieri, the financial crisis and monetary depreciation, and the ceaseless internecine wars of the Habsburgs hit the city hard; yet it remained a wealthy and important centre, and some of the Habsburgs were its generous patrons, notably Rudolph IV., who founded the university (1365) and did much for the reconstruction of the Stefanskirche. Under Frederick IV. Vienna at first preserved neutrality; but it was the centre of the movement against Frederick led by Eiczing, and after Archduke Albrecht had twice stormed the city in 1458, a radical opposition was formed, and Frederick was besieged in the Hofburg (1462). Frederick never liked Vienna, residing for preference in Wiener Neustadt, and later in Linz; Matthias Corvinus of Hungary, however, after taking Vienna, made it his residence. Maximilian I. showed an equal lack of interest in Vienna; and Ferdinand I., on arriving in Austria, found Vienna entirely old-fashioned. Another great fire raged in 1525, and in 1529 the city had to stand a siege from the Turkish troops. The suburbs were deserted, and more and more inhabitants crowded into the old town. Rudolph II. resided in Prague; but Ferdinand II. returned to Vienna, which remained the residence of the Habsburgs.

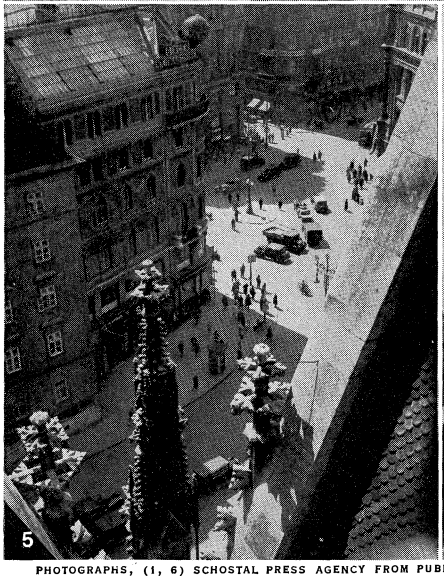
The spiritual forces of the Counter-Reformation were what gave Vienna its most characteristic aspect. The period of early baroque saw the foundation of a number of churches—the Franciscans, the Jesuits, the Capucines and many more, including a number outside the city walls, such as the Barmherziger Brüder, the Paulaner, Schwarzspanier and the Barnabiten; with a smaller output of other buildings such as the Archbishop's palace. The second siege of Vienna by the Turks (1683) was the indirect cause of the appearance of the characteristic Viennese cafés, almost simultaneously with another no less characteristically Viennese product of the Orient—the lilac, first planted in Vienna, to spread thence over Western Europe. The disappearance of the Turkish danger ushered in a time of rapid expansion; the Hofburg was rebuilt, its library and stables constructed, together with a number of buildings in sumptuous baroque style: the Karlskirche, the Peterskirche, the Reichskanzlei, Hofreitschule and Bürgerliches Zeughaus, the Pestsäule in the Graben, the Josefssäule in the Hoher Markt, the Lichtenstein, Starhemberg, Schwarzenberg, Kinsky, Esterhazy and Prince Eugen palaces. The Belvedere palace was built 1717–24; Schönbrunn was begun about 1695, but not finished till half a century later. The architecture of the later 18th century is by comparison sober and practical.

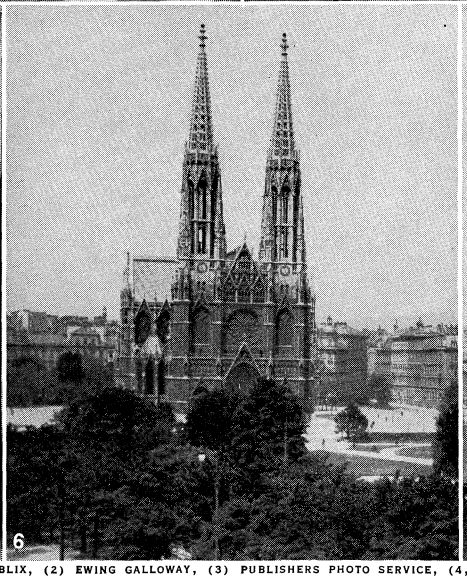
The reign of Francis I. created the typical Viennese of tradition; frivolous, non-political, discontented, easy-going; "Alt-Wien" with its waltzes, its Prater and its political spies. The revolution of 1848 showed that even the Viennese were not patient for ever. Its main driving forces in Vienna were the students and the workmen of the suburbs, in which a dense industrial population had begun to grow up with the development of machinery. Again Vienna suffered a siege; this time from the troops of its own emperor, by whom it was quickly reduced. The modern period under Francis Joseph saw another transformation. The old ramparts and glacis were levelled, the great Ringstrasse built in their place. Round it a number of great buildings were erected in various styles; the Opera, the new Rathaus, the Parliament, the Burgtheater, the new university and the Votivkirche. In the latter half of the 19th century the population of Vienna grew with great rapidity. The inner ring of suburbs was entirely incorporated with the city, which stretched out beyond the "Vorortlinie" to the outer ring, swallowing up many of the vineyards on which much of Vienna's old fame had rested. The municipality again became a powerful political force, and once again came into conflict with the emperor, who had twice refused to confirm the appointment of Karl Lueger as Burgomaster of Vienna.

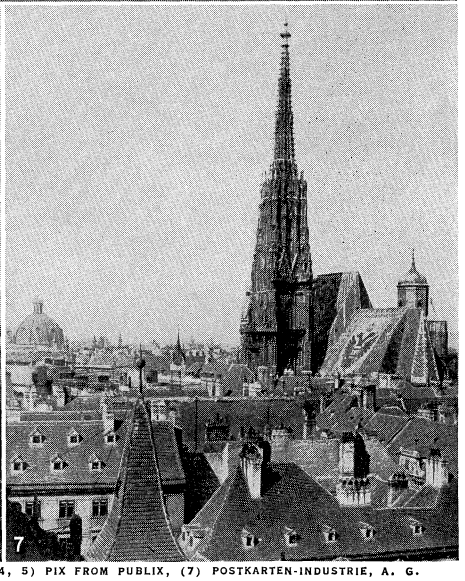
After World War I and the revolution of 1918, which caused untold suffering in Vienna, partially relieved by the general effort of many foreign charitable organizations, the power passed to the Social Democratic party. Vienna became capital of the new Austrian republic, receiving the status of a province in 1921. The











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SCENES IN VIENNA

1. The centre of the city—Kärtnerstrasse at the corner of Ringstrasse
2. General view of the Ring, showing the old Parliament building at the left, the Rathaus with the high tower, the Votive church with twin towers in the distance, and the Hofburg theatre (right) with part of the Volksgarten in front
3. A section of the Parliament building, facing the Ring
4. The Opera house, built during 1861 and 1869
5. View of the Graben and Stefansplatz
6. The Votive church
7. Spire of St. Stephen's cathedral, 450 ft. high, regarded as one of the finest of Gothic spires. It was rebuilt in 1860–64

Social Democratic municipality embarked on a far-reaching and ambitious program of social reform, which included a serious attempt to grapple with the very acute housing problem.

In 1927 the acquittal of three Nationalists of the murder of two Socialists led to a general strike and riots in Vienna. The mob burned the palace of justice, destroying many valuable records. In February 1934 a decree dissolving all political parties except the government's Fatherland Front caused a new bloody conflict in which government forces bombarded the new Karl Marx Hof, an elaborate Socialist modern housing settlement. Five months later, on July 25, Hitler's agents instigated an uprising of Austrian nazis that was quickly suppressed but resulted in the killing of the Austrian chancellor, Engelbert Dollfuss. His successor, Dr. Kurt von Schuschnigg, had to struggle with continually renewed intrigues by Hitler's followers.

With Hitler's seizure of Austria on March 13, 1938, Vienna suffered still further. National Socialists from Germany took over all the best jobs, compelled the hitherto easy-going Viennese to work hard, imposed heavy taxes and military conscription, and subordinated the former capital of a great monarchy to orders from Berlin.

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VIENNA, CONGRESS OF (1814–1815). The fall of Napoleon left the disposition of his empire to the four powers who had overthrown him—Austria, Prussia, Russia and Britain. Other countries, of whom Spain, Portugal and Sweden were the most important and signed the Treaties of Paris, May 30, 1814, had shared in this task, but the four greater powers were bound together by a special alliance (Treaty of Chaumont, March 1, 1814). Thus though the treaties with France stipulated that all countries who had taken part in the war should send plenipotentiaries to a congress at Vienna, the four powers meant to make the decisions themselves, and, as they could not agree at Paris, bound France by a secret article of the treaties to recognize these decisions at a future date.

The Delegates.—Thus the meeting at Vienna, where representatives began to arrive towards the end of September, was meant to be merely a convenient assembly to ratify the decisions of the "four." Nevertheless, all Europe sent its most important statesmen. Metternich, principal minister of Austria since 1809, naturally represented his Emperor Francis II, a stubborn man who sometimes had a policy of his own. The brilliant, but wayward and emotional, Alexander I of Russia directed his own diplomacy. The weak Frederick William III of Prussia had as his principal minister Prince von Hardenberg, who had lost credit owing to physical infirmities. Great Britain was represented by the foreign minister Lord Castlereagh, the creator of the Alliance of Chaumont. When Castlereagh had to return to his parliamentary duties the duke of Wellington replaced him and Lord Clancarty was principal representative after the duke's departure. The restored Louis XVIII sent the astute diplomatist, Prince Talleyrand. Spain, Portugal and Sweden also had only men of moderate parts to represent them, in Labrador, Palmella and Lövenheilm. Count Münster, who represented the British prince regent as ruler of Hanover, had much influence on German questions. Many of the rulers of the minor states of Europe put in an appearance. With them came a host of courtiers, secretaries and ladies to enjoy the magnificent hospitality of the almost bankrupt Austrian court. The social side of the congress made a great impression on the age, and on history. It was one of the causes of the long and unexpected delay in producing a result, for Metternich at least sometimes subordinated business to pleasure.

Procedure of the Congress.—This was due to the difficulty and complexity of the problems to be solved. First there was the problem of the organization of the congress, for which there was no precedent. The "four" were determined to keep the management of the main problems entirely in their own hands; but since they had rather rashly summoned a congress they must pay some attention to it. The ministers of the "four" assembled early to discuss this problem, and finally agreed on Sept. 22 that the "four" should have the "initiative," by which they meant the "decision" of the future of all the conquered territories. They were then to "communicate" with France and Spain. The "congress" was to be summoned only when all was ready.

This was the situation which Talleyrand found when he arrived on Sept. 24. He refused to accept it and was supported by Labrador. He denied that either the "four" or the "six" were legally constituted bodies, and desired that the congress should be summoned to elect a directing committee. If there was any other body which had any rights it was the "eight" Powers who had signed the Paris treaties. The "four" were much disturbed, for they knew that all the smaller Powers would support Talleyrand if they gave him the chance of appealing to them. But they had no intention of giving way, and refused to summon a meeting of all the plenipotentiaries. A notice was issued that the opening of the congress was postponed till Nov. 1. No solution could be found, however, and after a meeting of the "eight" on Oct. 30 the opening was again postponed.

Meanwhile the work of the congress proceeded without the sanction of the main body of plenipotentiaries. The "four" discussed the main territorial problems informally amongst themselves. The "eight" assumed the formal direction of the congress; a committee of German states met to draw up a constitution for Germany, and a special committee on Switzerland was appointed by the "four." Talleyrand was thus excluded from the main work of the congress, but his protests on behalf of the smaller Powers grew fainter as he realised that the "four" were not in agreement, Castlereagh and Metternich gradually won his confidence and at last insisted on France being admitted to the "four." The "four" thus became the "five" and it was this committee of five which was the real Congress of Vienna. Between Jan. 7 and Feb. 13 it settled the frontiers of all territories north of the Alps and laid the foundations for the settlement of Italy. In this it was much assisted by a statistical committee which Castlereagh had proposed. Meanwhile the committee of "eight" dealt with more general matters. The congress as a representative body of all Europe never met.

Poland and Saxony.—The great difficulty which nearly produced war was the disposition of Poland and Saxony. By treaties signed in 1813 Alexander had promised that the sovereigns of Prussia and Austria should rule over as many subjects as they had done before they were reduced in size by Napoleon. He had also promised that the duchy of Warsaw, which Napoleon had constituted out of the Prussian and Austrian shares of the Polish partitions, should be divided between the three Powers. After the battle of Leipzig, however, he claimed practically all Poland for Russia, and suggested that Austria could find compensation in Italy, and Prussia by annexing all Saxony, whose king had been the most faithful of Napoleon's vassals. In this plan he was moved by a sincere wish to give the Poles an opportunity for the expression of their nationality; but, of course, he intended to keep Russian sovereignty over all Poland. Metternich was much alarmed, and Hardenberg, while very desirous of Saxony, was not anxious to see Russia's frontier extended so far. Castlereagh was also, as a true disciple of Pitt, afraid of Russian expansion. Accordingly Castlereagh encouraged Austria to agree to the sacrifice of Saxony to Prussia so that the three Powers could oppose Russia's demands on Poland. With great difficulty he eventually succeeded in so doing, carrying on himself meanwhile an exceedingly frank controversy with Alexander. But the plan, which included an offer of constituting an entirely independent Poland, which it was known Alexander must reject, failed because Frederick William III., who was grateful to the tsar for his help in the overthrow of Napoleon, refused to support Hardenberg when the crisis came. Metternich and Hardenberg were, therefore, estranged, and the former withdrew his consent to Prussia's absorption of all Saxony. Prussia then went altogether on to Russia's side, and a complete deadlock resulted.

Castlereagh's Diplomacy.—Castlereagh had been much chagrined at the failure of his first plan. Moreover, his cabinet were alarmed at his activity in European matters, and he was warned against going too far. The difficult negotiations with the United States, with whom Britain was still at war, also made caution necessary. Nevertheless, Castlereagh saw that if a European war broke out both France and Britain would certainly be involved

before it was over. He had already prepared the way with Talleyrand, and in December both he and Metternich promised Talleyrand that the Bourbon house should be re-established in Naples instead of Murat. Secure of Talleyrand's support they insisted that France should be admitted to the committee of the "four." When Hardenberg threatened war, Castlereagh drew up a secret treaty of defensive alliance which Talleyrand and Metternich signed on Jan. 3, 1815. For a few days the issue was doubtful, but the tsar, who had already obtained most of Russia's demands, inclined to peace, and eventually Prussia gave way. With Castlereagh acting as mediator, a compromise was arranged on the question of Saxony, and then the rest of the territorial settlement was comparatively easy, especially as Castlereagh reduced the demands of both Hanover and the Netherlands, whose policy was ultimately controlled by Britain.

Decisions of the Congress.—Alexander gave back Galicia to Austria, Thorn and a region round it to Prussia, while Cracow was made a free town. The rest of the duchy of Warsaw was incorporated as a separate kingdom under the tsar's sovereignty. Prussia got two-fifths of Saxony, and was compensated by extensive additions in Westphalia and on the left bank of the Rhine. It was Castlereagh who insisted on her accepting this latter territory, with which it was suggested the king of Saxony should be compensated, for he wanted Prussia to guard the Rhine against France and act as a buttress to the new kingdom of the Netherlands, which Holland had formed by incorporating Belgium. Austria was compensated by Lombardy and Venice. She also got back most of the Tyrol. The South German States on the whole did well. Hanover was also enlarged. The outline of a constitution, a loose confederation, was drawn up for Germany. It was a triumph for Metternich and a defeat for Stein. Denmark lost Norway to Sweden but got Lauenberg, while Swedish Pomerania went to Prussia. In Italy, Piedmont absorbed Genoa; Tuscany and Modena went to an Austrian archduke; Parma was given to Marie Louise, though the young Napoleon's claims to succeed failed to win British and French approval. The papal territory was restored to the pope. Murat's fate was decided even before his rash attempt after Napoleon's return from Elba, and the Sicilian Bourbons restored to Naples. Switzerland was given a new constitution. Valuable articles were included on the free navigation of international rivers and diplomatic precedence. (*See* DIPLOMACY.) Castlereagh's great efforts on behalf of the abolition of the slave trade were only rewarded by a pious declaration.

The final act, which included all these agreements in one great instrument, signed on June 9, 1815, by the "eight" (except Spain, who refused as a protest against the Italian settlement) was afterwards acceded to by all the other Powers, and was the most comprehensive treaty which Europe had ever possessed.

As a result the lines laid down by the Congress of Vienna lasted, except for one or two changes, for over 40 years. The statesmen had successfully worked out their principle of a balance of power. But the idea of nationality had been almost entirely ignored—necessarily so because it was not yet ready for expression. Territories had been bartered about without much reference to the wishes of their inhabitants. Until an even greater settlement took place it was customary for historians to condemn the statesmen of Vienna. It is now realised how difficult their task was, and the fact that they secured for Europe a period of peace, which was its cardinal need, is fully recognized. But the statesmen failed to give to international relations any organ by which their work could be adapted to the new forces of the 19th century, and it was ultimately doomed to destruction.

BIBLIOGRAPHY.—Treaties and acts of the congress may be consulted in J. L. Klüber, *Acten des Wiener Congresses,* 9 vols. (1817–35); Comte d'Angeberg (J. L. Chodzko), *Le Congrès de Vienne* (1863); *British and Foreign State Papers,* vol. ii., gives some of the documents in English, and the final act is found in many collections. For the diplomacy, Duke of Wellington, *Supplementary Despatches,* vols. ix. and x. (1858–72); Viscount Castlereagh, *Memoirs and Correspondence* (ed. C. W. Vane; 12 vols. 1848–53); C. M. de Talleyrand-Périgord, *Memoirs,* vols. ii. and iii. (1891); the works of F. von Gentz; A. de la Garde-Chambonas, *Souvenirs du Congrès de Vienne,* ed., with introduction and note, Comte Fleury (1901), gives an interesting picture of the congress from its personal and social side; A. Fournier, *Die Geheimpolizei auf dem Wiener Congress* (1913); M. H. Weil, *Les dessous du Congrès de Vienne* (1917); C. K. Webster, *The Congress of Vienna* (1919), written for information of the Paris Conference, gives a bibliography. *See* also *British Diplomacy* (1813–15), ed. C. K. Webster (1921); *Cambridge Modern History,* vol. ix., ch. xix. and xxi., with bibliography (1902); *Cambridge History of British Foreign Policy* (ed. A. W. Ward and G. P. Gooch, vol. i., 1922). (C. K. W.)

VIENNE, a department of west-central France, formed in 1790 out of Poitou (four-fifths of its present area), Touraine (one-seventh), and Berry, and bounded by Deux-Sèvres on the west, Charente on the south, Haute-Vienne on the southeast, Indre on the east, Indre-et-Loire on the northeast and north and Maine-et-Loire on the northwest. Pop. (1936) 306,820. Area 2,720 sq.mi. The department includes the basin of the Vienne from the point at which it emerges from the Plateau Central down to its junction with the Creuse, while its extreme southwest corner includes a small part of the course of the Charente. It thus contains the famous gate of Poitou (Seuil du Poitou) between the Plateau Central and the Gâtine, the historic southwest entry into the Paris basin. The winter average temperature is 39° to 41° F., the summer average temperature being 66° to 68° F. The prevailing winds are from the southwest and west. The annual rainfall is 24 in. in the north to 32 in. in the south.

Wheat, oats and barley are the principal cereals grown, other important crops being lucerne, sainfoin, clover, mangel-wurzels and potatoes. Some colza and hemp are grown. The district of Poitiers grows good red wine, and the white wine of Trois-Moutiers near Loudun is well known. The breeding of live stock is fairly active. Poitou is famous for its mules, and the geese and turkeys of the department are highly esteemed. Among the fruit trees are the chestnut, walnut and almond. In the forests a small number of wild boars and other wild game survives. Freestone is quarried. There are mineral springs at La Roche-Posay. The most important industrial establishments are the national arms manufactory at Châtellerault and the cutlery works near that town. The capital of Vienne is Poitiers, and the department is divided into 3 arrondissements (Poitiers, Châtellerault, Montmorillon), 31 cantons and 300 communes. The chief towns are Poitiers, Châtellerault, Loudun, Chauvigny (*qq.v.*) and Montmorillon. Sanxay has ruins of a theatre and other Gallo-Roman remains nearby. Vienne is rich in megalithic monuments.

VIENNE, the chief town of an arrondissement of the department of the Isère, France. Pop. (1936) 22,885. Vienne stands on the left bank of the Rhône just below the junction of the Gère with the Rhône, between the river and low hills, and about 20 m. by rail S. of Lyons. Its site is an immense mass of ancient *débris,* which is constantly yielding interesting antiquities. On the bank of the Gère are traces of the ramparts of the old Roman city, and on the Mont Pipet (E. of the town) are the remains of an amphitheatre, while the ruined castle there was built in the 13th century on Roman substructures. Several of the ancient aqueducts (one only is now actually in use) are still to be seen.

Vienne, originally the capital of the Allobroges, became a Roman colony about 47 B.C. under Caesar, who embellished and fortified it. A little later these colonists were expelled by the Allobroges; the exiles then founded the colony of Lyons (Lugdunum). It was not till the days of Augustus and Tiberius that Vienne regained all its former privileges as a Roman colony. Later it became the capital of the Provincia Viennensis. In 257 Postumus was proclaimed emperor here, and for a few years Vienne was the capital of a short-lived provincial empire. It is said to have been converted to Christianity by Crescens, the disciple of St. Paul. There were Christians here in 177, as in the Greek letter (preserved to us by Eusebius) addressed at that date by the churches of Vienne and Lyons to those of Asia and Phrygia mention is made of "the" deacon of Vienne. The first bishop certainly known is Verus, who was present at the Council of Arles in 314.

About 450 Vienne became an archbishopric and continued one till 1790, when the see was suppressed. The archbishops disputed with those of Lyons the title of "Primate of All the Gauls." Vienne was conquered by the Burgundians in 438, and in 534 was taken by the Franks. Sacked in 558 by the Lombards and in

737 by the Saracens, the government of the district was given by Charles the Bald in 869 to a Count Boso, who in 879 was proclaimed king of Provence, and was buried in 887 in the cathedral church of St. Maurice. Vienne then continued to form part of the kingdom of Provence or Arles till in 1032 it reverted to the Holy Roman Empire. Vienne was sacked in 1562 by the Protestants under the baron des Adrets, and was held for the Ligue 1590–95, when it was taken by Montmorency. The fortifications were demolished between 1589 and 1636. In 1790 the archbishopric was abolished, the title "Primate of all the Gauls" being attributed to the archbishops of Lyons.

Ancient Monuments.—The town possesses two fine Roman monuments. One is the temple of Augusta and Livia, a building of the Corinthian order, built by the emperor Claudius, and inferior only to the Maison Carrée at Nîmes. From the 5th century to 1793 it was a church (Notre-Dame-de-Vie), and the "festival of reason" was celebrated in it at the time of the Revolution. The other is the *Plan de l'Aiguille,* a truncated quadrangular pyramid, about 52 ft. in height, resting on a portico with four arches; it is now generally believed to have been part of the *spina* of a large circus, the outlines of which have been traced. The church of St. Peter belonged to an ancient Benedictine abbey and was rebuilt in the 9th century, in the earliest Romanesque style. It has of late years been completely restored, and shelters the magnificent *Musée Lapidaire.* The former cathedral church of St. Maurice (11th to 16th centuries), has three aisles, but no apse or transepts. The most striking portion is the W. front (1533), which rises from a terrace overhanging the Rhône.

There are very important cloth factories and also distilleries, iron foundries, refining furnaces, etc. Vienne is the seat of a sub-prefect, of a tribunal of commerce, a chamber of commerce and a board of trade-arbitrators.

VIENNE, a river of central France, 219 m. long, a left-hand tributary of the Loire. Rising on the plateau of Millevaches at a height of 2,789 ft., the Vienne flows westward through the hilly country of the crystalline rocks of the Central Plateau of France. The first large town on its banks is Limoges, below its confluence with the Taurion (right). The river next reaches St. Junien, turns abruptly northwards to Confolens and passes on to the Jurassic rocks to flow through a picturesque and wider valley. Passing Chauvigny, it proceeds to the confluence of the Clain (left), on which stands Poitiers, just above Châtellerault. Below that town it receives the Creuse (right), which rises on the Millevaches Plateau and is 159 m. long. From near Châtellerault, past Chinon, to its junction with the Loire the Vienne flows across Cretaceous strata. There is little river-traffic on the Vienne below its confluence with the Creuse (30 m.). (*See* LOIRE.)

VIENNE, COUNCIL OF, an ecclesiastical council, which in the Roman Catholic Church ranks as the fifteenth ecumenical synod. It met from October 16, 1311, to May 6, 1312, under the presidency of Pope Clement V. The transference of the Curia from Rome to Avignon (1309) had brought the papacy under the influence of the French crown; and this position Philip the Fair of France now endeavoured to utilize by demanding from the pope the dissolution of the powerful and wealthy order of the Temple, together with the introduction of a trial for heresy against the late Pope Boniface VIII. To evade the second claim, Clement gave way on the first (*see* TEMPLARS). On the 22nd of March the order of the Temple was suppressed by the bull *Vox clamantis,* while further decisions as to the treatment of the order and its possessions followed later. Additional decisions were necessitated by the violent disputes which raged within the Franciscan order as to the observance of the rules of St. Francis of Assisi.

See Mansi, *Collectio Conciliorum,* vol. xxv.; Hefele, *Conciliengeschichte,* vol. vi. pp. 532–534.

VIERSEN, a town in the Prussian Rhine province, Germany, 11 mi. S.W. of Crefeld, at the junction of lines to München-Gladbach, Venlo, etc. Pop. (1939) 33,884. Viersen is one of the chief seats in the lower Rhine country for the manufacture of velvets, silks and plush, cotton, paper, boots and cement.

VIERZON, a town of central France, in the department of Cher, 20 m. N.W. of Bourges by rail. The Cher and the Yèvre unite at the foot of the hill on which lie Vierzon-Ville (pop. [1936] 10,070) and Vierzon-Villages (pop. 7,404); Vierzon-Bourgneuf (pop. 3,116) is on the left bank of the Cher. The town has a port on the canal of Berry and is an important junction on the Orléans railway; there are several large manufactories for the production of agricultural machines, also foundries, porcelain, brick and tile works and glass works.

VIETA (or VIÈTE), **FRANÇOIS,** SEIGNEUR DE LA BIGOTIÈRE (1540–1603), more generally known as FRANCISCUS VIETA, French mathematician, was born at Fontenay-le-Comte, in Poitou. According to F. Ritter, *Bolletino Boncompagni* (1868), Vieta was brought up as a Catholic, and died in the same creed; but there can be no doubt that he belonged to the Huguenots for several years. On the completion of his studies in law at Poitiers Vieta became an advocate in his native town, and later councillor of the parlement of Brittany. Rohan, the well-known chief of the Huguenots, took Vieta under his special protection. After the accession of Henry IV, Vieta became in 1589 councillor of the parlement at Tours, and subsequently a royal privy councillor.

We know of one important service rendered by Vieta as a royal officer. While at Tours he discovered the key to a Spanish cipher, consisting of more than 500 characters, and thenceforward all the despatches in that language which fell into the hands of the French could be easily read. Philip II was so convinced that his cipher was a safe one that when he found the French were aware of the contents of his letters he complained to the pope that the French were using sorcery against him.

Vieta printed at his own expense the numerous papers which he wrote on various branches of this science, and communicated them to scholars in almost every country of Europe.

Vieta has been called the father of modern algebra. All that is wanting in his writings, especially in his *Isagoge in artem analyticam* (1591), in order to make them look like a modern school algebra, is merely the sign of equality. His *Recensio canonica effectionum geometricarum* is what we now call an algebraic geometry.

He conceived methods for the general resolution of equations of the second, third and fourth degrees different from those of Ferro and Ferrari, with which, however, it is difficult to believe him to have been unacquainted. He knew the connection existing between the positive roots of an equation (which, in his day, were alone thought of as roots) and the coefficients of the different powers of the unknown quantity. He found out the formula for deriving the sine of a multiple angle, knowing that of the simple angle with due regard to the periodicity of sines. This formula must have been known to Vieta in 1593. In his *Apollonius Gallus* (1600) Vieta made use of the centre of similitude of two circles. Lastly he gave an infinite product for the number π. (*See* article on CIRCLE.)

Vieta's collected works were issued under the title of *Opera Mathematica* by F. van Schooten at Leyden in 1646.

VIGAN, a municipality and the capital of the province of Ilocos Sur, Luzon, Philippine Islands, near the mouth of the Abra river, about 200 mi. N. by W. of Manila. Pop. (1939) 20,939 (a gain of 3,174 since 1918); 21 were white. Ilocano is the vernacular. Of the inhabitants aged 6 to 19 inclusive, 51·3% were reported in 1939 as attending school, while 63·4% of the population 10 years old and over was literate.

VIGÉE-LEBRUN, MARIE-ANNE ELISABETH (1755–1842), French painter, was born in Paris on Apr. 16, 1755, the daughter of a painter, from whom she received her first instruction, though she benefited more by the advice of Doyen, Greuze, Joseph Vernet and others. When only about 20 years of age she had made her name by her portraits of Count Orloff and the duchess of Orleans, and had become a general favourite in society. In 1776 she married the painter and art-critic J. B. P. Lebrun, and in 1783 her picture of "Peace bringing back Abundance" (now at the Louvre) gained her the membership of the Academy. When the Revolution broke out in 1789 she escaped first to Italy, where she worked at Rome and Naples. At Rome she painted the Princesses Adelaide and Victoria, and at Naples the "Lady Hamilton as a Bacchante" now in the collection of

Tankerville Chamberlayne. She then visited Vienna, Berlin and St. Petersburg, returning to Paris in 1802. In April 1802 she went to London, where she painted Byron and the prince of Wales. She was a great traveller, and her portraits are to be found in the collections of many countries. She died in Paris on Mar. 30, 1842 at the age of 87, having been widowed for 29 years.

Among her many sitters was Marie Antoinette, of whom she painted over 20 portraits between 1779 and 1789. A portrait of the artist is in the hall of the painters at the Uffizi, and another at the National Gallery. The Louvre owns two portraits of Mme. Lebrun and her daughter, besides five other portraits.

A full account of her eventful life is given in her *Souvenirs* (1835, 1837) and in C. Pillet's *Mme. Vigée-Le Brun* (1890). The artist's autobiography has been translated by Lionel Strachey, *Memoirs of Mme. Vigée-Lebrun* (New York, 1903), fully illustrated.

VIGELAND, ADOLF GUSTAV (1869–), Norwegian sculptor, was born at Mandal in South Norway on April 11, 1869. In early youth he studied wood engraving and in 1889 at Christiania (Oslo), produced his first work as a sculptor, a relief depicting incidents from the *Iliad*. He afterwards travelled and studied under Skeibrok in Christiania and Bissen in Copenhagen. Vigeland's work deals with the primitive emotion of men. He forsook his earlier semi-impressionistic form of art and adopted a more classic style. His chief work "The Fountain," begun in 1915, was uncompleted at the time of the German invasion in 1940. It was intended, when complete, to consist of 4 large groups of granite and 58 figures in bronze; the whole depicting the history of mankind, from barbarism to civilisation. Vigeland also achieved a wide reputation as a portrait sculptor.

See M. G. Vidalene, *L'art norvégien contemporain* (1921).

VIGEVANO, a town and episcopal see of Lombardy, Italy, in the province of Pavia, on the right bank of the Ticino, 24 mi. by rail S.W. from Milan on the line to Mortara, 381 ft. above sea level. Pop. (1936) 24,609 (town); 38,039 (commune). It is a mediaeval walled town, with an arcaded market-place and a castle of the Sforza family, dating from the 14th century and adorned with a loggia by Bramante and a tower imitating that of Filarete in the Castello Sforzesco at Milan. It is a place of some importance in the silk trade.

VÍGFÚSSON, GÚDBRANDR (1828–1889), the foremost Scandinavian scholar of the 19th century, was born of a good Icelandic family in Breiðafjord. In 1849 he came to Copenhagen university as a *bursarius* in the Regense college. He was, after his student course, appointed *stipendiarius* by the Arna-Magnaean trustees, and worked for 14 years in the Arna-Magnaean library till, as he said, he knew every scrap of old vellum and of Icelandic written paper in that whole collection. During his Danish life he twice revisited Iceland (last in 1858), and made short tours in Norway and south Germany with friends. In 1866, after some months in London, he settled down in Oxford, which he made his home for the rest of his life. He held the office of reader in Scandinavian at the University of Oxford (a post created for him) from 1884 till his death. He was a jubilee doctor of Upsala, 1877, and received the Danish order of the Dannebrog in 1885. Vígfússon died of cancer and was buried in St. Sepulchre's cemetery, Oxford. His memory was remarkable; if the whole of the Eddic poems had been lost he could have written them down from memory.

By his *Túnatál* (written between Oct. 1854 and April 1855) he laid the foundations for the chronology of Icelandic history, in a series of conclusions that have not been displaced (save by his own additions and corrections), and that justly earned the praise of Jacob Grimm. His editions of Icelandic classics (1858–68), *Biskopa Sögur, Bardar Saga, Forn Sögur* (with Möbius), *Eyrbyggia Saga* and *Flateyar-bók* (with Unger) opened a new era of Icelandic scholarship, and can only fitly be compared to the Rolls Series editions of chronicles by Dr. Stubbs for the interest and value of their prefaces and texts. Seven years of constant and severe toil (1866–73) were given to the Oxford Icelandic-English dictionary, incomparably the best guide to classic Icelandic, and a monumental example of single-handed work. His later series of editions (1874–85) included *Orkneyinga* and *Háconar Saga,* the great and complex mass of Icelandic historical *sagas,* known as *Sturlunga* and the *Corpus Poeticum Boreale,* in which he edited the whole body of classic Scandinavian poetry.

VIGIL, in the Christian Church, the eve of a festival. The *vigiliae* (*pernoctationes, παννυχίδες*) were originally the services celebrated during the night preceding the feast. The abuses connected with nocturnal vigils led to their being attacked, especially by Vigilantius of Barcelona (*c.* 400), against whom Jerome fulminated in this as in other matters. The custom, however, persisted until the middle ages, when the nocturnal *vigiliae* were, except in the monasteries, gradually discontinued, the vigil services, with the term itself, being transferred to the day preceding the feast. The only surviving relic of the older custom, in the Roman Catholic Church, is the midnight mass at Christmas.

The Church of England has a special collect, gospel and epistle for "Easter Even" only. For the other vigils recognized, the rubric directs that the collect appointed for the feast "shall be said at the Evening Service next before."

VIGILANCE COMMITTEE, in the United States, a self-constituted judicial body, occasionally organized in the western frontier districts for the protection of life and property. The first committee of prominence bearing the name was organized in San Francisco in June 1851, when the crimes of desperadoes who had immigrated to the gold-fields were rapidly increasing in number and it was said that there were venal judges, packed juries and false witnesses. At first this committee was composed of about 200 members; afterwards it was much larger. The general committee was governed by an executive committee and the city was policed by sub-committees. Within about 30 days four desperadoes were arrested, tried by the executive committee and hanged, and about 30 others were banished. Satisfied with the results, the committee then quietly adjourned, but it was revived five years later. Similar committees were common in other parts of California and in the mining districts of Idaho and Montana. That in Montana exterminated in 1863–64 a band of outlaws organized under Henry Plummer, the sheriff of Montana City; 24 of the outlaws were hanged within a few months. Committees or societies of somewhat the same nature were formed in the Southern States during the Reconstruction period (1865–72) to protect white families from negroes and "carpet-baggers," and besides these there were the Ku-Klux-Klan (*q.v.*) and its branches, the Knights of the White Camelia, the Pale Faces and the Invisible Empire of the South, the principal object of which was to control the negroes by striking them with terror.

See T. J. Dimsdale, *The Vigilantes of Montana* (Virginia City, 1866); H. H. Bancroft, *Popular Tribunals* (San Francisco, 1887); P. Garnett, ed., *Papers of the San Francisco Committee of Vigilance of 1851* (Berkeley, Calif., 1910–19); Mary Floyd Williams, ed., *Papers of the San Francisco Committee of Vigilance of 1851* (Berkeley, 1919); Mary Floyd Williams, *History of the San Francisco Committee of Vigilance of 1851* (Berkeley, 1921); and William John McConnell, *Frontier Law* (Yonkers-on-Hudson, N.Y., 1924).

VIGILANTIUS (*fl. c.* 400), the presbyter, celebrated as the author of a work, no longer extant, against superstitious practices, which called forth one of the most violent and scurrilous of Jerome's polemical treatises, was born about 370 at Calagurris (Cazères or perhaps Saint Bertrand de Comminges, Haute-Garonne), where his father kept a "statio" or inn on the great Roman road from Aquitania to Spain. Sulpicius Severus sent him in 395 with letters to Paulinus of Nola. On his return to Severus in Gaul he was ordained, and set out for Palestine, where he was received by Jerome at Bethlehem. Vigilantius was dragged into the dispute then raging about Origen, in which he did not see eye to eye with Jerome. About 403, some years after his return from the East, Vigilantius wrote his work against superstitious practices, in which he argued against relic worship, as also against the vigils in the basilicas of the martyrs, the rejection of earthly goods and the attribution of special virtue to the unmarried state, especially in the case of the clergy. All that is known of the work is through Jerome's treatise *Contra Vigilantium,* or, as that controversialist would seem to prefer saying, "Contra Dormitantium." The influence of Vigilantius long remained potent both in France and Spain, as is proved by the polemical tract of

Faustus of Rhegium (d. *c.* 490).

VIGILIUS, pope from 537 to 555, succeeded Silverius and was followed by Pelagius I. He was ordained by order of Belisarius while Silverius was still alive; his elevation was due to Theodora, who had induced him to promise to disallow the council of Chalcedon, in connection with the "three chapters" controversy. But he failed to fulfil his promise, and was summoned to Constantinople, which he reached in 547. There he issued a document known as his *Judicatum* (548), in which he condemned indeed the three chapters, but expressly disavowed any intentions thereby to disparage the council of Chalcedon. After some trimming, he prepared another document, the *Constitutum ad Imperatorem,* which was laid before the so-called fifth "oecumenical" council in 553, and led to his condemnation by the majority of that body, some say even to his banishment. Ultimately, however, he was induced to confirm the decrees of the council, and was allowed after an enforced absence of seven years to set out for Rome. He died at Syracuse, before he reached his destination, on June 7, 555.

VIGINTISEXVIRI. This was the collective name which was given in Rome to "26" magistrates of inferior rank. They were divided into six boards, two of which were abolished by Augustus. Their number was thereby reduced to twenty and their name altered to VIGINTIVIRI ("the twenty"). The six boards were: (1) *Tresviri capitales* (*see* TRESVIRI); (2) *Tresviri monetales;* (3) *Quatuorviri viis in urbe purgandis,* who had the care of the streets and roads inside the city; (4) *Duoviri viis extra urbem purgandis* (*see* DUUMVIRI), abolished by Augustus; (5) *Decemviri stlitibus iudicandis* (*see* DECEMVIRI); (6) *Quatuor praefecti Capuam Cumas,* abolished by Augustus.

See Mommsen, *Römisches Staatsrecht,* ii. (1887), p. 592.

VIGLIUS, the name taken by WIGLE VAN AYTTA VAN ZUICHEM (1507–1577), Dutch statesman and jurist, a Frisian by birth, who was born on Oct. 19, 1507. He studied at various universities—Louvain, Dôle and Bourges among others—devoting himself mainly to the study of jurisprudence, and afterwards visited many of the principal seats of learning in Europe. His great abilities attracted the notice of Erasmus and other celebrated men, and his renown was soon wide and general. Having lectured on law at the universities of Bourges and Padua, he accepted a judicial position under the bishop of Münster which he resigned in 1535 to become assessor of the imperial court of justice (*Reichskammergericht*). For five years he was professor at Ingolstadt. In 1542 the official connection of Viglius with the Netherlands began. At the emperor's invitation he became a member of the council of Mechlin, and some years later president of that body. He was soon one of the most trusted of the ministers of Charles V., whom he accompanied during the war of the league of Schmalkalden in 1546. He was generally regarded as the author of the edict against toleration issued in 1550; a charge which he denied. When the emperor abdicated in 1555 Viglius was anxious to retire also, but at the instance of King Philip II. he remained at his post and was rewarded by being made coadjutor abbot of St. Bavon, and in other ways. In 1559, when Margaret, duchess of Parma, became regent of the Netherlands, Viglius was an important member of the small circle who assisted her in the work of government. He was president of the privy council, member, and subsequently president, of the state council, and a member of the committee of the state council called the *consulta.* In 1565 he was allowed to give up the presidency of the state council, but was persuaded to retain his other posts. However, he had lost favour with Margaret, who accused him to Philip of dishonesty and simony, while his orthodoxy was suspected. When the duke of Alva arrived in the Netherlands Viglius at first assisted him; but he subsequently opposed the duke's scheme of extortion. He died at Brussels on May 5, 1577.

He wrote a *Tagebuch des Schmalkaldischen Donaukriegs,* edited by A. von Druffel (Munich, 1877), and some of his lectures were published under the title *Commentarii in decem Institutionum titulos* (Lyons, 1564). His *Vita et opera historica* are given in the *Analecta Belgica* of C. P. Hoynck van Papendrecht (the Hague, 1743). *See* L. P. Gachard, *Correspondance de Philippe II. sur les affaires des Pays-Bas* (Brussels, 1848–79); and *Correspondance de Marguerite d'Autriche, duchesse de Parme, avec Philippe II.* (Brussels, 1867–81); and E. Poullet, *Correspondance de cardinal de Granvelle* (Brussels, 1877–81).

VIGNE, PAUL DE (1843–1901), Belgian sculptor, was born at Ghent. His first exhibit was the "Fra Angelico da Fiesole" at the Ghent Salon in 1868. In 1872 he exhibited at the Brussels Salon. He was employed by the government to execute caryatides for the Brussels conservatoire. In 1876 the Antwerp Salon accepted his busts of E. Hiel and W. Wilson, which were afterwards placed in the communal museum at Brussels. Until 1882 he lived in Paris, where he produced the marble statue "Immortality" (Brussels Gallery), and "The Crowning of Art," a bronze group on the façade of the Palais des Beaux-Arts at Brussels. His monument to the popular heroes, Jean Breydel and Pierre de Coninck, was unveiled at Bruges in 1887. At his death he left unfinished his principal work, the Anspach monument, which was erected at Brussels under the direction of the architect Janlet with the co-operation of various sculptors.

Other works are the bronze bust of "Psyche" (Brussels Gallery), of which there is an ivory replica; the marble statue of Marnix de Ste. Aldegonde in the Square du Sablon, Brussels; the Metdepenningen monument in the cemetery at Ghent; and the monument to Canon de Haerne at Courtrai.

See E. L. de Taeye, *Les Artistes Belges contemporains* (Brussels, 1896), and O. G. Destrée, *The Renaissance of Sculpture in Belgium* (London, 1895).

VIGNETTE, in architecture, a running ornament, representing a little vine, with branches, leaves and grapes, common in the Tudor period. It is also called *trayle.* From the transference of the term to book-illustration resulted the sense of a small picture, vanishing gradually at the edge.

VIGNY, ALFRED DE (1797–1863), French poet, was born at Loches (Indre-et-Loire) on March 27, 1797. For generations the ancestors of Alfred de Vigny had been soldiers, and he himself joined the army, with a commission in the Household Troops, at the age of sixteen. But the Revolutionary and Napoleonic wars were over, and after twelve years of life in barracks he retired. While still serving he had made his mark, if as yet unrecognized, by the publication in 1822 of a volume of poems, and in 1826 by another, together with the famous prose romance of *Cinq-Mars,* which derived some of its popularity from the enormous vogue of the novels of Scott. Some of his most celebrated pieces—*Eloa, Dolorida, Moïse*—appeared (1822–23) before the work of younger members of the Romantic school whose productions strongly resemble these poems. Nor is this originality limited to the point which he himself claimed in the Preface to his collected *Poems* in 1837—that they were "the first of their kind in France, in which philosophic thought is clothed in epic or dramatic form." Indeed this claim is disputable in itself; it is in *poetic,* not *philosophic* quality, that his idiosyncrasy and precursorship are most remarkable. It is quite certain that the other Alfred—Alfred de Musset—felt the influence of his elder namesake, and the verses of Hugo, and even of Lamartine, considerably his elder, owe something to him. His poetry, written for the most part in the earlier part of his life, is small in volume, but it forms probably his chief title to fame.

Alfred de Vigny, though he belonged to no *cénacle,* but shut himself up, as the saying went, in a *tour d'ivoire,* belonged to the Romantic movement of the 'thirties, and was stimulated by it to drama and to novel-writing. In the year before the revolution of July he produced at the Théâtre Français a translation, or rather paraphrase, of *Othello,* and an original piece, *La Maréchale d'Ancre.* In 1832 he published the curious book *Stello,* containing studies of unlucky youthful poets—Gilbert, Chatterton, Chénier—and in 1835 he brought out his drama of *Chatterton,* which, by the hero's suicide, shocked French taste even after five years of Romantic education, but had a considerable success. The same year saw the publication of *Servitude et grandeur militaires,* a collection of sketches rather than a connected work in which Vigny's military experience, his idea of the soldier's duties, and his rather poetical views of history were all worked in. The subjects of *Chatterton* and *Othello,* were, of course drawn from

English sources, and in fact Alfred de Vigny knew English well, lived in England for some time and married in 1828 an Englishwoman, Lydia Bunbury.

In 1845 Alfred de Vigny was elected to the Academy, but made no compromise in his "discourse of reception," which was unflinchingly Romantic. Still, he produced nothing save a few scraps; and, beyond the work already enumerated, little has to be added except his *Journal d'un poète* and the poems called *Les Destinées*. Vigny died at Paris on Sept. 17, 1863.

See M. Paléologue, "Alfred de Vigny" in the *Grands écrivains français* (1891); L. Dorison, *Alfred de Vigny, poète-philosophe* (1892) and *Un symbole social* (1894); G. Asse's *Alfred de Vigny et les éditions originales de sa poésie* (1895); E. Dupuy's *La Jeunesse des Romantiques* (1905); E. Lauvrière's *Alfred de Vigny* (Paris, 1910); L. Séché, *Alfred de Vigny* (2 vols., 1916); Anatole France, *Alfred de Vigny* (1923); M. Citoleux, *A. de Vigny, Persistances classiques et affinités étrangères* (1924); A. V. de Vigny, *Lettres inédites à Victor Hugo, 1820–1831* (1925). There are many editions of Vigny's works; there is a critical edition (1914) of his poems, edited by E. Estève for the Soc. des Textes français modernes.

VIGO, a seaport and naval station of north-western Spain, in the province of Pontevedra; on Vigo bay (Ria de Vigo) and on a branch of the railway from Tuy to Corunna. Pop. (1940) 44,188 (mun., 85,272). Vigo was attacked by Sir Francis Drake in 1585 and 1589. In 1702 a combined British and Dutch fleet under Sir George Rooke and the duke of Ormonde destroyed a Franco-Spanish fleet in the bay, and captured treasure of about £1,000,000. In 1719 Vigo was captured by the British; in 1936 by Spanish Nationalists. Vigo bay, one of the finest of the Galician fjords, extends inland for 19 mi., and is sheltered by low mountains and by the islands (Islas de Cies, ancient *Insulae Siccae*) at its mouth. The town is built on the south-eastern shore, and occupies a hilly site dominated by two obsolete forts. Vigo owes its importance to its deep and spacious harbour, and to its fisheries. It is a port of call for many lines trading between Western Europe and South America. The town contains flour, paper and sawmills, sugar and petroleum refineries, tanneries, distilleries and soap works.

VIIPURI, formerly Viborg, a seaport and summer resort of Finland in 60° 43′ N., 28° 45′ E., at the mouth of the Saima canal on the Bay of Viipuri in the Gulf of Finland. Pop. (est. 1939) 74,247. The canal links it with a series of lakes. Its exports are timber, timber products, cement and farm produce. and its imports coal, fertilizers, foodstuffs and manufactured goods. It is on glaciated granite hills surrounding the bay, guarded by the naval station of Björkö. Its castle, built in 1293 by Marshal Torkel Knutson, was the first centre for the spread of Christianity in Karelia. It was the chief loss to Russia in the winter war of 1940–41, and was regained in 1941, after Finland entered World War II for the second time.

VIJAYANAGAR (vē-jah-yahn′ạ-gạr) ("the city of victory"), an ancient Hindu kingdom and ruined city of southern India. The kingdom lasted from about 1336 to 1565, forming during all that period a bulwark against the Mohammedan invasion from the north. The great part of its history is obscure; but its power and wealth are attested by more than one European traveller, and also by the character of the existing ruins. At the beginning of the 14th century Mohammedan raiders had effectually destroyed every Hindu principality throughout southern India, but did not attempt to occupy the country permanently. In this state of desolation Hindu nationality rose again under two brothers, named Harihara and Bukka, of whom little more can be said than that they were Kanarese by race. Hence their kingdom was afterwards known as the Carnatic (*q.v.*). In 1565, on the downfall of the kingdom, the confederate sultans of Bijapur, Ahmednagar and Golconda, overwhelmed the Vijayanagar army in the plain of Talikota, and sacked the defenceless city. The city has ever since remained a wilderness of immense ruins, which are now conserved by the British Government.

See R. Sewell, *A Forgotten Empire* (1900); and B. S. Row, *History of Vijayanagar* (Madras, 1906).

VIKING. A word *wicing,* "warrior," corresponding to the O. Norse *vikingr* and the modern *viking,* was current in England at least a century before the earliest recorded Scandinavian descents upon the West. Its Scandinavian equivalent early acquired the more specialized sense of "sea-warrior," and the modern term "Viking age" is a convenient designation of the phase of Scandinavian history which produced the incessant raiding expeditions characteristic of the 9th and early 10th centuries. Most of our evidence as to the Vikings of this period is derived from the literature of the lands which they visited, and is therefore essentially hostile. To contemporary chroniclers they were utterly hateful, faithless, cruel and enemies of civilization and the arts of peaceful life. Their own side of the story is untold, for the men who created the great literature of western Scandinavia had no certain memory of events or personalities in the true Viking age. Their character can only be inferred from the scale upon which their raids were planned, the forms of society which arose in the different lands of their settlement, and the archaeological evidence which reveals something of their culture. Judged in this way they cease to appear as a mere blind force of destruction. It becomes clear that they possessed their own culture, though it was not the culture of the Christian West. Long before the end of the 9th century they had learned to penetrate all the greater water-ways of Europe. And the raids through which they gained this knowledge were only preliminary to wider voyages through which at last even the New World became known for a moment to men of Scandinavian birth.

The Viking Raids.—The Vikings began by more or less desultory raids, in the course of which they seized upon some island, which they generally used as an arsenal for attacks on the mainland. At first the raids were made in the summer, and the *first wintering* in any new scene of plunder meant settlement in the country, and some sort of division of territory. After that the northerners assimilated themselves more or less to the natives of the country. This course was followed in the history of the Viking attacks on Ireland, the earliest of their continuous series of attacks. Thus they began by seizing the island of Rechru (now Lambay) in Dublin bay (A.D. 795) and in 20 years were on the northern, western and southern coasts; by A.D. 825 they ventured raids to a considerable distance inland. In A.D. 832 came a large fleet under Turgesius (Thorgestr). The new invader extended his conquests till, in A.D. 842, one-half of Ireland (called Lethcuinn or Con's Half) had submitted; he established his wife, Ota, as a sort of *völva,* or priestess, in what had been one of Ireland's most famous literary monasteries, Clonmacnoise. Turgesius was killed soon after, in 845; and though in A.D. 853 Olaf the White was over-king of Ireland, the Vikings' power diminished. In the end, territory was—if by no formal treaty—ceded to their influence; and the (Irish) kingdoms of Dublin and Waterford were established on the island.

This sketch may be taken as the prototype of Viking invasion of any region of Western Christendom which was continuously attacked. Almost simultaneously with the attacks on Ireland came others, probably also from Norway, on the western coasts and islands of Scotland. Plunderings of Iona are mentioned in A.D. 802, 806, and in the course of a generation almost all the monastic communities in western Scotland had been destroyed. On the Continent there were three distinct regions of attack. The Danes early settled on the island of Walcheren, which had, in fact, been given by the emperor Louis the Pious to a fugitive Danish king, Harald by name, who sought the help of Louis and adopted Christianity. From the island the raids extended on either side: sometimes eastward as far as the Rhine, and so into Germany proper; at other times westward to the Somme, and thus into the territory of Charles the Bald, the future kingdom of France. Toward the end of the 9th century all Frisia between Walcheren and the German ocean seems to have been possessed by the invaders. The serious attacks of the pirates in any part of the empire distant from their own lands began about the middle of the century, when they first wintered in the Seine territory. Their first attack on Paris was in A.D. 845; in A.D. 885–887 a much more important but unsuccessful one took place, the invaders receiving an indemnity for raising the siege and leave to pass beyond Paris into Burgundy. The settlement of Danes under Rollo on the lower Seine, *i.e.,* in Normandy, belongs to the next century.

The third region is the mouth of the Loire, where the island *point d'appui* was Noirmoutier. The Northmen wintered there in A.D. 843. No region was more often ravaged than that of the lower Loire, so rich in abbeys—St. Martin of Tours, Marmoutiers, St. Benedict, etc. But the country ceded to the Vikings under Hasting at the Loire mouth was insignificant and not in permanent occupation.

Near the end of the 9th century, however, the plundering expeditions which emanated from these three sources became so incessant and so widespread that we can signalize no part of west France as free from them, and at the same time much mischief was wrought in the Rhine country and in Burgundy. Unfortunately, at this point our best authority ceases; and we cannot well explain the changes which brought about the Christianization of the Normans and their settlement in Normandy as vassals of the West Frankish kings.

For the Viking attacks in the British Isles, the course of events is clearer. In its general features it follows the normal course. The Vikings had begun to visit the English coast about the end of the 8th century, but their serious attacks do not begin till 838. Their first wintering was on the contiguous island of Thanet in A.D. 851. In 865 England was visited by a "great army," which overthrew the ancient kingdoms of Northumbria, Mercia and East Anglia. Wessex was saved only by Alfred's victory at Edington, after which Guthrum, the Danish leader, accepted baptism and settled with his men in East Anglia. But the forces defeated at Edington represented but half of the Viking army in England at the time. The other half had already settled in Northumbria, and the region between Humber and Welland.

The six territories which we have signalized—Ireland, Western Scotland, England, the three in West Francia which merge into each other by the end of the 9th century—do not comprise the whole field of Viking invasion. To the east they twice sailed up the Elbe (A.D. 851, 880) and burnt Hamburg. Southwards they plundered far up the Garonne, and in the north of Spain; and one fleet of them sailed round Spain, plundering, but attempting in vain to establish themselves in this Arab caliphate. They plundered on the opposite African coast, and at last got as far as the mouth of the Rhone, and thence to Luna in Italy.

In the third quarter of the 9th century two distinct tendencies appeared among the Vikings in the West. One section was ready to settle down and receive territory at the hands of the Christian rulers; the other section adhered to a life of adventure and of plunder. A large portion of the great army, unable to obtain settlement in England, sailed to the Continent and spread devastation far and wide. Under command of two Danish "kings," Godfred and Siegfried, they were first in the country of the Rhine-mouth or the Lower Scheldt; afterwards dividing their forces, some devastated far into Germany, others extended their ravages on every side in northern France down to the Loire. The whole of these vast countries, Northern Francia and part of Burgundy and the Rhineland, were as much at their mercy as England before the battle of Edington, or Ireland before the death of Turgesius. But in every country alike the wave of Viking conquest now began to recede. The settlement of Normandy was the only permanent outcome of the Viking age in France. In England, under Edward the Elder and Aethelflaed, Mercia recovered a great portion of what had been ceded to the Danes. In Ireland a great expulsion of the invaders took place in the beginning of the 10th century. In the following generations the kingdoms of Denmark and Sweden became consolidated, and the energy of the Norwegian peoples found vent in the settlement of Iceland.

Severe as were the raids in Europe, and great as was the suffering—on account of which a special prayer, *A furore Normannorum libera nos* was inserted in some of the litanies of the West—if the Vikings had been nothing more than pirates their place in history would be insignificant. But the Viking outbreak has to some extent the character of a national movement. While some were harrying in the West others were founding Garðaríki (Russia) in the East; others were pressing farther south till they reached the eastern empire in Constantinople, so that when Hasting and Björn had sailed to Luna in the Gulf of Genoa the northern folk had almost put a girdle round the Christian world. There is every evidence that they were not a mere lawless folk, but under suitable conditions, as in their 10th century colony of Jómborg, could develop an elaborate discipline and a strict code of honour. They were not entirely unlettered, for the use of runes dates back considerably earlier than the Viking age.

The Viking Ships.—In certain material possessions—those belonging to war and naval adventure—the Vikings were ahead of the Christian nations. There is certainly a historical connection between the ships which the tribes on the Baltic possessed in the days of Tacitus and the Viking ships, a fact which would lead us to believe that the art of shipbuilding had been better preserved there than elsewhere in northern Europe. Merchant vessels must, of course, have plied between England and France or Frisia. But it is certain that even Charlemagne possessed no adequate navy. Nor was any English king before Alfred stirred up to undertake the same task. The Viking ships had a character apart. They may have owed their origin to the Roman galleys; they did without doubt owe their sails to them. Their structure was adapted to short voyages in a sea not exposed to the most violent storms or dangerous tides. They were shallow, narrow in the beam, pointed at both ends, and so eminently suitable for manoeuvring (with oars) in creeks and bays. The Viking ship had but one large and heavy square sail, and when a naval battle was in progress it would depend for its manoeuvring on the rowers. In saga literature we read of craft (of "long ships") with 20 to 30 benches of rowers, which would mean 40 to 60 oars. It is not probable that the largest viking ships had more than ten oars a side. As these ships must often, against a contrary wind, have had to row both day and night, it seems reasonable to imagine the crew divided into three shifts which would give twice as many men available to fight on any occasion as to row. Thus a 20 oared vessel would carry 60 men. But some 40 men per ship seems, for this period, nearer the average. In 896, it is incidentally mentioned in one place that five vessels carried 200 Vikings, an average of 40 per ship. Elsewhere about the same time we read of 12,000 men carried in 250 ships, an average of 48.

The round and painted shields of the warriors hung outside along the bulwarks; the vessel was steered by an oar at the right side. Prow and stern rose high; and the former was carved most often as a snake's or dragon's head. The warriors were well armed. The *byrnie*, a mail-shirt, is often mentioned in Eddic songs; so are the axe, spear, javelin, the bow and arrows and the sword. An immense joy in battle breathes through the earliest Norse literature, which has scarce its like in any other literature; and we know that the language recognized a peculiar battle fury, a madness by which men were seized and which went by the name of "berserk's way" (*berserksgangr*). The courage of the Viking was proof against anything, even as a rule against superstitious terrors. He was unfortunately hardly less marked for cruelty and faithlessness. It is also true, however, that they showed a capacity for government, and in times of peace for peaceful organization. Normandy was the best-governed part of France in the 11th century; and the Danes in East Anglia and the Five Boroughs developed a form of society remarkable for its stability amid changing political conditions. Nevertheless, the significance of the Vikings in the history of western Europe lies less in the communities which they founded than in the stimulus given by their raids to the new military organization of society out of which feudalism was presently to arise.

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VIKRAMĀDITYA, a legendary Hindu king of Uzjain, who is supposed to have given his name to the Vikram Samvat, the era which is used all over northern India, except in Bengal, and at whose court the "nine gems" of Sanskrit literature are also supposed to have flourished. The Vikram era is reckoned from the vernal equinox of the year 57 B.C., but there is no evidence that that date corresponds with any event in the life of an actual king. As a matter of fact, all dates in this era down to the 10th

century never use the word Vikram, but that of Malava instead, that being the tribe that gives its name to Malwa. The name Vikramaditya simply means "sun of power," and was adopted by several Hindu kings, of whom Chandragupta II. (Chandragupta Vikramaditya), who ascended the throne of the Guptas about A.D. 375, approaches most nearly to the legend.

See Alexander Cunningham, *Book of Indian Eras* (1883); and Vincent Smith, *Early History of India* (1904).

VILL, the Anglicized form of the word *villa,* used in Latin documents to translate the Anglo-Saxon *tun,* township. Ultimately "vill" and "township" became regarded as equivalent terms, and so remained in legal use until the ecclesiastical parish became regarded as the normal unit of local administration. In classical Latin *villa* had meant "country-house," "farm," "villa" (*see* VILLA); but even by the 3rd century it had acquired the sense of "village." Later it even displaced *civitas,* for city; thus Rutilius Namatianus in his *Itinerarium* speaks of *villae ingentes, oppida parva;* whence the French *ville* (*see* Du Cange, *Glossarium lat. s.v.* Villa). In the Frankish empire *villa* was also used of the royal and imperial palaces or seats with their appurtenances. In the sense of a small collection of habitations the word came into general use in England in the French form "village." From *villa,* too, are derived villein and villeinage (*q.v.*).

VILLA, FRANCISCO (*"Pancho"*) (1877–1923), Mexican revolutionary general, born at Rio Grande, state of Durango, Mexico, Oct. 4, 1877. As a youth without a home, roaming and thieving, he gathered around him a band of rough followers and changed his real name, Doroteo Arango, to that of a bandit once notorious in his region. He headed a well-organized ring of cattle rustlers operating in the northern states and this caused a price to be placed on his head by the Diaz Government. He was, therefore, very willing in 1910 to join Madero in his revolt against Diaz. Villa was captured by Gen. Victoriano Huerta during the campaign but later escaped into Texas. In 1914 he reentered Mexico to join forces with Gen. Venustiano Carranza (*q.v.*) against Huerta who had in the meantime overthrown Francisco Madero (*q.v.*) and seized the presidency. The two generals drove Huerta from the country but in the moment of triumph could not agree between themselves. Carranza refused to treat with Villa, regarding him as a mere bandit and not trusting his intentions. Villa marched into Mexico City and Carranza fled to Vera Cruz. But Obregon (*q.v.*), Carranza's chief general, succeeded in driving Villa out of Mexico City and pursued him relentlessly until he took refuge in the mountains of the northern states. The United States recognized Carranza's Government and Villa, feeling he had been duped, developed a hatred for the "gringos" which led to his later outrages. On Mar. 9, 1916, with some 400 men he crossed the U.S. border and raided Columbus, N. Mex., killing 16 citizens and partly burning the town. The next day President Wilson ordered a force into Mexico to capture Villa and his band. It was expected that Carranza would co-operate in the pursuit of his enemy but instead he voiced his objections to the entrance of U.S. troops and on June 17th notified Gen. Pershing that further invasion would be resisted by arms. The American troops withdrew without effecting their object. Villa ceased to be an international menace but remained under arms until the Federals in 1920 bought his retirement with the gift of a large estate. On July 20, 1923, his automobile was swept by a shower of bullets and he and his three companions were killed.

VILLA, the Latin word (diminutive of *vicus,* a village) for a country-house. The word is loosely and incorrectly used, especially in England, for small detached or semi-detached suburban houses. In its correct usage, however, it signifies a summer residence of great extent, especially in Italy, or one in which Italian influence is dominant. References to the villa are constantly made by Roman writers. Cicero is said to have possessed no less than seven villas, the oldest of which was near Arpinum; Pliny the younger had three or four, two of which he described at length in his letters; that at Tusculum and that near Laurentium. The remains of the villa of Hadrian at Tivoli, which covered an area over 7 m. long and in which reproductions were made of all the most celebrated buildings he had seen during his travels, and the villas of the 16th century on similar sites, such as the Villa d'Este near Tivoli, enable one to form some idea of the exceptional beauty of the positions selected and of the splendour of the structures which enriched them. Literary descriptions, as well as existing remains, reveal the house proper of the Roman villa as a rather rambling building designed to take advantage of breeze and view, rather than to be symmetrical. Long colonnades were frequent, there were occasional towers, and the building was often on more than one level. R. Lanciani (*Ancient Rome in the Light of Recent Excavations,* 279 ff.) states that the Casino del Ligorio (Villa Pia) in the Vatican gardens (1558–62), by P. Ligorio, and the Barberini villa at Castel Gandolfo of all existing Renaissance villas most closely resemble their Roman prototypes. Such villas were not limited to Italy but are found throughout the empire.

According to Pliny, there were two kinds of villas, the *villa urbana,* which was a country-seat and the *villa rustica,* the farm-house. The Villa Boscoreale near Pompeii, which was excavated in 1893–94, is an example of the *villa rustica,* in which the principal room was the kitchen, with the bakery and stables beyond and room for the wine presses, oil presses, hand mill, etc. The villas near Rome were all built on hilly sites, so that the laying out of the ground in terraces formed a very important element in their design, and this forms the chief attraction of the Italian villas of the 16th century, among which the following are the best known: the Villa Madama, the design of which, attributed to Raphael, was carried out by Giulio Romano in 1520; the Villa Medici (1540); the Villa Albani, near the Porta Salaria; the Borghese; the Doria Pamphili (1650); the Villa di Papa Giulio (1550), designed by Vignola; the Aldobrandini (1598–1603) by G. della Porta; the Falconieri (1546) and the Mondragone Villas (1573–75) at Frascati, and the Villa d'Este near Tivoli (1549), by P. Ligorio.

The Italian villas of the 16th and 17th centuries, like those of Roman times, included not only the country residence, but all the other buildings on the estate, such as bridges, casinos, pavilions and small temples, which were utilized as summer-houses; and these seem to have had an influence in England and France.

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VILLACH, an old Austrian town, after 1938 in the German *reichsgau* of Carinthia on the Drava at the western end of the basin of Klagenfurt (*q.v.*). Lying on a through route from Vienna to Italy, much traffic passes through it. It is the timber trade centre for Italy and manufactures lead wares based upon the very rich lead-mines of Bleiberg, about 9 mi. west of the town. The town is a centre for tourist traffic to the surrounding Alpine highlands. The 15th century church of St. Jacob in Gothic style has a tower about 315 ft. high. Pop. (1939) 26,537. Warmbad Villach, a watering-place with hot sulphur baths, and Mittewald, a favourite summer resort, whence the ascent of the Dobratsch can be made, are in the neighbourhood of Villach. Some of the prettiest Carinthian lakes are to be found near Villach.

VILLA DE CURA, an inland town of the state of Aragua, Venezuela, 55 mi. S.W. of Caracas, near the Lago de Valencia. Pop. (1941) 8,294. The town stands in a broad, fertile valley, between the sources of streams running southward to the Guárico river and northward to the lake, with an elevation above sea level of 1,598 ft. Traffic between Puerto Cabello and the Guárico plains has passed through this town since early colonial times, and has made it a commercial centre, from which hides, cheese, coffee, cacao and beans are sent down to the coast for export. Villa de Cura was founded in 1730, and suffered severely in the war of independence.

VILLA DEL PILAR or **PILAR,** a city of Paraguay, 104

mi. south of Asunción, on the left bank of the Paraguay river opposite the mouth of the Bermejo. Pop. (1940 est.) 8,600. Villa del Pilar is among the more important of the smaller towns of Paraguay, has a good harbour, and is the capital of the department of Pilar. The surrounding region produces tobacco, yerba mate, cotton, oranges, hides and timber.

VILLAFRANCA DI VERONA, a town of Venetia, Italy, in the province of Verona, 11 mi. S.S.W. of Verona, on the railway to Mantua, 174 ft. above sea-level. Pop. (1936), 4,986 (town); 14,479 (commune). Here preliminaries of peace were signed between Napoleon III and the Austrians in 1859 after the battle of Solferino. Five miles to the N. is Custozza, where the Italians were defeated by the Austrians in 1848 and 1866.

VILLAGE COMMUNITIES. The study of village communities has become one of the fundamental methods of discussing the ancient history of institutions. It will be sufficient to confine the present inquiry to the varieties presented by nations of Aryan race, not because greater importance is to be attached to these nations than to other branches of humankind, although this view might also be reasonably urged, but principally because the Aryan race in its history has gone through all sorts of experiences, and the data gathered from its historical life can be tolerably well ascertained.

The best way seems to be to select some typical examples, chiefly from the domain of Celtic, Slavonic and Germanic social history, and to try to interpret them in regard to the general conditions in which communal institutions originate, grow and decay. As the principal problem will consist in ascertaining how far land was held in common instead of by individuals, it is advisable to look out for instances in which this element of holding in common is very clearly expressed. We ought to get, as it were, acclimatized to the mental atmosphere of such social arrangements in order to counteract a very natural but most pernicious bent prompting one to apply to the conditions of the past the key of our modern views and habitual notions. A certain acquaintance with the structure of Celtic society, more especially the society of ancient Wales, is likely to make clear from the outset to what extent the husbandry and law of an Aryan race may depend on institutions in which the individual factor is greatly reduced, while the union first of kinsmen and then of neighbours plays a most decisive part.

Seebohm called our attention to the interesting surveys of Welsh tracts of country made in the 14th century, soon after these regions passed into the hands of English lords. The fragments of these surveys published by him and his commentary on them are very illuminating, but further study of the documents themselves discloses many important details and helps to correct some theories propounded on the subject. Let us take up a concrete and simple case, *e.g.*, the description of Astret Canon, a trev or township (*villata*) of the honour of Denbigh, surveyed in 1334. In the time of the native Welsh princes it was occupied entirely by a kindred (*progenies*) of free tribesmen descended from a certain Canon, the son of Lawaurgh. The kindred was subdivided into four gavells or bodies of joint-tenants. On the half-gavell of Monryk ap Canon, *e.g.*, there are no less than 16 coparceners, of whom eight possess houses. The peculiarity of this system of land tenure consists in the fact that all the tenants of these gavells derive their position on the land from the occupation of the township by their kindred, and have to trace their rights to shares in the original unit. Although the village of Astret Canon was occupied by something like 54 male tenants, the majority of whom were settled in houses of their own, it continued to form a unit both in regard to the payment of land tax and other services and payments, and also in respect of the possession and usage of the soil. On the other hand, movable property is owned in severalty. Services have to be apportioned among the members of the kindreds according to the number of heads of cattle owned by them. From the description of another township—Pireyon—we hear that gavells ought to be considered as equal shares in respect of the arable, the wood and the waste of the township. If the shares were reduced into acres there would have fallen to each of the eight gavells of Pireyon 91ac., one rood and a half and six perches of arable and woodland, and 53⅓ac. and half a rood of waste land. But as a matter of fact the rights of the tenants of the gavell were realized not through the appropriation of definite acres, but as proportionate opportunities in regard to tillage and as to usages in pasture, wood and waste. Pastoral habits must have greatly contributed to give the system of landholding its peculiar character. It was not necessary, it would have been even harmful, to subdivide sharply the area on which the herds of cows and the flocks of sheep and goats were grazing.

We do not notice any systematic equalization between members of the tribal communities of the trevs. In fact, both differences in the ownership of cattle and differences of tribal standing, established by complex reckonings of pedigree and of social rank, led to marked inequalities. But there was also the notion of birthright, and we find in the laws that every free tribesman considered himself entitled to claim from his kindred grazing facilities and five erws for tillage. Such a claim could be made unconditionally only at a time when there was a superabundance of land to dispose of. In the 14th century, to which our typical descriptions refer, this state of things had ceased to be universal. Although great tracts of Welsh land were undoubtedly still in a state of wilderness, the soil in more conveniently situated regions was beginning to be scarce, and considerable pressure of population was already felt, with a consequent transition from pastoral pursuits to agriculture.

Although there are no rearrangements or redivision within the tribe as a whole, inside every gavell, representing more narrow circles of kinsmen, usually the descendants of one great-grandfather, *i.e.*, second cousins, the shares are shifted and readjusted according to one of two systems. In one case, that of the trev-cyvriv or joint-account village, every man receives "as much as another yet not of equal value"—which means, of course, that the members of such communities were provided with equal allotments, but left to make the best of them, each according to chance and ability. This practice of reallotment was, however, restricted in the 14th century to taeog trevs, to villages occupied by half-free settlers. The free tribesmen, the *priodarii* of Wales, held by *daddenhud,* were reallotted shares within the trev on the coming of each new generation or, conversely, on the going out, the dying out, of each older generation. In other words: at the demise of the last of the grandfathers in a gavell, all the fathers took equal rank and claimed equal shares, although formerly some of the portions had been distributed equally only between the grandfathers or their offspring (*stirps*). The right to claim redivision held good only within the circle of second cousins.

Another fact which is brought out with complete evidence by the Welsh Surveys is that the tenure is ascribed to communities of kinsmen and not to chiefs or headmen. The latter certainly existed and had exerted a powerful influence on the disposal of common land as well as on government and justice. But in the view of the 14th-century surveys each township is owned not by this or the other elder, but by numerous bodies of coparceners. In this way there is a clear attribution of rights of communal ownership, and not merely of rights of maintenance.

Let us now compare this description of Celtic tribal tenure with Slavonic institutions. The most striking modern examples of tribal communities settled on a territorial basis are presented by the history of the Southern Slavs in the Balkan Peninsula and in Austria, of Slovenes, Croats, Serbs and Bulgarians, but it is easy to trace customs of the same kind in the memories of Western Slavs conquered by Germans, of the Poles and of the different subdivisions of the Russians. A good clue to the subject is provided by a Serb proverb which says that *a man by himself is bound to be a martyr.* The Slavs of the mountainous regions of the Balkans and of the Alps in their stubborn struggle with nature and with human enemies have clustered and still cluster to some extent in closely united and widely spreading brotherhoods (*bratstva*) and tribes (*plemena*). Some of these brotherhoods derive their names from a real or supposed common ancestor, and are composed of relatives as well as of affiliated strangers. They number sometimes hundreds of members, of guns, as the fighting males are characteristically called. Such are the

Vuktići, Kovacevići,—as one might say in Old English the Vukotings or Kovachevings,—of Montenegro. The dwellings, fields, and pasturages of these brotherhoods or kindreds are scattered over the country. But there was the closest union in war, revenge, funeral rites, marriage arrangements, provision for the poor and for those who stood in need of special help, as in case of fires, inundations and the like. And corresponding to this union there existed a strong feeling of unity in regard to property, especially property in land. Although ownership was divided among the different families, a kind of superior or eminent domain stretched over the whole of the *bratstvo,* and was expressed in the participation in common in pasture and wood, in the right to control alienations of land and to exercise pre-emption.

As the Welsh kindreds were subdivided into gavells formed of extended family communities, even so the Bosnian, Montenegrin, Serbian and Slovene tribes fell into house communities, *Kućas, Zadrugas,* which were built up on the principle of keeping blood-relatives and their property together as long as possible. They consisted generally of some 15 to 20 grown-up persons, some six or seven first and second cousins with their wives and children, living in a hamlet around the central house of the *domaćin,* the house leader. In some instances the number of coparceners increased to 50 or even to 70. The members of the united house community, which in fact is a small village or hamlet, joined in meals and work. Their rights in the undivided household of the hamlet were apportioned according to the pedigree, *i.e.,* this apportionment took account first of the *stirpes* or extant descendants of former scions of the family, so that, say, the offspring of each of two grandfathers who had been brothers were considered as equal sharers although the *stirps,* the stock, of one was represented only by one person, while the *stirps* of the other had grown to consist of two uncles and of three nephews all alive. There was no resettlement of shares, as in the case of Wales, but the life of the house community while it existed unbroken led to work in common, the contributions to which were regulated by common consent and supervised by the leader. Grounds, houses, implements of agriculture (ploughs, oxen, carts) and of viniculture—casks, cauldrons for the making of brandy, etc.—were considered to be common capital and ought not to be sold unless by common consent. Divisions were not prohibited. Naturally a family had to divide sooner or later, and the shares had to be made real, to be converted into fields and vineyards. But this was an event which marked, as it were, the close of the regular existence of one union and the birth of similar unions derived from it. As a rule, the *kuća* kept together as long as it could, because co-operation was needed and isolation dangerous—for economic considerations as well as for the sake of defence.

Attention, however, should be called more particularly to the parallel phenomena in the social history of the Russians, where the conditions seem to stand out in specially strong contrast with those prevailing among the mountain Slavs of the Balkans and of the Alps. In the enormous extent of Russia we have to reckon with widely different geographical and racial areas, among others, with the Steppe settlements of the so-called Little Russians in the Ukraine, and the forest settlements of the Great Russians in the north. In spite of great divergencies the economic history of all these branches of Slavonic stock gravitates towards one main type, viz., towards rural unions of kinsmen, on the basis of enlarged households. In the south the typical village settlement is the *dvorišće,* the big court or hamlet consisting of some four to eight related families holding together; in the north it is the *pećišće,* the big oven, a hamlet of somewhat smaller size in which three to five families are closely united for purposes of common husbandry.

Another fact to be noticed is the tendency to form artificial associations on the pattern of the prevailing unions of kinsmen. People who have no blood-relations to appeal to for clearing the waste, for providing the necessary capital in the way of cattle and plough implements, for raising and fitting out buildings, join in order to carry on these economic undertakings, and also to help each other against aggressors. The members of these voluntary associations, which at once call to mind German, Norse and English gilds, are called "siabri," "skladniki," and the gilds themselves "spólkíe," in south Russia. In a district of the Ukraine called the "Ratensky Sharostvo" there were no fewer than 278 such gilds interchanging with natural kindreds. The organization of all these unions could in no way be called patriarchal. Even in cases when there is a definite elder or headman (*bolshoy*), he was only the first among equals and exercised only a limited authority over his fellows: all the important decisions had to be taken by the council of the community.

In Great Russia, in the districts gathered under the sway of the Moscow tsars, the basis of the household community and of the rural settlements which sprang from it was modified in another direction. The entire agricultural population was subjected to strict supervision and coercive measures for purposes of military organization and taxation. Society was drilled into uniformity and service on the principle that every man has to serve the tsar, the upper class in war and civil administration, the lower class by agricultural labour. A consequence of the heavy burden laid on the land and of the growth of a landed aristocracy was a change in the management of land allotments. They became as much a badge of service and a basis for fiscal requirements as a means of livelihood. The result was the practice of reallotments according to the strength and the needs of different families. The shifting of arable (*peredel*) was not in this case a reapportionment of rights, but a consequence of the correspondence between rights and obligations.

Let us now pass to village communities in Teutonic countries, including England. A convenient starting-point is afforded by the social and economic conditions of the southern part of Jutland. The Saxon or Dithmarschen portion of this region gives us an opportunity of observing the effects of an extended and highly systematized tribal organization on Germanic soil. The independence of this northern peasant republic, which reminds one of the Swiss cantons, lasted until the time of the Reformation. We find the Dithmarschen organized in the 15th, as they had been in the 10th century, in a number of large kindreds, partly composed of relatives by blood and partly of "cousins" who had joined them. The membership of these kindreds is based on agnatic ties—that is, on relationship through males—or on affiliation as a substitute for such agnatic kinship. The families or households are grouped into brotherhoods, and these again to clans or "Schlachten" (*Geschlechter*), corresponding to Roman *gentes.* Some of them could put as many as 500 warriors in the field. They took their names from ancestors and chieftains: the Wollersmannen, Hennemannen, Jerremannen, etc.—*i.e.,* the men of Woll, the men of Henne, the men of Jerre. In spite of these personal names the organization of the clans was by no means a monarchical one: it was based on the participation of the full-grown fighting men in the government of each clan and on a council of co-opted elders at the head of the entire federation.

Let us notice the influence of this tribal organization on husbandry and property. The regular economic arrangement was an open-field one based on a three-field and similar systems. The furlongs were divided into intermixed strips with compulsory rotation on the usual pattern. And it is interesting to notice that in these economic surroundings indivisible holdings corresponding to the organic unities required for efficient agriculture arose of themselves. In spite of the equal right of all coheirs to an estate, this estate does not get divided according to their numbers, but either remains undivided or else falls into such fractions, halves or fourths, as will enable the farming to be carried on successfully. The Hufe or Hof goes mostly to the eldest son, but also sometimes to the youngest, while the brothers of the heir either remain in the same household with him, generally unmarried, or leave the house after having settled with their heir, who takes charge of the holding, as to an indemnity for their relinquished claims.

This evidence is of decisive importance in regard to the formation of unified holdings; we are on entirely free soil, with no vestige whatever of manorial organization or of coercion of tenants by the lord. The Hufe, the normal holding, is preserved intact in order to secure agricultural efficiency. This "Anerben" system is widely spread all through Germany. The question whether the

eldest or the youngest succeeds is a subordinate one. Anyhow, manorial authority is not necessary to produce the limitation of the rights of succession to land and the creation of the system of holdings, although this has been often asserted, and one of the arguments for a servile origin of village communities turns on a supposed incompatibility between the unified succession and the equal rights of free coheirs.

We need not speak at any length about other parts of Germany, as space does not permit of a description of the innumerable combinations of communal and individual elements in German law, but we must point out some facts from the range of Scandinavian customs. In the mountainous districts of Norway we notice the same tendency towards the unification of holdings as in the plains and hills of Schleswig and Holstein. The bönder of Gudbrandsdalen and Telemarken, the free peasantry tilling the soil and pasturing herds on the slopes of the hills from the days of Harold Hárfagr to our own times, sit in *Odalgaards,* or freehold estates, from which supernumerary heirs are removed on receiving some indemnity, and which are protected from alienation into strange hands by the privilege of pre-emption exercised by relatives of the seller. Equally suggestive are some facts on the Danish side of the straits, viz., the arrangements of the *bóls* which correspond to the hides and virgates of England and to the Hufen of Germany. Here again we have to do with normal holdings independent of the number of coheirs, but dependent on the requirements of agriculture—on the plough and oxen, on certain constant relations between the arable of an estate and its outlying commons, meadows and woods. The ból does not stand by itself like the Norwegian gaard, but is fitted into a very close union with neighbouring bóls of the same kind. Practices of coaration, of open-field intermixture, of compulsory rotation of lot-meadows, of stinting the commons, arise of themselves in the villages of Denmark and Sweden.

We catch a glimpse, to begin with, of a method of dividing fields which was considered archaic even in those early times, the so-called "forniskift" and "hamarskift." The two principal features of this method are the irregularity of the resulting shapes of plots and the temporary character of their occupation. The first observation may be substantiated by a description like that of Laasby in Jutland: "These lands are to that extent scattered and intermixed by the joint owners that it cannot be said for certain what (or how much) they are." Swedish documents, on the other hand, speak expressly of practices of shifting arable and meadows periodically, sometimes year by year.

Now the uncertainty of these practices based on occupation became in process of time a most inconvenient feature of the situation and evidently led to constant wrangling as to rights and boundaries. The description of Laasby which I have just quoted ends with the significant remark: "They should be compelled to make allotment by the cord." This making of allotments by the cord is the process of rebning, from *reb,* the surveyor's cord, and the juridical procedure necessary for it was called "solskift"—because it was a division following the course of the sun.

The two fundamental positions from which this form of allotment proceeds are: (1) that the whole area of the village is common land (*faellesjord*), which has to be lotted out to the single householders; (2) that the partition should result in the creation of equal holdings of normal size (bóls). In some cases we can actually recognize the effect of these allotments by ancient solskift in the 18th century, at a time when the Danish enclosure acts produced a second general revolution in land tenure.

The 12 oldest inhabitants, elected as sworn arbitrators for effecting the allotment, begin their work by throwing together into one mass all the grounds owned by the members of the community, including dwellings and farm-buildings, with the exception of some privileged plots. There is a close correspondence between the sites of houses and the shares in the field. The first operation of the surveyors consists in marking out a village green for the night-rest and pasture of the cattle employed in the tillage (*fortá*), and assigning sites to the houses of the coparceners with orchards appendant to them (tofts); every householder getting exactly as much as his neighbour. From the tofts they proceed to the fields on the customary notion that the toft is the mother of the field. The fields are disposed into furlongs and shots, as they were called in England, and divided among the members of the village with the strictest possible equality. This is effected by assigning to every householder a strip in every one of the furlongs constituting the arable of the village. Meadows were often treated as lot-meadows in the same way as in England. After such a "solskift" the peasants held their tenements in undisturbed ownership, but the eminent demesne of the village was recognized and a revision of the allotment was possible.

After having said so much about different types of village communities which occur in Europe it will be easier to analyse the incidents of English land tenure which disclose the working of similar conceptions and arrangements. Features which have been very prominent in the case of the Welsh, Slavs, Germans or Scandinavians recur in the English instances sometimes with equal force and at other times in a mitigated shape.

There are some vestiges of the purely tribal form of community on English soil. Many Saxon and Anglian place-names are derived from personal names, followed by the suffix *ing,* and closely resemble the common patronymics of Saxon and German families and kindreds. It is most probable, as Kemble supposed, that we have to do in most of these instances with tribal and family settlements, although the mere fact of belonging to a great landowner may have been at the root of some cases.

A very noticeable consequence of tribal habits in regard to landownership is presented by the difficulties which stood in the way of alienation of land by the occupiers of it. The Old English legal system did not originally admit of any alienation of folkland, land held by folkright, or, in other words, of the estates owned under the ordinary customary law of the people. Such land could not be bequeathed out of the kindred and could not be sold without the consent of the kinsmen. Such complete disabilities could not be upheld indefinitely, however, in a growing and progressive community, and we find the ancient folkright assailed from different points of view. The Church insists on the right of individual possessors to give away land for the sake of their souls; the kings grant exemption from folkright and constitute privileged estates held by charter and following in the main the rules of individualized Roman law; the wish of private persons to make provision for daughters and to deal with land as with other commodities produces constant collisions with the customary tribal views. Already, by the end of the Saxon period, transfer and alienation of land make their way everywhere, and the Norman conquest brings these features to a head by substituting the notion of tenure—*i.e.,* of an estate burdened with service to a superior—for the ancient notion of tribal folkland.

But although the tribal basis of communal arrangements was shaken and removed in England in comparatively early times, it had influenced the practices of rural husbandry and landholding, and in the modified form of the village community it survived right through the feudal period, leaving characteristic and material traces of its existence down to the present day.

To begin with, the open-field system with intermixture of strips and common rights in pasture and wood was the prevailing system in England for more than a thousand years. Under the name of champion farming it existed everywhere in the country until the Enclosure Acts of the 18th and 19th centuries put an end to it; it may be found in operation even now in some of its features in backward districts. It would have been absurd to build up these practices of compulsory rotation of crops, of a temporary relapse of plots into common pasture between harvest and ploughing time, of the interdependence of thrifty and negligent husbandmen, from the point of view of individual appropriation. On the other hand, it was the natural system for the apportionment of claims to the shareholders of an organic and perpetual joint-stock company.

Practices of shifting arable are seldom reported in English evidence. There are some traces of periodical redivisions of arable land in Northumberland: under the name of runrig such practices seem to have been not uncommon in the outer fields, the non-manured portions, of townships in Scotland, both among the

Saxon inhabitants of the lowlands and the Celtic population of the highlands. The joining of small tenants for the purpose of coaration, for the formation of the big, heavy ploughs, drawn by eight oxen, sometimes caused a shifting in the possession of strips between the coparceners of the undertaking. But, as a rule, the arable was held in severalty by the different members of the township.

On the other hand, meadows were constantly owned by entire townships and distributed between the tenements entitled to shares from year to year either by lot or according to a definite order. These practices are in full vigour in some places even at the present day. Any person living in Oxford may witness the distribution by lot on Lammas day (Aug. 1) of the Lammas meadows, that is, the meadows inclosed for the sake of raising hay-grass in the village of Yarnton, some three miles to the north of Oxford.

Let us, however, return for a moment to the arable. Although held in severalty by different owners it was subjected to all sorts of interference on the part of the village union as represented in later ages by the manorial court framing by-laws and settling the course of cultivation. It might also happen that in consequence of encroachments, disputes, and general uncertainty as to possession and boundaries, the whole distribution of the strips of arable in the various fields had to be gone over and regulated anew. In such cases, as in the Danish examples quoted before, the strips were apportioned, not to single owners, but to the normal holdings, the hides, and the actual owners had to take them in proportion to their several rights in the hides. This point is very important. It gives the English village community its peculiar stamp. It is a community not between single members or casual households, but between definite holdings constructed on a proportional scale. Although there was no provision for the admeasurement or equalization of the claims of Smith and of Brown, each hide or ploughland of a township took as much as every other hide, each virgate or yardland as every other yardland, each bovate or oxgang as every other oxgang. Now the proportions themselves, although varying in respect of the number of acres included in each of these units in different places, were constant in their relation to each other. The yardland was almost everywhere one-fourth of the hide or ploughland, and corresponded to the share of two oxen in an eight-oxen plough; the oxgang was reckoned at one-half of the yardland, and corresponded to the share of one ox in the same unit of work.

The natural composition of the holdings has its counterpart, as in Schleswig-Holstein and as in the rest of Germany, in the custom of unified succession. The English peasantry worked out customary rules of primogeniture or of so-called Borough English or claim of the youngest to the land held by his father. The German examples already adduced teach us that the device is not suggested primarily by the interest of the landlord. Unified succession takes the place of the equal rights of sons, because it is the better method for preserving the economic efficiency of the household and of the tenement corresponding to it. There are exceptions, the most notorious being that of Kentish gavelkind, but in agricultural districts the holding remains undivided as long as possible, and if it gets divided, the division follows the lines not of the casual number of coheirs, but of the organic elements of the ploughlands. Fourths and eighths arise in connection with natural fractions of the ploughteam of eight oxen.

One more feature of the situation remains to be noticed, and it is the one which is still before our eyes in all parts of the country, that is, the *commons* which have survived the wholesale process of enclosure. They were an integral part of the ancient village community from the first, because there existed the most intimate connection between the agricultural and pastoral part of husbandry in the time of the open-field system. Pasture was not treated as a commodity by itself but was mostly considered as an adjunct, as appendant to the arable, and so was the use of woods and of turf. The problem of admeasurement of pasture was regulated in the same way as that of the apportionment of arable strips, by a reference to the proportional holdings, the hides, yardlands and oxgangs of the township, and the only question to be decided was how many heads of cattle and how many sheep each hide and yardland had the right to send to the common pasturage grounds.

When in course of time the open-field system and the tenure of arable according to holdings were given up, the right of freeholders and copyholders of the old manors in which the ancient townships were, as it were, encased, still held good, but it became much more difficult to estimate and to apportion such rights.

In connection with the individualistic policy of enclosure the old writ of admeasurement of commons was abolished in 1837 (3 & 4 Will. IV.). The ordinary expedient is to make out how much commonable cattle could be kept by the tenements claiming commons through the winter. It is very characteristic and important that in the leading modern case on sufficiency of commons—in *Robertson* v. *Hartopp*—it was admitted by the Court of Appeal that the sufficiency has to be construed as a right of turning out a certain number of beasts on the common, quite apart from the number which had been actually turned out at any given time. Now a vested right has to be construed from the point of view of the time when it came into existence. The standards used to estimate such rights ought not to be drawn from modern practice, which is generally independent of common of pasture, but ought to correspond to the ordinary usages established at a time when the open-field system was in full vigour. The legal view stands thus at present, but we cannot conceal from ourselves that after all the inroads achieved by individual appropriation it is by no means certain that the reference to the rights and rules of a previous period will continue to be recognized. However this may be, in the present commons we have certainly a system which draws its roots from customs as to the origin of which legal memory does not run.

We may, in conclusion, summarize very briefly the principal results of our inquiry as to the history of European village communities. It seems that they may be stated under the following heads: (1) Primitive stages of civilization disclose in human society a strong tendency towards mutual support in economic matters as well as for the sake of defence. (2) The most natural form assumed by such unions for defence and co-operation is that of kinship. (3) In epochs of pastoral husbandry and of the beginnings of agriculture land is mainly owned by tribes, kindreds and enlarged households, while individuals enjoy only rights of usage and possession. (4) In course of time unions of neighbours are substituted for unions of kinsmen. (5) In Germanic societies the community of the township rests on the foundation of efficient holdings—bóls, hides, hufen—kept together as far as possible by rules of united or single succession. (6) The open-field system, which prevailed in the whole of Northern Europe for nearly a thousand years, was closely dependent on the customs of tribal and neighbourly unions. (7) Even now the treatment of commons represents the last manifestations of ancient communal arrangements, and it can only be reasonably and justly interpreted by reference to the law and practice of former times.

An indication of the nature of modern work on this subject will be found in Vinogradoff, *Villainage in England* (1892), *The Growth of the Manor* (1905) and *English Society in the 11th Century* (1907). (P. Vi.)

VILLALBA, a town of north-western Spain, in the province of Lugo; on the left bank of the river Ladra, one of the headstreams of the Miño, and at the junction of the main roads from Ferrol and Mondoñedo to the city of Lugo. Pop. (1940) 2,546 (mun., 17,935). Villalba stands on a fertile plateau 1,500 ft. above sea-level. Cloth and pottery are manufactured, and there is some trade in grain and live stock. The nearest railway station is Otero, 15 mi. S. by E. on the Lugo-Corunna line.

VILLAMEDIANA, COUNT DE (1580–1622), Spanish poet, was born at Lisbon, the son of a diplomatist. He acquired a bad reputation as a gambler and was banished from court in 1608. On his return to Spain (1617) he proved himself a fearless, pungent satirist. So great was the resentment caused by his envenomed attacks that he was once more ordered to withdraw from court in 1618. Appointed gentleman in waiting (1621) to Philip IV.'s young wife, Isabel de Bourbon, daughter of Henri IV., his

ostentatious attentions to the queen supplied his numerous foes with a weapon which was destined to destroy him. A fire broke out while his masque, *La Gloria de Niquea,* was being acted before the court on May 15, 1622, and Villamediana carried the queen to a place of safety. Suspicion deepened and on Aug. 21 he was murdered as he stepped out of his coach. The responsibility for his death was divided between Philip IV. and Olivares, and naturally the crime remained unpunished.

Villamediana's works contain not only the nervous, blighting verses which made him widely feared and hated, but a number of more serious poems embodying the most exaggerated conceits of gongorism. But, even when adopting the perverse conventions of the hour, he remains a poet of high distinction, and his satirical verses, more perfect in form, are instinct with a cold, concentrated scorn which has never been surpassed.

VILLANELLE, primarily a round song taken up by men on a farm (Lat. *villa*); originally loose in form, but afterwards arbitrarily fixed. It was a pastoral, set to a rustic dance, and had, therefore, a regular system of repeated lines. The old French villanelles, however, were irregular; the "Rosette, pour un peu d'absence" of Desportes (d. 1606), is a sort of ballade, and those of d'Urfé (d. 1625) are scarcely less lax. The rigorous form seems to have been settled by accident. Among the posthumous poems of Jean Passerat (d. 1602) several villanelles were found, of which one became so popular as to set the standard for subsequent poets. It runs thus:

"J'ai perdu ma tourterelle:
Est-ce point celle que j'oi?
Je veux aller après elle.

Tu regrettes ta femelle?
Hélas! aussi fais-je moi:
J'ai perdu ma tourterelle.

Si ton amour est fidèle,
Aussi est ferme ma foi:
Je veux aller après elle.

Ta plainte se renouvelle?
Toujours plaindre je me dois:
J'ai perdu ma tourterelle.

En ne voyant plus la belle
Plus rien de beau je ne vois:
Je veux aller après elle.

Mort, que tant de fois j'appelle,
Prends ce qui se donne à toi:
J'ai perdu ma tourterelle,
Je veux aller après elle."

For 300 years the villanelle has been written in tercets, on two rhymes, the first and the third being repeated alternately in each tercet. It is usual to confine it to five tercets, but that is not essential; it must, however, close with a quatrain, the last two lines of which are the first and third of the original tercet. Boulmier, who was the first to show that Passerat was its inventor, published collections of these poems in 1878 and 1879, and was preparing another when he died, in 1881. When, in 1877, so many of the early French forms of verse were reintroduced into English, the villanelle attracted much attention; it was simultaneously cultivated by W. E. Henley, Austin Dobson, Lang and Gosse. Henley wrote a large number, and described the form in a specimen beginning: "A dainty thing's the Villanelle." There are several examples in English of humorous villanelles, especially by Austin Dobson and by Henley.

See J. Boulmier, *Les Villanelles* (2nd ed., 1879).

VILLANI, GIOVANNI (*c.* 1275–1348), Florentine chronicler, was born at Florence of a mercantile family, and spent much of his early manhood in travelling on business in Italy, France and the Netherlands. He returned definitely to Florence before 1312, and from 1316 onwards held many important offices in his native city, and was employed on various diplomatic missions. In his last years he was involved in the bankruptcy of the Bonaccorsi, and fell into poverty. He died in 1348 in the plague epidemic described by Boccaccio.

His *Historie Fiorentine,* or *Cronica universale,* begins with Biblical times and comes down to 1348. The ground covered by the narrative, especially in the times near Villani's own, bears witness to the author's extensive travels and to the breadth of his mind. It is the cornerstone of the early mediaeval history of Florence. Villani was Guelph, but without passion; and his book is more taken up with an enquiry into what is useful and true than with party considerations. He is a chronicler, not an historian, and has but little method in his narrative. He provides information on the constitution of Florence, its customs, industries, commerce and arts; and of the chroniclers of his day he is perhaps unequalled for the value of his statistical data. The *Chronicle* has been printed by L. A. Muratori in tome xiii. of the *Rerum Italicarum Scriptores* (Milan, 1728) and has been edited by I. Moutier and F. G. Dragomanni (Florence, 1844). Other editions appeared at Trieste (1857) and at Turin in 1879. Selections have been translated into English by R. E. Selfe (2nd ed. 1906).

See P. Scheffer-Boichorst, *Florentiner Studien* (Leipzig, 1874); G. Gervinus, "Geschichte der Florentinen Historiographie" in his *Historische Schriften* (1833); U. Balzani, *Le cronache Italiane nel medio evo* (Milan, 1884); A. Gaspary, *Geschichte der italienischen Literatur* (Berlin, 1885); O. Knoll, *Beitr. zur ital. Historiographie im 14. Jahr.* (Göttingen, 1876), and O. Hartwig, "G. Villani und die Leggenda di Messer Gianni di Procida" in H. von Sybel's *Historische Zeitschrift.* Bd. 25.

VILLANOVANS is merely a conventional term chosen by archaeologists as a distinctive and useful designation for a group of tribes exhibiting a fairly uniform civilization over a great part of Italy in the Early Iron Age (q.v.). Villanova itself, from which the name is derived, is a little village eight kilometres from Bologna, near which, between 1853 and 1855, was excavated a cemetery of previously unknown character. The burials were all cremations; the ashes of the deceased being deposited in a large jar of rough hand-made pottery, which was placed in a round hole in the ground, sometimes but not always enclosed in a rectangular cist of unhewn slabs. Inside the jar, which was of the very distinctive form shown in fig. 1, were the remains of human bones incompletely consumed by the fire; while in the layer of ashes surrounding the jars were bones of animals, together with small objects of use or ornament made of bronze, iron, amber, glass or bone.

Numerous other cemeteries of similar character have been discovered, first in the neighbourhood of Bologna, then in Etruria and the northern part of Latium. The civilization revealed in these was shown to belong to the first phases of the Iron Age, beginning about the 12th or 11th century B.C., and the general name of Villanovan was applied to it as descriptive of its homogeneous character. All these cemeteries, whatever may be the peculiarities of their local variation, are united by at least one common bond of custom; they all contain cremation burials with at most a very slight percentage of unburned bodies. In this respect they are contrasted with all the contemporary cemeteries of eastern and southern Italy, which consist exclusively of the inhumations of unburned bodies. Occasional examples of jars resembling the Villanovan burial-urn have indeed been found in Apulia and Calabria, but in these provinces they were never adopted for ceremonial purposes but simply used for carrying water. As all the tribes of eastern and southern Italy buried their dead without burning, this difference of custom implies a difference of religious belief, and probably a divergence of racial origin. This inference seems to be justified by a study of the dress, armament, arts and manufactures of the several regions, which shows the Bolognese and Etrurians to be closely allied in the principal details of their material culture, while the Apulians and the Calabrians are notably different and appear to have evolved independently from another inheritance.

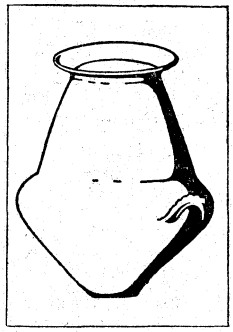

FIG. 1.—TYPICAL VILLANOVAN OSSUARY, AFTER GOZZADINI

Territorial Extension.—In the north the territory of the Villanovans began at the river Reno and extended from the Panaro on the west to Rimini on the east. South of Rimini they

never inhabited the east coast but on the west of the mountainous backbone they extended their sway over the whole of Etruria and down into Latium as far as the Alban hills. Roughly speaking, therefore, they occupied about a third of Italy north of Rome, the other two-thirds being taken up principally by the kindred civilizations of the Comacines (q.v.) and Atestines (q.v.) on the north and by a hostile block of Picenes on the east. (*See* PICENES.) It is useful to distinguish the inhabitants of the Bolognese region as the northern Villanovans, while those of Etruria and the adjoining parts of Latium may be termed the southern Villanovans.

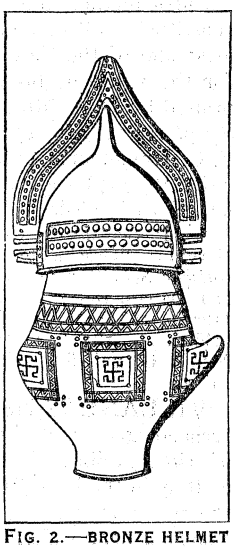

FIG. 2.—BRONZE HELMET

Theories of Origin.—As to the origin and racial affinities of this group of cremating tribes, which exercised such a profound influence upon Italy before the arrival of Etruscans or Greeks, there are two rival theories. To neither of these can exclusive preference be given; future discoveries must decide between them, and it is not likely that any final decision will be reached for many years. But on the most essential points the two theories are in complete agreement. Whether the Villanovans were direct lineal descendants of the builders of the Terremare or only a kindred race which did not enter Italy until the dawn of the Iron Age, three points are generally admitted: (1) that all the Villanovans are related by some degree of kinship as members of the same original family, (2) that their ultimate parentage is to be traced to the peoples of central Europe then settled on the middle Danube, and (3) that the direction of their occupation of Italy was from north to south.

However, while we are very fully informed as to the character of Villanovan culture in Italy itself, yet the nature and degree of its connections with the countries east and north of the Adriatic remain obscure. The relationship to Hallstatt in particular is far less close than might have been expected. To some extent, however, this may be explained by the circumstance that no graves at Hallstatt are as early as the beginnings of the Villanovan period. The very earliest graves of this people in Italy have been found in the mountainous tract of Tolfa and Allumiere on the coast of southern Etruria. They form a valuable link connecting the cemeteries of the Alban hills and the earliest graves of the Forum at Rome with sites like Corneto and Vetulonia. The cemeteries of Tolfa, Castel Gandolfo, Grottaferrata and two or three graves in the Forum may be assigned to the 12th and 11th centuries B.C.

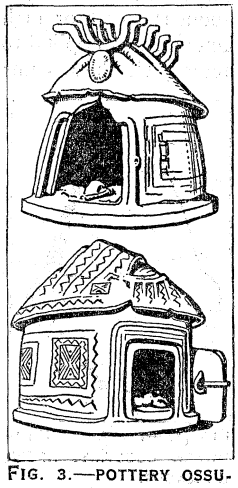

FIG. 3.—POTTERY OSSUARIES IN FORM OF HUTS

The First Benacci sites at Bologna begin in the 11th century, and are followed in due order by the Second Benacci, dating from 950 to 700 B.C., and by the Arnoaldi which covers 700 to 500 B.C. Cemeteries corresponding in date and style to the First and Second Benacci periods of Bologna have been found at various sites scattered over the country between Tolfa and Florence or Pisa. But the third, or Arnoaldi period, is not represented south of the Arno, because the southern Villanovans had been subjugated by the Etruscans before 700 B.C. and their civilization transformed by their conquerors. In the north the history is different, for as the Etruscans did not cross the Apennines to found any colonies there before the end of the 6th century, the Bolognese Villanovans survived as a distinct and highly characterized people till after 500 B.C.

Local Differences.—In spite of a close family resemblance in their general character there were many local differences of custom and practice. Thus the northern Villanovans invariably used the burial urn shown in fig. 1 and covered it with a pottery bowl. But on various Etrurian sites this standardized jar was not employed at all, and on others where it was used the jar was occasionally covered with a helmet instead of a bowl. To this practice is due the survival of some magnificent examples of 9th century bronze work, such as the helmet shown here (fig. 2).

Another alternative form of burial urn used by the south but not in the north was the pottery hut, a miniature model of the dwelling house, of which two examples are shown (fig. 3). Neither of those variations from their ceremonial form was adopted by the Bolognese, who retained the standard type of ritual urn with the most rigid conservatism, though the potters somewhat modified its outline in the course of centuries.

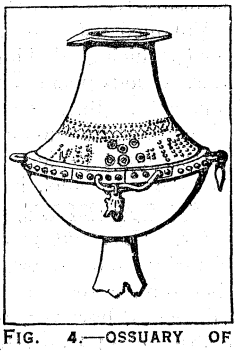

FIG. 4.—OSSUARY OF HAMMERED BRONZE

One of the most notable traits common to both branches of the Villanovans is their remarkable skill in metal work. Helmets such as fig. 2, large bronze vessels like fig. 4, or belts like that seen in fig. 8 were freely made in the 9th century B.C. by a primitive but extremely effective process. The technique consists in the hammering by hand of thin sheets of copper or bronze, which were then bent round and fastened together with rivets. Lines of these rivets generally form the principal decoration, which is extremely simple. This process is quite unlike anything used by the people of the Terremare, and it was probably learned by the Villanovans in their original transalpine homes. That they traded with the Danube region at this date is shown by the bronze swords of Hallstatt type with hilts terminating in spiral volutes, which have been found in small numbers at various places in Etruria as well as farther north. The skill of the Villanovan coppersmiths ex-

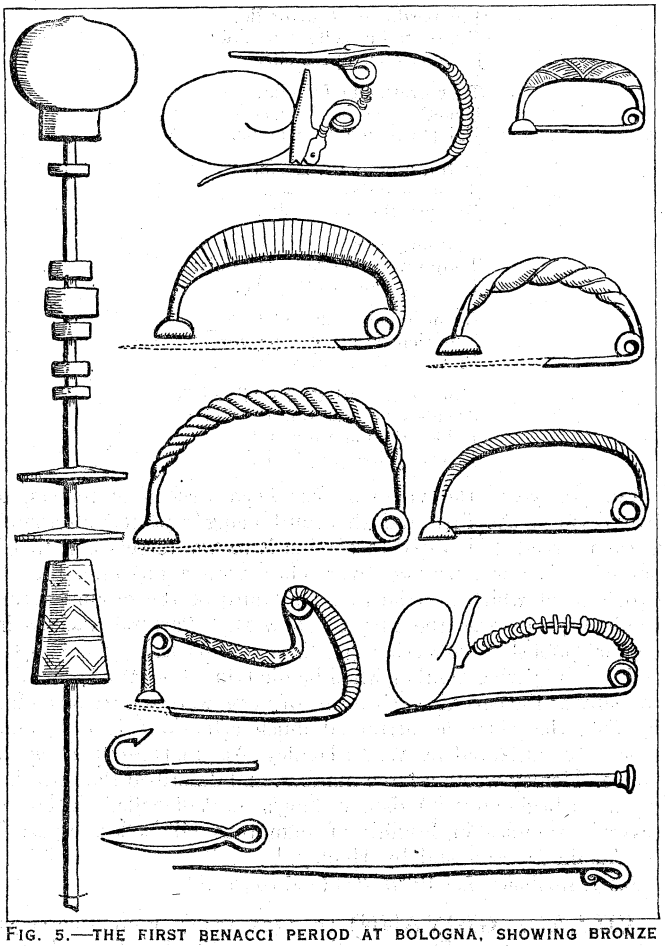

FIG. 5.—THE FIRST BENACCI PERIOD AT BOLOGNA, SHOWING BRONZE FIBULAE AND PINS, HOOK, TWEEZERS, OBJECT OF UNKNOWN USE WITH BRONZE STAFF AND HEAD, AND DISCS OF AMBER

plains the rapid development of every form of metal-work when the mines of Tuscany and Elba were more freely exploited in the 8th and following centuries. The Etruscans by themselves never constituted any large number of persons; they formed a small ruling aristocracy but the backbone of the population was always Villanovan. For this reason it is important to realize the high grade of that native Italian civilization upon which the Etruscan was grafted. Artistic spirit and enterprise, new ideas of decoration and ornament, improvements in technique were all contributed by the Etruscans, but there already existed a high standard of primitive workmanship and a long tradition amongst the native workmen whom they found in the country. The Villanovans in fact had attained a stage of civilization which must be considered quite high long before they came under any influences from the Aegean or the Orient. They owed a good deal to their intercourse with central Europe but nothing whatsoever to any of the Mediterranean peoples. As early as the 10th century B.C. the existence of considerable commerce with countries north of the Alps is proved by the presence of Baltic amber as well as of glass beads in the tombs. This is the natural continuation of a traffic which began in the Bronze Age, when Italy freely exported her own models of weapons to foreign countries.

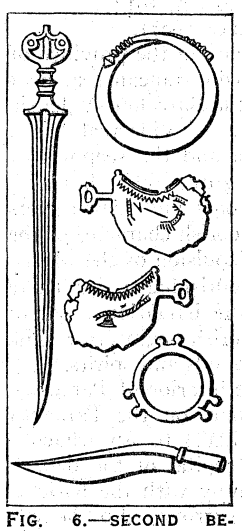

FIG. 6.—SECOND BENACCI PERIOD AT BOLOGNA, SHOWING SWORD, ARMLETS, RAZOR ENGRAVED WITH BOAT AND HAFTED AXE, PIKE, ALL OF BRONZE

In its general aspect the whole character of the civilization recalls that of central Europe. Art is still in its infancy, and decoration is entirely confined to a few geometric motives. Even on the pottery, which affords the greatest scope for decoration, the only schemes of ornament are incised rectilinear patterns of the simplest kind. All over Europe the same geometric school of design is dominant at this period. The first traces of naturalism in Italy begin to appear on a few rare pieces of imported pottery brought in from the Aegean during the 8th century, and on Etruscan bronze work of the same period.

The everyday life of the Villanovans may to some extent be estimated by the products of their tombs and dwellings. It may be inferred that they lived in small villages composed of wattle and daub huts roofed with wooden beams. Their clothing was of a thick material, doubtless wool spun from the fleeces of their own sheep on their own bronze distaffs and spindles. It was fastened with strong fibulae of bronze, or, in the later periods, of iron. These fibulae, often decorated with pieces of bone, amber or glass, follow a distinct course of evolution, which is a great help in tracing the stages of chronology. The Villanovans were well acquainted with the horse—bronze bits are very frequent even in the earliest cemeteries—but there is no evidence that they used chariots, which were first introduced by the Etruscans. That they were of warlike character is amply proved by the constant occurrence of swords, battle-axes and daggers. Defensive armour, however, was rare and confined to the use of helmets. The practice of hunting is vouched for by the bones of wild animals found in the ashes of the funeral feasts, and the occurrence of sheep and oxen shows familiarity with the farm.

FIG. 7.—SECOND BENACCI PERIOD AT BOLOGNA, SHOWING BRONZE FIBULAE OR SAFETY-PINS

As manufacturers these tribes were important principally for their metal-work. Pottery was made everywhere, but only for use in Italy, and seldom exported even to a neighbouring community. Until the 7th century it was all hand-made, but about 700 B.C. the wheel was introduced and with it came new processes of decoration. By the 7th century, however, the only Villanovans who retained their independence were the northern branch about Bologna. All Etruria and Latium had now been conquered by the Etruscans; but north of the Apennines the Bolognese continued to develop their provincial life without any interference from the foreigner. They entered, however, into peaceful trade relations with their new neighbours and acquired an occasional ornament or

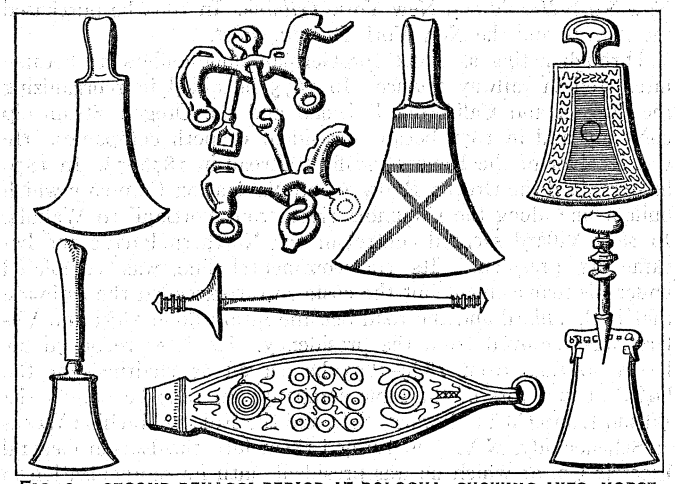

FIG. 8.—SECOND BENACCI PERIOD AT BOLOGNA, SHOWING AXES, HORSE-BIT, TINTINNABULUM, DISTAFF, GIRDLE, ALL OF BRONZE; AND TWO AXES WITH HANDLES OF BONE

piece of Etruscan jewellery from which it is possible to establish some valuable synchronisms of dating. When the Etruscans eventually crossed the Apennines and founded their colony of Felsina at Bologna about 500 B.C., they did not expel nor at once absorb the older inhabitants. For some generations the two peoples lived side by side, each preserving its own individuality, dwelling in separate settlements and burying their dead in separate cemeteries. It is only very rarely at Bologna that an Etruscan object is found in a Villanovan grave or vice versa. But gradually the superior civilization ousted the other, and before the Gauls put an end to the existence of both communities at Bologna in the 4th century Villanovanism was practically extinct. Its survival, however, in this northern region for nearly three centuries after it had been extinguished in Etruria affords a most valuable study of the process by which, presumably, the Etruscans gradually replaced and dominated the Villanovans in other parts of the country. The archaeological history of Bologna has made it possible to solve the principal difficulties which beset students of this subject in the last generation. We can now distinguish between the products of the Villanovans and those of the Etruscans and give due value and prominence to the older people whose contribution to the civilization of early Italy had so long been neglected or undervalued.

See D. Randall-MacIver, *Villanovans and Early Etruscans* (1924), which gives all the original Italian sources; A. Grenier, *Bologne villanovienne et étrusque* (1912), which is the most closely detailed study of the northern region; F. von Duhn, *Italische Gräberkunde* (1924), which deals with the subject incidentally rather than as a correlated whole. (D. R.-M.)

VILLANUEVA DE LA SERENA, a town of western Spain, in the province of Badajoz, near the left bank of the river Guadiana, and on the Madrid-Badajoz railway. Pop. (1940) 16,060 (mun., 16,088). Villanueva is the chief town of La Serena, locally celebrated for red wine and melons. Grain and hemp are also cultivated, and live stock extensively reared in the neighbourhood.

VILLANUEVA Y GELTRÚ, a seaport of N.E. Spain, in Barcelona province; on the Barcelona-Tarragona section of the coast railway. Pop. (1940) 16,677 (mun., 17,091). It is a modern town, with manufactures of cotton, woollen and linen goods, and of paper. It has also iron foundries and an important agricultural trade. The harbour affords safe and deep anchorage; it is a lifeboat station and the headquarters of a large fishing fleet. The coasting trade is also considerable. Villanueva has a museum, founded by the Catalan poet and historian, Victor Balaguer (1824–1901), which contains a large library, including

not only numerous historical works but also many valuable mss.

VILLARD, HENRY (1835–1900), American journalist and financier, was born in Speyer, Rhenish Bavaria, Apr. 10, 1835. He emigrated to America in 1853 and engaged in journalistic work for German-American newspapers and later for leading American dailies. He reported the Lincoln-Douglas debates for eastern newspapers, the Pikes Peak gold rush for the Cincinnati *Daily Commercial* and the Civil War from the field of action for the New York *Herald* and New York *Tribune*. In 1881 he purchased the *Nation* and the New York *Evening Post*.

Through acting as agent for German bondholders he became interested in railway finance. In 1875 he aided in reorganizing the Oregon and California Railroad and the Oregon Steamship company and in 1876 became president of both companies. He was receiver of the Kansas Pacific Railroad in 1876–78. In 1879 he organized the Oregon Railway and Navigation Company which built a line along the Columbia river from Portland to Wallula. In 1881 Villard secured control of the Northern Pacific and became its president. Its transcontinental line was completed under his management but the costs so far exceeded the estimate that both Villard and the road became insolvent in 1883 and Villard was removed from the presidency. He later recouped his losses so that from 1889–1893 he served as chairman of the board of directors of the same company. In 1890 he bought the Edison Lamp Co. at Newark, N.J., and the Edison Machine Works at Schenectady, N.Y., and formed them into the Edison General Electric Co. of which he was president until its reorganization in 1893 as the General Electric Co. He died at Dobbs Ferry, N.Y., Nov. 12, 1900.

See *Memoirs of Henry Villard* (2 vols., 1904).

VILLARET DE JOYEUSE, LOUIS THOMAS (1750–1812), French admiral, was born at Auch. He served for some time in the royal guard, but had to leave after killing one of his comrades in a duel. He then entered the navy, and in 1773 was lieutenant on the "Atalante" in Indian waters. In 1778 after the siege of Pondicherry, he was promoted captain. He took part in the battle of Cuddalore, and in 1781 was taken prisoner. He was released in 1783, and did not emigrate during the Revolution. In 1791 he commanded the "Prudente" at San Domingo, and in 1794 was appointed rear-admiral and assisted the Conventional, St. André, in the reorganization of the fleet. Villaret was in command of the French fleet at the battle of the First on June. He was a member of the Council of the Ancients in 1796, and was sentenced to deportation in 1797 on account of his royalist sympathies. He then lived in obscurity at Oléron. In 1801 he commanded the squadron which transported the French army to San Domingo, and in 1802 was made captain-general of Martinique, which he surrendered to the English in 1809. In 1811 he became governor-general of Venice.

VILLARI (vĭl'lahr-ĭ), **PASQUALE** (1827–1917), Italian historian and statesman, born at Naples Oct. 3, 1827, studied with Luigi la Vista under Francesco de Sanctis. Implicated in the riots of May 15, 1848, at Naples, against the Bourbon government, he took refuge in Florence where he published his *Storia di Girolamo Savonarola e de' suoi tempi* (2 vols. 1859–61). It was followed by a work of even greater critical value, *Niccolò Machiavelli e i suoi tempi* (1877–82). Both these works have been through many editions, the latest in 1927. Meanwhile Villari had been professor of history at Pisa, and now obtained the chair of philosophy of history at the Institute of Studii Superiori in Florence. He was also a member of the council of education (1862), and in 1869 was made under-secretary of state for education. In 1884 he was nominated senator, and in 1891–92 minister of education. His collected essays on Florentine history were published as *I primi due secoli della storia di Firenze* (1893–94), and in 1901 his *Le Invasioni barbariche in Italia*, a popular account of the events following the dissolution of the Roman empire. All these works have been translated into English by his wife. Villari died at Florence on Dec. 5, 1917. Villari's historical, political and social writings exercised a deep influence on his generation, and most of the Italian historians of to-day have been his pupils.

His other works include: *Saggi Critici* (1868); *Arte, Storia, e Filosofia* (Florence, 1884); *Scritti varii* (Bologna, 1894); another volume of *Saggi Critici* (Bologna, 1896); *Discussioni critiche e discorsi* (Bologna, 1905), containing his speeches as president of the Dante Alighieri Society; *Lettere Meridionali* containing the first exposure of conditions in south Italy (Turin, 1885), *Scritti sulla questione sociale in Italia* (Florence, 1902); *L'Italia da Carlo Magno alla Morte di Arrigo VII.* (Milan, 1910, Eng. trs. 1910) and *Storia, politica e istruzione* (Milan, 1914).

See F. Baldasseroni, *Pasquale Villari* (Florence, 1907).

VILLARREAL, a town of eastern Spain, in the province of Castellón de la Plana; 4 mi. from the Mediterranean sea, near the right bank of the river Mijares, and on the Barcelona-Valencia railway. Pop. (1940) 16,777 (mun., 20,025). Villarreal has a station on the light railway between Onda and the seaports of Castellón de la Plana and Burriana. Palm-groves, churches with blue-tiled cupolas, and houses with flat roofs and view-turrets (*miradores*) to some extent preserve the Moorish character of the town. Under Moorish rule, and up to the expulsion of the Moriscoes in 1609, it was the headquarters of a flourishing trade. There are extensive orange-groves, watered by the irrigation canal of Castellón, which is a good example of Moorish engineering skill. There are manufactures of paper, woollen goods and spirits.

VILLARRICA, the largest city in the interior of Paraguay, and the second largest city in the republic, on the Paraguay Central railway from Asunción (94 mi. N.W.) to Encarnación. Pop. (1940 est.) 27,885. Villarrica is the capital of the department of Guaira, and is connected by highway with the national capital. It is in a fertile agricultural region, surrounded by heavily wooded mountains. The principal products of the region are yerba maté, sugar cane, cotton, tobacco and hides.

VILLARS, CLAUDE LOUIS HECTOR DE, PRINCE DE MARTIGNES, MARQUIS AND DUC DE VILLARS AND VICOMTE DE MELUN (1653–1734), marshal of France, one of the greatest generals of French history, was born at Moulins on May 8, 1653, and entered the army through the corps of pages in 1671. He served in the light cavalry in the Dutch wars, and distinguished himself by his daring and resourcefulness. But in spite of a long record of excellent service under Turenne, Condé and Luxembourg, and of his aristocratic birth, his promotion was but slow, for he had incurred the enmity of the powerful Louvois, and although he had been proprietary colonel (*mestre de camp*) of a cavalry regiment since 1674, thirteen years elapsed before he was made a *maréchal de camp*. In the interval between the Dutch wars and the formation of the League of Augsburg, Villars was employed in an unofficial mission to the court of Bavaria, and there became the constant companion of the elector, with whom he took the field against the Turks and fought at Mohacs. He returned to France in 1690 and was given a command in the cavalry of the army in Flanders, but towards the end of the Grand Alliance War he went to Vienna as ambassador. His part in the next war (*see* SPANISH SUCCESSION, WAR OF THE), beginning with Friedlingen (1702) and Höchstett (1703) and ending with Denain (1712), has made him immortal. For Friedlingen he received the marshalate, for the pacification of the insurgent Cévennes the Saint-Esprit order and the title of duke. Friedlingen and Höchstett were barren victories, and the campaigns of which they formed a part, records of lost opportunities. Villars's glory thus begins with the year 1709 when France, apparently helpless, was roused to a great effort of self-defence by the exorbitant demands of the Coalition. In that year he was called to command the main army opposing Eugene and Marlborough on the northern frontier. During the famine of the winter he shared the soldiers' miserable rations. When the campaign opened the old Marshal Boufflers volunteered to serve under him, and after the terrible battle of Malplaquet (*q.v.*), in which he was gravely wounded, he was able to tell the king: "If it please God to give your majesty's enemies another such victory, they are ruined." Two more campaigns passed without a battle and with scarcely any advance on the part of the invaders, but at last Marlborough manoeuvred Villars out of the famous *Ne plus ultra* lines, and the power of the defence seemed to be broken. But Louis made

a last effort, the English contingent and its great leader were withdrawn from the enemy's camp, and Villars, though still suffering from his Malplaquet wounds, outmanoeuvred and decisively defeated Eugene in the battle of Denain. This victory saved France, though the war dragged on for another year on the Rhine, where Villars took Landau, led the stormers at Freiburg and negotiated the peace of Rastatt with Prince Eugene.

He played a conspicuous part in the politics of the Regency period as the principal opponent of Cardinal Dubois, and only the memories of Montmorency's rebellion prevented his being made constable of France. He took the field for the last time in the War of the Polish Succession (1734), with the title "marshal-general of the king's armies," that Turenne alone had held before him. But he was now over eighty years of age, and the war was more diplomatic than earnest, and after opening the campaign with all the fire and restless energy of his youth he died at Turin on June 17, 1734.

Villars' memoirs show us a "fanfaron plein d'honneur," as Voltaire calls him. He was indeed boastful, with the gasconading habit of his native province, and also covetous of honours and wealth. But he was an honourable man of high courage, moral and physical, and a soldier who stands above all his contemporaries and successors in the 18th century, on the same height as Marlborough and Frederick.

The memoirs, part of which was published in 1734 and afterwards several times republished in untrustworthy versions, were for the first time completely edited by the Marquis de Vogüé in 1884–92.

VILLARS (VILLARS-SUR-OLLON), a Swiss winter sports centre, frequented in summer also, situated at over 4,100ft. above sea-level, on a narrow gauge railway that branches from the Lausanne-Brig main line at Bex, about 8½m. beyond the point at which the railway leaves the Lake of Geneva. It is some distance above Gryon and commands a fine view of the Dent du Midi and the western Alps, and the Grand Muveran (3,061 metres) nearby. The railway runs on to Chesières, another resort which, in its turn, has road vehicles to Ollon, a station on the light railway from Monthey, which joins the Lausanne-Brig main line at Aigle.

VILLAVICIOSA, a seaport of northern Spain, in the province of Oviedo; on the Rio de Villaviciosa, an estuary formed by the small river Villaviciosa which here enters the Bay of Biscay. Pop. (1940) 2,219 (mun., 22,029). The town is the headquarters of a large fishery, and has some coasting trade. Its exports are chiefly agricultural produce.

VILLEFRANCHE, a manufacturing town of east-central France, capital of an arrondissement in the department of Rhône, on the Morgon river near its junction with the Saône, 21 mi. N. by W. of Lyons by rail. Population (1936) 18,603. Founded in 1212 by Guichard IV, count of Beaujeu, Villefranche became in the 14th century capital of the Beaujolais. Edward II was forced to surrender the Beaujolais to the duke of Bourbon. Among its industries the chief are the manufacture of working clothes, the manufacture, dyeing and finishing of cotton fabrics, including surgical dressings, linings, the spinning of cotton thread, copper founding and the manufacture of machinery and agricultural implements. The wines of Beaujolais, hemp, cotton cloth, linen, cotton thread, drapery goods and cattle are the principal articles of trade. An old Renaissance house is used as the town hall. The 15th century church of Notre-Dame des Marais has a 16th century tower and spire (rebuilt in 1862), standing to the right of the façade. Villefranche is the seat of a sub-prefect and has a tribunal of commerce and a chamber of commerce.

VILLEFRANCHE-DE-ROUERGUE, a town of France, capital of an arrondissement in the department of Aveyron, 36 mi. W. of Rodez by road. Pop. (1936) 6,852. Villefranche, founded about 1252, owes its name to the numerous immunities granted by its founder Alphonse, count of Toulouse (d. 1271), and in 1348 it was so flourishing that sumptuary laws were passed. Soon afterwards the town fell into the hands of Edward, the Black Prince, but was the first place in Guienne to rise against the English. New privileges were granted to the town by King Charles V, but these were taken away by Louis XI. In 1588 the inhabitants repulsed the forces of the League. Villefranche, which has a station on the Orléans railway, lies among the hills on the right bank of the Aveyron at its junction with the Alzou. One of the three bridges that cross the river is of the 13th century, and there are many houses of the 13th and 14th centuries. The church of Notre-Dame is flanked by a massive tower, beneath the porch of which passes one of the chief streets. The fine woodwork in the choir dates from the 15th century. The 15th and 16th century buildings (notably the fine refectory and two cloisters, the smaller a gem of late Gothic work) of a Carthusian monastery stand above the town on the left bank of the Aveyron. Quarries of phosphates and mines of galena and blende are worked near Villefranche. Villefranche is an agricultural centre with minor industries, and is the seat of a sub-prefect.

VILLEHARDOUIN, GEOFFROY DE (*c.* 1160–*c.* 1213), the first vernacular historian of France, and perhaps of modern Europe, who possesses literary merit, is rather supposed than known to have been born at the château from which he took his name, near Troyes, in Champagne, about the year 1160. Not merely his literary and historical importance, but almost all that is known about him, comes from his chronicle of the fourth crusade, or *Conquête de Constantinople.* He was one of a list of knights of Champagne who with their count, Thibault, took the cross at a tournament held at Escry-sur-Aisne in Advent 1199. The next year six deputies, two appointed by each of the three allied counts of Flanders, Champagne and Blois, were despatched to Venice to negotiate for ships. Of these deputies Villehardouin was one and Quesnes de Béthune, the poet, another. They concluded a bargain with the seigniory for transport and provisions at a fixed price. Villehardouin had hardly returned when Thibault fell sick and died. Villehardouin made another embassy into Italy to prevent if possible some of his fellow-pilgrims from breaking the treaty with the Venetians by embarking at their ports and employing other convoy.

Villehardouin does not tell us of any direct part taken by himself in the debates on the question of interfering or not in the disputed succession to the empire of the East—debates in which the chief ecclesiastics present strongly protested against the diversion of the enterprise from its proper goal. It is quite clear, however, that the marshal of Champagne, who was one of the leaders and inner counsellors of the expedition throughout, sympathized with the majority, and it is fair to point out that the temptation of chivalrous adventure was probably as great as that of gain. He narrates spiritedly enough the dissensions and discussions in the winter camp of Zara and at Corfu, but is evidently much more at ease when the voyage was again resumed, and, after a fair passage round Greece, the crusaders at last saw before them the great city of Constantinople which they had in mind to attack.

When the assault was decided upon, Villehardouin himself was in the fifth "battle," the leader of which was Mathieu de Montmorency. But he does not tell us anything of his own prowess. After the flight of the usurper Alexius, and when the blind Isaac, whose claims the crusaders were defending, had been taken by the Greeks from prison and placed on the throne, Villehardouin, with Montmorency and two Venetians, formed the embassy sent to arrange terms. He was again similarly distinguished when it became necessary to remonstrate with Alexius, the blind man's son and virtual successor, on the non-keeping of the terms. Indeed Villehardouin's talents as a diplomatist seem to have been held in very high esteem, for later, when the Latin empire had become a fact, he was charged with the delicate business of mediating between the emperor Baldwin and Boniface, marquis of Montferrat, in which task he had at least partial success. He was also appointed marshal of "Romanie"—a term very vaguely used, but apparently signifying the mainland of the Balkan Peninsula, while his nephew and namesake, afterwards prince of Achaia, took a great part in the Latin conquest of Peloponnesus.

Villehardouin himself before long received an important command against the Bulgarians. He was left to maintain the siege of Adrianople when Baldwin advanced to attack the relieving force, and with Dandolo had much to do in saving the defeated crusaders from utter destruction, and in conducting the retreat, in

which he commanded the rearguard, and brought his troops in safety to the sea of Rodosto, and thence to the capital. As he occupied the post of honour in this disaster, so he had that (the command of the vanguard) in the expedition which the regent Henry made shortly afterwards to revenge his brother Baldwin's defeat and capture. And, when Henry had succeeded to the crown on the announcement of Baldwin's death, it was Villehardouin who fetched home his bride Agnes of Montferrat, and shortly afterwards commanded under him in a naval battle with the ships of Theodore Lascaris at the fortress of Cibotus. In the settlement of the Latin empire after the truce with Lascaris, Villehardouin received the fief of Messinople from Boniface of Montferrat, with the record of whose death the chronicle abruptly closes.

Villehardouin reappears for us once, but once only, in the chronicle of his continuator, Henri de Valenciennes. There is a great gap in style, though none in subject, between the really poetical prose of the first historian of the fifth crusade and the Latin empire and the awkward mannerism (so awkward that it has been taken to represent a "disrhymed" verse chronicle) of his follower. But the much greater length at which Villehardouin appears on this one occasion shows us the restraint which he must have exercised in the passages which deal with himself in his own work. He again led the vanguard in the emperor Henry's expedition against Burilas the Bulgarian, and he is represented by the Valenciennes scribe as encouraging his sovereign to the attack in a long speech. Then he disappears altogether, with the exception of some brief and chiefly diplomatic mentions. Du Cange discovered and quoted a deed of donation by him dated 1207, by which certain properties were devised to the churches of Notre Dame de Foissy and Notre Dame de Troyes, with the reservation of life interests to his daughters Alix and Damerones, and his sisters Emmeline and Haye, all of whom appear to have embraced a monastic life. A letter addressed from the East to Blanche of Champagne is cited, and a papal record of 1212 styles him still "marshal of Romania." The next year this title passed to his son Erard; and 1213 is accordingly given as the date of his death.

It would be out of place to attempt any further analysis of the *Conquête* here. But it is not impertinent, and is at the same time an excuse for what has been already said, to repeat that Villehardouin's book, brief as it is, is in reality one of the capital books of literature, not merely for its merit, but because it is the most authentic and the most striking embodiment in contemporary literature of the sentiments which determined the action of a great and important period of history. There are but very few books which hold this position, and Villehardouin's is one of them. If every other contemporary record of the crusades perished, we should still be able by aid of this to understand and realize what the mental attitude of crusaders, of Teutonic knights, and the rest was, and without this we should lack the earliest, the most undoubtedly genuine, and the most characteristic of all such records. The very inconsistency with which Villehardouin is chargeable, the absence of compunction with which he relates the changing of a sacred religious pilgrimage into something by no means unlike a mere filibustering raid on the great scale, add a charm.

The book appears to have been known in the ages immediately succeeding his own; and, though there is no contemporary manuscript in existence, there are some half-dozen which appear to date from the end of the 13th or the course of the 14th century, while one at least appears to be a copy made from his own work in that spirit of unintelligent faithfulness which is much more valuable to posterity than more pragmatical editing. The first printed edition of the book, by a certain Blaise de Vigenère, dates from 1585, is dedicated to the seigniory of Venice (Villehardouin, it should be said, has been accused of a rather unfair predilection for the Venetians), and speaks of either a part or the whole of the memoirs as having been printed twelve years earlier. Of this earlier copy nothing seems to be known. A better edition, founded on a Netherlandish ms., appeared at Lyons in 1601. But both these were completely antiquated by the great edition of Du Cange in 1657, wherein that learned writer employed all his knowledge, never since equalled, of the subject, but added a translation, or rather paraphrase, into modern French which is scarcely worthy either of himself or his author. Dom Brial gave a new edition from different ms. sources in 1823, and the book figures with different degrees of dependence on Du Cange and Brial in the collections of Petitot, Buchon, and Michaud and Poujoulat.

All these, however, have been superseded for the modern student by the editions of Natalis de Wailly (1872 and 1874), in which the text is critically edited from all the available mss. and a new translation added, while there is a still later and rather handier one by E. Bouchet (2 vols., Paris, 1891), which, however, rests mainly on N. de Wailly for text. The charm of Villehardouin can escape no reader; but few readers will fail to derive some additional pleasure from the two essays which Sainte-Beuve devoted to him, reprinted in the ninth volume of the *Causeries du lundi*. *See* also A. Debidour, *Les Chroniqueurs* (1888). There are English translations by T. Smith (1829), and (more literally) Sir F. T. Marzials (Everyman's Library, 1908).

VILLEINAGE (VILLAINAGE, VILLENAGE), a mediaeval term (from *villa, villanus*), pointing to serfdom, a condition of men intermediate between freedom and slavery. It occurs in France as well as in England, and was certainly imported into English speech through the medium of Norman French.

The materials for the formation of the villein class were already in existence in the Anglo-Saxon period. On the one hand, the Saxon ceorls (*twihyndemen*), although considered as including the typical freemen in the earlier laws (Aethelberht, Hlothhere and Edric, Ine), gradually became differentiated through the action of political and economic causes, and many of them had to recognize the patronage of magnates or to seek livelihood as tenants on the estates of the latter. These ceorls, sitting on gafolland, were, though personally free, considered as a lower order of men, and lapsed gradually into more or less oppressive subjection to the lords of whom they held their land. It is characteristic in this connection that the West Saxon laws do not make any distinction between ceorls and laets or half-freemen as the Kentish laws had done: this means that the half-free people were, if not Welshmen, reckoned as members of the ceorl class. Another remarkable indication of the decay of the ceorl's estate is afforded by the fact that in the treaties with the Danes the twihynde ceorls are equated with the Danish leysings or freedmen. It does not mean, of course, that their condition was practically the same, but in any case the fact testifies to the gulf which had come to separate the two principal subdivisions of the free class —the ceorl and the thegn. The Latin version of the *Rectitudines Singularum Personarum,* a document compiled probably in the 11th century, renders *geneat* (a peasant tenant of a superior kind performing lighter services than the gebur, who was burdened with heavy week-work) by *villanus;* but the gebur came to be also considered as a *villanus* according to Anglo-Norman terminology. The group designated as *geburs* in Anglo-Saxon charters, though distinguished from mere slaves, undoubtedly included many freedmen who in point of services and economic subjection were not very much above the slaves. Both ceorls and geburs disappear as separate classes, and it is clear that the greater part of them must have passed into the rank of villeins.

In the terminology of the Domesday Inquest we find the villeins as the most numerous element of the English population. Out of about 240,000 households enumerated in Domesday 100,000 are marked as belonging to villeins. They are rustics performing, as a rule, work services for their lords. But not all the inhabitants of the villages were designated by that name. Villeins are opposed to socmen and freemen on one hand, to *bordarii,* cottagers and slaves on the other. The distinction in regard to the first two of these groups was evidently derived from their greater freedom, although the difference is only one in degree and not in kind. In fact, the villein is assumed to be a person free by birth, but holding land of which he cannot dispose freely. The distinction as against *bordarii* and cottagers is based on the size of the holding: the villeins are holders of regular shares in the village —that is, of the virgates, bovates or half-hides which constitute the principal subdivisions in the fields and contribute to form the plough-teams—whereas the *bordarii* hold smaller plots of some five acres, more or less, and *cottarii* are connected with mere cottages and crofts. Thus the terminology of Domesday takes note of two kinds of differences in the status of rustics: a legal one in connection with the right to dispose of property in land, and an economic one reflecting the opposition between the holders of shares in the fields and the holders of auxiliary tenements. The feature of personal serfdom is also noticeable, but it provides a

basis only for the comparatively small group of *servi,* of whom only about 25,000 are enumerated in Domesday Book. The contrast between this exceptionally situated class and the rest of the population shows that personal slavery was rapidly disappearing in England about the time of the Conquest. It is also to be noticed that the Domesday Survey constantly mentions the *terra villanorum* as opposed to the lord's demesne, and that the land of the rustics is taxed separately for the geld, so that the distinction between the property of the lord and that of the peasant dependent on him is clearly marked.

The Domesday Survey puts before us the state of things in England as it was at the very beginning of the Norman and at the close of the Saxon period. The development of feudal society, of centralizing kingship and ultimately of a system of common law, brought about great changes which all hinge on the fundamental fact that the kings, while increasing the power of the State in other respects, surrendered it completely as regards the relations between the peasants and their lords. The protection of the assizes was tendered in civil matters to free tenants and refused to villeins. The royal courts refused to entertain suits of villeins against their lords, although there was a good deal of vacillation before this position was definitely taken up. Bracton speaks in his treatise of the possibility of interference by the courts against intolerable cruelty on the part of the lord involving the destruction of the villein's waynage, that is, of his tillage, and in the *Notebook* of Bracton may be found a couple of cases which prove that 13th century judges occasionally allowed themselves to entertain actions by persons holding in villeinage against their lords. Gradually, however, the exception of villeinage became firmly settled. As the historical and practical position was developing on these lines the lawyers who fashioned English common law in the 12th and 13th centuries did not hesitate to apply to it the teaching of Roman law on slavery. Bracton fits his definition of villeinage into the Romanesque scheme of Azo's *Summa* of the Institutes, and the judges of the royal courts made sweeping inferences from this general position. To begin with, the relation between the villein and his lord was regarded as a personal and not a praedial one. Everyone born of villein stock belonged to his master and was bound to undertake any service which might be imposed on him by the master's or the steward's command. The distinction between villeins in gross and villeins regardant, of which much is made by modern writers, was suggested by modes of pleading and does not make its appearance in the Year-Books before the 15th century. Secondly, all independent proprietary rights were denied to the villein as against his lord, and the legal rule "quicquid servo acquiritur domino acquiritur" was extended to villeins. The fact that a great number of these serfs had been enjoying protection as free ceorls in former ages made itself felt, however, in three directions. (1) In criminal matters the villein was treated by the King's Court irrespectively of any consideration as to his debased condition. More especially the police association, organized for the keeping of the peace and the presentation of criminals—the frankpledge groups—were formed of all "worthy of were and wite," villeins as well as freemen. (2) Politically the villeins were not eliminated from the body of citizens; they had to pay taxes, to serve in great emergencies in the militia, to serve on inquests, etc., and although there was a tendency to place them on a lower footing in all these respects yet the fact of their being lesser members of the commonwealth did not remove the fundamental qualification of citizenship. (3) Even in civil matters villeins were deemed free as regards third persons. They could sue and be sued in their own name, and although they were able to call in their lords as defendants when proceeded against, there was nothing in law to prevent them from appearing in their own right. The state even afforded them protection against extreme cruelty on the part of their masters in respect of life and limb, but in laying down this rule English lawyers were able to follow the precedents set by late Roman jurisprudence, especially by measures of Hadrian, Antonine and Constantine the Great.

There was one exception to this harsh treatment of villeins. The rustic tenantry in manors of *ancient demesne,* that is, in estates which had belonged to the crown before the Conquest, had a standing-ground even against their lords as regards the tenure of their plots and the fixity of their services. Technically this right was limited to the inhabitants of manors entered in the Domesday Survey as *terra regis* of Edward the Confessor. On the other hand the doctrine became effective if the manors in question had been granted by later kings to subjects, because if they remained in the hand of the king the only remedy against ejectment and exaction lay in petitioning for redress without any definite right to the latter. If, however, the two conditions mentioned were forthcoming, villeins, or, as they were technically called, villein socmen of ancient demesne manors, could resist any attempt of their lords to encroach on their rights by depriving them of their holdings or increasing the amount of their customary services. Their remedy was to apply for a little writ of right in the first case and for a writ of *monstraverunt* in the second. These writs entitled them to appear as plaintiffs against the lord in his own manorial court and, eventually, to have the question at issue examined by way of appeal, on a writ of error, or by reservation on some legal points in the upper courts of the king. A number of cases arising from these privileges of the men of ancient demesne are published in the *Notebook* of Bracton and in the *Abbreviatio placitorum.* This exceptional procedure does not simply go back to the rule that persons who had been tenants of the king ought not to have their condition altered for the worse in consequence of a royal grant. If this were the only doctrine applicable in the case there would be no reason why similar protection should be denied to all those who held under grantees of manors escheated after the Conquest. A material point for the application of the privilege consists in the fact that ancient demesne has to be proved from the time before the Conquest, and this shows clearly that the theory was partly derived from the recognition of tenant right in villeins of the Anglo-Saxon period who, as we have said above, were mostly ceorls, that is, freeborn men.

In view of the great difference in the legal position of the free man and of the villein in feudal common law, it became very important to define the exact nature of the conditions on which the status of a villein depended. The legal theory as to these conditions was somewhat complex. Of course, persons born from villein parents in lawful wedlock were villeins, but as to the condition of illegitimate children there was a good deal of hesitation. There was a tendency to apply the rule that a bastard follows the mother, especially in the case of a servile mother. In the case of mixed marriages, the condition of the child was determined by the free or villein condition of the tenement in which it was born. This notion of the influence of the tenement is in accord with feudal ideas and makes itself felt again in the case of the pursuit of a fugitive villein. He can be seized without further formalities if he is caught in his "nest," that is, in his native place. If not, the lord can follow him in fresh pursuit for four days; once these days are past, the fugitive is maintained provisionally in possession of his liberty, and the lord has to bring an action *de nativo habendo* and has to assume the burden of proof.

So much as to the proof of villeinage by birth or previous condition. But there were numbers of cases when the discussion as to servile status turned not on these formal points but on an examination of the services performed by the person claimed as a villein or challenged as holding in villeinage. In both cases the courts had often recourse to proof derived not from direct testimony but from indirect indications as to the kind of services that had been performed by the supposed villein. Certain services, especially the payment of *merchet*—the fine for marrying a daughter—were considered to be the badge of serfdom. Another service, the performance of which established a presumption as to villeinage, was compulsory service as a reeve. The courts also tried to draw a distinction from the amount and regularity of agricultural services to which a tenant was subjected. Bracton speaks of the contrast between the irregular services of a serf, "who could not know in the evening what he would have to do in the morning," and services agreed upon and definite in their amount. The customary arrangements of the work of villeins,

however, render this contrast rather fictitious. The obligations of downright villeins became so far settled and regular that one of the ordinary designations of the class was *custumarii.* Therefore in most cases there were no arbitrary exactions to go by, except perhaps one or the other tallage imposed at the will of the lord. The original distinction seems to have been made not between arbitrary and agreed but between occasional services and regular agricultural week-work. While the occasional services, even when agricultural, in no way established a presumption of villeinage, and many socmen, freemen and holders by serjeanty submitted to them, agricultural week-work was primarily considered as a trait of villeinage and must have played an important part in the process of classification of early Norman society.

This point brings us to consider the matter-of-fact conditions of the villeins during the feudal period, especially in the 12th, 13th and 14th centuries. As is shown by the Hundred Rolls and countless other records of the same kind, the customary conditions of villeinage did not tally by any means with the identification of villeinage with slavery suggested by the jurists. It is true that in nomenclature the word *servi* is not infrequently used (*e.g.,* in the Hundred Rolls) where *villani* might have been mentioned, and the feminine *nief* (*nativa*) appears as the regular parallel to *villanus,* but in the descriptions of usages and services we find that the power of the lord loses its discretionary character and is in every respect moderated by custom. As personal dependents of the lord native villeins were liable to be sold, and we find actual sales recorded: Glastonbury Abbey, *e.g.,* sells a certain Philipp Hardyng for 20 shillings. But such transfers of human chattels occur seldom, and there is nothing during the English feudal period corresponding to the brisk trade in men characteristic of the ancient world. *Merchet* was regarded as a badge of serfdom in so far as it was said to imply a "buying of one's own blood" (*servus de sanguine suo emendo*). The explanation is even more characteristic than the custom itself, because fines on marriage might be levied and were actually levied on people of different condition, on the free as well as on the serf. Still the tendency to treat *merchet* as a distinctive feature of serfdom has to be noted, and we find that the custom spread for this very reason in consequence of the encroachments of powerful lords; in the Hundred Rolls it is applied indiscriminately to the whole rustic population of certain hundreds in a way which can hardly be explained unless by artificial extension. *Heriot,* the surrender of the best horse or ox, is also regarded as the common incident of villein tenure, although, of course, its very name proves its intimate connection with the outfit of soldiers (*here-geatu*).

Economically the institution of villeinage was bound up with the manorial organization—that is, with the fact that the country was divided into a number of districts in which central home farms were cultivated by work supplied by villein households.

The most important of villein services is the *week-work* performed by the peasantry. Every virgater or holder of a bovate has to send a labourer to do work on the lord's farm for some days in the week. Three days is indeed the most common standard for service of this kind, though four or even five occur sometimes, as well as two. It must be borne in mind in the case of heavy charges, such as four or five days' week-work, that only one labourer from the whole holding is meant, while generally there were several men living on every holding—otherwise the service of five days would be impossible to perform. In the course of these three days, or whatever the number was, many requirements of the demesne had to be met. The principal of these was *ploughing the fields* belonging to the lord, and for such ploughing the peasant had not only to appear personally as a labourer, but to bring his oxen and plough, or rather to join with his oxen and plough in the work imposed on the village; the heavy, costly plough with a team of eight oxen had to be made up by several peasants contributing their beasts and implements towards its composition. In the same way the villagers had to go through the work of harrowing with their harrows, and of removing the harvest in their vans and carts. *Carriage* duties in carts and on horseback were also apportioned according to the time they took as a part of the week-work. Then came innumerable varieties of manual work for the making and keeping up of hedges, the preservation of dykes, canals and ditches, the threshing and garnering of corn, the tending and shearing of sheep, and so forth. All this hand-work was reckoned according to customary standards as day-work and week-work. But besides all these services into which the regular week-work of the peasantry was differentiated, there were some additional duties. The ploughing for the lord, for instance, was not only imposed in the shape of a certain number of days in the week, but took sometimes the shape of a certain number of acres which the village had to plough and to sow for the lord irrespectively of the time employed. This was sometimes termed *gafolearth.* Exceedingly burdensome services were required in the seasons when farming processes are at their height—in the seasons of mowing and reaping, when every day is of special value and the working power of the farm hands is strained to the utmost. At those times it was the custom to call up the whole able-bodied population of the manor, with the exception of the housewives, for two, three or more days of mowing and reaping on the lord's fields; to these *boon-works* the peasantry was asked or invited by special summons, and their value was so far appreciated that the villagers were usually treated to meals in cases where they were again and again called off from their own fields to the demesne. The liberality of the lord actually went so far, in exceptionally hard straits, that ale was served to the labourers.

By the 14th century this social arrangement, based primarily on natural economy, had given way; the time of *commercial, contractual, cash intercourse* was fast approaching.

If we now turn to the actual stages by which this momentous passage from the manorial to the commercial arrangement was achieved, we have to notice first of all a rapid *development of contractual relations.* We know that in feudal law there was a standing contrast between *tenure by custom*—villein tenure—and *tenure by contract*—free tenure. While the manorial system was in full force this contrast led to a classification of holdings and affected the whole position of people on the land. Still, even at that time it might happen that a freeholder owned some land in villeinage by the side of his free tenement, and that a villein held some land freely by agreement with his lord or with a third person. But these cases, though by no means infrequent, were still exceptional. As a rule people used land as holdings, and those were rigidly classified as villein or free tenements. The interesting point is that, without any formal break, *leasing land for life and for terms of years* is seen to be rapidly spreading during the 13th century, and many small tenancies are created which break up the disposition of the holdings. From the close of the 13th century countless transactions on the basis of leases for terms of years occur between the peasants themselves. Any suitably kept set of 14th century court rolls contains entries in which such and such a villein is said to appear in the *halimote* and to surrender for the use of another person named a piece of land belonging to the holding. The number of years and the conditions of payment are specified. Thus, behind the screen of the normal shares a number of small tenancies arise which run their economic concerns in independence of the cumbersome arrangements of tenure and service, and, needless to add, all these tenancies are burdened with money rents.

Another series of momentous changes took place in the *arrangement of services.* Even the manorial system admitted the buying off for money of particular dues in kind and of specific performance of work. A villein might be allowed to bring a penny instead of a chicken, or to pay a rent instead of appearing with his oxen three times a week on the lord's fields. Such rents were called *mal* or *mail* in contrast with the *gafol,* ancient rents which had been imposed independently, apart from any buying off of customary services. There were even whole bodies of peasants called *Molmen,* because they had bought off work from the lord by settling with him on the basis of money rents. As time went on these practices of *commutation* became more and more frequent. There were, for both sides, many advantages in arranging their mutual relations on this basis. The lord got clear money—a much-coveted means of satisfying needs and wishes of any kind—instead of

cumbrous performances which did not come always at the proper moment, were carried out in a half-hearted manner, yielded no immediate results, and did not admit of convenient rearrangement. The peasant got rid of a hateful drudgery which not only took up his time and means in an unprofitable manner, but placed him under the arbitrary control of stewards or reeves and gave occasion to all sorts of fines and extortions.

With the growth of intercourse and security money circulated more freely and the number of such transactions increased in proportion. But it must be kept in mind that the conversion of services into rents went on very gradually, as a series of private agreements, and that it would be wrong to suppose, as some scholars have done, that it had led to a general commutation by the middle or even the end of the 14th century. The 14th century was marked by violent fluctuations in the demand and supply of labour, and particularly the tremendous loss in population caused in the middle of this century by the Black Death produced a most serious crisis. No wonder that many lords clung very tenaciously to customary services, and ecclesiastical institutions seem to have been especially backward in going over to the system of money rents. There is evidence to show, for instance, that the manors of the abbey of Ramsey were managed on the system of enforced labour right down to the middle of the 15th century, and, of course, survivals of these customs in the shape of scattered services lived on much longer. A second drawback from the point of view of the landlords was that commutation for fixed rents gradually lessened the value of the exactions to which they were entitled. Money not only became less scarce but it became cheaper, so that the couple of pence for which a day of manual work was bought off in the beginning of the 13th century did not fetch more than half of their former value at its end. As quit rents were customary and not rack rents, the successors of those who had redeemed their services were gaining the whole surplus in the value of goods and labour as against money, while the successors of those who had commuted their right to claim services for certain sums in money lost all the corresponding difference. These inevitable consequences came to be perceived in course of time and occasioned a tendency to revert to services in kind which could not prevail against the general movement from natural economy to money dealings, but was strong enough to produce social friction.

The economic crisis of the 14th century has its complement in the legal crisis of the 15th. At that time the courts of law began to do away with the denial of protection to villeins which, as we have seen, constituted the legal basis of villeinage. This is effected by the recognition of copyhold tenure (*see* COPYHOLD).

It is a fact of first-rate importance that in the 15th century customary relations on the one hand, and the power of government on the other, reached a stage of development at which the judges of the king began to take cognizance of the relations of the peasants to their lords. The first cases which occur in this sense are still treated not as a matter of common law, but as a manifestation of equity. As doubtful questions of trust, of wardship, of testamentary succession, they were taken up not in the strict course of justice, but as matters in which redress was sorely needed and could only be given by the exceptional power of the court of chancery. But this interference of 15th century chancellors paved the way towards one of the greatest revolutions in the law; without formally enfranchising villeins and villein tenure they created a legal basis for it in the law of the realm. In the formula of copyhold—*tenement held at the will of the lord and by the custom of the manor*—the first part lost its significance and the second prevailed, in downright contrast with former times when, on the contrary, the second part had no legal value and the first expressed the view of the courts. One may almost be tempted to say that these obscure decisions rendered unnecessary in England the work achieved with such a flourish of trumpets in France by the emancipating decree of Aug. 4, 1789.

The personal condition of villeinage did not, however, disappear at once with the rise of copyhold. It lingered through the 16th century and appears exceptionally even in the 17th. Deeds of emancipation and payments for personal enfranchisement are often noticed at that time. But these are only survivals of an arrangement which has been destroyed in its essence by a complete change of economic and political conditions.

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VILLÈLE, JEAN BAPTISTE GUILLAUME MARIE ANNE SÉRAPHIN, COMTE DE (1773–1854), French statesman, was born at Toulouse on April 14, 1773 and educated for the navy. He joined the "Bayonnaise" at Brest in July 1788 and served in the West and East Indies. Arrested in the Isle of Bourbon under the Terror, he was set free by the revolution of Thermidor (July 1794). He acquired some property in the island, and married in 1799 the daughter of a great proprietor, M. Desbassyns de Richemont, whose estates he had managed. The arrival of General Decaen, sent out by Bonaparte in 1802, restored security to the island, and five years later Villèle, who had now realized a large fortune, returned to France. He was mayor of his commune, and a member of the council of the Haute-Garonne under the Empire. At the restoration of 1814 he at once declared for royalist principles. He was mayor of Toulouse in 1814–15 and deputy for the Haute-Garonne in the "Chambre Introuvable" of 1815. Villèle, who before the promulgation of the charter had written some *Observations sur le projet de constitution* opposing it, as too democratic in character, naturally took his place on the extreme right with the ultra-royalists. In the new Chamber of 1816 Villèle found his party in a minority, but his personal authority nevertheless increased. He was looked on by the ministerialists as the least unreasonable of his party, and by the "ultras" as the safest of their leaders. Under the electoral law of 1817 the Abbé Grégoire, who was popularly supposed to have voted for the death of Louis XVI. in the Convention, was admitted to the Chamber of Deputies. The Conservative party gained strength from the alarm raised by this incident and still more from the shock caused by the assassination of the duc de Berri. The duc de Richelieu was compelled to admit to the cabinet two of the chiefs of the Left, Villèle and Corbière. Villèle resigned within a year, but on the fall of Richelieu at the end of 1821 he became the real chief of the new cabinet, in which he was minister of finance. Although not himself a courtier, he was backed at court by Sosthènes de la Rochefoucauld and Madame du Cayla, and in 1822 Louis XVIII. gave him the title of count and made him formally prime minister.

He immediately proceeded to muzzle opposition by stringent press laws, and the discovery of minor Liberal conspiracies afforded an excuse for further repression. Forced against his will into interference in Spain, he reaped some credit from the campaign of 1823. Meanwhile he had persuaded Louis XVIII. to swamp the Liberal majority in the upper house by the nomination of twenty-seven new peers; he availed himself of the temporary popularity of the monarchy after the Spanish campaign to summon a new Chamber of Deputies. This new and obedient legislature, to which only nineteen Liberals were returned, made itself into a septennial parliament, thus providing time, it was thought, to restore some part of the *ancien régime*. Villèle's plans were assisted by the death of Louis XVIII. and the accession of his bigoted brother. Prudent financial administration since 1815 had made possible the conversion of the state bonds from 5 to 4%. It was proposed to utilize the money set free by this operation to indemnify by a milliard francs the *émigrés* for the loss of their lands at the Revolution; it was also proposed to restore their former privileges to the religious congregations. Both these propositions were, with some restrictions, secured. Sacrilege was made a crime punishable by death, and the ministry were preparing a law to alter the law of equal inheritance, and thus create anew the great estates. These measures roused violent opposition in the country, which a new and stringent press law, nick-

named the "law of justice and love," failed to put down. The peers rejected the law of inheritance and the press law; it was found necessary to disband the National Guard; and in November 1827 seventy-six new peers were created, and recourse was had to a general election. The new Chamber proved hostile to Villèle, who resigned to make way for the short-lived moderate ministry of Martignac.

The new ministry made Villèle's removal to the upper house a condition of taking office, and he took no further part in public affairs. At the time of his death, on March 13, 1854, he had advanced as far as 1816 with his memoirs, which were completed from his correspondence by his family as *Mémoires et correspondance du comte de Villèle* (Paris, 5 vols., 1887–90).

See also C. de Mazade, *L'Opposition royaliste* (Paris, 1894); J. G. Hyde de Neuville, *Notice sur le comte de Villèle* (Paris, 1899); and M. Chotard, "L'Oeuvre financière de M. de Villèle," in *Annales des sciences politiques* (vol. v., 1890).

VILLENA, ENRIQUE DE (1384–1433), Spanish author, sometimes wrongly called marqués de Villena. About 1402 he married Maria de Castilla, who speedily became the recognized mistress of Henry III.; the complaisant husband was rewarded by being appointed master of the military order of Calatrava in 1404, but the nomination was rescinded in 1415. Villena is represented by a fragment of his *Arte de trobar* (1414), an indigestible treatise composed for the Barcelona Consistory of Gay Science; by *Los Trabajos de Hércules* (1417), a pedantic and unreadable allegory; by his *Tratado de la Consolación* and his handbook to the pleasures and fashions of the table, the *Arte cisoria*, both written in 1423; by the *Libro de Aojamiento* (1425), a ponderous dissertation on the evil eye and its effects; and by a translation of the *Aeneid*, the first ever made (1428). His treatise on leprosy exists but has not been published. Villena's writings do not justify his extraordinary fame; his subjects are devoid of charm, and his style is so uncouth as to be almost unintelligible. Yet he has an assured place in the history of Spanish literature; he was a generous patron of letters and his translation of Virgil marks him out as a pioneer of the Renaissance.

VILLENA, a town of eastern Spain, in Alicante province; on the right bank of the river Vinalapó, and at the junction of railways from Valencia, Alicante, Albacete and Yecla. Pop. (1940) 14,674 (mun., 19,065). It contains some interesting examples of Moorish domestic architecture and is dominated by a Moorish castle. The surrounding hills are covered with vines, and to the east there is an extensive salt lagoon. Silk, linen, flour, wine, brandy, oil, salt and soap are the chief industrial products.

VILLENEUVE, PIERRE CHARLES JEAN BAPTISTE SILVESTRE (1763–1806), French admiral, was born at Valensoles (Provence) on Dec. 31, 1763. He entered the French royal navy as a "garde du Pavillon," and received rapid promotion, being named post-captain in 1793, and rear-admiral in 1796. At the close of the year he took part in the unsuccessful expedition to Ireland.

He accompanied the expedition to Egypt, with his flag in the "Guillaume Tell" (86). She was the third ship from the rear of the French line at the battle of the Nile, and escaped in company with the "Généreux" (78). Villeneuve reached Malta on Aug. 23. His conduct was severely blamed, and he defended himself by a specious letter to his colleague Blanquet-Duchayla on Nov. 12, 1800, from Paris. In a letter written to him on Aug. 21, 1798, Napoleon says that the only thing with which Villeneuve had to reproach himself was that he had not retreated sooner, since the position taken by the French commander-in-chief had been forced and surrounded. But, in dictating his account of the expedition to Egypt to General Bertrand at St. Helena, the ex-emperor attributed the defeat at the Nile largely to the "bad conduct of Admiral Villeneuve." Villeneuve failed in the execution of the scheme for the invasion of England in 1805.

Nevertheless, Napoleon selected him to succeed Latouche Tréville at Toulon on his death in August 1804. The duty of the Toulon squadron was to draw Nelson to the West Indies, return rapidly, and in combination with other French and Spanish ships, to enter the Channel with an overwhelming force. It is quite obvious that Villeneuve had from the first no confidence in the success of the operation. He knew that the French were not efficient, and that their Spanish allies were in a far worse state than themselves. It required a very tart order from Napoleon to drive him out of Paris in October 1804. He took the command in November. For the details of the campaign *see* TRAFALGAR. Having undertaken to carry out a plan of which he disapproved, it was clearly his duty to execute the orders he received. But Villeneuve could not free himself from the conviction that it was his business to save his fleet even if he ruined the emperor's plan of invasion. Thus after he returned to Europe and fought his confused action with Sir R. Calder off Ferrol on July 22, 1805, he first hesitated, and then, in spite of vehement orders to come on, turned south to Cadiz.

His decision to leave Cadiz and give battle in October 1805, which led directly to the battle of Trafalgar, cannot be justified even on his own principles. He foresaw defeat to be inevitable, and yet he went out solely because he learnt from the Minister of Marine that another officer had been sent to supersede him. At Trafalgar he showed personal courage, but the helpless incapacity of the allies to manoeuvre gave him no opportunity to influence the course of the battle. He was taken as a prisoner to England, but was soon released. He committed suicide at Rennes, on April 22, 1806.

The correspondence of Napoleon contains many references to Villeneuve. Accounts of the naval operations in which he was concerned will be found in James's *Naval History*. Troude, in his *Batailles navales de la France*, vol. iii., publishes several of his letters and orders of the day.

VILLENEUVE-LÈS-AVIGNON, a town of south-eastern France, in the department of Gard on the right bank of the Rhône opposite Avignon. Pop. (1936) 2,921. In the 6th century the Benedictine abbey of St. André was founded on Mont Andaon, and the village which grew up round it took its name. In the 13th century the monks, acting in concert with the crown, established a *bastide*, or "new town," which came to be called Villeneuve. The town was the resort of the French cardinals during the sojourn of the popes at Avignon, and was important till the Revolution.

Villeneuve preserves many remains of its mediaeval importance. The hospice, once a Franciscan convent, and the church and other remains of the Carthusian monastery of Val-de-Bénédiction, founded in 1356 by Innocent VI., are notable. A 17th century gateway and a rotunda, built as shelter for a fountain, are interesting. On the Mont Andaon, a hill to the north-east of the town, stands the fort of St. André (14th century), with a fortified entrance gateway and a Romanesque chapel and remains of the abbey of St. André.

VILLENEUVE-SUR-LOT, a town of south-western France, capital of an arrondissement in the department of Lot-et-Garonne, 22 mi. N. by E. of Agen on a branch line of the Orléans railway. Pop. (1936) 8,427. Villeneuve was founded in 1254 by Alphonse, count of Poitiers, brother of Louis IX., on the site of the town of Gajac, which had been deserted during the Albigensian crusade.

The river Lot divides the town into two parts. The chief quarter stands on the right bank and is united to that on the left bank by a 13th century bridge. On the left bank portions of the 13th century ramparts, altered and surmounted by machicolations in the 15th century, remain, and high square towers rise above the gates to the north-east, the Porte de Paris, and south-west, the Porte de Pujols. Arcades of the 13th century surround the Place La Fayette, and there are old houses of the 13th, 14th and 15th centuries in various parts of the town. On the left bank of the Lot, 2 m. S.S.W. of Villeneuve, are the 13th-century walls of Pujols. The buildings of the ancient abbey of Eysses, about a mile to the N.E., mainly 17th century, remain. Villeneuve has a sub-prefecture and a tribunal of commerce. It is an important agricultural centre and has a very large trade in plums (*prunes d'ente*) and in the produce of the market gardens which surround it, as well as in cattle, horses and wine. The preparation of preserved plums and the tinning of peas and beans occupy many hands; there are also manufactures of shoes and tin boxes.

VILLEROI, FRANÇOIS DE NEUFVILLE, DUC DE (1644–1730), French soldier, came of a noble family which had risen into prominence in the reign of Charles IX. His father Nicolas de Neufville, Marquis de Villeroi, marshal of France (1598–1685), created a duke by Louis XIV, was the young king's governor, and the boy was thus brought up in close relations with Louis. An intimate of the king, a finished courtier and leader of society and a man of great personal gallantry, Villeroi was marked out for advancement in the army, which he loved, but which had always a juster appreciation of his incapacity than Louis. In 1693, without having exercised any really important and responsible command, he was made a marshal. In 1695, when Luxembourg died, he obtained the command of the army in Flanders, and William III found him a far more complaisant opponent than the "little hunchback." In 1701 he was sent to Italy to supersede Catinat and was soon beaten by the inferior army of Eugene at Chiari (*see* SPANISH SUCCESSION WAR). In the winter of 1701 he was made prisoner at the surprise of Cremona, and the wits of the army made at his expense the famous rhyme:

> Par la faveur de Bellone, et par un bonheur sans égal,
> Nous avons conservé Crémone—et perdu notre général.

In the following years he was pitted against Marlborough in the Low Countries. Marlborough's own difficulties with the Dutch and other allied commissioners, rather than Villeroi's own skill, put off the inevitable disaster for some years, but in 1706 the duke attacked him and thoroughly defeated him at Ramillies (*q.v.*). Louis consoled his old friend with the remark, "At our age, one is no longer lucky," but superseded him in the command and henceforward Villeroi lived the life of a courtier, much busied with intrigues but retaining to the end the friendship of his master. He died on July 18, 1730, at Paris.

VILLERS LA VILLE, a village of Belgium in the province of Brabant, 2 mi. E. of Quatre Bras, with a station on the direct line from Louvain to Charleroi. Pop. (1939) 1,109. It is chiefly interesting on account of the fine ruins of the Cistercian abbey of Villers founded in 1147 and destroyed by the French in 1795.

VILLETTE, CHARLES, MARQUIS DE (1736–1793), French writer and politician, was born in Paris on Dec. 4, 1736. He became the *protégé* of Voltaire, who had known his mother. During the Revolution Villette publicly burned his letters of nobility, wrote revolutionary articles in the *Chronique de Paris,* and was elected deputy to the Convention by the department of Seine-et-Oise. He died in Paris on July 7, 1793.

VILLIERS, BARBARA: *see* CLEVELAND, DUCHESS OF.

VILLIERS DE L'ISLE-ADAM, PHILIPPE AUGUSTE MATHIAS, COMTE DE (1838–1889), French poet, was born at St. Brieuc in Brittany and baptized on Nov. 28, 1838. He may be said to have inaugurated the Symbolist movement in French literature, and *Axël,* the play on which he was engaged during so much of his life, though it was only published after his death, is the typical Symbolist drama. He began with a volume of *Premières Poésies* (1856–58). This was followed by a wild romance of the supernatural, *Isis* (1862), and by two plays in prose, *Elën* (1866) and *Morgane* (1866). *La Révolte,* a play in which Ibsen's *Doll's House* seems to be anticipated, was represented at the Vaudeville in 1870; *Contes cruels,* his finest volume of short stories, in 1883, and a new series in 1889; *Le Nouveau Monde,* a drama in five acts, in 1880; *L'Ève future,* an amazing piece of buffoonery satirizing the pretensions of science, in 1886; *Tribulat Bonhomet* in 1887; *Le Secret de l'échafaud* in 1888; *Axël* in 1890. He died in Paris, under the care of the Frères Saint-Jean-de-Dieu, on Aug. 19, 1889.

Villiers has left behind him a legend probably not more fantastic than the truth. Sharing many of the opinions of Don Quixote, he shared also Don Quixote's life. He was the descendant of the Grand Master of the Knights of Malta, famous in history, and his pride as an aristocrat and as an idealist were equal. He hated mediocrity, science, progress, the present age, money and "serious" people. He remains a remarkable poet and a remarkable satirist, imperfect as both. He improvised out of an abundant genius, but the greater part of his work was no more than improvisation. He was accustomed to talk his stories before he wrote them. Sometimes he talked them instead of writing them. But he has left, at all events, the *Contes cruels,* in which may be found every classic quality of the French *conte,* together with many of the qualities of Edgar Allan Poe and Ernst Hoffman; and the drama of *Axël,* in which the stage takes a new splendour and a new subtlety of meaning. Villiers's influence on the younger French writers was considerable. It was always an exaltation. No one in his time followed a literary ideal more romantically. (A. SY.)

See also R. du Pontavice de Heussey, *Villiers de l'Isle-Adam* (1893), a biography, English trans. (1904) by Lady Mary Loyd; S. Mallarmé, *Les Miens. Villiers de l'Isle-Adam* (1892); R. Martineau, *Un vivant et deux morts* (1901), bibliography. A selection from his stories, *Histoires souveraines,* was made by his friends (Brussels, 1899); there is a translation of the *Contes cruels* by Hamish Miles (*Sardonic Tales,* 1927).

VILLON, FRANÇOIS (1431–*c.* 1463), French poet, was born in 1431, and, as it seems, certainly at Paris. He was entered on the books of the university of Paris as François de Montcorbier, but was always known by the name of his patron, Guillaume de Villon. It appears that he was born of poor folk, that his father died in his youth, but that his mother, for whom he wrote one of his most famous *ballades,* was alive when her son was 30 years old. Villon was received into the house of Guillaume de Villon, chaplain in the collegiate church of Saint-Benoît-le-Bestourné, and a professor of canon law, who was probably a relative. The poet became a student in arts, no doubt early and took the degree of bachelor in 1449 and that of master in 1452.

On June 5, 1455, being in the company of a priest named Giles and a girl named Isabeau, he met, in the rue Saint-Jacques, a certain Breton, Jean le Hardi, a master of arts, who was with a priest, Philippe Chermoye or Sermoise or Sermaise. A scuffle ensued; daggers were drawn; and Sermaise, who started the broil, died of his wounds. Villon fled, and was sentenced to banishment—a sentence which was remitted in January 1456, the formal pardon being extant in two different documents, in one of which the culprit is described as "François des Loges, autrement dit Villon," in the other as "François de Montcorbier." By the end of 1456 he was again in trouble. In his first broil "la femme Isabeau" is only generally named, and it is impossible to say whether she had anything to do with the quarrel. In the second, Catherine de Vaucelles, of whom we hear not a little in the poems, is the declared cause of a scuffle in which Villon was so severely beaten that, to escape ridicule, he decided to flee to Angers, where he had an uncle who was a monk. As he was preparing to leave Paris he composed the *Petit Testament.* Hitherto Villon had been rather injured than guilty. But on the eve of leaving Paris he was concerned, just before Christmas 1456, in robbing the chapel of the college of Navarre from which five hundred gold crowns were stolen. The robbery was not discovered till March 1457, and in May the police came on the track of a gang of student-robbers owing to the indiscretion of one of them, Guy Tabarie. A year more passed, when Tabarie, being arrested, turned king's evidence and accused Villon, who was then absent, of being the ringleader, and of having gone to Angers, partly at least, to arrange for similar burglaries there. Villon, for this or some other crime, was sentenced to banishment: and he did not attempt to return to Paris. For four years he was a wanderer, apparently a pedlar for some part of the time; and he may have been, as each of his friends Regnier de Montigny and Colin des Cayeux certainly was, a member of a wandering thieves' gang. It is certain that at one time (in the winter of 1457), and probable that at more times than one, he was in correspondence with Charles d'Orléans, and visited that prince's court at Blois. He made his way to Bourges where he was again in trouble, and had a taste of prison. From Bourges he went to the Bourbonnais, where he found shelter for a brief period with Jean II de Bourbon. Thence, if his own words are to be taken literally, he wandered to Dauphiné. He was in prison at Orleans, put to the question and under sentence of death, when he was released on the passage of the little princess of Orleans through the town on July 17, 1460. He had spent the summer of 1461 in the bishop's prison of Meung. Villon owed his release to Louis XI, who passed through Meung on a royal

progress and freed prisoners on Oct. 2.

It was now that he wrote the *Grand Testament,* the work which has immortalized him. Although he was only 30 nothing appears to be left him but regret; his very spirit has been worn out by excesses or sufferings or both. In the autumn of 1462 we find him once more living in the cloisters of Saint-Benoît, and in November he was in the Châtelet for theft. In default of evidence the old charge of the college of Navarre was revived, and even a royal pardon did not bar the demand for restitution. Bail was, however, accepted, but Villon was present at a street quarrel from which he hastily got away. Nevertheless he was arrested, tortured and condemned to be hanged, but the sentence was commuted to banishment (for ten years) by the parlement on Jan. 5, 1463. From this time he disappears from history.

Villon's two *Testaments* are made up of eight-line stanzas of eight-syllabled verses, varied in the case of the *Grand Testament* by the insertion of ballades and rondeaux. The sense of the vanity of human life pervades the whole of Villon's poetry. It is the very keynote of his most famous and beautiful piece, the *Ballade des dames du temps jadis,* with its refrain, "Mais où sont les neiges d'antan?", of the ballade of *La Grosse Margot,* with its burden of hopeless entanglement in shameless vice; and of the equally famous *Regrets de la Belle Heaulmière,* in which a woman, once young and beautiful, now old and withered, laments her lost charms. So it is almost throughout his poems, including the grim *Ballade des pendus,* and hardly excluding the very beautiful *Ballade que Villon feist a la requeste de sa mère, pour prier Nostre-Dame,* with its sincere and humble piety. In Villon's verse mediaeval Paris lives. Villon himself was beloved by the Paris of his day. His bright keen intellect, the exquisite polish of his verses and his realism, make him one of the great forces in French poetry. His influence on the moderns has been very great.

His certainly genuine poems consist of the two *Testaments* with their codicil (the latter containing the *Ballade des pendus,* or more properly *Épitaphe en forme de ballade,* and some other pieces of a similarly grim humour), a few miscellaneous poems, chiefly ballades, and an extraordinary collection (called *Le Jargon ou jobelin*) of poems in *argot,* the greater part of which is now totally unintelligible, if, which may perhaps be doubted, it ever was otherwise. Several poems usually printed with Villon's works are certainly, or almost certainly, not his. The chief are *Les Repues Franches,* a curious series of verse stories of cheating tavern-keepers, etc., having some resemblance to those told of George Peele, but of a broader and coarser humour. These, though in many cases "common form" of the broader tale-kind, are not much later than his time, and evidence to reputation if not to fact.

The first dated edition of Villon is of 1489. Before 1542 there were very numerous editions, the most famous being that (1533) of Clément Marot, one of whose most honourable distinctions is the care he took of his poetical predecessors. The Pléiade movement and the classicizing of the *grand siècle* put Villon rather out of favour, and he was not again reprinted till early in the 18th century, when he attracted the attention of students of old French like Le Duchat, Bernard de la Monnoye and Prosper Marchand.

The first critical edition in the modern sense—that is to say, an edition founded on mss. (of which there are in Villon's case several, chiefly at Paris and Stockholm)—was that of the Abbé J. H. R. Prompsault in 1832. The next was that of the "Bibliophile Jacob" (P. Lacroix) in the *Bibliothèque Elzévirienne* (Paris, 1854). The standard editions are *Oeuvres complètes de François Villon,* by M. Auguste Longnon (1892), a revision of this text by Lucien Foulet, *François Villon: Oeuvres* (1923); and L. Thuasne, *François Villon; Oeuvres: édition critique* (1923), based on the Stockholm ms. of 1470, the ms. Fr. 20041 of the Bibliothèque Nationale, and Levet's text of 1489. M. Marcel Schwob discovered new documents relating to the poet, but died before he could complete his work, which was posthumously published in 1905. The researches of Schwob were completed by P. Champion in his *François Villon, sa vie et son temps* (1913). *See* also A. Longnon, *Étude biographique sur François Villon* (1877); Gaston Paris, *François Villon* (1901); D. B. Wyndham Lewis, *François Villon, A Documented Survey* (1928), with preface by H. Belloc, which contains renderings of the individual poems by Rossetti, Swinburne and Henley, and a full survey of the documents.

VILNIUS (WILNO, VILNA), administrative district of soviet Lithuania, whose boundaries have shifted considerably with changes of political control. (*See* VILNIUS city). As restored to Lithuania in 1939 the district was bounded by Latvia on the north, U.S.S.R. on the east, and the soviet White Russian republic on the south, being about one-quarter the area and population of the former Polish province of Wilno (1920–39) and considerably smaller than the tsarist government of Vilna. The area forms an extension of the Baltic uplands and is drained in the north by the Disna and by the Neris (Vilija) in the south. Sand, numerous glacial lakes and marshes, some partially forested, cover large areas. The transportation is primitive except for a few railroads. The climate, slightly tempered by the Baltic sea, has a mean temperature of 43.7° F. and an average precipitation of 23.8 in. Agriculture is backward, with rye, potatoes and flax the main crops grown on the badly eroded land. Timber and timber products are of considerable importance. The population, actually as well as in allegiance, has been unstable. Estimates of composition vary from 8.2% Poles (1897 Russian census) to 59.9% (1931 Polish census); from 50% Lithuanians (Lebedekin's 1861 estimate) to 10% in various Polish surveys. Statistics on Jewish (6% to 13%) and Russian (20% to 61%) groups are little more consistent, but the White Russians are generally considered the largest group. After the U.S.S.R. seized eastern Poland in Sept. 1939, it ceded parts of the Vilnius province to Lithuania. Chief city in this district is Vilnius (*q.v.*), but Trakai (Troki), Trumont, Dukszty, Nowoswieciany, and Podbrodzie are of some importance. The soviets absorbed the entire country in 1940, lost it to the German army in 1941, and regained it during the summer of 1944.

VILNIUS (*Russian,* VILNA; *Polish,* WILNO) capital of soviet Lithuania and political centre of province of the same name, located 436 mi. S.S.W. of Leningrad at the intersection of railways from Liepāja, Königsberg, Warsaw, the Ukraine, Gomel and Leningrad. Pop. (Ger. 1942 census) 182,000. The city and its suburbs, Antokol, Lukiski, Pohulanka and Zarzecze, stand on and around an amphitheatre of wooded hills (2,450 ft.) which faces S.E. at the confluence of the Neris and Vilejka. The old section of the city, resembling an overgrown village with its narrow winding streets, lies at the foot of Castle Hill on which the ruins of Gediminas' (Gedymin's) castle are still visible. The newer areas, which spread up the hills and along the Neris, present a more modern aspect.

Situated between eastern and western Europe, Vilnius bears marks of many cultures. There are 28 Roman Catholic churches, 7 Orthodox, 2 Protestant, 1 Moslem mosque, and numerous synagogues. The public buildings show Byzantine, German, Latin, baroque, rococo and gothic influence. Most prominent is the Cathedral of St. Stanislas, built originally in 1387 and subsequently destroyed at least three times. The present neo-classical structure, designed by Gucewicz, was completed in 1801. There is a second cathedral, that of St. Nicholas, built in 1596–1604. Twelve of the city's churches were built in the 17th century by one Pac; one of these, the church of Sts. Peter and Paul, is a fine specimen of baroque style. The church of St. Martin was built on the site of the ancient pagan temple of Perkunas; while the small St. Anne's church, with its intricate gothic façade, so impressed Napoleon in 1812 that he wished he could take it with him to Paris. The Pointed Gate (Ostra Brama), with its venerated 16th century Madonna, is all that remains of the Jagellon wall of 1522.

The old university, in its neo-classical buildings, was originally founded as a Jesuit academy by Stephen Bathory in 1579. It was re-established as the Superior school of the Lithuanian grand duchy in 1781, and toward the end of the 18th and early 19th centuries became an agitation centre of Polish culture. Political reasons caused the school to be closed in 1832 and, except for the faculties of astronomy and medicine, it remained inactive until 1919. In 1940, following the reoccupation of Vilnius by Lithuania, the school was reorganized, without most of the Polish staff, as the Lithuanian university. During the subsequent German occupation the school was closed and much of its equipment and archival collection destroyed.

The city possessed a Superior School of Political Science (est.

1930) as well as a college of dramatic art, academy of science, academy of art, academy of music, Roman Catholic and Orthodox seminaries, public library and botanical garden. It is a centre for timber, timber products, and furs, although the relative importance of the city declined between 1920 and 1939 because the city was separated from its natural economic hinterland. The German census of 1942 showed that in the city itself 53.2% of the population were Polish, 18.3% Lithuanian, 6.6% Jews, and 20.3% Russian groups. Heavy Polish refugee immigration and the German Jewish policy are reflected in these figures; the 1897 census reported 30.9% Poles and 40.3% Jews. The population composition of the Vilnius rural district is entirely different with a much stronger White Russian and Lithuanian proportion, fewer Jews, and probably not more than 15% Poles.

History.—Although it was founded in the 10th century, Vilnius was unimportant until Grand Duke Gediminas (Gedymin, *q.v.*) made it the capital of Lithuania (*q.v.*) in 1323. It was destroyed by Teutonic Knights in 1377 and was not completely restored until after the Union of Kreva of 1385. Two years later the first bishopric in Lithuania was established there. The city suffered bitterly in the two centuries following the Lithuanian-Polish Union of Lublin of 1569: the plague of 1588, a fire in 1610, Russian occupation from 1655–60, occupation by Charles XII during the Great Northern War in 1702 and again in 1706 when the city was burned, and a plague in 1710 which killed 35,000. Stanislas Augustus partially restored the city before it fell again to the Russians in 1788. Russian rule did not become permanent until 1795. The city and its Roman Catholic population suffered because of the abortive revolutions in 1831 and 1863.

Vilnius fell easily to the Germans on Sept. 19, 1915. At the end of the war Polish leaders sought to annex all Lithuania including Vilnius, demanding renewal of the ancient union. While the subsequent Polish-soviet frontier war was raging, the supreme allied command three times tried to draw a line of demarcation between Lithuania and Poland, each of which granted Vilnius to Lithuania, but Polish troops violated each one. Vilnius changed hands several times during the war, but the soviets turned over the city to Lithuanian troops on Aug. 24, 1920, according to the conditions of the Litho-soviet Moscow treaty of July 12.

Finally, on Sept. 7, the Polish and Lithuanian governments signed an armistice at Suwalki in the presence of the Allied control commission. Two days later, Gen. Lucien Zeligowski with a freebooting army recruited from the Polish forces and with the secret approval of Joseph Pilsudski, Polish chief of state, captured the city. The Council of the League of Nations immediately made plans for a plebiscite under the supervision of an international police force, but both the Poles and the Lithuanians refused. Paul Hymans, for the League council, then began, in May 1921, to mediate the dispute. His first proposal was to create two autonomous cantons in Lithuania, one centred at Vilnius and one at Kaunas, but with a joint Polish-Lithuanian foreign policy and military co-operation. Lithuania demanded reunion of Vilnius and a guarantee of her independence preliminary to all agreements, but Poland would not yield.

Meanwhile, on Jan. 8, 1922, Zeligowski held a plebiscite in "Central Lithuania." The Lithuanians and Jews boycotted the polls and the results called for union with Poland. In April the Polish Sejm voted to accept the offer and Vilnius was incorporated.

On Feb. 3, 1923, a month after the Lithuanian freebooting occupation of Memel, the League council decided to divide the neutral zone established by the military control commission, replacing it with a demarcation line granting Vilnius to Poland. But Poland and Lithuania remained in a state of war. The Litho-soviet treaty of 1926, stating that the Vilnius occupation was illegal, encouraged Lithuania. On Dec. 10, 1927, the League council forced a termination of the state of war, but the frontier remained closed. A World Court decision in 1931 sustained Lithuania's policy.

Polish suppression of Lithuanian-speaking individuals remained mild until 1937 when the Lithuanian daily papers were banned and Lithuanian leaders arrested. The Polish pretext was the closed frontier. Finally, on March 17, 1938, while the world's attention was distracted by the German occupation of Austria, the Polish government demanded the opening of the frontiers and the renunciation of Vilnius within 24 hours. Lithuania yielded.

The U.S.S.R. seized Vilnius along with eastern Poland in Sept. 1939, and shortly afterwards, on Oct. 10, ceded the city and adjoining areas to Lithuania. Soviet military occupation took place on June 15, 1940, and continued until the Red army was driven out by the German forces on June 22, 1941. The midsummer soviet offensive, 1944, shoved the Germans from the city.

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(F. D. S.)

VIMEIRO, BATTLE OF, 1808. Advancing upon Lisbon (*see* PENINSULAR WAR), Wellesley halted to cover the landing of reinforcements at the mouth of the Alcabrichella. Two miles from the sea this river cuts its way through a high ridge, which it divides into a western and an eastern section; at the southern entrance of the gorge thus formed lies the village of Vimeiro. Wellesley's force, 20,000 strong, was encamped upon the western ridge, with two brigades upon Vimeiro hill, a knoll just south of the village. On the morning of Aug. 21, 1808, Wellesley learned that Junot, with 13,000 men, was advancing to attack him. Junot, ignoring the western ridge, directed the brigades of Thomières and Charlot to attack Vimeiro hill, while Brennier mounted the eastern ridge and swept along it from the east. Wellesley at once sent five brigades on to the eastern ridge, two to overlook Vimeiro hill and three to stop Brennier's advance along its crest. The attack on Vimeiro hill followed a course that was to be the pattern for many such engagements throughout the war. The French advanced in solid columns on a narrow frontage, having thus little fire power; the British received them in line, wrapping themselves round the head and flanks of the columns, withered them with volleys of musketry, charged with the bayonet and swept them down the hill with heavy loss. A second attack by four battalions of grenadiers met with a similar fate, though two battalions did fight their way into Vimeiro village and were only dislodged after heavy hand-to-hand fighting. Meanwhile Brennier had lost himself among ravines north of the eastern ridge, but Solignac, who had been sent to reinforce him, struck correctly westwards along the ridge and blundered into three British brigades in line. Within a few minutes Solignac's brigade had practically ceased to exist, but as the bulk of the British chased joyfully along the ridge in pursuit of the survivors Brennier's brigade came up from the valley behind them and roughly handled two battalions that had been left to guard Solignac's abandoned guns. Fortunately their comrades returned in time to scatter Brennier's men. The moment was ripe for a general advance and pursuit of Junot's beaten army, but Sir Harry Burrard at this point arrived to take over command from Wellesley and timidly ordered hostilities to cease. Junot had lost half his guns and a quarter of his men, the British loss being only 750.

VINCENNES, a suburb 7 kilometres east of Notre Dame de Paris, in the department of Seine, on a wooded plateau. Pop. (1936), 48,967. Its celebrated castle, situated to the south of the town and on the northern border of the Bois de Vincennes, was formerly a royal residence, begun by Louis VII in 1164 and more than once rebuilt. It was frequently visited by Louis IX. The chapel, an imitation of the Sainte Chapelle at Paris, was begun by Charles V in 1379, continued by Charles VI and Francis I, consecrated in 1552 and restored in modern times. In the sacristy is the monument erected in 1816 to the memory of the duke of Enghien, who was shot in the castle moat in 1804. Louis XI made the castle a state prison in which Henry of Navarre, the great Condé, Mirabeau and other distinguished persons were afterwards confined. Louis XVIII added an armoury, and under Louis Philippe numerous casemates and a new fort to the east of the donjon were constructed. Vincennes has a school of military

administration and carries on horticulture and the manufacture of ironware, rubber goods, chemicals, etc.

VINCENNES, a city of S.W. Indiana, U.S.A., on the Wabash river; county seat of Knox county, the oldest settlement of the state. It is on federal highways 41, 50, 150 and Indiana 61, 67; is served by the Baltimore and Ohio, Big Four, Chicago and Eastern Illinois and Pennsylvania railways. Pop. (1940) 18,228 (94% native white).

Vincennes is in a rich agricultural region surrounded by large coal fields, natural gas and oil. Manufactures include steel, glass, shoes, paper products, ice cream, flour, canned goods, bread, cold storage.

A French trading post was established as early as 1702, with a fort erected by François Margane de Vincennes which remained under the French until 1777 when it was captured by the British and named Fort Sackville. George Rogers Clark captured Fort Sackville Feb. 25, 1779, for the American colonies.

Vincennes was the capital of Indiana territory from 1800–13, with William Henry Harrison as governor.

It was incorporated as a city in 1856. It is a centre of historic interest.

Among the notable edifices are the $3,000,000 George Rogers Clark national memorial, the Old Cathedral (erected in 1826) and library, the Lincoln memorial bridge, the first capital building of Indiana territory (1800), Governor William Henry Harrison's mansion, and Vincennes university (1806).

The court-house was built in 1873–74 as a memorial to the pioneers and soldiers of Knox county.

VINCENT (or VINCENTIUS), **ST.,** deacon and martyr, whose festival is celebrated on Jan. 22. In several of his discourses St. Augustine pronounces the eulogy of this martyr, and refers to *Acts* which were read in the church. It is doubtful whether the *Acts* that have come down to us (*Acta Sanctorum,* January, ii, 394–397) are those referred to by St. Augustine, since it is not certain that they are a contemporary document. According to this account, Vincent was born of noble parents in Spain, and was educated by Valerius, bishop of Saragossa, who ordained him to the diaconate. Under the persecution of Diocletian, Vincent was arrested and taken to Valencia. He was subjected to excruciating tortures and thrown into prison, where angels visited him, lighting his dungeon with celestial light and relieving his sufferings. His warders, having seen these wonders through the chinks of the wall, forthwith became Christians. He died in an interval when new torments were being prepared. His body, exposed to the wild beasts in vain, was thrown into the sea, but was recovered and buried outside Valencia.

See T. Ruinart, *Acta martyrum sincera* (Amsterdam, 1713), pp. 364–366; Le Nain de Tillemont, *Mémoires pour servir à l'histoire ecclésiastique* (Paris, 1701, *seq.*), v, 215–225, 673–675.

VINCENT, GEORGE EDGAR (1864–1941), American educationist, was born at Rockford, Ill., on March 21, 1864. After graduating at Yale in 1885, he engaged in editorial work and in 1886 was made literary editor of the Chautauqua press. He was president of the Chautauqua institution from 1907 to 1915 and thereafter honorary president. In 1892 he was appointed fellow at the University of Chicago. He taught at Chicago as instructor, assistant professor, associate professor, and from 1904 to 1911 as professor of sociology. He was dean of the junior colleges from 1900 to 1907, and then for four years was dean of the faculties of arts, literature and sciences. From 1911 to 1917 he was president of the University of Minnesota. He became a member of the General Education board in 1914, and from 1917 to 1929 he was president of the Rockefeller foundation. Vincent wrote *The Social Mind and Education* (1897), and with Albion W. Small *An Introduction to the Study of Society* (1894).

VINCENT DE PAUL, ST. (1576–1660), French divine, founder of the "Congregation of Priests of the Mission," usually known as Lazarites (*q.v.*), was born on April 24, 1576, at Pouy, near Dax, in Gascogne, and was educated by the Franciscans at Dax and at Toulouse. He was ordained priest in 1600. Voyaging from Toulouse to Narbonne, he was captured by Barbary pirates, who took him to Tunis and sold him as a slave. He converted his third master, a renegade Italian, and escaped with him to Aigues-Mortes near Marseilles in June 1607. After short stays at Avignon and Rome, Vincent found his way to Paris, where he became acquainted with Pierre de Bérulle (*q.v.*), who found him a curacy at Clichy near Paris (1611). He then became tutor to the count of Joigny at Folleville, in the diocese of Amiens, where his success with the peasants led to the "missions" with which his name is associated. In 1617 he became curate of Châtillon-lès-Dombes (or sur-Chalaronne), and the countess of Joigny supplied him with money to found his first *confrérie de charité,* an association of women who ministered to the poor and the sick.

Among the works of benevolence with which his name is associated are the establishment of a hospital for galley slaves at Marseilles, the institution of two establishments for foundlings at Paris, and the organization of the *Filles de la Charité,* to supplement the work of the *confréries,* whose members were mainly married women with domestic duties. He died at Paris on Sept. 27, 1660, and was buried in the chuch of St. Lazare. He was beatified by Benedict XIII in 1729, and canonized by Clement XII in 1737. The Society of St. Vincent de Paul was founded by Frédéric Ozanam and others in 1833.

Lives by Maynard (4 vols., Paris, 1860), Bougaud (2 vols., Paris, 1891), E. de Broglie (5th edition, Paris, 1899); *Letters* (2 vols., Paris, 1882); A. Loth (Paris, 1880); H. Simard (Lyons, 1894); E. K. Sanders, *V. de Paul, priest and philanthropist* (1913).

VINCENT OF BEAUVAIS, or VINCENTIUS BELLOVACENSIS (*c.* 1190–*c.* 1264), the encyclopaedist of the middle ages, was probably a native of Beauvais. The exact dates of his birth and death are unknown. A tolerably old tradition, preserved by Louis a Valleoleti (*c.* 1413), gives the latter as 1264; but Tholomaeus de Luca, Vincent's younger contemporary (d. 1321), seems to reckon him as living during the pontificate of Gregory X (1271–76). If we assume 1264 as the year of his death, the immense volume of his works forbids us to think he could have been born much later than 1190. Very little is known of his career. It is certain, however, that he at one time held the post of "reader" at the monastery of Royaumont (*Mons Regalis*), not far from Paris, on the Oise.

The *Speculum Majus,* the great compendium of all the knowledge of the middle ages, as it left the pen of Vincent, seems to have consisted of three parts only, viz., the *Speculum Naturale, Doctrinale* and *Historiale.* Such, at least, is Échard's conclusion, derived from an examination of the earliest extant mss. All the printed editions, however, consist of four parts, the additional one being entitled *Speculum Morale.* This has been clearly shown to be the production of a later hand, and is ascribed by Échard to the period between 1310 and 1325.

The *Speculum Naturale* is divided into 32 books and 3,718 chapters. It is a vast summary of all the natural history known to western Europe towards the middle of the 13th century. It is, as it were, the great temple of mediaeval science, whose floor and walls are inlaid with an enormous mosaic of skilfully arranged passages from Latin, Greek, Arabic and Hebrew authors.

The *Speculum Doctrinale,* in 17 books and 2,374 chapters, is a summary of all the scholastic knowledge of the age. It is intended to be a practical manual for the student and the official alike; and, to fulfil this object, it treats of the mechanic arts of life as well as the subtleties of the scholar, the duties of the prince and the tactics of the general. It also treats of mathematics, under which head are included music, geometry, astronomy, astrology, weights and measures, and metaphysics. It is noteworthy that in this book Vincent shows a knowledge of the Arabic numerals, though he does not call them by this name. The last book (xvii) treats of theology or mythology, and winds up with an account of the Holy Scriptures and of the Fathers, down to Bernard of Clairvaux and the brethren of St. Victor.

As the 15th book of the *Speculum Doctrinale* is a summary of the *Speculum Naturale,* so the *Speculum Historiale* may be regarded as the expansion of the last book of the same work. It consists of 31 books divided into 3,793 chapters. It brings history down from the creation to the crusade of St. Louis. Four of the mediaeval historians from whom he quotes most frequently

are Sigebert of Gembloux, Hugh of Fleury, Helinand of Froidmont, and William of Malmesbury.

Vincent has hardly any claim to be reckoned as an original writer. But it is difficult to speak too highly of his immense industry in collecting, classifying and arranging these three huge volumes of 80 books and 9,885 chapters. The undertaking to combine all human knowledge into a single whole was in itself a colossal one and could only have been born in a mind of no mean order. Indeed more than six centuries passed before the idea was again resuscitated; and even then it required a group of brilliant Frenchmen to do what the old Dominican did unaided.

A list of Vincent's works, both ms. and printed, will be found in the *Histoire littéraire de France,* vol. xviii, and in Jacques Échard's *Scriptores ordinis praedicatorum* (1719–21). The *Tractatus consolatorius pro morte amici* and the *Liber de eruditione filiorum regalium* (dedicated to Queen Margaret) were printed at Basle in Dec. 1480.

See J. B. Bourgeat, *Études sur Vincent de Beauvais, théologien, philosophe, encyclopédiste* (Paris, 1856); E. Boutaric, *Examen des sources du Speculum historiale de Vincent de Beauvais* (Paris, 1863); and in tome xvii of the *Revue des questions historiques* (Paris, 1875); W. Wattenbach, *Deutschlands Geschichtsquellen,* vol. ii (1894); B. Hauréau, *Notices . . . de MSS. latins de la Bibliothèque Nationale,* tome v (1892); and E. Mâle, *L'art religieux du XIIIe siècle en France.*

VINCENT OF LERINS, ST., or VINCENTIS LERINENSIS (d. *c.* A.D. 450), theologian, was a native of Gaul, possibly brother of St. Loup, bishop of Troyes. He became a monk and priest at Lerinum (Lerins), an island off Cannes, and died in or about 450. The monastery of Lerins produced many eminent churchmen, among them Hilary of Arles. In 434, three years after the council of Ephesus, he wrote the *Commonitorium adversus profanas omnium haereticorum novitates,* in which he ultimately aims at Augustine's doctrine of grace and predestination. In it he discusses the "notes" which distinguish Catholic truth from heresy, and (cap. 2) lays down and applies the famous threefold test of orthodoxy—*quod ubique, quod semper, quod ab omnibus creditum est.*

The *Commonitorium* has been edited by Baluze (Paris, 1663, 1669 and 1684), by Klüpfel (Vienna, 1809), and by R. S. Moxon (1915). It also occurs in vol. i of Migne's *Patrol. Ser. Lat.* (1846). A full summary is given in A. Harnack's *History of Dogma,* iii, 230 ff. *See* also F. H. Stanton, *Place of Authority in Religion,* pp. 167 ff.; A. Cooper-Marsdin, *The School of Lerins* (Rochester, 1905).

VINDELICIA, in ancient geography, a country bounded on the south by Rhaetia, on the north by the Danube and the Vallum Hadriani, on the east by the Oenus (Inn), on the west by the territory of the Helvetii. It thus corresponded to the north-eastern portion of Switzerland, the southeast of Baden, and the south of Württemberg and Bavaria. Together with the neighbouring tribes it was subjugated by Tiberius in 15 B.C., and towards the end of the 1st century A.D. was made part of Rhaetia.

VINDHYA, a range of mountains in Central India. They form a well marked, though not continuous, chain with the river Narbada on the south and separate the Ganges basin from the Deccan. Starting on the west in Gujarat, they cross the southern edge of the Malwa plateau and, continued by the Bhanrer and Kaimur ranges, abut on the Ganges valley near Benares. They have an elevation of 1,500 to 4,500 ft., nowhere exceeding 5,000 ft.

They are built of the "Vindhyan formation" (part of the Pre-Cambrian rocks of India). Traditionally they formed the boundary between the Madyadesha of the Sanskrit invaders and the non-Aryan Deccan.

VINE: *see* GRAPE.

VINEGAR. Vinegar is the product made by the alcoholic and subsequent acetic fermentation of any of a wide variety of saccharine liquids. It is essentially a dilute solution of acetic acid containing salts and extracted matter from its source material. As the name indicates, vinegar was first obtained by the natural souring of wine. Its origin is remote. Biblical writers mentioned it, and Hippocrates used it as a medicine. By the 16th century, wine vinegar was being produced in France for home consumption and for export. Sugar is the base of the acetic acid production, and almost any solution containing sufficient sugar fermentable by yeast may be converted into vinegar under proper conditions. Apple and grape juices are well suited to this purpose, as they contain fermentable sugars and other nutrients for the organisms bringing about the changes. Oranges, pineapples and honey have also been used for the production of vinegar. In England vinegar was first made from malt liquors as a method of disposing of ale or beer which had soured. Malt vinegar is the standard product of the British Isles, whereas in the United States cider vinegar is standard. Grape vinegar is the standard product in France and on most of the continent. Vinegar may also be produced by acetic fermentation of a diluted alcohol solution, the product being known as distilled vinegar. Wood vinegar, an artificial product, is merely a dilute solution of acetic acid. Its name is derived from the fact that acetic acid was formerly produced commercially by the distillation of wood. Commercial vinegar may be marketed in combinations of these forms, and also as flavoured or spiced products such as tarragon vinegar.

The chemical changes which take place in the production of acetic acid from sugar may be represented as follows:

(1) $C_6H_{12}O_6$ (Sugar) $\xrightarrow{\text{Yeast}}$ $2C_2H_5OH+CO_2$ (Alcohol + Carbon Dioxide)

(2) $CH_3CH_2OH+O_2$ (Alcohol + Oxygen) $\xrightarrow{\text{Acetobacter}}$ $CH_3COOH+H_2O$ (Acetic Acid + Water)

Both steps are brought about by living organisms. The second, requiring oxygen, is produced by the vinegar organism, *Acetobacter aceti.* Yeast fermentation produces a percentage of alcohol equal to about one-half the percentage of sugar being fermented. Theoretically, acetic fermentation should yield more acetic acid than alcohol in the feed liquor since oxygen is added during the process. In actual practice the yield is about the same, as some alcohol is used by the acetobacter and some is lost by evaporation.

Processes.—There are two well known methods of vinegar manufacture, the slow barrel process and the quick generator process. The latter is used almost exclusively in commercial manufacture. The slow process is used in household or small-scale manufacture. In the slow process the fermented material, containing 5% to 10% alcohol, is put into barrels or casks holding 50 to 100 gal. The barrels are filled only about three-quarters full to give room for exposure to air. Mother of vinegar containing the acetic acid bacteria is added, and the fermentation proceeds at a slow rate, requiring three to six months for completion. Portions of cider or wine may be added at intervals of two or three weeks, thus producing a series of successive fermentations. The cider or wine should have undergone complete alcoholic fermentation before inducing the acetic fermentation as acetic acid is toxic to yeast. If the wine is made from grape must of high sugar content, and has developed a high alcohol content, it may be necessary to reduce the alcohol by adding water before acetic fermentation. A good practice is to adjust the sugar content before yeast fermentation to 10% or 12%, or the alcohol content before acetification to 5% or 6%.

E. Le Fevre described a convenient method of making vinegar for the household or farm. The process, which is essentially that used in the Orleans district of France in making wine vinegar, is

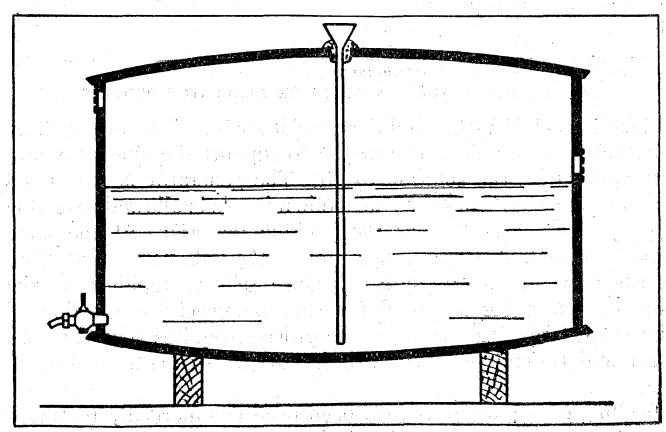
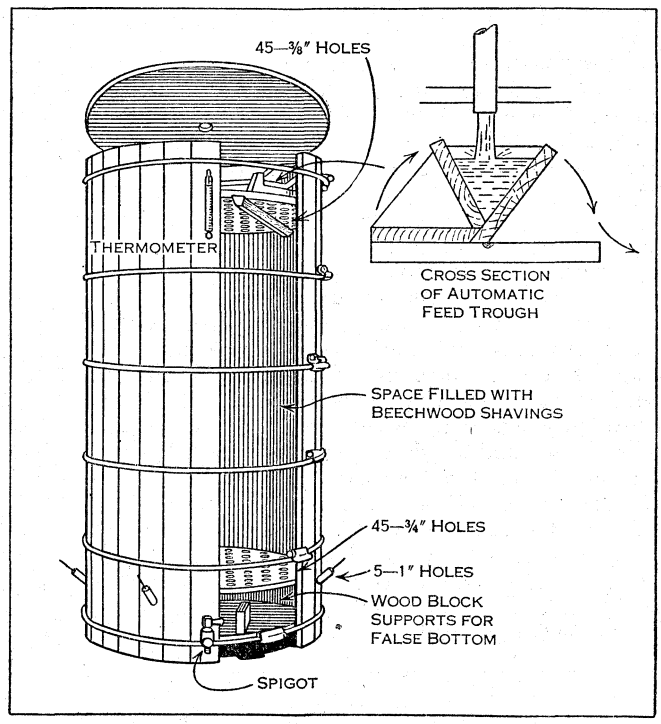


FIG. 1—CONVERTER FOR FARM MANUFACTURE OF VINEGAR

adaptable to the acetification of any alcoholic fermented liquor that might be used for vinegar manufacture. A barrel or wine tun holding 50 to 100 gal. is made into a "converter."

The barrel is supported on its side with the bunghole up. A 2-in. hole is bored slightly above the centre in one end of the barrel and another in the other end just under the stave containing the bunghole. The holes are covered with plastic screen or well-varnished fine wire screen to keep out small vinegar or fruit flies. A spigot is fitted in place. A piece of rubber or plastic tubing, one-half inch in diameter is attached to a glass or plastic funnel. The tubing should be long enough to nearly touch the opposite side of the barrel when the funnel is placed in the bunghole. The funnel is held in the bunghole by a wad of cotton or clean dry cloth. About 3 gal. of unpasteurized vinegar containing the mother is poured into the converter through the funnel. The yeast-fermented alcoholic liquor is now run in until the surface of the liquid is nearly level with the centre air hole. The converter is allowed to remain in a warm place at 30–35° C. (86–95° F.) until the acetification is more or less complete. The film which forms on the surface should not be disturbed. When a sufficient degree of acidity has been produced the vinegar is drawn off through the spigot, about 3 gal. being left in the barrel. A new supply of yeast-fermented liquor is then run in through the funnel. The transfer should be made slowly in order not to disturb the film, which rises to the surface and starts fermentation quickly. The converter can be drained and recharged every two to three months.

The quick process makes use of a tall wooden vat $3\frac{1}{2}$ to 6 ft. in diameter and 8 to 16 ft. in height, known as a generator.



COURTESY, U.S. DEPARTMENT OF AGRICULTURE

FIG. 2.—GENERATOR FOR QUICK OR GENERATOR PROCESS

This is packed with suitable material such as beechwood shavings, corncobs, pumice, coke or tile to support the vinegar organism and expose the solution to air. The generator is inoculated with acetic bacteria, and the alcoholic mixture is allowed to trickle slowly over the surface of the packing material. At the same time a current of air rises up through the vat, permitting rapid acetification of the mixture. Because of the rapidity of the process, generators are used for the commercial production of vinegar in large quantities. As the process requires special equipment and trained supervision, it is not practical for small-scale use.

Rolling generators have also been used commercially to aerate the alcoholic liquor and bring it into intimate contact with the acetobacter, but these require a longer time for the acetification process and consume a great deal of power. For these reasons they have largely been replaced by upright generators. H. Frings patented a generator (U.S. Pat. 1,880,381, Oct. 4, 1932), which has proved successful in the production of distilled vinegar. It is large (14 ft. in diameter by 15 ft. in height), and provides for recirculation of the mixture under controlled conditions of temperature, flow and aeration. This generator produces 105 to 120 grain vinegar in eight to ten days.

The first steps of malt vinegar manufacture are closely similar to those in the preparation of beer. Any cereal or mixture of cereals may be used whose starch can be economically converted into sugar by malt. A formula for English malt vinegar calls for malt, 27.5%; barley, 55%; and oats, 17.5%. A wort may be prepared by extracting malt, using 100 gal. of hot water to six bushels of malt. Or corn may be cooked under pressure to gelatinize the starch and, after cooling, barley malt added to convert the starch to sugar. The wort is then fermented with yeast. In about three days all the sugar is converted to alcohol. The fermented wort or gyle is then put through a generator as described for the quick process. By using a low proportion of water in making the wort, malt vinegar can be prepared of higher acid content than that obtained from cider. Such vinegar has special uses in the manufacture of certain foods, and being less bulky, is more easily shipped. In the United States cider vinegar is preferred for table use but distilled vinegar made from diluted alcohol at a strength of 10% to 12% acetic acid has largely displaced cider and malt vinegar for commercial use.

The most common difficulties encountered in vinegar making are corrosion and contamination with vinegar eels. Because of its volatility, the acetic acid in vinegar extends its area of action to almost every metallic object in the plant. Consequently, wooden equipment is used wherever suited. Pipe lines are usually constructed of hard rubber, but glass and plastic pipes will undoubtedly be used more in the future. Ferric iron reacts with tannin, phosphates, and probably with proteins to produce a haze or precipitate. Clouding may also be caused by copper and tin salts.

The vinegar eel, *Anguillula aceti,* is thought to be spread by spoiled fruit and by vinegar flies. It is about $\frac{1}{16}$ in. in length and very slender, resembling a thread worm. It may be seen by holding a small sample of contaminated vinegar in a tumbler to the light. It is of aesthetic rather than physiological significance to the consumer, but its presence may seriously interfere with acetification. To eliminate it the packing of the generator must be removed, and the generator and other material entering it must be sterilized with steam. The eel is strongly aerobic and is destroyed by a temperature of 54° C. (130° F.), therefore it does not develop in pasteurized bottled vinegar.

Standards and Analysis.—Most standards for vinegar call for a minimum of 4% total acid calculated as acetic. Such vinegar is known to the trade as "40 grain," the term designating ten times the acetic acid content. Vinegars of higher acidities are desired for certain uses such as pickle and mayonnaise manufacture; or use on shipboard and by expeditionary forces. Concentration can be effected by freezing out the water, but it is usually more economical to use a vinegar of high acidity or to fortify with acetic acid.

Vinegars from cider, wine and malt contain appreciable solids including ash, but distilled vinegar contains little of these constituents, as shown by the following table of analyses compiled from various sources.

	Cider Vinegar	*Wine Vinegar*	*Malt Vinegar*	*Distilled Vinegar*
Specific gravity	1.013 to 1.014	1.013 to 1.021	1.015 to 1.025	1.008 to 1.013
Acetic acid	4.84%	6.55%	4.23%	6.34%
Total solids	2.49%	1.93%	2.70%	.35%
Ash	.34	.32	.34	.04
Sugar	.25	.46	—	—

See E. Le Fevre, "Making Vinegar in the Home and on the Farm," *U.S. Dept. Agri. Farmers' Bull. 1424,* (1924); C. A. Mitchell, *Vinegar: its Manufacture and Examination* (1927); C. H. Campbell, *Campbell's Book,* pp. 592–641, 845–48 (1937) (73 references). (H. H. MN.)

VINELAND, a borough of Cumberland county, New Jersey, U.S.A., 35 mi. S. of Philadelphia; served by the Central of New Jersey and the Pennsylvania railways. Pop. (1940) 7,914. It has an area of 1.1 sq.mi., laid out in unusually broad streets, straight and well shaded. The surrounding country is devoted largely to fruit, poultry and sweet potatoes, and the borough has a great variety of manufacturing industries. It is the seat of the New Jersey training school for backward children (1888), the state home for the care and training of feeble-minded women (1888) and the state home for disabled soldiers, sailors, marines and their wives. Vineland was founded in 1861 by Charles K. Landis (1835–1900). The village was incorporated in 1880.

VINER, SIR ROBERT (1631–1688), lord mayor of London, was born in Warwick. He was apprenticed in London to his uncle, Sir Thomas Viner (1558–1665), a goldsmith, who was lord mayor of London in 1653–54. Robert became a partner in his business, and was chosen lord mayor in 1674. Sir Robert, who was knighted in 1665, was appointed the king's goldsmith in 1661, and lent large sums of money for the expenses of the state and the extravagances of the court; over £400,000 was owing to him when the national exchequer suspended payment in 1672, and he became bankrupt. He obtained from the state an annuity of £25,000. Viner died at Windsor on Sept. 2, 1688.

See *Viner: a Family History,* published anonymously (1885).

VINET, ALEXANDRE RODOLPHE (1797–1847), French critic and theologian, of Swiss birth, was born near Lausanne on June 17, 1797. He was educated for the Protestant ministry, being ordained in 1819, when already teacher of French language and literature in the gymnasium at Basel; and during the whole of his life he was *littérateur* as well as theologian. His literary criticism brought him into contact with Sainte Beuve, who recognized his quality. Vinet's *Chrestomathie française* (1829), *Études sur la littérature française au XIXme siècle* (1849–51), and *Histoire de la littérature française au XVIII ^me^ siècle,* together with his *Études sur Pascal, Études sur les moralistes aux XVIme et XVIIme siècles, Histoire de la prédication parmis les Réformés de France* and other works, show wide knowledge, moral seriousness, and a fine faculty of appreciation.

As theologian he gave a fresh impulse to Protestantism especially in French-speaking lands, but also in England and elsewhere. Lord Acton classed him with Rothe. He built all on conscience, as that wherein man stands in direct personal relation with God, and as the seat of a moral individuality which nothing can rightly infringe. Hence he advocated complete freedom of religious belief, and to this end the formal separation of church and state, in his *Mémoire en faveur de la liberté des cultes* (1826), *Essai sur la conscience* (1829), *Essai sur la manifestation des convictions religieuses* (1842). Accordingly, when in 1845 the civil power in the canton of Vaud interfered with the church's autonomy, he led a secession which took the name of *L'Église libre.* A considerable part of his works was not printed till after his death at Clarens, May 4, 1847. They were re-edited with notes by Ph. Bridel in 1912 (Lausanne).

His life was written in 1875 by Eugène Rambert, who re-edited the *Chrestomathie* in 1876. *See* also L. M. Lane, *Life and Writings of A. Vinet* (1890); L. Molines, *Étude sur Alexandre Vinet* (Paris, 1890); V. Rivet, *Études sur les origines de la pensée religieuse de Vinet* (Paris, 1896); A. Schumann, *Alex. Vinet* (1907); E. A. L. Seillière, *A. Vinet, historien de la pensée française* (1925). A uniform edition of his works dates from 1908. (J. V. B.)

VINGT-ET-UN (colloquially, "Van John"), a round game of cards, at which any number of persons may play, though five or six are enough. The right to deal having been decided, the dealer gives one card face downwards to each person, including himself. The others thereupon look at their cards and declare their stakes—one, two, three or more counters or chips—according to the value of their cards. When all have staked, the dealer looks at his own card and can double all stakes if he chooses. The amount of the original stake should be set by each player opposite his card. Another card is then dealt, face downwards, all round; each player looking at his own. The object of the game is to make 21, by the pips on the card, an ace counting as 1 or 11, and the court cards as 10 each. Hence a player who receives an ace and a ten-card scores 21 at once. This is called a "natural"; the holder receives twice—sometimes thrice—the stake or the doubled stake. If the dealer has a natural too, the usual rule is that the other natural pays nothing, in spite of the rule of "ties pay the dealer." The deal passes to the player who turns up the natural, unless it occurs in the first round of a deal or the dealer has a natural too. If the dealer has not a natural, he asks each player in turn, beginning with the player on his left, if he wishes for another card or cards, the object still being to get to 21, or as near up to it as possible. The additional cards are given him one by one, face upwards, though the original cards are not exposed. If he requires no additional card, or when he has drawn sufficient, he says, "Content," or "I stand." If a player overdraws, *i.e.,* if his cards count more than 21, he pays the dealer at once. When all are either overdrawn or content, the dealer may "stand" on his own hand, or draw cards, till he is overdrawn or stands. All the hands are then shown, the dealer paying those players whose cards are nearer to 21 than his own, and receiving from *all* the others, as "ties pay the dealer." If the dealer's cards, with the additions, make exactly 21, he receives double the stake, or doubled stake; if a player holds 21, he receives double likewise, but ties still pay the dealer. If a player receives two similar cards he *may* put his stake on each and draw on them separately, receiving or paying according as he stands successfully or overdraws, but the two cards must be similar, *i.e.,* he cannot draw on both a knave and a queen, or a king and a ten, though their values are equal for the purpose of counting. A natural drawn in this way, however, only counts as 21, and does not turn out the dealer. Similarly a player may draw on three cards, or even four, should they be dealt him. A player who overdraws on one of such cards must declare and pay immediately, even though he stands on another. After a hand is played, the "pone" (Latin for "behind")—the player on the dealer's right—collects and shuffles the cards played, the dealer dealing from the remainder of the pack, till it is exhausted, when he takes the cards the pone holds, after the pone has cut them. It is a great advantage to deal. (W. Da.)

VINITA, a city of northeastern Oklahoma, U.S.A., on federal highways 59, 60, 66 and 69, and served by the Frisco and the Missouri-Kansas-Texas railways; county seat of Craig county. Pop. (1940) 5,685. It is the headquarters for the Grand river dam authority. Vinita is the trade centre and shipping point of a large agricultural area. The city was founded in 1870 and chartered in 1898.

VINLAND or **WINELAND.** This was the southernmost of the countries discovered by Leif Ericsson (*q.v.*), the Scandinavian discoverer, on his voyage from Norway to Greenland in the year 1000, and it was later visited also by Thorfinn Karlsefni (*q.v.*), probably in the year 1004. It derived its name from the wild grapes which the discoverer found there. It is first mentioned in writing by Adam of Bremen (*q.v.*) in his description of the northern countries, about 1075, his informant being King Svein Estridsson of Denmark. The fullest information about this country, as well as about these voyages in general is to be found in the *Saga of Eric the Red* and the *Tale of the Greenlanders.* All these sources agree as to the general characteristics of the country: wild grapes, self-sown wheat, and very mild winter. In some Icelandic writings the name Vinland the Good occurs, and this led Dr. Fridtjof Nansen to assume that the story about Vinland was merely a transformation of the old legends about the Isles of the Blest (*q.v.*). His arguments have not been generally accepted, although it is possible that the epithet "the good" may have later been added under the influence of these legends. The historicity of the discovery can hardly be disputed, nor that Vinland was a part of the American continent, but more definite location is difficult. If we are to accept the account of the wild grapes as authentic, the location of Vinland must fall within the northern limits for this plant which, on the Atlantic coast, are generally put at Passamaquoddy bay. Of the principal writers who have dealt with the problem, C. C. Rafn placed Vinland round Mount Hope bay, in the state of Rhode Island, Gustav Storm in Nova Scotia, where the existence of wild grapes is, however, doubtful. W. H. Babcock and W.

Hovgaard have practically reverted to Rafn's view, while G. M. Gathorne-Hardy looks for it at the mouth of the Hudson river.

For bibliography of the subject *see* the articles on AMERICA, *Pre-Columbian Discoveries,* and LEIF ERICSSON. (H. HE.)

VINOGRADOFF, SIR PAUL GAVRILOVICH (1854–1925), Anglo-Russian scholar, was born at Kostromo, near Moscow, and educated at the University of Moscow. As a young man he travelled widely, and obtained a working knowledge of at least seven modern languages, before being appointed a professor in his own university. He then interested himself in the Zemstvo movement, and sought to improve the provision for the education of the Russian people. His activities, however, were displeasing to the authorities; consequently he resigned his professorship and in 1902 settled in England, where he had already made friends with many English scholars. In 1903 he was appointed Corpus professor of jurisprudence at Oxford, and there he remained until his death on Dec. 19, 1925.

Vinogradoff's first book was on *The Origin of Feudalism in Italy* (1887). This was written in Russian, but his later works were appropriately written in English, and he became recognized as probably the first authority on the early laws and customs of England. His standard work is *Villeinage in England* (1892), in which he put forward the theory that the Anglo-Norman manor descended not from a condition of serfdom, but from a free village community. His article "Folkland," published in *The English Historical Review* in 1893, enunciated an entirely new theory on this subject. His other works include: *English Society in the Eleventh Century* (1908); *The Growth of the Manor* (1905); *Roman Law in Mediaeval Europe* (1909); *Self-government in Russia* (1915) and *Outlines of Historical Jurisprudence* (1920–22). He also contributed to the *Encyclopædia Britannica* and *The Cambridge Modern History.*

VINOGRADSKY (WINOGRADSKI), SERGEI NIKOLAEVICH (1856–), Russian phytochemist and biochemist, was born at Kiev on Sept. 1, 1856, and was educated at Kiev and St. Petersburg, graduating in 1879. He continued his post-graduate studies at the physiological laboratories of St. Petersburg university until 1884, when he obtained the degree of M.S. and went to Strasbourg to work under A. de Bary and to study analytical chemistry. In 1888, after the death of De Bary, he removed to Zurich where he pursued his study of nitrification. In 1891 he returned to Russia to become head of the section of general microbiology of the Institute of Experimental Medicine. He was appointed director of the same institute in 1902 and held that position until 1905 when he resigned, and although he was on the staff until 1912, he was practically inactive. He resumed his scientific activity only in 1922 when he accepted the position of head of the division of agricultural microbiology, Pasteur institute, Brie-Comte-Robert, near Paris.

Vinogradsky made epoch-making research in the fields of bacteriology, especially bacteriology of soil, and the physiology of micro-organisms. He studied sulphur and iron bacteria under De Bary and discovered that colourless sulphur bacteria in the absence of light can oxidize hydrogen sulphide (H_2S) and sulphur to sulphuric acid. Even more important were his investigations of nitrification (1888–90) and the role of bacteria in that process. In 1893 he discovered an anaerobic organism (*Clostridium pasteurianum*) and showed its ability to fix nitrogen from the atmosphere. The last period of his life in France was devoted to study of the methods in soil microbiology and to investigation of the role of bacteria in the decomposition of cellulose and nitrogen fixation.

His publications include "Ueber Schwefelbacterien," *Bot. Zeit.,* vol. xlv (1887); "Ueber Eisenbacterien," *ibid.,* vol. xlvi (1888); *Beiträge zur Morphologie und Physiologie der Bacterien* (1888); "Sur l'assimilation de l'azote gazeux par les microbes," *Ark. Biol. Nauk,* vol. iii (1895), etc.

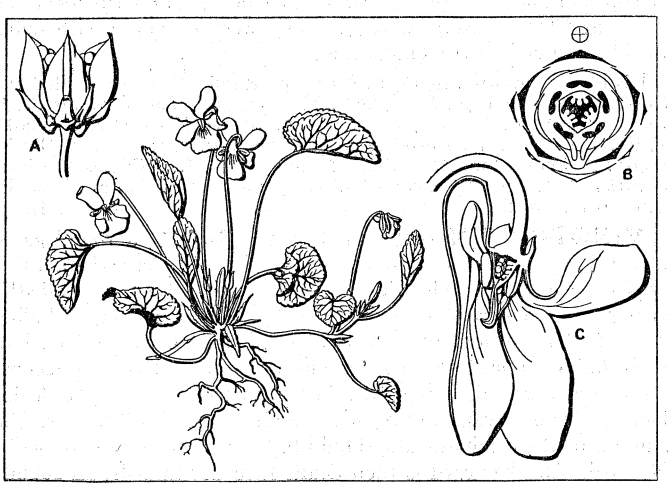
See *Ark. Biol. Nauk,* vol. xxvii (1927) and *Priroda,* vol. xvi, no. 1 (1927).

VINTON, FREDERIC PORTER (1846–1911), American portrait painter, was born at Bangor, Maine, on January 29, 1846. He was a pupil of Duveneck, of William M. Hunt in Boston, of Léon Bonnat and Jean Paul Laurens in Paris, and of the Royal Academy of Munich. In 1891 he was elected a full member of the National Academy of Design, New York. He died in Boston, Mass., May 19, 1911.

VIOL, a generic term for the bowed precursors of the violin (*q.v.*), but in England more specially applied to those immediate predecessors of the violin which are distinguished in Italy and Germany as the *Gamba* family. The chief characteristics of the viols were a flat back, sloping shoulders, "c"-shaped sound-holes, and a short finger-board with frets. All these features assumed different forms in the violin, which was derived rather from the guitar-fiddle than from the viol, the back becoming delicately arched, the shoulders reverting to the rounded outline of the guitar, the shape of the sound-holes changing from "c" to "*f*" and the finger-board being carried considerably nearer the bridge. The viol family consisted of treble, alto, tenor and bass instruments, being further differentiated as *da braccio* or *da gamba* according to the positions in which they were held, against the arm or between the knees.

VIOLA, a member of the violin family standing in point of size between the violin and the violoncello. It is known variously as the tenor and the alto member of the family, the latter term obtaining in France and Italy and being derived from the fact that in earlier days, before the full development of the violin, the highest part was usually assigned to it. Having regard to its pitch moreover, which is a fifth below that of the violin, the term seems equally appropriate, the violoncello being then regarded as the real tenor of the family, with the violin and the double-bass completing the quartet as the treble and the bass respectively. To which it may be added that alto was originally the true and only name of the viola, there having been then another and a larger instrument, now obsolete, which was known as the tenor. Apart from its greater size, the construction of the viola is the same as that of the violin. Its tone lacks the brilliance and incisiveness of the latter, being much more dark and veiled in quality, and for this reason it is less effective as a solo instrument than the violin. But it is capable of producing fine results when played by a master, while in the orchestra and in chamber music it is invaluable. For full discussion of instruments of the violin family *see* VIOLIN.

VIOLET. The violets comprise a large botanical genus (*Viola*), in which about 250 species have been described, found principally in temperate or mountain regions of the northern hemisphere; they also occur in mountainous districts of South America and South and tropical Africa, while a few are found in Australasia. The species are mostly low-growing herbs with alternate leaves provided with large leafy stipules. The flowers, which are solitary, or rarely in pairs, at the end of slender axillary flower-stalks, are very irregular in form, with five sepals prolonged at the base, and five petals, the lowest one larger than the others and with a spur, in which honey collects. The irregular



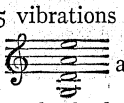
BY COURTESY OF THE TRUSTEES OF THE BRITISH MUSEUM (NATURAL HISTORY) (A, B & C), FROM CHURCH, "TYPES OF FLORAL MECHANISM" (CLARENDON PRESS)

SWEET VIOLET (VIOLA ODORATA), SHOWING WHOLE PLANT
A. Fruit. B. Floral diagram. C. Longitudinal section through flower

construction of the flower is connected with pollination by insect agency. In the sweet violet (*V. odorata*) and other species, inconspicuous permanently closed or cleistogamous basal flowers occur of a greenish colour. They offer no attractions to insects and their form is regular; they are self-pollinated and produce the only seeds found in such plants, as the showy flowers are infertile. (*See* POLLINATION.) Several species of *Viola* are found in Great Britain. *Viola canina* is the dog violet, many forms or subspecies of which are recognized; *V. odorata,* sweet violet, is highly prized for its fragrance, and in cultivation numerous varieties have originated, especially the Neapolitan violet. Other species known in gardens are: *V. altaica,* flowers yellow or violet with yellow eye; *V. biflora,* a pretty little species 3 to 4 in. high with small yellow flowers, the large petal being streaked with black; *V. calcarata,* flowers light blue or white, or yellow in var. *flava; V. cornuta,* the tufted violet or bedding pansy, flowers pale blue—there are a few good varieties of this, including one with white flowers; *V. cucullata,* a free-flowering American species with violet-blue or purple flowers; *V. munbyana,* a native of Algeria, with large violet or yellow flowers; *V. pedata,* the bird's-foot violet, with pedately divided leaves and usually bright blue flowers. The garden pansies or heartseases (*V. tricolor hortensis*) are probably derived from *V. tricolor,* a cornfield weed, and other species. (*See* PANSY.) About 75 species of *Viola* are native to North America, of which about 50 occur from the Rocky mountains eastward, and the remainder chiefly on the Pacific coast. They are all herbaceous and fall into two general groups: (1) the leafy-stemmed; (2) the stemless violets. While the distinctive characters in many species are sharply marked, the determination of numerous others is difficult, because of the profusion of natural hybrids. These hybrids were made the subject of intensive experimental study by Ezra Brainerd.

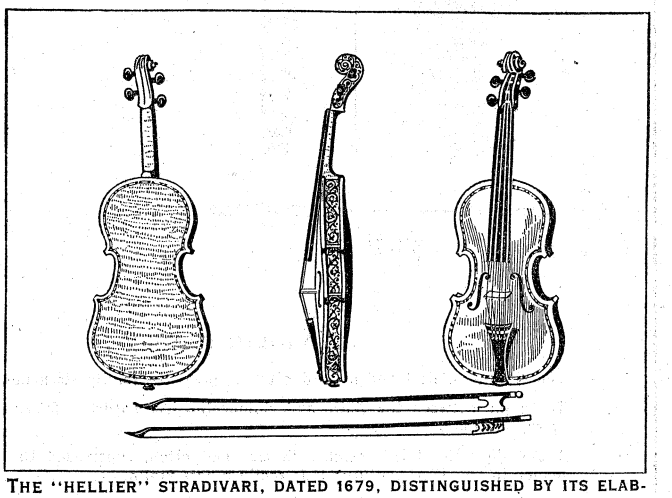
Representative North American violets are the bird's-foot violet (*V. pedata*), the early blue violet (*V. palmata*), the bog blue violet (*V. cucullata*), the arrow-leaved violet (*V. sagittata*), the butterfly violet (*V. papilionacea*), the southern wood violet (*V. villosa*), the striped violet (*V. striata*), the sweet white violet (*V. blanda*), the beaked violet (*V. rostrata*), the Canada violet (*V. canadensis*), the round-leaved violet (*V. rotundifolia*) and the hairy yellow violet (*V. pubescens*), of the eastern states and provinces; the prairie yellow violet (*V. nuttalli*), of the great plains region; and the pine violet (*V. lobata*), the mountain violet (*V. purpurea*), the yellow pansy (*V. pedunculata*), the western heartsease (*V. ocellata*) and the wood violet (*V. sarmentosa*) of the Pacific coast. Numerous species are transplanted.

For the North American species *see* also Ezra Brainerd, "Violets of North America," *Vermont Agric. Exper. Sta. Bull. 224* (1921) and "Some Natural Violet Hybrids of North America," *ib. Bull. 239* (1924).

VIOLIN, the smallest and highest-pitched of one of the most important families of stringed musical instruments, to which it gives its name. It consists essentially of a resonant box of peculiar form, over which four strings of different thicknesses are stretched across a bridge standing on the box in such a way that the tension of the strings can be adjusted by means of revolving pegs, to which they are severally attached at one end. The strings are tuned, by means of the pegs, in fifths, from the second or A string, which is tuned to a fundamental note of about 435 vibrations per second at the modern normal pitch, thus giving  as the four open notes. To produce other notes of the scale the length of the strings is varied by "stopping" them—*i.e.,* pressing them down with the fingers—on a finger-board, attached to a "neck" at the end of which is the "head" in which the pegs are inserted. The strings are set in vibration by drawing across them a bow strung with horse-hair, which is rosined to increase adhesion.

The characteristic features which, in combination, distinguish the violin (including in that family name its larger brethren the viola and violoncello, and in a lesser degree the double-bass) from other stringed instruments are the restriction of the strings to four, and their tuning in fifths; the peculiar form of the body, or resonating chamber, especially the fully moulded back as well as front, or belly; the shallow sides or "ribs" bent into characteristic curves; the acute angles of the corners where the curves of the ends and middle "bouts" or waist ribs meet; and the position and shape of the sound-holes, cut in the belly. By a gradual process of development in all these particulars the modern violin was evolved from earlier bowed instruments, and attained its highest perfection at the hands of the great Italian makers in the 16th, 17th and early 18th centuries, since which time, although many experiments have been made, no material improvement has been effected upon the form and mode of construction then adopted.

The following are the exact principal dimensions of a very fine



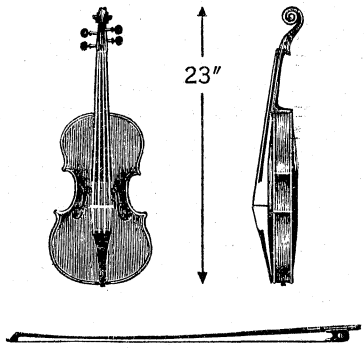
THE "HELLIER" STRADIVARI, DATED 1679, DISTINGUISHED BY ITS ELABORATE INLAID ORNAMENTATION AND SLIGHTLY LARGER AND HEAVIER THAN THE MASTER'S OTHER MODELS

specimen of Stradivari's work, which has been preserved in perfect condition since the latter end of the 17th century:—

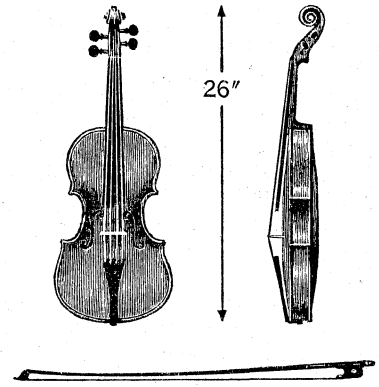
Length of body	14 in. full
Width across top	$6\frac{11}{16}$ in. bare
Width across bottom	$8\frac{1}{4}$ in.
Height of sides (top)	$1\frac{3}{16}$ in.
Height of sides (bottom)	$1\frac{7}{32}$ in.

The back is in one piece, supplemented a little in width at the lower part, after a common practice of the great makers, and is cut from very handsome wood; the ribs are of the same wood, while the belly is formed of two pieces of soft pine of rather fine and beautifully even grain. The sound-holes, cut with perfect precision, exhibit much grace and freedom of design. The scroll, which is very characteristic of the maker's style and beautifully modelled, harmonizes admirably with the general modelling of the instrument. The model is flatter than in violins of the earlier period, and the design bold, while displaying all Stradivari's microscopic perfection of workmanship. The whole is coated with a very fine orange-red-brown varnish, untouched since it left the maker's hand in 1690, and the only respects in which the instrument has been altered since that date are in the fitting of the longer neck and stronger bass-bar necessitated by the increased compass and raised pitch of modern violin music.

Acoustic Principles.—The acoustics of the violin are extremely complex. Certainly so far as the elementary principles which govern its action are concerned, it follows sufficiently familiar laws (*see* SOUND). The different notes of the scale are produced by vibrating strings differing in weight and tension, and varying in length under the hand of the player. The vibrations of the strings are conveyed through the bridge to the body of the instrument, which fulfils the common function of a resonator in reinforcing the notes initiated by the strings. So far first principles carry us at once. But when we endeavour to elucidate in detail the causes of the peculiar character of tone of the violin family, the great range and variety in that character obtained in different instruments, the extent to which those qualities can be controlled by the bow of the player, and the mode in which they are influenced by minute variations in almost every component part of the instrument, we find ourselves faced by a series of problems which have so far defied any but very partial solution.



VIOLIN



VIOLA

THE VIOLIN FAMILY

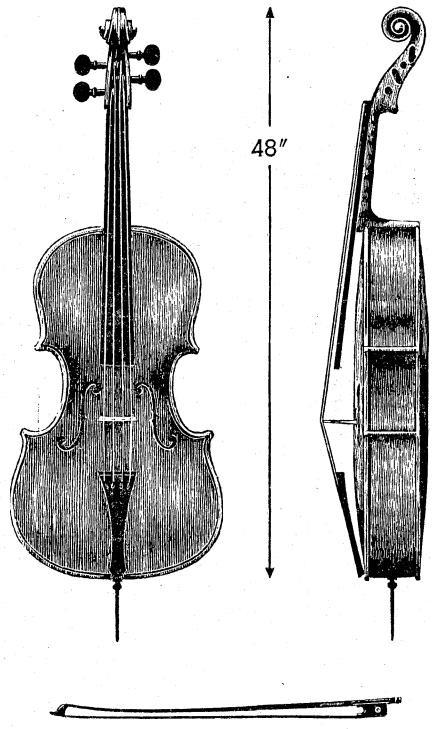
The violin, smallest and highest pitched, gives the family its name.

The viola, between the violin and violoncello, has a pitch a fifth below that of the violin.

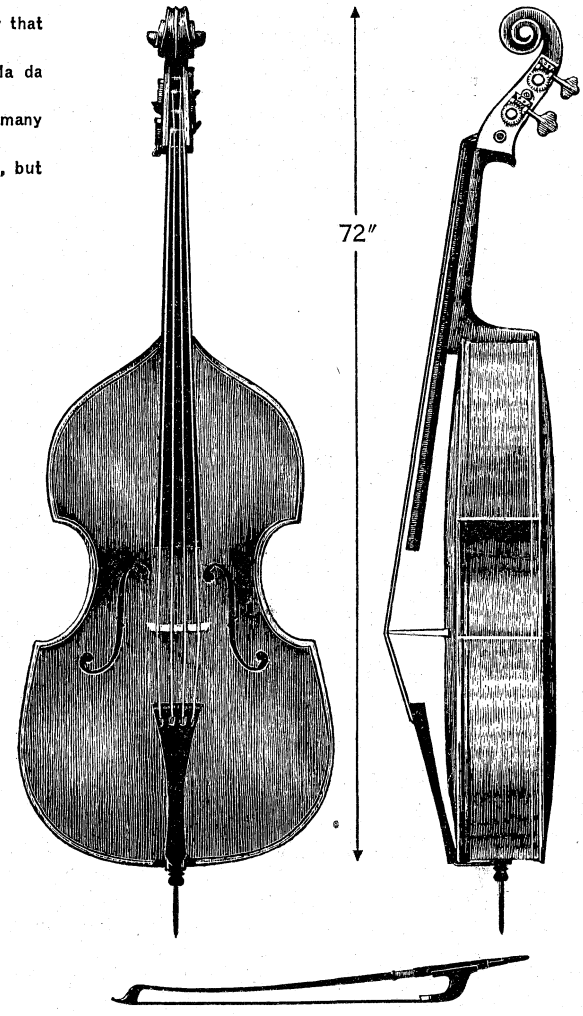
The violoncello, third member in size and pitch, superseded the viola da gamba in the 18th century; it is really a bass violin.

The double bass, sole survivor of the viol type of instrument, retains many of its characteristics.

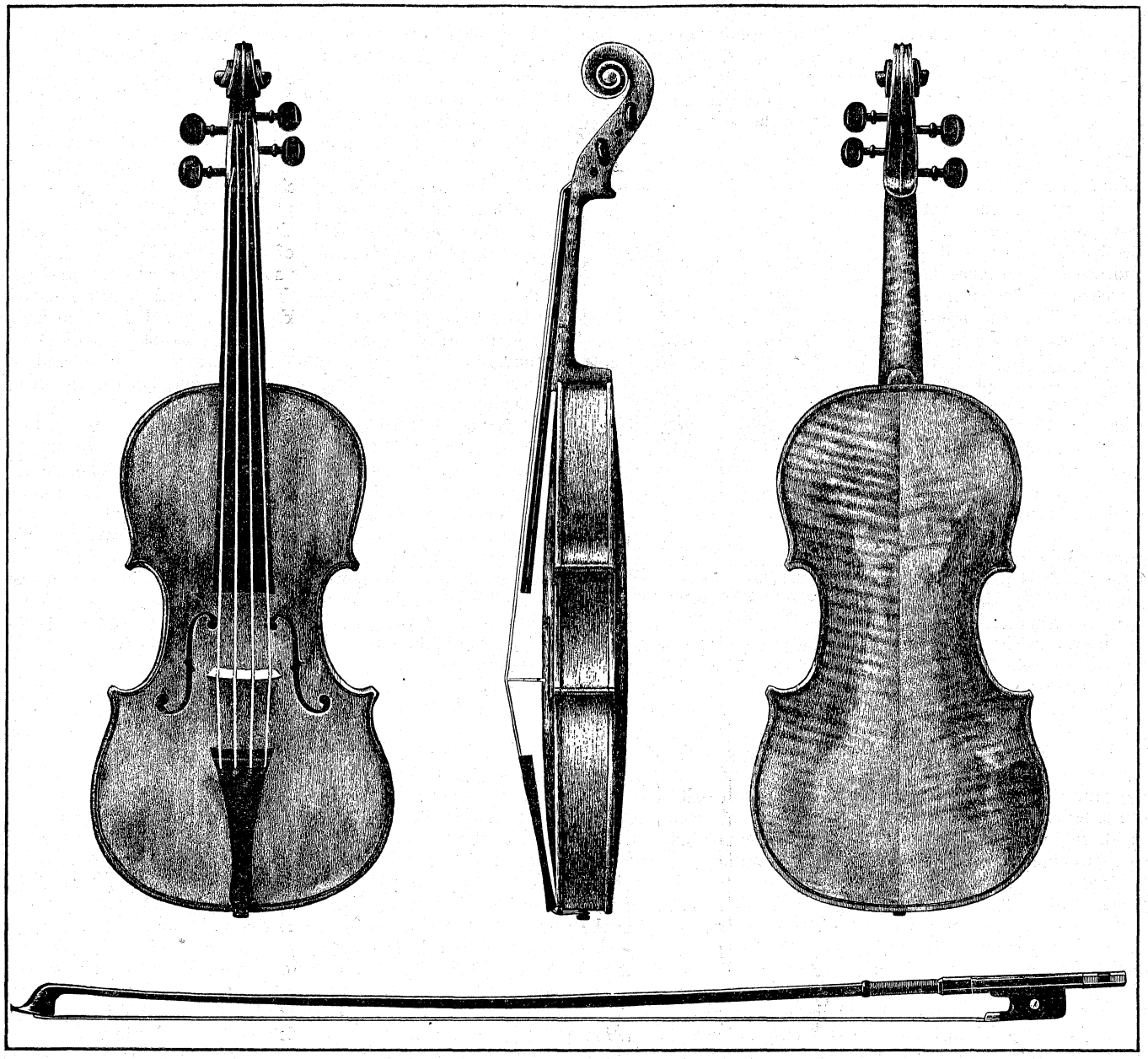
The bows used with these instruments are of nearly the same length, but vary in weight and construction.



VIOLONCELLO



DOUBLE BASS



THE VIOLIN

Front, side, and rear views of the modern violin. This instrument reached its highest perfection at the hands of the great Italian makers in the 16th, 17th and early 18th centuries; no material improvement has since been effected upon the form and mode of its construction

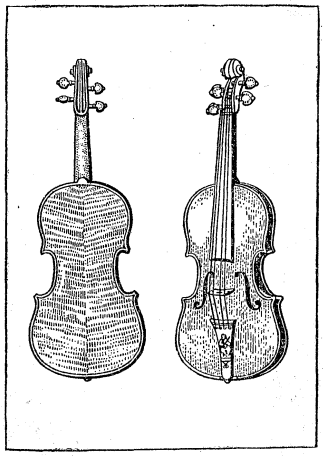
The distinctive quality of the musical tones of the violin is generally admitted to be due largely to its richness in the upper harmonic or partial tones superimposed on the fundamental notes produced by the simple vibrations of the strings. The characteristic tone and its control by the player are undoubtedly conditioned in the first place by the peculiar response of the vibrating string under the action of the rosined bow. This takes the form not of a symmetrical oscillation but of a succession of alternating bound and free movements, as the string adheres to the bow according to the pressure applied, and, releasing itself by its elasticity, rebounds. The lightness of the material of which the strings are made conduces to the production of very high upper partial tones which give brilliancy of sound, while the low elasticity of the gut causes these high constituents to be quickly damped, thus softening the ultimate quality of the note.

In order that the resonating body of the instrument may fulfil its purpose in reinforcing the complex vibrations set up by the strings, it is essential that the plates, and consequently the body of air contained between them, should respond sensitively to the selective impulses communicated to them, and it is the attainment of this perfect selective responsiveness which marks the construction of the best instruments. Many factors contribute to this result—the thickness of the plates in different parts of their areas, the size and form of the interior of the body, the size and shape of the sound-holes through which the vibrations of the contained air are communicated to the external air, and which also influence the nodal points in the belly, according to the number of fibres of the wood cut across, varying with the angle at which the sound-holes cross the grain of the wood. And all these important factors are influenced by the quality and elasticity of the wood employed.

Old Instruments' Superiority.—Many speculations have been advanced with regard to the superiority in tone of the old Italian instruments over those of modern construction. After taking into account the practical identity in dimensions and construction between the classical and many of the best modern models, the conclusion suggests itself that the difference must be attributed in part to the nature of the materials used and in part to the method of their employment as influenced by local conditions and practice. The argument, not infrequently advanced, that the great makers of Italy had special local sources of supply can

hardly be sustained. Undoubtedly they exercised great care in the selection of sound and handsome wood; but there is evidence that some of the finest wood they used was imported from across the Adriatic in the ordinary course of trade; and the matter was for them, in all probability, largely one of expense. There is good reason to suppose, indeed, that a far larger choice of equally good material is accessible to modern makers.

There remains the varnish with which the completed instrument is coated. This was an item in the manufacture which received most careful attention at the hands of the great makers, and much importance has been attached to the superiority of their varnish to that used in more recent times—so much so that its composition has been attributed to secret processes known only to themselves. But that the Italian makers individually or collectively attempted, or were able, to preserve as a secret the composition of the varnish they used is unlikely. Instruments exhibiting similar excellence in this respect were too widespread in their range, both of period and locality, to justify the assumption that the general composition of the finest varnish of the early makers was not a matter of common knowledge in an industry so flourishing as that of violin-making in the 17th and early 18th centuries.



THE "ALARD," ONE OF THE MOST FAMOUS OF STRADIVARI'S VIOLINS, MADE IN 1715

The excellence of an instrument in respect of its varnish depended on the quality of the constituent materials, on the proportions in which they were combined, and, perhaps mainly, on the method of its application. The most enduring and perfect varnish used for violins is an oil varnish, and the best results therewith can only be obtained under the most advantageous conditions for the drying process. In this respect there can be no doubt that the southern climate placed the makers whose work lies in higher latitudes at a disadvantage. In a letter to Galileo in 1638 concerning a violin which he had ordered from Cremona, the writer states that "it cannot be brought to perfection without the strong heat of the sun"; and all recorded experience indicates the great importance of slow drying of the varnish under suitable conditions. Stradivari himself wrote to account for delay in the delivery of an instrument because of the time required for the drying of the varnish.

That a perfect varnish conduces to the preservation of a fine tone in the instrument is generally admitted; and its operation in this respect is due, not merely to the external protection of the wood from deterioration, but especially to its action, when applied under favourable conditions to wood at a ripe stage of seasoning (when that process has proceeded far enough, but not so far as to allow the fibres to become brittle), in soaking into the pores of the wood and preserving its elasticity. This being so, successful varnishing will be seen to be an operation of great delicacy, and one in which the old masters found full scope for their skill and large experience. It seems not unreasonable to conclude, therefore, that the varnish of the old instruments contributed probably the most important single element of their superiority in tone.

History.—The immediate ancestors of the violins were the viols, which were the principal bowed instruments in use from the end of the 15th to the end of the 17th century, during the latter part of which period they were gradually supplanted by the violins; but the bass viol did not go out of use finally until towards the latter part of the 18th century, when the general adoption of the larger pattern of violoncello drove the viol from the field which it had occupied so long. The sole survivor of the viol type of instrument, although not itself an original member of the family, is the double bass of the modern orchestra, which retains many of the characteristic features of the viol, notably the flat back, with an oblique slope at the shoulders, the high bridge and deep ribs.

Excepting the marine trumpet or bowed monochord, we find in Europe no trace of any large bowed instruments before the appearance of the viols, the bowed instruments of the middle ages being all small enough to be rested on or against the shoulder during performance. The viols probably owe their origin directly to the minnesinger fiddles, which possessed several of the typical features of the violin, as distinct from the guitar family, and were sounded by a bow. These in their turn may be traced to the "guitar fiddle" (*q.v.*), a bowed instrument of the 13th century.

The parentage of the fiddle family may safely be ascribed to the rebec, a bowed instrument of the early middle ages, with two or three strings stretched over a low bridge, and a pear-shaped body pierced with sound-holes, having no separate neck, but narrowed at the upper end to provide a finger-board, and (judging by pictorial representations, for no actual example is known) surmounted by a carved head holding the pegs, in a manner similar to that of the violin. The bow, which was short and clumsy, had a considerable curvature.

So far it is justifiable to trace back the descent of the violin in a direct line; but the earlier ancestry of this family is largely a matter of speculation. The best authorities are agreed that stringed instruments in general are mainly of Asiatic origin, and there is evidence of the mention of bowed instruments in Sanskrit documents of great antiquity. Too much genealogical importance has been attached by some writers to similarities in form and construction between the bowed and plucked instruments of ancient times. They probably developed to a great extent independently, and the bow is of too great and undoubted antiquity to be regarded as a development of the plectrum or other devices for agitating the plucked string.

The two classes of instrument no doubt were under mutual obligations from time to time in their development.

From Viol to Violin.—The viol was made in three main kinds, similar to the cantus, medius and bassus of vocal music. Each of these three kinds admitted of some variation in dimensions, especially the bass, of which three distinct sizes ultimately came to be made—(1) the largest, called the concert bass viol; (2) the division or solo bass viol, usually known by its Italian name of viola da gamba; and (3) the lyra or tablature bass viol. The earliest use of the viols was to double the parts of vocal concerted music; they were next employed in special compositions for the viol trio written in the same compass; and finally they were employed as solo instruments, the methods of composition and execution being based on those of the lute. Most lute music is in fact equally adapted for the bass viol, and vice versa. Subsequently the viols were further developed structurally, such instruments as the quinton and the viola d'amore resulting.

The chief defect of the viols was their weakness of tone; this the makers thought to remedy in two ways: first by additional strings in unisons, fifths and octaves; and secondly by sympathetic strings of fine steel wire, laid under the finger-board as close as possible to the belly, and sounding in sympathy with the notes produced on the bowed strings.

This system of reinforcement was applied to all the various sizes of viols.

The improvements which resulted in the production of the violin proceeded on different lines. They consisted in increasing the resonance of the body of the instrument, by making it lighter and more symmetrical, and by stringing it more lightly. These changes transformed the body of the viol into that of the violin, and the transformation was completed by rejecting the lute tuning with its many strings, and tuning the instrument by fifths, as the fiddle had been tuned. The tenor viol appears to have been the first instrument in which the change was made, and thus the viola or tenor may probably be claimed as the father of the modern violin family.

The viola and violoncello are made on the same general model and principles as the violin, but with modifications. Both are, relatively to their pitch, made in smaller proportions than the violin, because, if they were constructed to dimensions having the same relation to pitch and tension of strings as the violin, they would not only have an overpowering tone but would be unmanageable

from their size. These relatively-diminished dimensions, both in the size of the instrument and in the thickness of the wood and strings, give to the viola and violoncello a graver and darker quality of tone. To some extent the reduced size is compensated by giving them a greater proportional height in the ribs and bridge; an increase hardly perceptible in the viola but very noticeable in the violoncello. To lighten the tension and thus allow greater freedom of vibration to the belly on the bass side, as with the lowest string of the violin, the two lowest of the viola and violoncello are made of thin gut, covered with fine metal wire, thus providing the necessary weight without inconvenient thickness.

Many other instruments of the violin family, of various sizes and designs, and correspondingly different pitch and tuning, have existed at various times, such as the viola pomposa (a kind of small violoncello invented by Bach), the violoncello piccolo (an instrument half the size of the ordinary violoncello), the arpeggione or guitar violoncello (a six stringed instrument for which Schubert wrote a sonata), the cellone (a deeper violoncello) and the octobass (a deeper doublebass), but all of these are now obsolete.

None the less others continue to make their appearance from time to time, no fewer than six, designed to fill supposed gaps in the existing quartet, having been invented within recent years by a French violin maker, Léo Sir.

Makers.—As regards makers, the early Italian school is chiefly represented by the Brescian makers, Gaspar da Salò, Giovanni Paolo Maggini, Giovita Rodiani and Zanetto Peregrino. It is, however, somewhat misleading to denominate it the Brescian school, for its characteristics are shared by the earliest makers of Cremona and Venice. To eyes familiar with the geometrical curves of the later Cremona school, most of the violins of these makers have a rude and uncouth appearance. The height of the model varies; the pattern is attenuated; the *f*-holes share the general rudeness of design, and are set high in the pattern. Andreas Amati of Cremona, the eldest maker of that name, effected some improvements on this primitive model; but the violin owes most to his sons, Antonio and Geronimo, who were partners. They introduced the substantial improvements which developed the Brescian violin into the modern instrument.

Nicholas Amati (1596–1684), son of Geronimo, made some slight further improvements and his pupil Antonio Stradivari (1644–1737) finally settled the typical Cremona pattern, which has been generally followed ever since.

Only less famous than the last named is Giuseppe Guarnieri (del Gesù) one of several makers of the same name (wherefore the distinguishing "del Gesù") whose instruments if less carefully finished than those of Stradivari are remarkable for the boldness of their design and their powerful tone, so that the finest of them have been preferred by some of the great players to those of Stradivari himself.

Paganini among others habitually played on one.

Among non-Italian makers a high model was adopted by Jacob Stainer of Absam, near Hall in Tirol, whose well-known pattern was chiefly followed by the makers of England, Tirol and Germany, down to the middle of the 18th century, when it fell into disuse, owing to the superior musical qualities of the Cremona violin. The English makers may be divided into three successive groups (1) an antique English school, having a character of its own (Rayman, Urquhart, Pamphilon, Barak, Norman, Duke of Oxford, etc.); (2) imitators of Stainer, at the head of whom stands Peter Wamsley (Smith, Barrett, Cross, Hill, Aireton, Norris, etc.); (3) a later school which leaned to the Cremona model (Banks, Duke of Holborn, Betts, the Forsters, Gilkes, Carter, Fendt, Parker, Harris, Matthew Hardie of Edinburgh, etc.). The early French makers have little merit or interest (Bocquay, Gavinies, Pierray, Guersan, etc.), but the later copyists of the Cremona models (Lupot, Aldric, Chanot the elder, Nicholas, Pique, Silvestre, Vuillaume, etc.) produced admirable instruments, some of which rank next in merit to the first-rate makers of Cremona.

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VIOLLET-LE-DUC, EUGENE EMMANUEL (1814–1879), French architect and writer on archaeology, was born in Paris on Jan. 21, 1814, and died at Lausanne on Sept. 17, 1879. He was a pupil of Achille Leclère, and in 1836–37 studied Greek and Roman architecture in Sicily and Rome. His chief interest was in the art of the Gothic period, and he was employed to restore some mediaeval buildings of France, his earliest restorations being the abbey church of Vézelay, St. Michel at Carcassonne, the church of Semur in Côte-d'Or, and the Gothic town halls of Saint-Antonin and Narbonne, 1840–50. From 1845 to 1856 he restored Notre Dame in Paris in conjunction with Lassus, and the abbey of St. Denis; in 1849 he began the restoration of the fortifications of Carcassonne and of Amiens cathedral. As a writer on mediaeval architecture and the kindred arts he takes the highest rank. His two dictionaries are the standard works in their class, and are beautifully illustrated.

His principal literary works were the *Dictionnaire de l'architecture française du XI au XVI siècle* (1854–68); *Dictionnaire du mobilier français* (1858–75); *L'Architecture militaire au moyen âge* (1854); *Entretiens sur l'architecture* (1863–72); *Cités et ruines américaines* (1863); *Mémoire sur la défense de Paris* (1871); *Habitations modernes* (1874–77); *Histoire d'une maison* (1873); *Histoire d'une forteresse* (1874); *Histoire de l'habitation humaine* (1875); *Le Massif du Mont Blanc* (1876); *L'Art russe* (1877); *Histoire d'un hôtel-de-ville et d'une cathédrale* (1878); *La Décoration appliquée aux édifices* (1879). *See* P. Gout, *Viollet-le-Duc* in *Revue de l'Art Chrétien* Supplements III (1914); A. Fontainas and G. Gromont, *Histoire Générale de l'Art Français,* vol. ii (1925).

VIOLONCELLO, the third largest member of the violin family, standing midway in point of size and pitch between the viola and the double-bass. Although the word violoncello is a diminutive, signifying "small violone," or double-bass, the instrument is really a bass violin, formed on a different model from the violone, which has the sloping shoulders, and flat back of the viol family, whereas those of the violoncello are rounded as in the violin. As the word violoncello is a diminutive, the adoption of the second half of it, 'cello, as a contraction, is hardly a happy procedure. The violoncello came into existence soon after the violin and took the place of the viola da gamba, or bass viol, which, however, it only supplanted very gradually. Its construction is the same as that of the violin but on a larger scale, the total length of the instrument being 48½ in., though the earliest instruments were somewhat larger. Although at first the viola da gamba continued to be preferred by connoisseurs to the violoncello, which was considered suitable only for accompaniment purposes, the violoncello established its superiority in due course and today, alike in concerted music and for solo purposes, ranks second only to the violin among the instruments of its class. Its full rich tone lends itself especially to the execution of expressive cantabile passages. (*See* VIOLIN.)

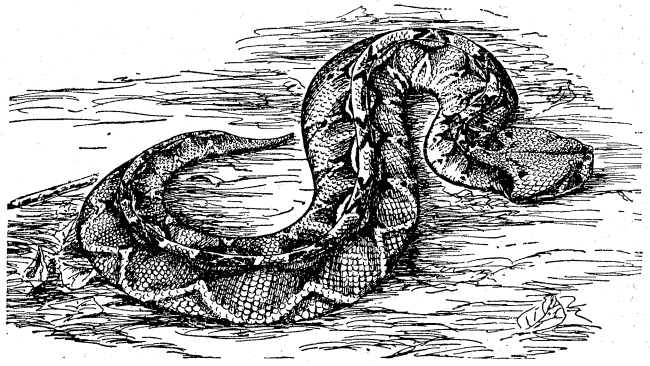
VIONVILLE, a village of Lorraine, near Metz, celebrated as the scene of the battle of Vionville (also called Rezonville or Mars-la-Tour), fought on Aug. 16, 1870, between the French and the Germans. (*See* METZ and FRANCO-GERMAN WAR.)

VIPER. In a broad sense vipers include the snakes of the family Viperidae, which is characterized by the presence of poison fangs on a movable upper jaw. The fangs are simply enlarged teeth perforated longitudinally for the passage of the venom and, like those of all other snakes, they are fused to the supporting bones. In this family, however, there are no other teeth on the maxillary bone, which is movable so that the fangs are folded down parallel with the roof of the mouth when not in use. The same mechanism is present in the pit vipers.

Venom is secreted by a pair of glands, situated behind the angle of the mouth, and is carried to the fangs by a short duct that opens close to their base inside a fold of skin (the *vagina dentis*) which surrounds them; within this fold of skin there is also a series of reserve fangs in different stages of development and, should one of the functional fangs be broken, the largest of these

reserve teeth moves into its place and becomes fused to the jaw. Vipers, as a rule, are stout sluggish creatures with a broad, flattened head, and lack the large head shields so characteristic of the majority of other poisonous snakes; most of them are terrestrial, though there are aquatic, arboreal and burrowing species. A few lay eggs but the majority produce fully developed young.

All the Viperidae are very poisonous and the bite of most of them is dangerous to man; the toxicity of the venom varies with



COMMON EUROPEAN VIPER (VIPERA BERUS) ABOVE; GABOON VIPER OF TROPICAL AFRICA (BITIS GABONICA) BELOW

each species, and the virulence of any bite depends not only on the species of snake responsible for it but also on the amount of venom injected, the position of the bite and the physical condition of the snake. In composition viper venom resembles that of the back-fanged colubrids, rather than that of the cobras and their allies, and its action consists largely in the destruction of the blood corpuscles and vessels.

The family is closely allied to that of the pit vipers (Crotalidae), which have a similar venom-injecting apparatus, but are well distinguished by the presence of a sensory pit between the eye and the nostril.

The majority of the true vipers are terrestrial, though *Atractaspis* of tropical and South Africa is a genus of small burrowing creatures with enlarged shields on the head; the night adders (*Causus*) of the same region, have the head similarly covered. *Causus* is remarkable for greatly enlarged poison glands that extend into the neck. Arboreal forms are represented by *Atheris*, of the forests of tropical Africa, which is equipped with a prehensile tail and is usually green or olive in colour to harmonize with its surroundings. The colours of the terrestrial species, on the other hand, are more frequently shades of gray, brown or black to correspond to the rocky or sandy localities they frequent. The puff adder (*Bitis arietans*), which occurs throughout the drier areas of Africa, is a sluggish, heavily-built creature that may grow to a length of four or five feet; it is usually pale brown with a series of regular, dark, chevron-shaped crossbars along the back, a colouring that harmonizes so well with sandy soil that many accidents occur when people fail to notice the animal until they actually tread upon it. The Gaboon viper (*Bitis gabonica*), and the nose-horned viper, *B. nasicornis*, unlike their relative, are inhabitants of the forested regions of Africa and exhibit a geometrical "camouflage" colour pattern of blues, reds and yellows. Many desert species show the feature characteristic of desert-dwelling animals and plants, the development of spines; *Cerastes cornutus*, the horned viper of Egypt and northern Africa, has a prominent spine above each eye, *Cerastes* and *Echis*, the latter found through northern Africa and southern Asia, including India, exhibit a specialization for desert life not found elsewhere; the scales of the sides are small and have pronounced, serrated ridges which act, through lateral shovelling movements of the body, as scoops to dig up loose sand and throw it onto the creatures' backs, and so enable them to bury themselves completely. In Europe the family is represented by the genus *Vipera* of which the adder (*V. berus*) is the best known species; it is an inhabitant of the northern countries and is the only venomous serpent in Great Britain.

In southern Europe an allied species *V. aspis*, is more common, characterized by a "snub-nose." This feature is even more pronounced in *V. latastei* of the Iberian peninsula, while in *V. ammodytes* of S. E. Europe the tip of the snout is prolonged upward into a definite scaly appendage. In India the commonest and most dangerous viper is the handsomely coloured daboia or tic polonga (*V. russelli*), which reaches a length of five feet.

The extensive parallelism between the genera of the viper family and those of the pit vipers well illustrates the principles of adaptive radiation in an evolutionarily successful group. The arboreal *Atheris*, with their green or mottled colors and prehensile tails are matched by the prehensile-tailed species of the pit viper genus *Trimeresurus* in the East Indies and in tropical America. "Desert coloration" reaches a high development in the vipers of the genera *Vipera* and *Bitis* and in the rattlesnakes of the southwestern deserts of North America. (K. P. S.)

VIPER'S BUGLOSS (*Echium vulgare*), a hairy herb of the borage family (Boraginaceae), indigenous to Europe, including Great Britain, and western Asia. The flowers are brilliant blue when expanded, but the buds are reddish. Viper's bugloss, called also blue-weed, has become widely naturalized in the United States and Canada, from Nova Scotia to Ontario and Nebraska and southward to North Carolina; in some sections it is a troublesome weed. It prefers dry soil. The genus *Echium* contains about 30 species, all found in Europe.

VIRBIUS, an old Italian divinity, associated with the worship of Diana at Aricia (*see* DIANA). Under Greek influence, he was identified with Hippolytus (q.v.), who after he had been trampled to death by his own horses was restored to life by Asklepios and removed by Artemis to the grove at Aricia, which horses were not allowed to enter. Virbius was the oldest priest of Diana, and the first *Rex Nemorensis*, "king of the grove."

See Virgil, *Aen.*, vii. 761 and Servius, l.c.; Ovid. *Fasti*, iii. 265, vi. 737; *Metam.*, XV. 497; Suetonius, *Caligula*, 35; Strabo V. p. 239; G. Wissowa, *Religion und Kultus der Römer.* (2nd. ed. 1912); J. G. Frazer, *The Golden Bough* (3rd ed.); A. B. Cook, *Zeus* (1925).

VIRCHOW, RUDOLF (1821–1902), German pathologist and politician, was born on Oct. 13, 1821, at Schivelbein, in Pomerania. In 1843 he received an appointment as assistant-surgeon at the Charité Hospital, becoming pro-rector three years later. In 1847 he began to act as *Privatdozent* in the university, and founded with Reinhardt the *Archiv für pathologische Anatomie und Physiologie*, which, after his collaborator's death in 1852, he carried on alone. In 1848 he went as a member of a government commission to investigate an outbreak of typhus in upper Silesia. About this time, having shown too open sympathy with the revolutionary or reforming tendencies, he was for political reasons obliged to leave Berlin and retire to the seclusion of Würzburg, the medical school of which profited enormously by his labours as professor of pathological anatomy. In 1856 he was recalled to Berlin as ordinary professor of pathological anatomy. As director of the Pathological Institute he formed a centre for research whence flowed a constant stream of original work.

Pathology.—Wide as were Virchow's studies, and successful as he was in all, yet the foremost place must be given to his achievements in pathological investigation. In his book on *Cellularpathologie*, published at Berlin in 1858, he established what Lord Lister described as the "true and fertile doctrine that every morbid structure consists of cells which have been derived from preexisting cells as a progeny." Virchow made many important contributions to histology and morbid anatomy and to the study of particular diseases. The classification into epithelial organs, connective tissues, and the more specialized muscle and nerve, was largely due to him; and he proved the presence of neuroglia in the brain and spinal cord, discovered crystalline haematoidine, and

made out the basic structure of the umbilical cord. Among the books he published on pathological and medical subjects may be mentioned *Vorlesungen über Pathologie,* the first volume of which was the *Cellular-pathologie* (1858), and the remaining three *Die Krankhaften Geschwülste* (1863–67); *Handbuch der speziellen Pathologie und Therapie* (3 vols., 1854–62), in collaboration with other German surgeons; *Vier Reden über Leben und Kranksein* (1862); *Untersuchungen über die Entwicklung des Schädelgrundes* (1857); *Lehre von den Trichinen* (1865); *Ueber den Hunger-typhus* (1868); and *Gesammelte Abhandlungen aus dem Gebiete der öffentlichen Medizin und der Seuchenlehre* (1879).

Anthropology.—Another science which Virchow cultivated with conspicuous success was anthropology. In ethnology he published a volume of essays on the physical anthropology of the Germans, with special reference to the Frisians; and at his instance a census, which yielded remarkable results, was carried out among school children throughout Germany, to determine the relative distribution of blondes and brunettes. His archaeological work included the investigation of lake dwellings and other prehistoric structures; he went with Schliemann to Troy in 1879, fruits of the expedition being two books, *Zur Landeskunde der Troas* (1880) and *Alt-trojanische Gräber und Schädel* (1882); in 1881 he visited the Caucasus, and on his return published *Das Gräberfeld von Koban im Lande der Osseten.*

Politics.—In 1862 Virchow was elected a member of the Prussian Lower House. He was a founder and leader of the Fortschrittspartei, and the expression *Kulturkampf* had its origin in one of his electoral manifestos. For many years he was chairman of the finance committee, and in that capacity was chief founder of the constitutional Prussian Budget system. In 1880 he entered the Reichstag as representative of a Berlin constituency, but was ousted in 1893 by a Social Democrat. In the Reichstag he became the leader of the Opposition, and a vigorous antagonist of Bismarck. In the local and municipal politics of Berlin again he took a leading part, and as a member of the municipal council was largely responsible for the transformation which came over the city in the last thirty years of the 19th century. It was his unceasing efforts that secured for its inhabitants the drainage system, sewage farms and good water-supply.

Of his writings on social and political questions may be mentioned *Die Erziehung des Weibes* (1865); *Ueber die nationale Entwicklung und Bedeutung der Naturwissenschaften* (1865); *Die Aufgaben der Naturwissenschaften in dem neuen nationalen Leben Deutschlands* (1871); *Die Freiheit der Wissenschaft im modernen Staat* (1877), in which he opposed the idea of Haeckel—that the principles of evolution should be taught in elementary schools—on the ground that they were not as yet proved, and that it was mischievous to teach a hypothesis which still remained in the speculative stage.

See *Lives* by Becher (Berlin, 1894) and Pagel (Leipzig, 1906); *Rudolf Virchow als Patholog* by Marchand (Munich, 1902); *Rudolf Virchow als Arzt* by Ebstein (Stuttgart, 1903); *Gedächtnisrede auf R. Virchow* (Berlin, 1903); and *Briefe Virchows an seine Eltern 1839–1864,* by Marie Rabl (Leipzig, 1907). A bibliography of his works was published at Berlin in 1901.

VIRE, a town of northwestern France, capital of an arrondissement in the department of Calvados, 47 mi. S.W. of Caen by rail. Pop. (1936) 5,917. Vire stands on a hill surrounded on three sides by the Vire and crowned by the remains of a 12th-century château. The church of Notre-Dame (13th to 15th century), and the picturesque Tour de l'Horloge (13th century), beneath which runs the chief street, are the principal buildings. Vire grew up around a castle built in the 12th century by Henry I of England, and in the middle ages was one of the important strongholds of Normandy. Southwest of the town is the gorge called Vaux-de-Vire, where stood the mill of Olivier Basselin (15th century), the fuller and reputed author of the satiric songs hence known as "vaudevilles." (*See* BASSELIN, OLIVIER.)

Vire is an important market town, with trade in horses and cattle, and has various small manufactures. It is the seat of a sub-prefect and a tribunal of commerce.

VIRELAY, the title applied to more than one fixed form of verse (*virer,* to turn). Its history and character are very obscure. It may be connected with the Provençal *ley.* Historians agree that it is a modification of the mediaeval *lai;* but no example of the *lai* is known except the following (first printed by Père Mourgues in his *Traité de la Poésie*):

"Sur l'appui du monde Que faut-il qu'on fonde
D'espoir?
Cette mer profonde Et débris féconde
Fait voir
Calme au matin l'onde Et l'orage gronde
Le Soir."

But this seems to be a mere fragment of a virelay, which proceeds by "veering" the two rhymes *ad libitum.* This is the *virelai ancien,* of which examples are rare in recent literature. There is also the *virelai nouveau,* which was used by Alain Chartier in the 15th century. In French the old and popular *Adieu vous dy triste Lyre* is a perfect example; and in English we have one admirable specimen in Austin Dobson's "Good-bye to the Town, good-bye." A so-called Virelay is found among Chaucer's spurious works (Skeat, vii., 448). The New Virelay is written on two rhymes, and begins with two lines that recur throughout as refrains, and (reversed in order) close the poem in a couplet. The Virelay is a vague and invertebrate form of verse, and one of little importance.

VIREO, the common name of birds of the American passerine family *Vireonidae.* There are about 50 species of these insectivorous birds, which have characteristic and often very musical songs. Twelve species inhabit the United States, all building deep, pendent, cup-shaped nests, usually hung between the forks of a branch. The red-eyed vireo (*V. olivaceus*) breeds from the Gulf States to Labrador and British Columbia, wintering in Central and South America. West of the Cascade mountains, it is replaced by Hutton's vireo (*V. huttoni*), with three subspecies, lacking the slate crown of *V. olivaceus.* The warbling vireo (*V. gilvus*) of eastern U.S.A. and Canada has a fine song.

VIRGIL (PUBLIUS VERGILIUS MARO) (70–19 B.C.) the great Roman poet, was born on Oct. 15, 70 B.C., on a farm not far from the town of Mantua. In the region north of the Po a race of more imaginative susceptibility than the people of Latium formed part of the Latin-speaking population. It was favourable to his development as a national poet that he was born and educated during the interval of comparative calm between the first and second Civil Wars, and that he belonged to a generation which, as the result of the Social War, first enjoyed the sense of an Italian nationality. It is remarkable that the two poets whose imagination seems to have been most powerfully possessed by the spell of Rome—Ennius and Virgil—were born outside the pale of Roman citizenship.

Like his friend and contemporary Horace, he sprang from the class of yeomen, whose state he pronounces the happiest allotted to man and most conducive to virtue and piety. At the age of twelve he was taken for his education to Cremona, and from an expression in one of his minor poems it may be inferred that his father accompanied him. Afterwards he removed to Milan, where he continued to study till he went to Rome two years later.

After studying rhetoric he began the study of philosophy under Siron the Epicurean. One of the minor poems written about this time in the scazon metre tells of his delight at the immediate prospect of entering on the study of philosophy; at the end of the poem, the real master-passion of his life, the charm of the Muses, reasserts itself (*Catalepton* v.).

Our next knowledge of him is derived from some allusions in the *Eclogues,* and belongs to a period nine or ten years later. Of what happened to him in the interval, during which the Civil War took place and Julius Caesar was assassinated, we have no indication from ancient testimony or from his own writings. In 42 B.C., the year of the battle of Philippi, we find him "cultivating his woodland Muse" under the protection of Asinius Pollio, governor of the district north of the Po. In the following year the famous confiscations of land for the benefit of the soldiers of the triumvirs took place. Of the impression produced on Virgil by these confiscations, and of their effect on his fortunes, we have a vivid record in the first and ninth eclogues. Mantua, in consequence of its vicinity to Cremona, which had been faithful to the cause of the republic, was involved in this calamity; and Virgil's father was driven from his farm. By the influence of his powerful friends, and by personal application to the young Octavian, Virgil

obtained the restitution of his land. In the meantime he had taken his father and family with him to the small country house of his old teacher Siron (*Catalepton* x.).

Soon afterwards we hear of him living in Rome, enjoying the favour of Maecenas, intimate with Varius, who was at first regarded as the rising poet of the new era, and later on with Horace. His friendship with Gallus, for whom he indicates a warmer affection and more enthusiastic admiration than for any one else, was formed before his second residence in Rome, in the Cisalpine province. The pastoral poems, or "eclogues," commenced in his native district, were finished and published in Rome, probably in 37 B.C. Soon afterwards he withdrew from Rome, and lived chiefly in Campania, either at Naples or in the neighbourhood of Nola. He was one of the companions of Horace in the famous journey to Brundisium; and it seems not unlikely that, some time before 23 B.C., he made the voyage to Athens which forms the subject of the third ode of the first book of the *Odes* of Horace.

The seven years from 37 to 30 B.C. were devoted to the composition of the *Georgics*. In the following year he read the poem to Augustus, on his return from Asia. The remaining years of his life were spent on the composition of the *Aeneid*. In 19 B.C., after the *Aeneid* was finished but not finally corrected, he set out for Athens, intending to pass three years in Greece and Asia and to devote that time to perfecting the poem. At Athens he met Augustus, and was persuaded by him to return with him to Italy. While visiting Megara under a burning sun, he was seized with illness, and, as he continued his voyage without interruption, he grew rapidly worse, and died on Sept. 21, 19 B.C., a few days after landing at Brundisium. In his last illness he called for the cases containing his manuscripts, with the intention of burning the *Aeneid*. He had previously left directions in his will that his literary executors, Varius and Tucca, should publish nothing of his which had not already been given to the world by himself. A passage from a letter of his to Augustus is also quoted, in which he speaks as if he felt that the undertaking of the work had been a mistake. This dissatisfaction with his work may be ascribed to his passion for perfection of workmanship, which death prevented him from attaining. The command of Augustus overrode the poet's wish and rescued the poem.

Virgil was buried at Naples, where his tomb was long regarded with religious veneration. Horace is our most direct witness of the affection which he inspired among his contemporaries. The qualities by which he gained their love were, according to his testimony, *candor*—sincerity of nature and goodness of heart—and *pietas*—the union of deep affection for kindred, friends and country with a spirit of reverence. The statement of his biographer, that he was known in Naples by the name "Parthenias," is a testimony to the exceptional purity of his life in an age of licence. The seclusion of his life and his devotion to his art touched the imagination of his countrymen as the finer qualities of his nature touched the heart of his friends. It had been, from the time of Cicero, the ambition of the men of finest culture and most original genius in Rome to produce a national literature which might rival that of Greece; and the feeling that at last a poem was about to appear which would equal or surpass the greatest among all the works of Greek genius found a voice in the lines of Propertius—

> Cedite Romani scriptores, cedite Graii;
> Nescio quid maius nascitur Iliade.

The veneration in which his name was held between the overthrow of Western civilization and the revival of letters affords testimony of the depth of the impression which he made on the imagination of the ancient world. The traditional belief in his pre-eminence has been on the whole sustained, though not with absolute unanimity, in modern times.

The effect of this was a juster estimate of Virgil's relative position among the poets of the world. Lucretius, it may be thought, was individually the greater poet. But it can hardly be questioned, on a survey of Roman literature, that the position of Virgil is central and commanding, while that of Lucretius is in a great measure isolated. If we could imagine the place of Virgil in Roman literature vacant, it would be much the same as if we imagined the place of Dante vacant in modern Italian, and that of Goethe in German literature.

Virgil's fame as a poet rests on the three acknowledged works of his early and mature manhood—the pastoral poems or *Eclogues*, the *Georgics* and the *Aeneid*—all written in that hexameter verse which Tennyson has called

> The stateliest measure ever moulded by the lips of man.

Eclogues.—The pastoral poems or *Eclogues*—a word denoting short selected pieces—were composed between the years 42 and 37 B.C. His expressed aim is to pay in the Latin language to the Italian countryside the tribute of Theocritus to Sicily.

The earliest poems in the series were the second, third and fifth; and these, along with the seventh, are the most purely Theocritean in character. The first and ninth, which probably were next in order, are much more Italian in sentiment, and have a much more direct reference both to his own circumstances and the circumstances of the time. The first is a reflex of the distress and confusion which arose out of the new distribution of lands. The ninth contains the lines which seem accurately to describe the site of Virgil's farm, at the point where the range of hills which accompany the river Mincio for some distance from the foot of the Lago di Garda sinks into the plain about 14 or 15 m. above Mantua. The sixth is addressed to Varus, who succeeded Pollio as governor of the Cisalpine district. Its theme is the creation of the world, and the oldest tales of mythology. The fourth and eighth are both closely associated with the name of Virgil's earliest protector, Pollio. The fourth celebrates the consulship of his patron in 40 B.C., and also the prospective birth of a child, though it was disputed in antiquity, and still is disputed, who was meant by this child whose birth was to be coincident with the advent of the new era, and who, after filling the other great offices of state, was to "rule with his father's virtues the world at peace." The main purpose of the poem, however, is to express the longing of the world for a new era of peace and happiness, of which the treaty of Brundisium seemed to hold out some definite hopes. Some of the phraseology of the poem led to a belief in the early Christian church that Virgil had been an unconscious instrument of inspired prophecy. The date of the eighth is fixed by a reference to the campaign of Pollio against the Dalmatians in 39 B.C. It brings before us two love tales of homely Italian life. The tenth reproduces the Daphnis of Theocritus, and is a dirge over the unhappy love of Gallus and Lycoris.

There is no important work in Latin literature, with the exception of the comedy of Terence, so imitative as the *Eclogues*. But they are not purely exotic. They are rather composite, partly Greek and partly Italian, and, as a vehicle for the expression of feeling, hold an undefined place between the objectivity of the Greek idyll and the subjectivity of the Latin elegy. For the most part, they express the sentiment inspired by the beauty of the world, and the kindred sentiment inspired by the charm of human relationships. The supreme charm of the diction and rhythm is universally recognized.

Georgics.—It is stated that Maecenas, acting on the principle of employing the poets of the time in favour of the conservative and restorative policy of the new government, directed the genius of Virgil to the subject of the *Georgics*. No object could be of more consequence to a supporter of Augustus' policy leaders than the revival of the great national industry, which had fallen into abeyance owing to the long unsettlement of the revolutionary era as well as to other causes. Virgil's previous life and associations made it natural for him to identify himself with this object, while his genius fitted him to enlist the imagination of his countrymen in its favour. His aim was to describe with realistic fidelity, and to surround with an atmosphere of poetry, the annual round of labour in which the Italian yeoman's life was passed; to bring out the intimate relation with nature into which man was brought in the course of that life, and to suggest the delight to heart and imagination which he drew from it; to contrast the simplicity, security and sanctity of such a life with the luxury and lawless passions of the great world; and to associate the ideal of a life of rustic labour with the beauties of Italy and the glories of Rome. This larger conception of the dignity of his subject separates the

didactic poem of Virgil from all other didactic, as distinct from philosophic, poems. He has produced in the *Georgics* a new type of didactic, as in the *Aeneid* he has produced a new type of epic, poetry.

The subject is treated in four books, varying in length from 514 to 566 lines. The first treats of the tillage of the fields, of the constellations, the rise and setting of which form the farmer's calendar, and of the signs of the weather, on which the success of his labours largely depends. The second treats of trees, and especially of the vine and olive, two great staples of the national wealth and industry of Italy; the third of the rearing of herds and flocks and the breeding of horses; the fourth of bees.

Hesiod Virgil regarded as his prototype; he supplied the outline of the form. The Alexandrian scientific poets provided him with examples for his method of treatment. But a more powerful influence on the form, ideas, sentiment and diction of the *Georgics* was exercised by the great philosophical poem of Lucretius, of which Virgil had probably been a diligent student since the time of its first appearance, and with which his mind was saturated when he was engaged in the composition of the *Georgics*. So far as any speculative idea underlying the details of the *Georgics* can be detected, it is one of which the source can be traced to Lucretius—the idea of the struggle of human force with the forces of nature. In the general plan of the poem Virgil follows the guidance of Lucretius rather than that of any Greek model. The distinction between a poem addressed to national and one addressed to philosophical sympathies is marked by the prominence assigned in the one poem to Caesar as the supreme personality of the age, in the other to Epicurus as the supreme master in the realms of mind. In the systematic treatment of his materials, and the interspersion of episodes dealing with the deeper poetical and human interest of the subject, Virgil adheres to the practice of the older poet.

The *Georgics* is not only the most perfect, but the most native of all the works of the ancient Italian genius. Even where he borrows from Greek originals, Virgil makes the Greek mind tributary to his national design. The *Georgics*, the poem of the land, is as essentially Italian as the *Odyssey*, the poem of the sea, is essentially Greek.

Aeneid.—The work which yet remained for Virgil to accomplish was the addition of a great Roman epic to literature. This had been the earliest effort of the national imagination, when it first departed from the mere imitative reproduction of Greek originals. The work which had given the truest expression to the genius of Rome before the time of Virgil had been the *Annales* of Ennius. This had been supplemented by various historical poems but had never been superseded. It satisfied the national imagination as an expression of the national life in its vigorous prime, but it could not satisfy the newly developed sense of art; and the expansion of the national life since the days of Ennius, and the changed conditions into which it passed after the battle of Actium, demanded a newer and ampler expression. It had been Virgil's earliest ambition to write an heroic poem on the traditions of Alba Longa; and he had been repeatedly urged by Augustus to celebrate his exploits. The problem before him was to compose a work of art on a large scale, which should represent a great action of the heroic age, and should at the same time embody the most vital ideas and sentiment of the hour—which in substance should glorify Rome and the present ruler of Rome, while in form it should follow closely the great models of epic poetry and reproduce all their sources of interest. It was his ambition to be the Homer, as he had been the Theocritus and Hesiod, of his country.

Various objects had thus to be combined in a work of art on the model of the Greek epic: the revival of interest in the heroic foretime; the satisfaction of national sentiment; the expression of the deeper currents of emotion of the age; the personal celebration of Augustus. A new type of epic poetry had to be created. It was desirable to select a single heroic action which should belong to the cycle of legendary events celebrated in the Homeric poems, and which could be associated with Rome. The only subject which in any way satisfied these conditions was that of the wanderings of Aeneas and of his final settlement in Latium. The story, though not of Roman origin but of a composite growth, had long been familiar to the Romans, and had been recognized by official acts of senate and people. The subject enabled Virgil to tell again of the fall of Troy, and to weave a tale of sea-adventure similar to that of the wanderings of Odysseus. It was also recommended by the claim which the Julii, a patrician family of Alban origin, made to descent from Iulus, the supposed son of Aeneas.

The *Aeneid* is thus at once the epic of the national life under its new conditions and an epic of human character. The true keynote of the poem is struck in the line with which the proem closes—

Tantae molis erat Romanam condere gentem.

The idea which underlies the whole action of the poem is that of the great part played by Rome in the history of the world, that part being from of old determined by divine decree, and carried out through the virtue of her sons. The idea of universal empire is thus the dominant idea of the poem. With this idea that of the unbroken continuity of the national life is intimately associated. The reverence for old customs and for the traditions of the past was a large element in the national sentiment, and has a prominent place in the *Aeneid*. So too has the feeling of local attachment and of the power of local association over the imagination. The poem is also characteristically Roman in the religious belief and observances which it embodies. Behind all the conventional machinery of the old Olympic gods there is the Roman apprehension of a great inscrutable power, manifesting itself by arbitrary signs, exacting jealously certain observances, working out its own secret purposes through Roman arms and Roman counsels.

The idealization of Augustus is no expression of servile adulation. It is through the prominence assigned to him that the poem is truly representative of the critical epoch in human affairs at which it was written. The cardinal fact of that epoch was the substitution of personal rule for the rule of the old commonwealth over the Roman world. Virgil shows the imaginative significance of that fact by revealing the emperor as chosen from of old in the counsels of the supreme ruler of the world to fulfil the national destiny, as descendant of gods and heroes of old poetic renown.

Virgil's true and yet idealizing interpretation of the imperial idea of Rome is the basis of the greatness of the *Aeneid* as a representative poem. It is on this representative character and on the excellence of its artistic execution that the claim of the *Aeneid* to rank as one of the great poems of the world mainly rests. The inferiority of the poem to the *Iliad* and the *Odyssey* as a direct representation of human life is so unquestionable that we are in danger of underrating the real though secondary interest which the poem possesses as an imitative epic of human action, manners and character. In the first place it should be remarked that the action is chosen not only as suited to embody the idea of Rome, but as having a peculiar nobleness and dignity of its own. It brings before us the spectacle of the destruction of the city of greatest name in poetry or legend, of the foundation of the imperial city of the western seas, in which Rome had encountered her most powerful antagonist in her long struggle for supremacy, and that of the first rude settlement on the hills of Rome itself. It might be said of the manner of life represented in the *Aeneid*, that it is no more true to any actual condition of human society than that represented in the *Eclogues*. But may not the same be said of all idealizing restoration of a remote past in an age of advanced civilization? The life represented in the *Oedipus Tyrannus* or in *King Lear* is not the life of the Periclean nor of the Elizabethan age, nor is it conceivable as the real life of a prehistoric age. Where Virgil is least real, and most purely imitative, is in the battle-scenes of the later books.

But the adverse criticisms of the *Aeneid* are chiefly based on Virgil's supposed failure in the crucial test of the creation of character. And his chief failure is pronounced to be the "pious Aeneas." Is Aeneas a worthy and interesting hero of a great poem of action? Not, certainly, according to the ideals realized in Achilles and Odysseus, nor according to the modern ideal of heroism. Virgil wishes to hold up in Aeneas an ideal of pious obedience and persistent purpose—a religious ideal belonging to the ages of faith combined with the humane and self-sacrificing qualities belonging to an era of moral enlightenment. His own sympathy

is with his religious ideal rather than with that of chivalrous romance. He felt that the deepest need of his time was not military glory, but peace, reconciliation, restoration of law, and piety.

In Dido Roman poetry has added to the great gallery of men and women, created by the imaginative art of different times and peoples, the ideal of a true queen and a true woman. On the episode of which she is the heroine the most passionate human interest is concentrated. It has been objected that Virgil does not really sympathize with his own creation, that he gives his approval to the cold desertion of her by Aeneas. But if he does not condemn his hero, he sees in the desertion and death of Dido a great tragic issue in which a noble and generous nature is sacrificed to the larger purpose of the gods.

Virgil brought the two great instruments of varied and continuous harmony and of a rich, chastened and noble style to the highest perfection of which the Latin tongue was capable. The rhythm and style of the *Aeneid* is more unequal than the rhythm and style of the *Georgics,* but is a larger and more varied instrument. The note of his supremacy among all the poetic artists of his country is that subtle fusion of the music and the meaning of language which touches the deepest and most secret springs of emotion. He touches especially the emotions of reverence and of yearning for a higher spiritual life, and the sense of nobleness in human affairs, in great institutions and great natures; the sense of the sanctity of human affections, of the imaginative spell exercised by the past, of the mystery of the unseen world. This is the secret of the power which his words have had over some of the deepest and greatest natures in all ages. (W. Y. S.; X.)

BIBLIOGRAPHY.—*Appendix Vergiliana.*—Under this collective name there are current several poems of some little length and some groups of shorter pieces, all attributed to Virgil in antiquity. Virgil wrote a *Culex,* but not the *Culex* now extant, though it passed for his half a century after his death. The *Aetna,* the *Ciris* and the *Copa* are clearly not Virgil's. The *Moretum* is said to have been translated by him from a Greek poem by his teacher Parthenius; it is an exquisite piece of work, familiar perhaps to English readers in Cowper's translation. The case of the *Catalepton* (κατὰ λεπτὸν) is peculiar. Two of these little poems (*Ite hinc inanes* and *Villula, quae Sironiseras*) are generally accepted as Virgil's; opinion varies as to the rest, with very little to go upon, but generally rejecting them. The whole are printed in the larger editions of Virgil. For English readers the most obvious edition is that of Robinson Ellis (1907), who has also edited the *Aetna* separately.

Manuscripts.—Gellius (*Noctes Atticae,* ix. 14, 7) tells us of people who had inspected *idiographum librum Vergilii,* but this has of course in all probability long since perished. There are, however, seven very ancient MSS. of Virgil. (1) The Mediceus at Florence, with a note purporting to be by a man, who was consul in 494, to say he had read it. (2) The Palatinus Vaticanus of the 4th or 5th century. (3) The Vaticanus of the same period. (4) The "Schedae Vaticanae." (5) The "Schedae Berolinenses," perhaps of the 4th century. (6) The "Schedae Sangallenses." (7) The "Schedae rescriptae Veronenses" —the last three of insignificant extent. For a fully detailed account of the MSS., *see* Henry, *Aeneidea,* i., and Ribbeck, *Prolegomena ad Verg.*

Ancient Commentators.—Commentaries on Virgil began to be written at a very early date. Suetonius, *V. Verg.* 44, mentions an *Aeneidomastix* of Carvilius Pictor and other works on Virgil's "thefts" and "faults," besides eight "volumina" of Q. Octavius Avitus, setting out in parallel passages the "likenesses" (ὁμοιότητες was the name of the work) between Virgil and more ancient authors. M. Valerius Probus (latter part of 1st century A.D.) wrote a commentary, but it is doubtful for how much of what passes under his name he is responsible, if for any of it. At the end of the 4th century come the commentaries of Tiberius Claudius Donatus and of Servius, the former writing as a teacher of rhetoric, the latter of style and grammar. The work of Servius was afterwards expanded by another scholar, whose additions greatly added to its worth, as they are drawn from older commentators and give us very valuable information on the old Roman religion and constitution, Greek and Latin legends, old Latin and linguistic usages. In this enlarged form the commentary of Servius and the *Saturnalia* of Macrobius (also of the end of the 4th century) are both of great interest to the student of Virgil. There are, further, sets of Scholia in MSS. at Verona and Bern, which draw their material from ancient commentaries. *See* H. Nettleship, *Essays in Latin Literature,* xi. and Comparetti, *Vergil in the Middle Ages* (1875; trans. 1895), ch. 5 (1885; 2nd series, 1895).

Editions.—The editions of Virgil are innumerable; Heyne (1767–1800), Forbiger (1872–75) and Ribbeck (1859–66) in Germany, Benoist (1876) in France, and Conington (completed by Nettleship, and edited by Haverfield, 1898, etc.) in England, are perhaps the most important. Good school editions in English have been produced by Page, Sidgwick and Papillon. Conington's work, however, is without question the best in English.

Translations.—Famous English translations have been made by Dryden and by a host of others since his day. Since the middle of the 19th century the most important are Conington (*Aeneid* in verse, whole works in prose); J. W. Mackail (*Aeneid* and *Georgics* in prose); William Morris (*Aeneid* in verse); Lord Justice Bowen (*Eclogues* and *Aeneid,* i.–vi. in verse); Canon Thornhill (verse); C. J. Billson (verse, 1906); J. Rhoades (verse, new ed., 1907). For essays on translating Virgil, *see* Conington, *Miscellaneous Works,* vol. i.; R. Y. Tyrrell, *Latin Poetry* (appendix).

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Virgil-literature: Sainte-Beuve, *Étude sur Virgile* (one of the great books on Virgil); Comparetti, *Virgilio nel medio Evo* (1872)— Eng. tr., *Vergil in the Middle Ages,* by E. F. M. Benecke (1895) (a book of very great and varied interest); Heinze, *Virgil's epische Technik* (1902); W. Y. Sellar, *Roman Poets of the Augustan Age: Virgil* (2nd ed. 1883); Glover, *Studies in Virgil* (1904). Essays in the following: F. W. H. Myers, *Essays* [*Classical*] (1883), the most famous English essay on Virgil; J. R. Green, *Stray Studies* (1876) (an excellent study of Aeneas); W. Warde Fowler, *A Year with the Birds* (on Virgil's bird-lore); Nettleship, *Essays in Latin Literature* (1884); Tyrrell, *Latin Poetry* (1898); Patin, *Essais sur la poésie Latine* (4th ed. 1900) (one of the finest critics of Latin literature); Goumy, *Les Latins* (1892) (a volume of very bright essays); J. W. Mackail, *Latin Literature* (3rd ed. 1899); H. W. Garrod, *Vergil* (1912); T. Frank, *Vergil. A biography* (1922); J. W. Mackail, *Virgil and his meaning to the world of to-day* (1923).

THE VIRGIL LEGEND

Virgil's great popularity in the middle ages is to be partly explained by the fact that he was to a certain extent recognized by the Church. He was supposed to have prophesied the coming of Christ in the fourth *Eclogue,* and by some divines the *Aeneid* was held to be an allegory of sacred things. This position was sufficiently emphasized by Dante when he chose him from among all the sages of antiquity to be his guide in the *Divina Commedia.* Ancient poets and philosophers were commonly transformed by mediaeval writers into necromancers; and Virgil and Aristotle became popularly famous, not for poetry and science, but for their supposed knowledge of the black art. Naples appears to have been the home of the popular legend of Virgil, which represented him as the special protector of the city, but was probably never quite independent of learned tradition.

One of the earliest references to the magical skill of Virgil occurs in a letter of the imperial chancellor Conrad of Querfurt (1194), reproduced by Arnold of Lübeck in the continuation of the *Chronica Slavorum* of Helmold. John of Salisbury alludes to the brazen fly fabricated by Virgil; Hélinand (d. 1227) speaks of similar marvels in a work from which Vincent of Beauvais has borrowed; and Gervase of Tilbury, in his *Otia Imperialia* (1212), and Alexander of Neckam (d. 1217), in *De Naturis Rerum,* have reproduced these traditions. Many current tales of magic were referred to Virgil, and gradually developed into a completely new life, strangely different from that of the real hero. They were collected in French under the title of *Les Faitz Merveilleux de Virgille* (*c.* 1499), a quarto chapbook of ten pages, which became extremely popular, and was printed, with more or

less additional matter, in other languages. The English version, beginning "This is resonable to wryght the mervelus dedes done by Virgilius," was printed about 1520. We are told how Virgil beguiled the devil at a very early age, in the same fashion as the fisherman persuaded the jinnee in the *Arabian Nights* to re-enter Solomon's casket. Another reproduction of a widely spread tale was that of the lady who kept Virgil suspended in a basket. To revenge the affront the magician extinguished all the fires in the city, and no one could rekindle them without subjecting the lady to an ordeal highly offensive to her modesty. Virgil made for the emperor a castle in which he could see and hear everything done or said in Rome, an ever-blooming orchard, statues of the tributary princes which gave warning of treason or rebellion, and a lamp to supply light to the city. He abducted the soldan's daughter, and built for her the city of Naples upon a secure foundation of eggs. At last, having performed many extraordinary things, he knew that his time was come. In order to escape the common lot he placed all his treasures in a castle defended by images unceasingly wielding iron flails, and directed his confidential servant to hew him in pieces, which he was to salt and place in a barrel in the cellar, under which a lamp was to be kept burning. The servant was assured that after seven days his master would revive, a young man. The directions were carried out; but the emperor, missing his medicine-man, forced the servant to divulge the secret and to quiet the whirling flails. The emperor and his retinue entered the castle and at last found the mangled corpse. In his wrath he slew the servant, whereupon a little naked child ran thrice round the barrel, crying, "Cursed be the hour that ye ever came here," and vanished.

For the legends connected with Virgil *see* especially D. Comparetti, *Virgilio nel medio evo* (2nd ed., Florence, 1896; English trans. E. F. M. Benecke, 1895). The chief original source for the Neapolitan legends is the 14th-century *Cronica di Partenope*. *See* further W. J. Thoms, *Early Eng. Prose Romances* (1858); G. Brunet, *Les Faitz merveilleux de Virgile* (Geneva, 1867); E. Duméril, "Virgile enchanteur" (*Mélanges archéologiques,* 1850); Gervase of Tilbury, *Otia Imper.* (ed. Liebrecht, 1856); P. Schwubbe, *Virgilius per mediam aetatem* (Paderborn, 1852); Siebenhaar, *De fabulis quae media aetate de Virgilio circumf.* (Berlin, 1837); J. G. T. Graesse, *Beiträge zur Lit. u. Sage des Mittelalters* (1850); Bartsch, "Gedicht auf. d. Zaub. Virgil" (Pfeiffer's *Germania,* iv. 1859); F. Liebrecht, "Der Zauberer Virgilius" (ibid. x. 1865); K. L. Roth, "Über d. Zaub. Virgilius" (ibid. iv. 1859); W. Victor, "Der Ursprung der Virgilsage" (*Zeit. f. rom. Phil.* i. 1877); A. Graf, *Roma nella memoria e nelle imaginazioni del medio evo* (Turin, 1882); F. W. Genthe, *Leben und Fortleben des Publius Virgilius Maro als Dichter und Zauberer* (2nd ed., Magdeburg, 1857).

VIRGIL, POLYDORE (*c.* 1470–1555), English historian, of Italian extraction, otherwise known as P. V. CASTELLENSIS, was a kinsman of Cardinal Hadrian Castellensis, a native of Castro in Etruria. His father's name is said to have been George Virgil; his great-grandfather, Anthony Virgil, "a man well skilled in medicine and astrology," had professed philosophy at Paris, as did Polydore's own brother and protégé John Matthew Virgil, at Pavia, in 1517. A third brother was a London merchant in 1511. Polydore was born at Urbino, is said to have been educated at Bologna, and was probably in the service of Guido Ubaldo, duke of Urbino, before 1498, as in the dedication of his first work, *Liber Proverbiorum* (April 1498), he styles himself this prince's client. Polydore's second book, *De Inventoribus Rerum,* is dedicated to Guido's tutor, Ludovicus Odaxius, from Urbino, in Aug. 1499. After being chamberlain to Alexander VI. he came to England in 1501 as deputy collector of Peter's pence for the cardinal. As Hadrian's proxy, he was enthroned bishop of Bath and Wells in Oct. 1504. It was at Henry VII.'s instance that he commenced his *Historia Anglica* (1534), on which he had been engaged for nearly 30 years. A rash letter, reflecting severely on Henry VIII. and Wolsey, was intercepted early in 1515, after which Polydore was cast into prison for several months, and supplanted in his collectorship (March and April). In 1525 he published the first edition of *Gildas,* dedicating the work to Tunstall, bishop of London. Next year appeared his *Liber de Prodigiis,* dedicated from London (July) to Francesco Maria, duke of Urbino. Somewhere about 1538 he left England, and remained in Italy for some time. About the end of 1551 he went home to Urbino, where he appears to have died in 1555. He had been naturalized an Englishman in Oct. 1510, and had held several clerical appointments in England. In 1508 he was appointed archdeacon of Wells, and in 1513 prebendary of Oxgate in St. Paul's cathedral, both of which offices he held after his return to Urbino.

The first edition of the *Historia Anglica* (26 books) was printed at Basle in 1534; the 27th book, dealing with the reign of Henry VIII. down to the birth of Edward VI. (October 1536), was added to the third edition of 1555. It is mainly from the time of Henry VI. that Polydore's work is useful.

Polydore's *Adagia* (Venice, April 1498) was the first collection of Latin proverbs ever printed; it preceded Erasmus's by two years, and the slight misunderstanding that arose for the moment out of rival claims gave place to a sincere friendship. A second series of Biblical proverbs (553 in number) was dedicated to Wolsey's follower, Richard Pace, and is preceded by an interesting letter (June 1519), which gives the names of many of Polydore's English friends, from More and Archbishop Warham to Linacre and Tunstall. The *De Inventoribus* treating of the origin of all things whether ecclesiastical or lay (Paris, 1499), originally consisted of only seven books, but was increased to eight in 1521. It was exceedingly popular, and was early translated into French (1521), German (1537), English (1546) and Spanish (1551). All editions, however, except those following the text sanctioned by Gregory XIII. in 1756, are on the Index Expurgatorius. The *De Prodigiis* also achieved a great popularity, and was soon translated into Italian (1543), English (1546) and Spanish (1550).

VIRGINAL or **PAIR OF VIRGINALS,** a name applied in England (and also recognized on the Continent of Europe) to the spinet as being pre-eminently an instrument for girls. (For further particulars *see* PIANOFORTE.)

VIRGINIA or **VERGINIA,** in Roman legendary history, daughter of L. Virginius, a plebeian centurion. Her beauty attracted the notice of the decemvir Appius Claudius, who instructed Marcus Claudius, one of his clients, to claim her as his slave. Marcus accordingly brought her before Appius, and asserted that she was the daughter of one of his female slaves, who had been stolen and passed off by the wife of Virginius as her own child. Appius, refusing to listen to any argument, declared Virginia a slave and the property of Marcus. Virginius thereupon stabbed her to the heart in the presence of Appius and the people. A storm of popular indignation arose and the decemvirs were forced to resign. The people for the second time "seceded" to the Sacred Mount, and refused to return to Rome until the old form of government was re-established.

See Livy iii. 44–58; Dion. Halic. xi. 28–45, whose account differs in some respects from Livy's; Cicero, *De finibus,* ii. 20; Val. Max. vi. 1, 2; for a critical examination of the story and its connection with the downfall of the decemvirs, *see* Schwegler, *Röm. Gesch.,* bk. xxx. 4, 5; E. Pais, *Ancient Legends of Roman History* (Eng. trans. 1906), p. 185.

VIRGINIA, "The Old Dominion," is the most southerly of the middle Atlantic group of states in the United States of America, and lies between 36° 32′ and 39° 27′ N. lat., and 75° 15′ and 83° 41′ W. long. The Potomac river separates it on the north from Maryland, except east of Chesapeake bay where the boundary is a parallel of latitude, and another east-west line separates it on the south from North Carolina and Tennessee. On the east lies the Atlantic ocean, along which the state possesses a tidal shore line, following indentations, of 780 miles. The states of Kentucky and West Virginia form the western boundary. The total land area is 39,899 sq.mi.; there are 916 sq.mi. of inland water area.

In length east and west along the southern boundary the state measures about 430 mi., its extreme breadth north and south is about 200 miles. The state is the remnant of a much greater area named by Sir Walter Raleigh "Virginia" in honour of Queen Elizabeth, who was known as "The Virgin Queen."

Physiography.—Virginia is crossed from north-east to south-west by three distinct physiographic provinces, which, named from east to west, are: (1) The Coastal plain or Tidewater region, including the Eastern Shore; (2) The Piedmont plateau; (3) the Appalachian Mountain province. The latter is sometimes subdivided (from east to west) into the Blue Ridge, Great valley and Allegheny ridges. The Tidewater province occupies about 11,000 square miles. Once the plain of which it is formed was raised to a higher elevation above sea level than now, and it was much dissected by streams. When it was subsequently depressed, the sea invaded these stream valleys to form the branching bays which characterize the region. Chief of these are the long estuaries of the lower Potomac, Rappahannock, York and James rivers. Chesapeake bay, into which these flow, is itself the drowned lower course of the Susquehanna. The land between these arms of the ocean is relatively flat. In the south-east, where

the drainage is particularly poor, is the Great Dismal Swamp (*q.v.*), a fresh-water marsh covering 700 square miles. Along the shores of Chesapeake bay and the Atlantic ocean are low, sandy beaches, often enclosing lagoons or salt marshes. Westward the Tidewater province reaches to the "fall-line" of the rivers, approximated by a line drawn north and south through Richmond.

The largest of the physiographic provinces, the Piedmont plateau, extends from an elevation of 150 to 300 ft. along the "fall-line" westward to an elevation of 700 to 1,200 ft. along the foot of the Blue Ridge. It varies in width from 40 m. in the north to about 175 m. along the southern border. The sloping surface is gently rolling, and has resulted from the uplift and dissection of a nearly level plain of erosion developed on folded crystalline rocks. Occasional hard rock ridges rise to a moderate elevation.

The mountain belt known as the Blue Ridge, from 3 to 20 m. in breadth, passes entirely across the State from north-east to south-west and forms the division between the Piedmont plateau and the Great valley. In elevation it varies from 1,460 ft. at Harper's Ferry, where the Potomac breaks through it in a picturesque water-gap, to 5,719 ft. in Mt. Rogers, Grayson county, the highest point in the State. In the north the range is narrow, but southward it broadens toward a greater expansion in west North Carolina and east Tennessee. Most of the rivers flowing through the Piedmont district to the Tidewater region have their origin on the eastern slopes of the Blue Ridge, but two of the largest, the James and Roanoke rivers, have cut passes through from the Great valley where they have their origin.

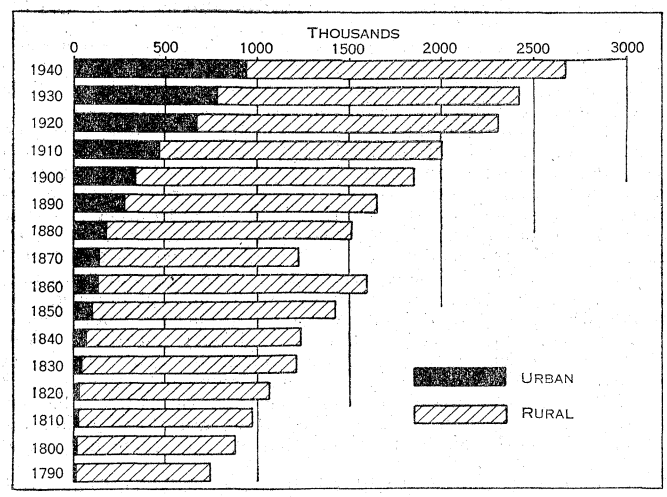
The Great valley is in its general configuration one continuous valley between the two great mountain ranges extending diagonally across the State, but it is drained by five separate rivers, each with its separate valley. The Shenandoah river drains the northern one-third and flows north into the Potomac at Harper's Ferry. The middle one-third is drained by the upper tributaries of the James and Roanoke rivers which break through the Blue Ridge and flow east. The southern one-third of the valley is drained by the New river, which breaks through the Allegheny ridges to the west and flows to the Ohio, and by the Holston river, which flows south-west into Tennessee. The valley averages from 25 to 30 m. in width and rises in elevation from 300 ft. at Harper's Ferry to about 1,700 ft. in south-west Virginia. Its formations are mostly of limestone, which accounts for the many remarkable caves in the region, and the famous Natural bridge, 215 ft. high, in Rockbridge county.

The altitude of the mountainous ridges to the west of the Great valley varies from 1,500 to above 4,000 feet. Some of the valleys and slopes are of sandstone, some of slates and shales, some of limestone, so that they present a great variety of surface.

The rainfall is everywhere sufficient for farming. Snowfall is confined almost entirely to the three winter months and in the Piedmont and Tidewater region snow is infrequent and of short duration. In the mountains it often becomes very deep.

Flora.—The Coastal plain is covered with pine forests, which merge westward with the hard woods of the Piedmont section, where oaks formerly prevailed, but where a second growth of pine now constitutes part of the forest. The Blue Ridge and Allegheny regions are covered with pine, hemlock, white oak, cherry and yellow poplar; while toward the south-west corner of the State there are still groves of walnut and hickory. The cypress grows in the Dismal swamp, the river birch along the streams of the coastal plain, and sweet gum and black gum where the ground is swampy. Characteristic plants of the coastal region are the cranberry, wild rice, wild yam, wax myrtle, wistaria, trumpet flower, passion flower, holly and white alder. Many of these continue into the Piedmont section. Rhododendron, mountain laurel and azaleas are common in the mountains.

Population.—The population of Virginia in 1790 was 747,610; in 1820 it was 1,065,366; in 1850, 1,421,661; in 1880, 1,512,565; in 1910, 2,061,612; and in 1940, 2,677,773. This last figure represents an increase of 10·6% over the population in 1930. The population per square mile was 67·1, as compared with 44·2 for the United States as a whole. Of the 1940 population, 944,675, or 35·3%, lived in urban areas, these comprising all cities and towns of 2,500 or more, and the whole of Arlington county, which is suburban to Washington, D.C. The number of occupied dwelling units returned in the housing census of 1940 was 627,659, which is approximately the same as the number of families.



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URBAN AND RURAL POPULATION OF VIRGINIA: 1790–1940

The average population per family (occupied dwelling unit) declined from 4·6 in 1930 to 4·3 in 1940. The white population of Virginia formed 75·2% of the total in 1940, as compared with 73·1% in 1930, practically all the nonwhite population being Negro. The number of males per 100 females in the entire population of the state was 101·7, the sex ratio being 101·8 for the white and 101·7 for the nonwhite population. The number of persons 65 years old and over in Virginia increased from 116,678, or 4·8% of the total population, in 1930 to about 152,500, or 5·7%, in 1940. The population of the state and of its principal cities is summarized for recent censuses in the following table:

Area	Population			Percent of increase	
	1940	1930	1920	1930–40	1920–30
The State	2,677,773	2,421,851	2,309,187	10·6	4·9
Urban	944,675	785,537	673,984	20·3	16·6
Rural	1,733,098	1,636,314	1,635,203	5·9	0·1
Percent urban	35·3	32·4	29·2	..	..
Principal cities:					
Richmond	193,042	182,929	171,667	5·5	6·6
Norfolk	144,332	129,710	115,777	11·3	12·0
Roanoke	69,287	69,206	50,842	0·1	36·1
Portsmouth	50,745	45,704	54,387	11·0	—16·0
Lynchburg	44,541	40,661	30,070	9·5	35·2
Newport News	37,067	34,417	35,596	7·7	—3·3
Alexandria	33,523	24,149	18,060	38·8	33·7
Danville	32,749	22,247	21,539	47·2	3·3
Petersburg	30,631	28,564	31,012	7·2	—7·9

Government.—Virginia has had six State Constitutions: the first was adopted in 1776, the second in 1830, the third in 1851, the fourth in 1864, the fifth in 1869 and the sixth, the present, in 1902. Amendments to the present Constitution may be proposed in either house of the general assembly, and if they pass both houses of that and the succeeding general assembly by a majority of the members elected to each house and are subsequently approved by a majority of the votes polled at the next general election they become a part of the Constitution. A majority of the members in each house of the general assembly may at any time propose a convention to revise the Constitution and, if at the next succeeding election a majority of the voters approve, the general assembly must provide for the election of delegates. To be entitled to vote one must be a citizen of the United States and 21 years of age; have been a resident of the State for one year, of the county, city or town for six months, and of the election precinct for 30 days next preceding the election.

The general assembly consists of a senate and a house of delegates. Senators and delegates are elected by single districts (into which the State is supposed to be apportioned once every ten years according to population), the senators for a term of

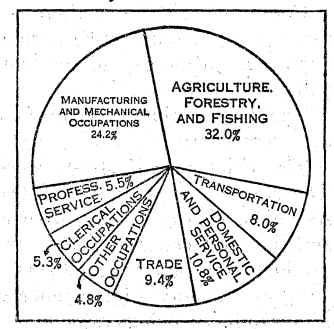
four years, the delegates for a term of two years. The membership of both the senate and the house was in 1937 at the maximum allowed by the state constitution, 40 senators and 100 delegates. The general assembly meets regularly at Richmond on the second Wednesday in January of each even-numbered year. The length of a regular session is limited to 60 days unless three-fifths of the members of each house concur in extending it.

The governor, lieutenant-governor and attorney-general are elected for a term of four years. The governor appoints the secretary of the commonwealth, treasurer, superintendent of public buildings, commissioner of agriculture, controller and numerous officers with the concurrence of the general assembly. He has the power of vetoing legislative bills or any item of an appropriation bill (a bill can be passed over his veto by a two-thirds vote of the members present in each house), and has authority to inspect the records of officers or to employ accountants to do so, and to suspend, during a recess of the general assembly, any executive officer at the seat of government except the lieutenant-governor.

A consolidation and reorganization of administrative bodies was effected by a legislative act in 1927 which created 12 administrative departments, namely, the departments of taxation, finance, highways, education, corporations, labour and industry, agriculture and immigration, conservation and development, health, public welfare, law, and workmen's compensation.

The administration of justice is vested in a supreme court of appeals, circuit courts, city courts and justices of the peace. The supreme court of appeals consists of seven judges, but any three of them may hold a court or they may sit in two divisions of not less than three judges each except in cases involving constitutional questions, when the full court is required. They are chosen for a term of 12 years by the joint vote of the two houses of the general assembly. The court sits at Richmond, Staunton and Wytheville. Provision is made for a special court of appeals where the majority of the judges of the supreme court may not properly sit or where the docket of that court is too crowded to be disposed of "with convenient dispatch." The State is divided into 34 judicial circuits and in each of these a circuit judge is chosen for the term of eight years by a joint vote of both houses of the general assembly. Similar to the circuit court is the corporation court in each city having a population of more than 10,000, the judge of which is also chosen by a joint vote of both houses for a term of eight years.

Finance.—The value of all tangible property in the State had increased from $1,288,000,000 ($666 per caput) in 1904 to $2,402,000,000 ($1,140 per caput) in 1912 and $4,892,000,000 ($2,050 per caput) in 1922 as estimated by the Federal Census Bureau. The valuation of property assessed for taxation purposes in 1939 amounted to $2,209,351,355, of which $1,179,641,432 was real estate. In 1939 real estate and tangible personal property were locally taxed, the taxation rates per $100 assessed valuation were 75 cents on intangible property, except capital, which was $1.00, bonds of counties, cities and towns which were 50 cents, shares of bank stock which were $1.00, and money which was 20 cents. Receipts and disbursements of the state treasury during the fiscal year ending June 30, 1940, amounted to $83,938,725 and $85,489,886 respectively.



OCCUPATIONS OF THE 880,211 PERSONS TEN YEARS OF AGE AND OVER ENGAGED IN GAINFUL EMPLOYMENT, 1930

The chief items of expenditure were for the construction and maintenance of roads, $26,945,978; for the support of education, $21,843,946; for net additions to funds, $6,200,381; for unemployment compensation commission, $5,945,872; for the department of public welfare, $8,968,123; for the department of health, $2,338,159; for finance, executive and judicial agencies, $5,074,789; and $997,100 for conservation. The total outstanding state debt amounted in 1940 to $20,580,853, or $7.69 per caput. Of this aggregate debt $19,515,732 was funded.

Education.—The Virginia free school system, established in 1870, is controlled by the state board of education, composed of seven members appointed by the governor. The chief executive of the system is the superintendent of public instruction also appointed by the governor.

The constitution provides that white and Negro children shall be taught in different schools. Attendance is compulsory for children from 8 to 14 years of age, except for pupils of high school grade.

The school census of 1940 recorded 712,081 children in the state from 5 to 17 years of age, of whom 195,427 were Negroes. Of the total 556,552 were enrolled in public schools during the 1939–40 session. In addition there were approximately 17,281 in private and parochial schools, of which Virginia has a large number. The average length of school term was 180.2 days.

There were 130,518 pupils enrolled in the public secondary schools of the state, and 7,271 registered in the private high schools. The average daily attendance in the public school system in 1940 was 494,023 and the average number of days attended per year per pupil enrolled was 154.9.

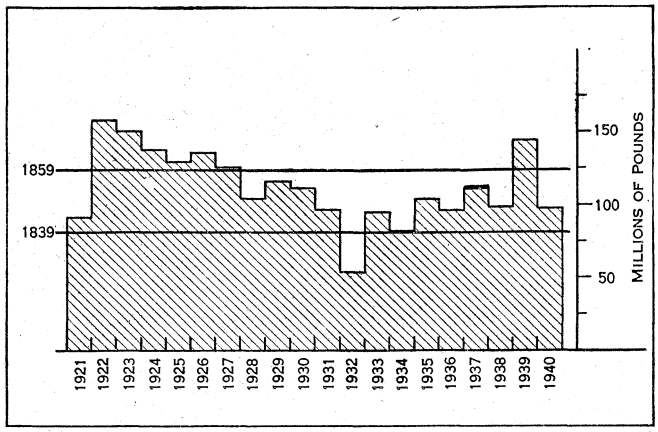
There were 17,734 school teachers in the public school system in 1940. Their total salary was $16,883,626, or $952 each. Total expenditures for the public schools in 1939–40 amounted to $31,466,399 as compared to $22,318,000 in 1932. This amounted to $11.75 per capita of population, or $44.19 for each child of school age.

Institutions for higher learning receiving state support are the University of Virginia at Charlottesville, the College of William and Mary at Williamsburg, the Virginia Polytechnic institute at Blacksburg, the Medical College of Virginia at Richmond, the Virginia Military institute at Lexington, four state teachers colleges for women, located at Farmville, Fredericksburg, Harrisonburg and Radford. These are for whites. The state supports one normal school for Negro teachers at Petersburg, and in addition there is the Hampton Normal and Industrial institute at Hampton, supported by endowment. Special schools are the Virginia School for the Deaf and Blind at Staunton, and the Virginia school for the Negro deaf and blind at Newport News. Important private institutions of higher learning are: for men, Washington and Lee university at Lexington, Roanoke college at Salem. University of Richmond, which includes Westhampton college (for women), Emory and Henry college at Emory, Hampden-Sydney college at Hampden-Sydney, Bridgewater college at Bridgewater, Randolph-Macon college at Ashland and Lynchburg college; for women, Hollins college at Hollins, Randolph-Macon Woman's college at Lynchburg, and Sweet Briar college at Sweet Briar. Virginia Union university at Richmond is for Negro students. For theological education there are the Theological seminary at Alexandria (Episcopal) and the Union Theological seminary at Richmond (Presbyterian).

Charities and Corrections.—The department of public welfare has for its duties the inspection of all state, county, municipal and private institutions of a charitable or correctional nature, or those which have to do with the care or training of defective, dependent, neglected or criminal classes. It also enforces the juvenile and probations laws, inspects maternity hospitals, child-placing agencies, children's nurseries and orphan homes and administers mother's aid to widows with children under 16 years of age. The state penitentiary is located at Richmond, and there is a state penitentiary farm at Lassiter. There is a state home and industrial school for white girls at Bon Air and for Negro girls at Peaks Turnout, a state industrial school for white boys at Beaumont and for Negro boys at Hanover.

Agriculture and Livestock.—Agriculture is an important industry of Virginia. Its fluctuating fortunes are revealed by the following figures. Value of land and buildings amounted in the year 1920 to $1,024,435,000, in 1930 to $855,850,000 and in 1935 to $593,855,000. The amount of land in farms fell from 19,908,000 ac. in 1900 to 18,561,000 ac. in 1920 and 17,645,000 ac. in 1935 or from slightly more than three-fourths the area of the

State in 1900 to approximately two-thirds the area in 1935. Despite this loss in acreage the number of farms increased from 170,610 in 1930 to 197,632 in 1935, their average size decreasing from 98·1 ac. in 1930 to 89·3 ac. in 1935. The average value per acre of farm land decreased between 1920 and 1930 from $40.75 to $30.24. Farm population was 950,757 (39·3% of the total) in 1930 and 1,053,469 (39·9% of the total) in 1935. Of the 197,632



TOBACCO CROP EACH YEAR, 1921–1940. ALSO IN 1839–1859, INDICATED BY THE HORIZONTAL LINES CROSSING THE FIGURE

farms in 1935, 138,139 were operated by their owners, 58,386 by tenants and 1,107 by managers. Rural population (outside cities of more than 2,500) was 1,733,098 in 1940.

The total harvested acreage of principal crops in 1940 was estimated at 3,791,000, slightly below the ten-year average (1929–38) of 3,842,000 ac. harvested. Cash farm income in 1940 amounted to $120,914,000, of which $63,534,000 represented income from crops and $57,380,000 income from livestock and livestock products. Government payments of $4,724,000 brought the total farm income of the state to $125,638,000. In 1939 cash farm income and government payments were $115,713,000 and $6,288,000 respectively; in 1938, $120,435,000 and $4,083,000.

In 1940 Virginia ranked fourth among the states in the production of tobacco, with 97,540,000 lb. of all types. This output, compared with the production of 143,847,000 lb. in 1939, was typical of the sharp curtailment which resulted from the outbreak of war in Europe. Virginia ranked sixth in production of peanuts in 1940, and third in production of apples. The acreage of leading crops in 1940 was as follows: corn, 1,377,000; wheat, 546,000; tame hay 1,091,000; tobacco, 114,000; peanuts, 169,000; potatoes, 76,000; rye, 48,000; cotton, 31,000. The production figures for these crops, with the yield per acre indicated in parentheses, was as follows: corn, 36,490,000 bu. (26·5); wheat, 8,463,000 bu. (15·5); tame hay, 1,252,000 tons (1·15); tobacco, 97,540,000 lb. (856); peanuts, 202,800,000 lb. (1,200); potatoes, 10,412,000 bu. (137); rye, 576,000 bu. (12·0); cotton, 25,000 bales (385 lb.). Of minor value were barley, soybeans, pears, cowpeas, grapes, buckwheat and sorghums. The great acreage of tobacco, potatoes and truck crops gives Virginia a high rank in the average value per acre of all crops. Tobacco is the most important strictly money crop. With few exceptions its cultivation is confined to the section east of the Blue Ridge and west of the fall-line, and, excepting portions of a half-dozen counties, south of the James river. The Great valley and the Allegheny valleys are unsurpassed hay regions. Clover, timothy, herdsgrass or red-top, and alfalfa grow anywhere in the State. Long seasons and abundant rainfall give several cuttings. Wheat is the principal money crop in the Shenandoah and Rappahannock river valleys.

Cotton and peanuts are grown almost entirely in the south-eastern counties, where they constitute a large share of the farm income.

The number and value of livestock on farms Jan. 1, 1941 were as follows: horses, 166,000, $16,732,000; mules, 95,000, $12,889,000; milch cows, 446,000, $22,746,000; other cattle, 521,000, $17,433,000; sheep, 379,000, $2,760,000; swine, 688,000, $4,610,000; chickens, 9,968,000, $7,077,000.

Fisheries.—Virginia has about 3,000 sq.mi. of tidal waters along the eastern coast and in Chesapeake bay where commercial fishing proves very profitable. In 1929 the season's catch totalled 211,285,000 lb.; value, $7,285,700. In 1938 it amounted to 237,331,000 lb.; value, $4,403,200. In value the 1938 catch exceeded that of all other Atlantic and Gulf States, except Massachusetts and New York. The season is usually about 5½ months in the spring and summer, and employs about 30,000 men. Chesapeake bay produces more oysters than any other body of water in the world, and Maryland and Virginia lead all states in oyster production with over 5,000,000 bu. annually. There were in Virginia in 1925 56,744 ac. of recorded oyster-planting grounds, the chief locations beside Chesapeake bay being Chincoteague bay, the western shore of Accomac and Northampton counties, and the Potomac, Rappahannock, York and James rivers.

Mines and Quarries.—Virginia's mineral resources are abundant and varied. Many are as yet undeveloped. In 1929 there were 196 mines and quarries which employed 15,015 workers. The value of mineral production reached $39,753,000 in 1929; thereafter, due to the world-wide economic depression, it fell sharply. In 1932 mineral production was valued at only $16,927,000; but by 1938 it had reached $42,370,169. In that year the chief mineral products in order of value were: coal, $24,054,000; stone, $5,606,470; sand and gravel, $2,186,111; clay products, $1,855,876; and lime, $1,014,607. Coal is found in Virginia in three important districts. The Pennsylvania coal measures extend into the seven Allegheny counties in the extreme south-western corner and it is from here that the bulk of the output comes. In Tazewell county is the famous Pocahontas bed which produces one of the highest grades of coking and steam coal to be found in the United States. There is a coal field of Mississippian age in the counties of the Great valley bordering the New river, in which production is still light, but rapidly increasing. Just a short distance west of Richmond is a third bed, one of the first in the United States to be mined, though not now a producer. There are rich deposits of iron ore in the Alleghenies and western slopes of the Blue Ridge and iron mining has been carried on since the 17th century. Rocks quarried for various uses included granite, limestone, marble, sandstone, slate and basalt, and of all there are practically unlimited quantities.

Manufactures.—In this branch of industry there has been rapid growth. In 1914 there were 5,508 establishments employing 102,820 wage earners and having an output valued at $264,039,000. In 1929 there were 3,252 establishments employing 119,110 wage earners, and turning out products valued at $730,470,008. Wages paid in the state increased from $44,873,000 in 1914 to $117,576,116 in 1929.

Compared with 1929 there were in 1939, 605 fewer establishments, 14,786 more wage earners, $2,037,494 less paid in wages, $256,294,226 more paid for materials, and $258,343,238 more in value of production.

The total value of manufactures in 1940 was estimated at $1,040,000,000.

The chief manufactures were those connected with tobacco. The state in 1939 ranked fourth in the manufacture of cigars, second in cigarettes, and fifth in the production of chewing and smoking tobacco and snuff. In that year the value of tobacco products reached $352,490,441, an increase over 1935 of $118,147,769. Second in importance were the textile industries, cotton-mill products being valued at $31,871,947, silk and all rayons at $80,334,030 and woollen-mill products at $7,981,079. Lumber and wood products are probably third in importance as a class. The output of sawmills in the state was valued at $18,559,755, of planing-mill products at $10,714,072, of furniture factories at $31,283,358, of box and crate factories at $1,833,398, of cooperage, barrels and staves at $871,631. Other products ranking high among the manufactures of the state were those of shipbuilding plants, $65,126,212; chemical plants, $33,554,440; paper manufactures, $26,750,860; railroad repair shops, $25,122,541; fertilizer factories, $19,377,213; flour and grain mill products, $14,338,259; wood pulp, $17,072,846; bread and bakery products, $12,193,874; knitted goods, $17,031,334; men's work cloth-

ing, $11,212,678; newspaper and periodical printing and publishing, $9,762,385.

The chief manufacturing city in 1939 was Richmond with 326 establishments, 18,326 wage earners, and products valued at $373,146,751.

Tobacco products predominate and Richmond in 1939 had the largest cigar factory in the world. Here are also large paper mills and woodwork plants. Far behind in the value of their products were Norfolk, $56,281,223; Lynchburg, $26,481,871; and Portsmouth, $11,108,110.

Virginia has the advantages of excellent transportation, high-grade steam coal and abundant water-power resources. Where the Tidewater region joins the Piedmont section there is an abrupt rocky ledge that forms falls and rapids in the rivers that pour over it.

At this fall-line with its excellent power sites are the cities of Petersburg, Richmond and Fredericksburg, while Alexandria is located near the falls of the Potomac.

Transportation and Commerce.—Five large railway systems practically originate in the State and radiate to the south and west. The Southern railway, with its main line traversing the State in the direction of its greatest length leaves Washington to run south-west through Charlottesville, Lynchburg and Danville to the North Carolina line with connections to Richmond and Norfolk on the east; the Atlantic Coast line with its main lines runs south from Richmond and Norfolk; the Seaboard Air line also has its main lines running to the south from Richmond and Norfolk; the Norfolk and Western crosses the State from east to west in the southern part with Norfolk its eastern terminus and the Chesapeake & Ohio crosses from east to west farther north from Newport News on the eastern coast through Richmond to the West Virginia line. Of more recent construction is the Virginia railway, opened for traffic in 1909, which connects the coal region of West Virginia with Norfolk. The Baltimore & Ohio has a line down the Shenandoah valley to Lexington. Connection between Richmond and Washington is over the Richmond, Fredericksburg and Potomac, controlled by the Southern, Atlantic Coast line, Seaboard Air line, Chesapeake & Ohio, Pennsylvania and Baltimore and Ohio railways.

Hampton Roads, at the mouth of the James river, which forms the harbour for the leading ports of the State, Norfolk and Newport News, affords one of the best anchorages of the Atlantic coast, giving shelter not only to vessels plying to its adjoining ports but serving often as a harbour of refuge for shipping bound up or down the coast. It is frequently used for the assembly of naval fleets. There is a large foreign commerce and regular steamship service to Boston, Providence, New York, Philadelphia and Savannah. There is bay and river steamship service from Norfolk, Old Point Comfort and Newport News to Baltimore, Washington, Fredericksburg, Richmond and Petersburg.

There were in 1941, 47,900 mi. of public highways in Virginia, 46,945 of which constitute the state system of primary and secondary roads. Of the 9,404 mi. in the primary system 8,453 mi. were surfaced; of the 37,541 mi. in the secondary system, 6,185 mi. were surfaced. Expenditures by the state highway department in 1940 were $26,945,978, of which federal aid for road construction was $7,071,410. Motor vehicles numbered 540,810.

HISTORY

Virginia was the first permanent English settlement in North America. From 1583 to 1588 attempts had been made by Sir Walter Raleigh and others to establish colonies on the coast of what is now North Carolina. The only result was the naming of the country Virginia in honour of Queen Elizabeth. But glowing accounts were brought back by the early adventurers, and in 1606 an expedition was sent out by the London Company, which was chartered with rights of trade and settlement between 34° and 41° N. lat. It landed at Jamestown on May 14, 1607, and effected the establishment of many plantations along the James river. The purpose of the company was to build up a profitable commercial and agricultural community, and also to hold the country against Spain; but the hostility of the natives, unfavourable climatic conditions and the inexperience of the colonists delayed the growth of the new community. John Smith became the head of the government in Sept. 1608, governed with firmness and ability, built a church and prepared for more extensive agricultural and fishing operations. In 1609 the London Company was reorganized, other colonists were sent out and the boundaries of the new country were fixed, according to which Virginia was to extend from a point 200 m. south of Old Point Comfort, at the mouth of Chesapeake bay, to another point 200 m. north, "west and northwest to the South Sea."

Before the arrival of the new governing body and additional settlers the original Colony was reduced to the direst straits. Capt. Christopher Newport, Sir Thomas Gates and Sir George Somers, the new authorities, reached Jamestown at last with 150 men, but things were in such a deplorable state that all agreed (June 7, 1610) to give up the effort to found a colony on the James and set sail for home. At the mouth of the river they met Lord de la Warr, the governor-in-chief, who brought other colonists and plentiful supplies; and they returned, set up a trading post at what is now Hampton and undertook to bring the hostile natives into subjection. In 1611, 650 additional colonists landed, the James and Appomattox rivers were further explored and "plantations" were established at Henrico and Bermuda Hundred. New colonists were constantly being sent over and many "indentured" servants were imported as labourers.

Struggles for Self-Government.—At the beginning Virginia colonists had held their land and improvements in common. But in 1616 the land was parcelled out and the settlers were scattered along the banks of the James and Appomattox rivers many miles inland. The rapid expansion of tobacco culture soon made the community self-supporting. The year 1619 that saw the first Negroes brought in also saw the first representative assembly in North America, the Virginia House of Burgesses, a meeting of planters sent from the plantations to assist the governor and council in reforming and remaking the laws of the Colony. In 1621, a Constitution was granted whereby the London Company appointed the governor and a council, and the people were to choose annually from their counties, towns, hundreds and plantations delegates to the House of Burgesses. The popular branch, like the English House of Commons, granted supplies and originated laws, and the governor and council enjoyed the right of revision and veto as did the king and the House of Lords at home. Later the council also originated bills. The council sat also as a supreme court to review the county courts and had in important cases original jurisdiction. This system remained unchanged throughout the colonial period but in 1624 the king took the place and exercised the authority of the London Company.

On March 22, 1622, the Indians fell upon the whites and slew 350 persons. Sickness and famine once again visited the Colony, and the population was reduced by nearly one-half. These losses were repaired, however; the tobacco industry grew in importance and the settlers built their cabins far in the interior of lowland Virginia. This rapid growth was scarcely retarded by a second Indian attack, in April 1644, which resulted in the death of several hundred settlers. By 1648 the population was 15,000.

In her attitude toward the war in England between King Charles and parliament, Virginia sympathized with the king. However, though Sir William Berkeley, who had been governor since 1641, was absolutely loyal to the crown, it was considered the part of wisdom to surrender to a fleet sent over by parliament in 1652, after a slight show of resistance; but substantial acknowledgments were made by the parliamentary commissioners of Virginia's rights. Richard Bennett, a Puritan, now ruled the province. He and his Puritan successors, Edward Digges and Samuel Mathews, made no serious change in the administration of the Colony. The return of Berkeley, who was restored to power in 1660, was the beginning of a reaction which concentrated authority in the hands of the older families and thus created a privileged class. The governor, supported by the privileged families, retained the same House of Burgesses for 16 years lest a new one might not be submissive. The increasing mass of the population who dwelt along the western border and on the less fertile ridges developed

a feeling of hostility towards the oligarchy. They desired a freer land-grant system, protection against the inroads of the Indians along the border and frequent sessions of an assembly to be chosen by all the free-holders. In 1676 the Indians again attacked the border farmers, but the governor had refused assistance, being willing, it was charged, that the border population should suffer while he and his adherents enjoyed a lucrative fur trade with the Indians. Under these circumstances Nathaniel Bacon (1647–76), took up the cause of the borderers and severely punished the Indians at the battle of Bloody Run. Berkeley meanwhile had outlawed Bacon, whose forces now marched on the capital demanding recognition as the authorized army of defence. This was refused and civil war began, in which the governor was defeated and Jamestown was burned. But Bacon fell a victim to malaria and died in October in Gloucester county. Berkeley closed the conflict with wholesale executions and confiscations. Censured by the king, he sailed to England to make his defence, but died in London in 1677 without having seen Charles. Until the accession of William and Mary there was continued unrest in Virginia and a bitter struggle between the popular party in Virginia and the English Government seeking to reduce the privileges of the House of Burgesses. In many respects the Government came off victorious but the House retained the all important power of levying taxes. In 1689 James Blair was made commissary in Virginia of the Bishop of London and throughout a long life did valiant service for the colony. In 1693 he obtained the charter for William and Mary college and became its first president. It was founded at Williamsburg, which in 1699 was made the capital.

Westward Expansion.—By 1700 the population of Virginia had reached 70,000, of whom about 10,000 were Negroes. The majority of whites were small farmers, who constantly encroached upon the Indian lands in the Rappahannock region or penetrated the forests south of the James, several thousand having reached North Carolina. Between 1707 and 1740 many Scottish immigrants (traders, teachers and tobacco growers) settled along the upper Rappahannock, and, uniting with the borderers in general, they offered strong resistance to the older planters.

Tobacco growing was the one vocation of Virginia, and many of the planters were able to spend their winters in London or Glasgow and to arrange for their sons to attend the finishing schools of the mother country. Negro slavery grew rapidly during the first half of the 18th century, and the Negroes approached the number of whites by 1740. In 1716 an expedition of Governor Alexander Spotswood over the mountains made known to the world the rich back-country, now known as the Valley of Virginia. A migration thither from Pennsylvania and from Europe followed in course of time which revolutionized the province. The proportion of Negroes to whites soon fell before the influx of white immigrants, and in 1756 there was a population of 292,000, of whom only 120,000 were Negroes, and the small farmer class had grown so rapidly that the old tidewater aristocracy was in danger of being overwhelmed. The "West" had now appeared in American history. This first West, made up of the older small farmers, of the Scottish settlers, of the Germans from the Palatinate and the Scottish-Irish, far outnumbering the people of the old counties, demanded the creation of new counties and proportionate representation in the Burgesses. They did not at first succeed, but when the Seven Years' War came on they proved their worth by fighting the battles of the community against the Indians and the French. When the war was over the prestige of the up-country had been greatly enhanced, and its people soon found eastern leaders in the persons of Richard Henry Lee and Patrick Henry. In the meantime the Presbyterians, who had been officially recognized in Virginia under the Toleration Act in 1699, and had been guaranteed religious autonomy in the Valley by Governor Gooch in 1738, had sent missionaries into the border counties of eastern Virginia. The Baptists somewhat later entered the Colony both from the north and the south and established scores of churches. The new denominations vigorously attacked the methods and immunities of the established church, whose clergy had grown somewhat lukewarm in zeal and a few of them lax in morals. When the clergy, refusing to acknowledge the authority of the burgesses in reducing their stipends, and, appealing to the king against the assembly, entered the courts to recover damages from the vestries, Patrick Henry at Hanover court in 1763 easily convinced the jury and the people that the old church was well-nigh worthless. From this time the old order was doomed. The passage of the Stamp Act hastened the catastrophe and gave the leaders of the new combination, notably Henry, an opportunity to humiliate the British ministry, whom not even the tidewater party could defend. The Townshend scheme of indirect taxation displeased Virginia quite as much as had the former more direct system of taxation. When the burgesses undertook in May 1769 to discuss the right and power of taxation, the governor hastily dissolved them only to find the same men assembling in the Raleigh tavern in Williamsburg and issuing resolutions in defiance of executive authority.

The Struggle for Independence.—The struggle with England reached a crisis. Virginia, supporting with zeal the revolutionary movement, took the lead in the Continental Congresses which directed the succeeding war (*see* UNITED STATES: *History*). In April 1775, Patrick Henry at the head of the Hanover minute men, who had been joined by others, compelled Governor Dunmore (*q.v.*) to pay for the Colony's powder removed by the governor's order to a British war vessel. On June 8, Lord Dunmore and his family took refuge aboard an English man-of-war lying off Yorktown. When the Continental Congress issued the famous Declaration of Independence, Virginia had already assembled in convention to draft a new Constitution. A draft of a Constitution containing universal suffrage, proportional representation and religious freedom was sent to the convention by Jefferson, but the convention rejected it. The system which was adopted allowed the older counties a large majority of the representatives in the new assembly, on the theory that the preponderance of property (slavery) in that section required this as security against the rising democracy. The franchise, though not universal, was generously bestowed; it was a very liberal freehold system.

Of actual fighting there was not a great deal in Virginia till the later years of the war, for Lord Dunmore was soon driven out of the State, not, however, before he had done much damage along the seaboard and the largest town in the State, Norfolk, had been burned. The British came again in May 1779, took Portsmouth and Suffolk, burning the latter and plundering the surrounding country. In Jan. 1781, Benedict Arnold captured Richmond, now the capital. His force was not large but it was composed of regulars, and Jefferson, who was then governor, found it impossible to collect a sufficient force in time to offer effective resistance. Later in the year, Cornwallis came up with his troops from the south and made a junction with the British already in Virginia. A masterly campaign by the Americans, supported by a French army and fleet, resulted in the surrender of Cornwallis and his forces at Yorktown on Oct. 19, 1781. This was the closing scene of the struggle of American independence. In the meantime George Rogers Clark, in command of Virginians, had conquered that vast domain known later as the North-west Territory.

Virginia and the Federal Constitution.—Virginia leaders, including Henry, were the first to urge the formation of a national government with adequate powers to supersede the lame confederacy. In 1787, under the presidency of Washington, the National Convention sat in Philadelphia, with the result that the present Federal Constitution was submitted to the States for ratification during 1787–89. In Virginia the tidewater leaders urged adoption, while the up-country men, following Henry, who thought that the Federal Government was given too much power, opposed; but after a long and bitter struggle, in the summer of 1788 the new instrument was accepted, the low-country winning by a majority of ten votes, partly through the influence of James Madison.

In 1784, Virginia ceded to the Federal Government the North-west Territory, which it held under the charter of 1609 and also by conquest; in 1792 another large strip of the territory of Virginia became an independent State under the name of Kentucky. But the people of these cessions, especially of Kentucky, were closely allied to the great up-country party of Virginia, and altogether they formed the basis of the Jeffersonian democracy, which from 1794 opposed the chief measures of Washington's

administration, and which on the passage of the alien and sedition laws in 1798 precipitated the first great constitutional crisis in Federal politics by the adoption in the Kentucky and Virginia legislatures of resolutions strongly asserting the right and duty of the States to arrest the course of the National Government whenever in their opinions that course had become unconstitutional. The election of 1800 rendered unnecessary all further agitation by putting Jefferson in the president's chair. The up-country party in Virginia, with their allies along the frontiers of the other States, was now in power, and the progressives of 1776 shaped the policy of the nation during the next 25 years. Virginia held the position of leadership in Congress, and controlled the cabinet. Virginia also gave to the Supreme Court its greatest chief justice, John Marshall.

A Constitutional Convention was called in 1829 to revise the fundamental law in such a way as to give the more populous counties of the west their legitimate weight in the legislature. The result was failure, for the democracy of small farmers which the east feared would have taxed slavery out of existence was denied proportionate representation. The slave insurrection under Nat Turner in 1831 led to a second abortive effort, this time by the legislature, to do away with the fateful institution. The failure of these popular movements led to a sharp reaction in Virginia, as in the whole South, in favour of slavery.

Secession and Reconstruction.—In the national elections of 1860 Virginia returned a majority of unionist electors as against the Democratic candidates, Breckinridge and Lane. The governor of Virginia called an extra session of the legislature soon after the Federal election, and this in turn called a convention to meet on Feb. 13, 1861. The majority of this body consisted of Unionists, but the convention passed the ordinance of secession when the Federal Government (April 17) called upon the State to supply its quota of armed men to suppress "insurrection" in the lower Southern States. An alliance was made with the provisional government of the Confederate States on April 25, without waiting for the vote of the people on the ordinance. The governor called out 10,000 troops and placed in command Robert E. Lee, a colonel of the United States army. On May 23, the people of the eastern counties almost unanimously voted approval of the acts of the convention, and some of the people of the northwestern counties took steps to form the state of West Virginia. Richmond had become the capital of the confederacy on May 21.

BY COURTESY OF ERNEST CRANDELL, WASHINGTON, D.C.

HARPER'S FERRY, A HISTORIC TOWN IN VIRGINIA, SCENE OF THE FAMOUS ATTACK OF JOHN BROWN, AMERICAN ABOLITIONIST, IN 1859

The Civil War had already begun, and Virginia was of necessity the battle-ground. Of the six great impacts made upon the Confederacy, four were upon Virginia soil: the first Manassas campaign (1861), the Peninsula battles and battles around Richmond (1862), second Manassas (1862), Fredericksburg and Chancellorsville (1862–63) and the great Wilderness-Petersburg series of attacks (1864–65).

With the surrender of the Confederate army under Gen. Lee to Grant at Appomattox the task of reconstruction began. Governor Francis H. Pierpoint set up in Richmond a government based upon the Lincoln plan and supported by President Johnson, who, however, was in conflict with the majority in Congress, which passed over his veto a radical Reconstruction Act. According to the new policy Virginia, on March 2, 1867, became military district No. 1. Gen. John M. Schofield was put in charge, and under his authority a Constitutional Convention was summoned which bestowed the suffrage upon the former slaves. These, led by a small group of whites, that had come into the State with the invading armies, ratified the 14th and 15th amendments to the Federal Constitution and governed the community until 1869. Then the secessionists and Union men of 1861 united and regained control. Virginia was readmitted to the Union on Jan. 26, 1870.

The 20 years following the end of the war in 1865 were years of humiliation, poverty and political strife; also years of economic readjustment. In many cases farms were deserted by their owners, who moved to the cities or left the State entirely. The general poverty was augmented by a State debt of over $45,000,000 that had been contracted before the Civil War for works of internal improvement. By a bill passed in 1871 two-thirds of the debt was funded into bonds, and the remaining one-third was allotted to West Virginia as her fair share, though that State refused to admit the obligation. For two decades the debt settlement was the chief issue in Virginia politics and the main subject of legislative deliberation. Educational and other improvements, badly needed, were allowed to drift in the meantime. Financial settlement was not reached until 1891–92. A bill establishing a State-wide system of public free schools was passed in 1870. Some educational progress had been made when the payment of the public debt began to absorb the school revenue. From 1870 to 1879 $1,544,765 was diverted from school funds for this purpose. In the latter year enrolment in the schools dropped from 202,244 to 108,074 and in some counties every school was closed. After 1882 the State began to repay this money, and schools reopened, but their work was still handicapped by irregular attendance and lack of good teachers.

Recovery and Progress.—One of the most encouraging economic developments after the Civil War was the gradual extension of railways. These in their turn served in time to aid in the development of other industries. By 1885 the railways had extended down the Eastern Shore, down the peninsula, into the Great valley and across the Piedmont region between Lynchburg and Danville. This railway development accelerated the growth of many villages and brought others into existence. Newport News came into existence as a shipping point during the decade 1880–90. The mineral wealth of the south-west began again to be developed on a large scale and agriculture to be intensively practised. The recovery increased in momentum in the early decades of the 20th century, only to suffer a sudden check in the years after 1929. The constitution of 1902 practically eliminated the Negro from politics by the device of literacy and property qualifications. Virginia has remained solidly Democratic in every election since the Civil War except for a Republican victory in the Presidential election in 1928.

In 1932, 1936 and 1940 the state returned Franklin D. Roosevelt and the New Deal by huge majorities.

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(H. F. By.)

VIRGINIA, a city of St. Louis county, Minnesota, U.S.A., 62 mi. N.W. of Duluth, at an altitude of 1,440 ft., in the heart of the Mesabi iron range and the vast playground of "the Arrowhead country." It is on federal highway 169; is served by the Duluth, Missabe and Northern, the Duluth, Winnipeg and Pacific and the Great Northern railways. Pop. (1930) federal census 11,963; in 1940, 12,264. Virginia has one of the last sawmill plants in the state; it has operated continuously for 40 years. Mining is the principal industry. Large iron mines in the city limits and immediate vicinity (worked by stripping or open-pit method) are the largest employers of labour. The city owns and operates the water, gas, electric light and heat plant, and also a steam plant which heats 225 blocks, serving 4,816 customers. Virginia was founded in 1892 and incorporated in 1895.

VIRGINIA, UNIVERSITY OF, a State institution for higher education, situated at Charlottesville, Va., among the foot-hills of the Blue Ridge Mountains. Its buildings, arranged around a large rectangular lawn, were erected from a plan prepared by Thomas Jefferson. The university comprises 26 independent schools, but the courses of instruction given in these are so co-ordinated as to form six departments; two academic—the college and the department of graduate studies; and four professional—law, medicine, engineering and education. The institution owns (1936) 522 acres of land, has productive endowment funds amounting to $10,000,000, and receives from the State an annual appropriation of $400,000. The total budget of the university for 1936 was $2,140,000. It is governed by a rector, chosen by and from nine visitors, and a board of visitors appointed by the governor, and two visitors *ex officio,* the State superintendent of public instruction and the president of the university. The corporate name of the university is "The Rector and Visitors of the University of Virginia." In 1936 the faculty and officers numbered 251, the students 2,345 (2,233 men, 112 women), and the number of volumes in the libraries 265,273.

The university traces its beginning to an act of the legislature in January 1803 for incorporating the "Trustees of Albemarle academy." In 1814, before the site of this proposed institution had been chosen, Thomas Jefferson was elected a trustee, and under his influence the legislature, in February 1816, authorized the establishment of Central college in lieu of Albemarle academy. The corner-stone of Central college was laid in October 1817, and Jefferson, who was rector of its board of trustees, evolved a plan for its development into the University of Virginia. The legislature, thanks to the efforts of Joseph Carrington Cabell, a close personal friend of Jefferson, adopted the plan in 1818 and 1819, and seven independent schools—ancient languages, modern languages, mathematics, natural philosophy, moral philosophy, chemistry and medicine—were opened to students in March 1825. A school of law was opened in 1826. In 1837 the School of Medicine became a department of three individual schools; and in 1850 the School of Law became a department of two schools. After the gift of $500,000 by Andrew Carnegie there were established in 1909 the Andrew Carnegie School of Engineering, the James Madison School of Law, the James Monroe School of International Law, the James Wilson School of Political Economy, the Edgar Allan Poe School of English and the Walter Reed School of Pathology.

Under Jefferson's plan only two degrees were granted: "Graduate" to any student who had completed the course of any one school; and "Doctor" to a graduate in more than one school who had shown powers of research. But in 1831, for the doctor's degree the faculty substituted, following British custom, the degree of Master of Arts. The college now grants the customary university degrees.

See J. S. Patton, *Jefferson, Cabell and the University of Virginia* (1906). (J. L. N.)

VIRGINIA COWSLIP (*Mertensia virginica*), a North American plant of the borage family (Boraginaceae), called also bluebells, Roanoke bells, and tree, or American, lungwort. It grows in low meadows and in open woods along streams from New York and Ontario to Minnesota and southward to Tennessee and Kansas. The plant is a smooth perennial, with a usually erect simple or somewhat branching stem, 1 ft. to 2 ft. high, with large, oblong, long-stalked, very veiny basal leaves. In early spring it bears at the top of the stem showy clusters of blue-purple flowers. These are pink in the bud but when expanded are about an inch long and trumpet-shaped, with a purple tube and a blue bell. This beautiful plant, one of the most popular wild flowers of the eastern states, transplants well and is often cultivated. *See* Boraginaceae; Mertensia.

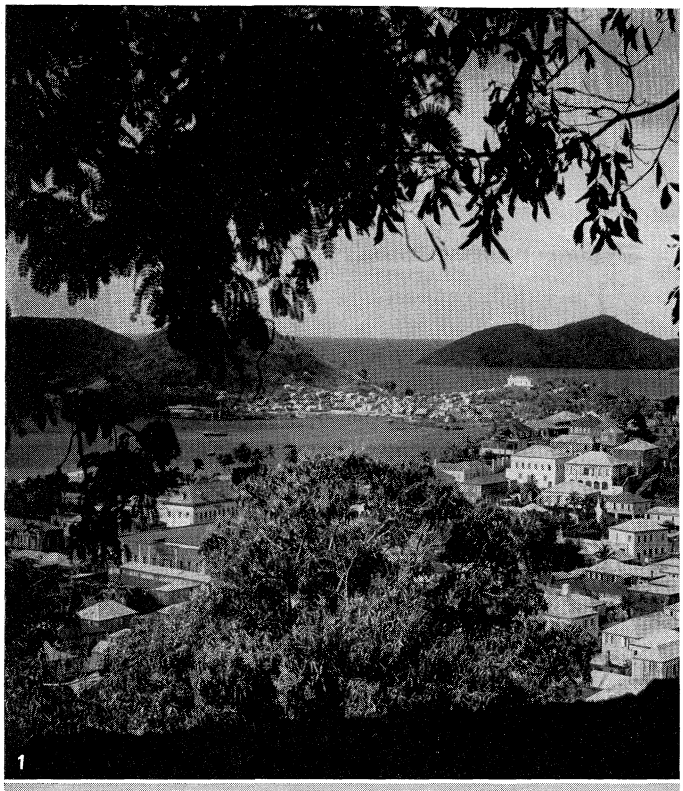
VIRGINIA CREEPER, a well-known woody vine (*Parthenocissus quinquefolia*) of eastern North America, sometimes cultivated for ornament, but not so well suited for this purpose as the related Boston ivy (*P. tricuspidata*), of Japan and China. *Parthenocissus* belongs to the family Vitaceae and climbs by means of sucker-like tendrils. The leaves are split into leaflets, of which *P. quinquefolia* (Virginia creeper) has five. The beautiful reds and yellows assumed by the leaves in autumn add to the attractiveness of this plant, which is sometimes confused with the poison ivy (*q.v.*).

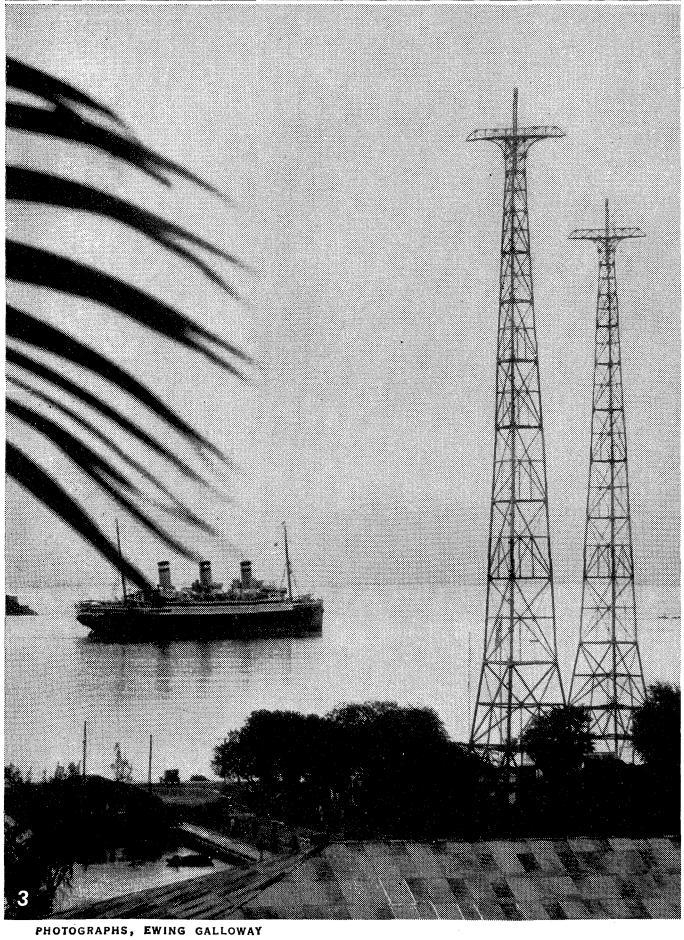
VIRGINIA REEL, a lively American country-dance, formerly very popular in the United States, derived from the Sir Roger de Coverley. Originally intended for six couples only, in longways formation, it later became common practice to form in one long set, the men and women in separate lines facing each other. The steps include the usual country-dance, march and galop steps, best danced to the music of the violin, with the fiddler "calling" the figures, the partners advancing and swinging each other and other couples in turn, in a pattern in which the reel is most prominent.

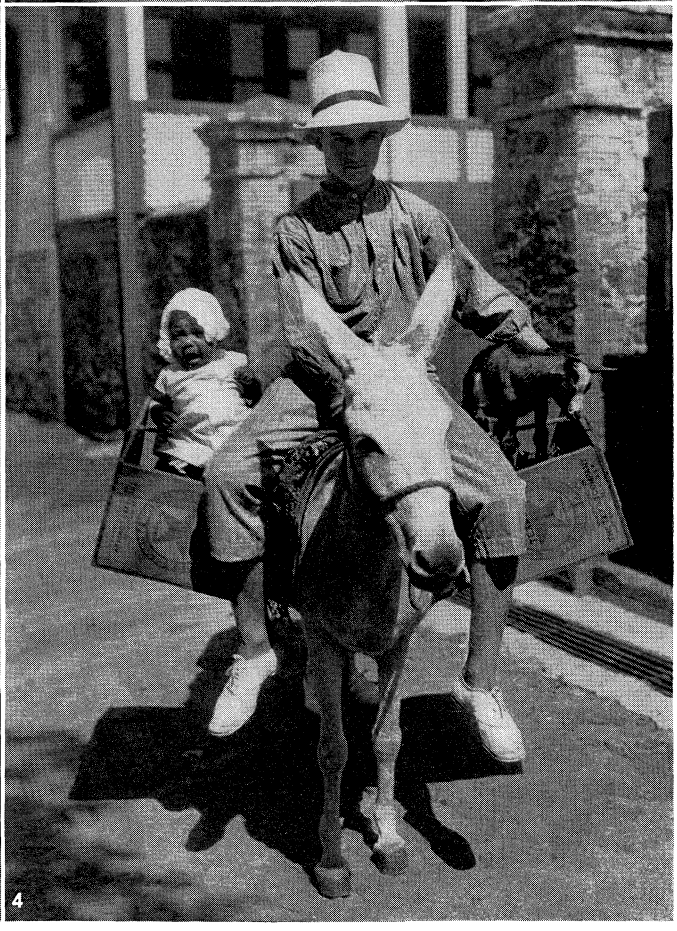
VIRGIN ISLANDS, a group of small islands in the west Indies, about 100 in number, mostly uninhabited. They extend E. from Puerto Rico, lying between 17° and 18° 50′ N., and 64° 10′ and 65° 30′ W.: total area about 465 sq.mi. The islands are rocky, or sandy and barren, but the cultivated portions yield cotton, sugar and the usual W. Indian food-crops. Guinea grass grows abundantly on the hillsides, and good cattle are reared. The coasts abound with fish. The climate is healthy and the heat moderate. Culebra Island and Vieques or Crab Island were acquired by the United States from Spain in 1898 with Puerto Rico.

Of the British Islands, 32 in all with an area of 67 sq.mi., the principal are Tortola, Anegada, Virgin Gorda, Jost van Dyke, Peter's Island and Salt Island. With the exception of the island of Sombrero they form one of the five presidencies in the colony of the Leeward Islands. The inhabitants are peasants who raise cattle and burn charcoal. Some are fishermen and boatmen. The chief town is Road Town (pop. 400) at the head of a fine harbour on the S. of Tortola, and trade is mostly with St. Thomas. Sombrero is maintained as a lighthouse by the British government. Population of the presidency, mostly Negroes (1941) 6,720.

The Virgin Islands were discovered by Columbus in his second voyage, in 1493, and named Las Virgenes, in honour of St. Ursula and her companions. In 1666 the British occupied Tortola, and







PHOTOGRAPHS, EWING GALLOWAY

CHARLOTTE AMALIE, CAPITAL OF THE VIRGIN ISLANDS

1. General view of the capital city from Synagogue hill. The French village, with its white church crowning the hillock, is in the distance. Charlotte Amalie, formerly St. Thomas, is on St. Thomas island, most important of the three Virgin Islands
2. Native woman buying a sour-sop fruit, which grows wild in the hills of St. Thomas
3. Harbour and the naval radio station
4. Young farmer bringing his baby to the free public clinic in Charlotte Amalie

have held it ever since. In the 17th century the Virgin Islands were favourite resorts of the buccaneers. The islands of St. Thomas and St. John were taken by the British from Denmark in 1801, but restored in the following year. In 1807 they surrendered to the British, and continued in their hands till 1815, when they were again restored. In 1917, after unsuccessful negotiations begun before 1867, the three islands, St. Croix, St. Thomas and St. John (*qq.v.*) were bought from Denmark by the United States for $25,000,000. St. Thomas and St. John form one administrative municipality, St. Croix another, and each has a local legislative council. The population of the Virgin Islands in 1917, at the time of their acquisition by the United States, was 26,051; in 1930 it was 22,012, and in 1940, 24,889. The urban population in 1940, comprising the population of the three cities, was 16,794, or 67.5% of the total. The area of the islands is 133 sq.mi. Charlotte Amalie, the largest city and the seat of the government, had 9,801 inhabitants in 1940. Of the 1940 population, 2,236 were white, 17,176 were Negro, and 5,477 were of mixed race. Charlotte Amalie has a fine harbour and is 1,442 mi. from New York and 1,029 mi. from the Panama canal. Administrative officers for the islands are appointed by the United States navy department. St. Croix (towns Christiansted and Frederiksted) produces sugar, molasses and hides. St. John and St. Thomas have little agriculture, but from the *Pimenta acris* is produced bay oil and bay rum, considerable quantities of which are exported.

VIRGINIUS RUFUS, LUCIUS (A.D. 15–97), Roman soldier, three times consul (A.D. 63, 69, 97), was born near Comum. When governor of upper Germany under Nero (68), after he had put down the revolt of Iulius Vindex in Gaul, he was urged by his troops to assume the supreme power; but he refused, declaring that he would recognize no one as emperor who had not been chosen by the senate. Galba, on his accession, aware of the feelings of the German troops induced Virginius to accompany him to Rome. After the death of Otho, the soldiers again offered the throne to Virginius, but he again refused it. They then attacked him, and he had to escape through the back of his tent. Under Vitellius, one of Virginius's slaves was arrested and charged with the design of murdering the emperor. Virginius was accused of being implicated in the conspiracy, and his death was demanded by the soldiers. Vitellius refused to sacrifice him to the army's resentment, and Virginius subsequently lived in retirement, chiefly in his villa at Alsium, on the coast of Etruria, till his death in 97, in which year he held the consulship, together with the emperor Nerva. At the public burial with which he was honoured, the historian Tacitus (then consul) delivered the funeral oration.

See Tacitus, *Hist.* i, ii; Dio Cassius lxiii, 24–27, lxiv, 4, lxviii, 2; Pliny, *Epp.* ii, 1, vi, 10; Juvenal viii, 221, with Mayor's note; L. Paul in *Rheinisches Museum* (1899), liv. pp. 602–630.

VIRGO ("the virgin"), in astronomy, the sixth sign of the zodiac, denoted by the symbol ♍. The Greeks represented this constellation as a virgin, but different fables are current as to the identity of the maid. She is variously considered to be: Iustitia, daughter of Astraeus and Ancora; according to Hesiod, the virgin is the daughter of Jupiter and Themis; others make her to be Erigone, daughter of Icarius, or Parthene, daughter of Apollo. The constellation contains a first magnitude star, Spica. The latter is a blue star, located at a distance of about 250 light years from the sun.

VIRTUE: *see* CARDINAL VIRTUES.

VIRUS: *see* FILTER-PASSING VIRUSES; BACTERIA AND DISEASE; BACTERIOLOGY.

VIS: *see* LISSA.

VISĀKHĀ, Buddhist laywoman whom Buddha called "chief of almsgivers," a distinction she shared with Anāthapindika, a layman. She was disciple, friend and adviser of Buddha and the orders, and a loyal mother of the new creed. Visākhā, the daughter and granddaughter of merchants of vast wealth in Bhaddiya, was directly converted by Buddha in her youth. Following her marriage at sixteen to a son of the rich Migāra in Sāvatthi, she devoted her life and wealth to helping the Buddhist orders. Buddha granted her request for permission to bestow eight kinds of permanent alms: to provide robes for the rainy season, food for the incoming monks, for the departing monks, for the sick and their attendants, a supply of medicine, a permanent supply of gruel, and bathing-dresses for the almswomen who were not to bathe nude. Her unwavering fidelity, constant gifts of alms, clothing and dwellings, and her friendly criticism helped to bind the almsfolk together and to the laity. She was the trusted friend of the almsmen and had free access to the monasteries. They considered that Visākhā, as well as Mahāpajāpātī, held reliable powers of discretion like themselves, and was equally familiar with the Dhamma. A conversation between Buddha and Visākhā has survived in the *Anguttara-nikāya* as a talk to laywomen. The monastery that Visākhā built in the Pubbārāma was used as a retreat by Buddha after he settled permanently at Sāvatthi.

VISALIA, a city of south central California, U.S.A., 160 mi. N. of Los Angeles; the county seat of Tulare county. It has a municipal airport, and is served by the Santa Fe and the Southern Pacific railways. The population in 1920 was 5,753 (85% native white); in 1930 by the federal census 7,263; and in 1940, 8,904. It is the trading centre and shipping point for a rich farming, dairying and poultry-raising region, where fruits, vegetables and other agricultural products (including cotton) are grown in great variety. Thirty miles east is the Sequoia National park of 604 sq.mi., containing over 1,000,000 trees, 12,000 of which are 10 ft. or more in diameter. Visalia was founded in 1852 and incorporated in 1874.

VISBY, the capital of the Swedish island and administrative district (*län*) of Gotland, in the Baltic sea. Pop. (1941) 12,507. The name Visby is derived from the old Norse *ve* (sanctuary) and *by* (town). This was no doubt a place of religious sacrifice in heathen times. At any rate it was a notable trading place and emporium as early as the end of the stone age, and long continued to enjoy its importance as such, as is proved by the large number of Arabic, Anglo-Saxon and other coins found.

In mediaeval times Visby was the centre of trade between Asia, Russia and Europe and grew to great wealth and power. It made its own maritime laws and coined its own money. The city was besieged in 1361 by king Valdemar IV of Denmark, who won it in a fierce battle. The defeated people of Gotland buried their warriors in one common grave on which they placed a cross. This grave was opened by archaeologists shortly before World War II, and it revealed many articles of mediaeval warfare and art objects.

Visby is the seat of a bishop, the port of the island, and a favourite watering place. It is picturesquely situated on the west coast, 150 mi. S. by E. of Stockholm by sea. The houses cluster beneath and above a cliff (*klint*) 100 ft. high, and the town is thoroughly mediaeval in appearance. The remains from its period of extraordinary prosperity from the 11th to the 14th century are of the highest interest. Its walls date from the end of the 13th century, replacing earlier fortifications, and enclose a space much larger than that now covered by the town. Massive towers rise at close intervals along them, and nearly 40 are in good preservation. Between them are traces of bartizans. The cathedral church of St. Mary dates from 1190–1225, but has been much altered in later times; it has a great square tower at the west end and two graceful octagonal towers at the east, and contains numerous memorials of the 17th century. There are ten other churches, in part ruined. Among those of chief interest St. Nicholas', of the early part of the 13th century, formerly belonged to a Dominican monastery. It retains two beautiful rose-windows in the west front. The church of the Holy Ghost (*Helgeands-Kyrka*) in a late Romanesque style (*c.* 1250) is a remarkable structure with a nave of two stories. The Romanesque St. Clement's has an ornate south portal, and the churches of St. Drotten and St. Lars, of the 12th century, are notable for their huge towers. St. Catherine's, of the middle of the 13th century, is Gothic, with a pentagonal apse. Galgberget, the place of execution, has tall stone pillars still standing; and there is a stone labyrinth at Tröjeborg. Modern buildings include the Gotland museum of antiquities. The artificial harbour, somewhat exposed, lies south of the ancient Hanseatic harbour, now filled up. (*See* GOTLAND and SEA LAWS.)

VISCACHA or **BISCACHA,** a large South American burrowing rodent belonging to the family Chinchillidae. The viscacha (*Lagostomus*) is 20 in. long, with a tail 8 in.; it is heavy-set, with short ears and massive head. The fur is short and soft, dark gray in colour, with black and white markings on the face. Viscachas inhabit the South American pampas between the Uruguay river and the Rio Negro in Patagonia, where they dwell in warrens covering from 100 to 200 sq.ft. and forming mounds penetrated by numerous burrows. The ground around the "viscachera" is cleared from vegetation, the refuse of which is heaped upon the mound. Anything the rodents meet with on their journeys, such as thistle stalks or bones, are deposited on the viscachera. In frequented districts they seldom emerge till evening. Their chief food is grass and seeds, but they also consume roots.

The mountain viscachas, *Lagidium,* are built like the chinchillas, but have rabbitlike ears and yellowish gray fur. (*See* RODENTIA.)

(J. E. HL.)

VISCERAL SENSATIONS, the sensations that arise from the viscera and other internal bodily organs and tissues. The visceral sensations belong to the general class of organic sensations (*q.v.*) and are distinguished among them only by the seat of their origin. They are characterized by their paucity of qualitative variety and by their functional importance in consciousness. On the side of quality they include only cold and warmth, and the dull pressures and the aches that come from muscle and other tissue beneath the skin. (*Cf.* SKIN, SENSORY FUNCTIONS OF.) On the side of function they form the sensory basis for many of the vague awarenesses or "conscious attitudes" that are ever present in the mental life. For instance, recognition is a perception coloured by a feeling of familiarity, and this feeling often has its seat in the viscera although it has no fixed sensory basis. Visceral sensations are also functionally important as carrying much of the conscious organic reverberation that is characteristic of strong emotion. The oesophagus and stomach are sensitive to pressure on distension and to ache on extreme distension, as well as to warmth and to cold. This fact can be brought out only by research, because the stomach is ordinarily not often distended without distension of the bodily walls and is altered appreciably in temperature only by large quantities of hot or cold material. The common belief in the insensitivity of the oesophagus comes about because its sensations are ordinarily localized as above or below the bony chest wall, *i.e.*, either in the throat or in the stomach. The intestines are less accessible to experimentation, but it is probable that they are sensitive to pressure and pain like the stomach, but that excitation of these sensations is rare.

It is well known that in surgical operations the viscera appear to be almost entirely insensitive. The meaning of this finding is that cutting and ordinary pressure are not adequate stimuli to the sensations that they arouse on the skin. Apparently distension or muscular contraction of the viscera themselves are the proper stimuli. The peritoneum, its extension in the mesentery, and possibly the pleura are very sensitive to pain, even upon cutting.

The more usual attack upon the problem of visceral sensations has been by way of the perceptions which they mediate. These perceptions seem to involve no unique qualities, but nevertheless to carry very specific significance for the organism. Thirst arises from dryness of the membranes of the oral cavity, and is ordinarily caused by a lack of water in the system. It is no more a new quality than is the perception of dryness on the skin. Hunger is an ache of a peculiar temporal pattern, for it is caused by certain slow rhythmic contractions of the stomach that appear in the absence of stomachic contents or at regular intervals by habit. Any substance introduced into the stomach to inhibit these contractions abolishes hunger. The alimentary experiences of fullness, repletion and nausea, and the experiences of the excretory processes, are simply internal perceptions, in terms of pressure or pain, of the states or processes to which they correspond. Appetite is the desire for food in the absence of hunger, and is ordinarily associated with all normal food-taking, since the first food that enters the stomach inhibits the hunger contractions. Appetite, however, seems to have no peculiar sensory or perceptual basis at all. Its mechanism is purely unconscious as in the instincts and habits, although of course the eater perceives his desire for food by perceiving his behaviour toward it. Some psychologists have thought that there are sensations of oppression from the heart and of stuffiness from the lungs, but the matter remains undetermined. Sexual experience involves unique perceptual patterns of pressure and pain. Like appetite, however, the psychology of sex is best understood functionally as an instinctive urge and a form of behaviour, although to the individual the earlier perceptions of bodily state may seem to be the causes of subsequent behaviour. That emotion involves visceral sensations is well known, but we are still ignorant of their degree and nature, although a great deal is now known of the visceral state during emotion (*q.v.*).

See A. F. Hertz, *Sensibility of the Alimentary Canal* (1911); A. J. Carlson, *Control of Hunger in Health and Disease* (Chicago, 1916); W. B. Cannon, *Bodily Changes in Pain, Hunger, Fear and Rage* (London and New York, 1915); E. G. Boring, *American Journal of Psychology,* vol. xxvi., pp. 1–57, 485–494 (1915); vol. xxviii., pp. 443–453 (1917); *Psychological Review,* vol. xxii., pp. 306–331 (1915).

(E. G. BOR.)

VISCHER, the name of a family of Nuremberg sculptors, who contributed largely to the masterpieces of German art in the 15th and 16th centuries.

1. HERMANN, the elder, came to Nuremberg as a worker in brass in 1453 and there became a "master" of his gild. There is only one work that can be ascribed to him with certainty, the baptismal font in the parish church of Wittenberg (1457). This is decorated with figures of the Apostles.

2. His son, PETER, the elder, was born about 1455 in Nuremberg, where he died on the 7th of January 1529. He became "master" in 1489, and in 1494 was summoned by the Electoral Prince Philipp of the Palatinate to Heidelberg. He soon returned, however, to Nuremberg, where he worked with the help of his five sons, Hermann, Peter, Hans, Jakob and Paul. His works are: the tomb of Bishop Johannes IV., in the Breslau cathedral (1496); the tomb of Archbishop Ernest, in Magdeburg cathedral (1497); the shrine of Saint Sebald in the Sebalduskirche at Nuremberg, between 1508 and 1519; a large grille ordered by the Fugger brothers in Augsburg (lost); a relief of the "Crowning of the Blessed Virgin" in the Erfurt cathedral (a second example in the Wittenberg Schlosskirche, 1521); the tombstones for Margareta Tucherin in the Regensburg cathedral (1521), and for the Eisen family in the Ägidienkirche at Nuremberg (1522); the epitaph for the cardinal Albrecht of Brandenburg in the collegiate church at Aschaffenburg (1525); the tomb of the electoral prince Frederick the Wise in the Schlosskirche at Wittenberg (1521); the epitaph of the duchess Helene of Mecklenburg in the cathedral at Schwerin. Besides these works there are a number of others ascribed to Peter the elder with less certainty. In technique few bronze sculptors have ever equalled him, but his designs are marred by an excess of realism and a too exuberant fancy.

His chief early work, the tomb of Archbishop Ernest in Magdeburg cathedral (1495), is surrounded with fine statuettes of the Apostles under semi-Gothic canopies; it is purer in style than the magnificent shrine of St. Sebald, a tall canopied bronze structure, lavishly decorated with reliefs and statuettes. The general form of the shrine is Gothic, but the details are those of the 16th-century Italian Renaissance treated with much freedom and originality. Some of the statuettes of saints attached to the slender columns of the canopy are modelled with much grace and even dignity of form. A small portrait figure of Peter himself, introduced at one end of the base, is a marvel of clever realism: he has represented himself as a stout, bearded man, wearing a large leathern apron and holding some of the tools of his craft. This gorgeous shrine is a remarkable example of the uncommercial spirit which animated the artists of that time, and of the evident delight which they took in their work Dragons, grotesques and little figures of boys, mixed with graceful scroll foliage, crowd every possible part of the canopy and its shafts, designed in the most free and unconventional way and executed with an utter disregard of the time and labour which were lavished on them.

See R. Bauer, *Peter Vischer und das alte Nürnberg* (1886); C. Headlam, *Peter Vischer* (1901).

VISCHER, FRIEDRICH THEODOR (1807–1887), German writer on the philosophy of art, was born at Ludwigsburg on June 30, 1807, the son of a clergyman. He was educated at Tübingen, and began life in his father's profession. In 1835 he became *Privatdozent* in aesthetics and German literature at his old university, was advanced in 1837 to extraordinary professor, and in 1844 to full professor. In consequence, however, of his outspoken inaugural address, he was suspended for two years by the Württemberg government, and in his enforced leisure wrote the first two volumes of his *Aesthetik oder Wissenschaft des Schönen* (1846), the fourth and last volume of which did not appear till 1857. Vischer threw himself heartily into the great German political movement of 1848–49, and shared the disappointment of patriotic democrats at its failure. In 1855 he became professor at Zürich. In 1866, his fame being now established, he was invited back to Germany with a professorship at Tübingen combined with a post at the Polytechnikum of Stuttgart. He died at Gmunden on Sept. 14, 1887.

Vischer was not an original thinker, and his monumental *Aesthetik,* in spite of industry and learning, has not the higher qualities of success. Still, he had a thorough knowledge of every branch of art except music, and much valuable material is buried in his volumes.

His writings include literary essays collected under the titles *Kritische Gänge* and *Altes und Neues,* poems, an excellent critical study of Goethe's *Faust* (1875), and a successful novel, *Auch Einer* (1878; 25th ed., 1904).

See O. Keindl, *F. T. Vischer, Erinnerungsblätter* (1888); J. E. von Günthert, *F. T. Vischer, ein Charakterbild* (1888); I. Frapan, *Vischer-Erinnerungen* (1889); T. Ziegler *F. T. Vischer* (*Vortrag*) (1893); J. G. Oswald, *F. T. Vischer als Dichter* (1896).

VISCONTI, the name of a celebrated Italian family which long ruled Milan; they claimed descent from King Desiderius, and in the 11th century possessed estates on Lakes Como and Maggiore. A certain OTTONE, who distinguished himself in the First Crusade, is mentioned in 1078 as viscount of Milan. The real basis for the family's dominion was laid, however, by another OTTONE (d. 1295), a canon of Desio, appointed archbishop of Milan by Pope Urban IV. in 1262 through the influence of Cardinal Ubaldini. The Della Torre family, who then controlled the city, opposed the appointment, and not until his victory at Desio in 1277 was Ottone able to take possession of his see. He imprisoned Napoleone Della Torre and five of his relatives.

His nephew, MATTEO, born at Invorio on Aug. 15, 1255, succeeded him as political leader of Milan, and although an uprising of the Della Torre in 1302 compelled him to take refuge at Verona, the emperor Henry VII., restored him to Milan in 1310 and made him imperial vicar of Lombardy. He brought under his rule Piacenza, Tortona, Pavia, Bergamo, Vercelli, Cremona and Alessandria. An able general, he yet relied for his conquests more on diplomacy and bribery, and was esteemed as a model of the prudent Italian despot. Persevering in his Ghibelline policy, and quarrelling with Pope John XXII. over an appointment to the archbishopric of Milan, he was excommunicated by the papal legate Bertrand du Puy in 1322. He at once abdicated in favour of his son Galeazzo, and died at Crescenzago on June 24.

GALEAZZO I. (1277–1328), who ruled at Milan from 1322 to 1328, defeated the Holy Army which the pope had sent against the Visconti at Vaprio on the Adda (1324), with the aid of the emperor Louis the Bavarian. In 1327 he was imprisoned for a short time by the emperor at Monza because he was thought guilty of making peace with the church. By his wife Beatrice d'Este he had the son Azzo who succeeded him. His brother MARCO commanded a band of Germans, conquered Pisa and Lucca and died in 1329. Azzo (1302–1339), who succeeded his father in 1328, bought the title of imperial vicar for 25,000 florins from the same Louis who had imprisoned Galeazzo I. He conquered ten towns, murdered his uncle Marco (1329), suppressed a revolt led by his cousin Lodrisio, reorganized the administration of his estates, built the octagonal tower of S. Gottardo, and was succeeded in turn by his uncles Lucchino and Giovanni. LUCCHINO made peace with the church in 1341, bought Parma from Obizzo d'Este and made Pisa dependent on Milan. He was poisoned in 1349 by his wife Isabella Fieschi.

GIOVANNI, brother of the preceding, archbishop of Milan and lord of the city from 1349 to 1354, was one of the most notable characters of his time. He befriended Petrarch, extended the Visconti sway over Bologna (1350), defied Pope Clement VI., annexed Genoa (1353), and died on Oct. 5, 1354, after having established the rule of his family over the whole of northern Italy except Piedmont, Verona, Mantua, Ferrara and Venice. The Visconti from the time of Archbishop Giovanni were no longer mere rivals of the Della Torre or dependants on imperial caprice, but real sovereigns with a recognized power over Milan and the surrounding territory. The State was partitioned on the death of Giovanni among his brother Stefano's three sons, Matteo II., Galeazzo II. and Bernabò. MATTEO II., who succeeded to Bologna, Lodi, Piacenza and Parma, abandoned himself to the most revolting immorality, and was assassinated in 1355 by direction of his brothers, who thenceforth governed the State jointly and with considerable ability. GALEAZZO II., who held his court at Pavia, was the patron of Petrarch, the founder of the University of Pavia, and a gifted diplomat. He married his daughter Violante to the duke of Clarence, son of Edward III. of England, giving a dowry of 200,000 gold florins; and his son Gian Galeazzo to Isabella, daughter of King John of France. He died in 1378. BERNABÒ, who held his court at Milan, was involved in constant warfare, to defray the expenses of which he instituted very oppressive taxes. He fought Popes Innocent VI. and Urban V., who proclaimed a crusade against him, and the emperor Charles IV., who declared the forfeiture of his fief. He endeavoured to exercise sole power in the State after the death of his brother, but his young nephew Gian Galeazzo put him to death (1385).

GIAN GALEAZZO, the most powerful of the Visconti, became joint ruler of the Milanese territories on the death of his father in 1378 and sole ruler on the death of his uncle seven years later. He founded the cathedral of Milan, built the Certosa and the bridge across the Ticino at Pavia, improved the University of Pavia and established the library there, and restored the university at Piacenza. He was an able and economical administrator, and was reputed to be one of the wealthiest princes of his time. Ambitious to reduce all Italy under the sway of the Visconti, he conquered Verona in 1387; and in the following year, with the aid of the Venetians, took Padua. He plotted successfully against the rulers of Mantua and Ferrara, and finally turned his attention to Tuscany. In 1399 he bought Pisa and seized Siena. The emperor Wenceslaus had already conferred on him the title of duke of Milan for 100,000 florins, reserving only Pisa, and refused to take arms against him. Gian Galeazzo took Perugia, Lucca and Bologna (1400–01), and was besieging Florence when he died of the plague (Sept. 3, 1402). His sons, Giovanni Maria and Filippo Maria, were mere boys at the time of his death, and were taken under the protection of the celebrated condottiere Facino Cane de Cesale; but most of Gian Galeazzo's conquests were lost.

GIOVANNI MARIA was proclaimed duke of Milan in 1402, displayed an insane cruelty, and was killed in 1412 by Ghibelline partisans. FILIPPO MARIA, who became nominal ruler of Pavia in 1402, succeeded his brother as duke of Milan. Cruel and extremely sensitive about his personal ugliness, he nevertheless was a great politician, and, by employing powerful condottieri, managed to recover the Lombard portion of his father's duchy. From his marriage with the unhappy widow of the above-mentioned Facino Cane he received a dowry of nearly half a million florins. He died in 1447, the last of the Visconti in direct male line, and was succeeded in the duchy, after the shortlived Ambrosian republic, by Francesco Sforza, who had married his daughter Bianca in 1441. (*See* SFORZA.)

There is a contemporary history of the principal members of the family by Paolo Giovio, bishop of Nocera, which may be had in several editions. *See* J. Burckhardt, *The Civilization of the Renaissance in Italy,* trans. by S. G. C. Middlemore (London, 1898); J. A. Symonds, *Age of the Despots* (New York, 1888); C. Magenta, *I Visconti e gli Sforza nel Castello di Pavia* (1883); A. Medin, *I Visconti nella poesia contemporanea* (Milan, 1891); F. Mugnier, "Lettres des Visconti de Milan" in *Mémoires et documents de la*

société savoisienne d'histoire et d'archéologie, vol. x. of the second series (1896).

VISCONTI-VENOSTA, EMILIO, MARQUIS (1829–1914), Italian statesman, was born at Milan on Jan. 22, 1829. A disciple of Mazzini, he took part in all the anti-Austrian conspiracies until the ineffectual rising at Milan on Feb. 6, 1853, of which he had foretold the failure, induced him to renounce his Mazzinian allegiance. Continuing, nevertheless, his anti-Austrian propaganda, he rendered good service to the national cause. He was obliged in 1859 to escape to Turin, and during the war with Austria of that year was appointed by Cavour royal commissioner with the Garibaldian forces. Elected deputy in 1860, he accompanied Farini on diplomatic missions to Modena and Naples, and was subsequently despatched to London and Paris to acquaint the British and French Governments with the course of events in Italy. Cavour gave him a permanent appointment in the Italian foreign office, and he was subsequently appointed under-secretary of State by Count Pasolini. Upon the latter's death he became minister of foreign affairs (March 24, 1863) in the Minghetti cabinet, in which capacity he negotiated the September Convention for the evacuation of Rome by the French troops. Resigning office with Minghetti in the autumn of 1864, he was in March 1866 sent by La Marmora as minister to Constantinople, but was almost immediately recalled and reappointed foreign minister by Ricasoli. Assuming office on the morrow of the second battle of Custozza, he succeeded in preventing Austria from burdening Italy with a proportion of the Austrian imperial debt, in addition to the Venetian debt proper. The fall of Ricasoli in Feb. 1867 deprived him for a time of his office, but in Dec. 1869 he entered the Lanza-Sella cabinet as foreign minister, and retained his portfolio in the succeeding Minghetti cabinet until the fall of the Right in 1876. During this long period he was called upon to conduct the delicate negotiations connected with the Franco-German War, the occupation of Rome by the Italians, and the consequent destruction of the temporal power of the pope, the Law of Guarantees and the visits of Victor Emmanuel II. to Vienna and Berlin. In 1894, after 18 years' absence from active political life, he was chosen to be Italian arbitrator in the Bering Sea question, and in 1896 once more became foreign minister in the Di Rudini cabinet at a juncture when the disasters in Abyssinia and the indiscreet publication of an Abyssinian Green Book had rendered the international position of Italy exceedingly difficult. His first care was to improve Franco-Italian relations by negotiating with France a treaty with regard to Tunis. During the negotiations relating to the Cretan question and the Graeco-Turkish War, he secured for Italy a worthy part in the European Concert, and joined Lord Salisbury in saving Greece from the loss of Thessaly. Resigning office in May 1898, on a question of internal policy, he once more retired to private life, but in May 1899 again assumed the management of foreign affairs in the second Pelloux cabinet, and continued to hold office in the succeeding Saracco cabinet until its fall in Feb. 1901. During this period his attention was devoted chiefly to the Chinese problem and to the maintenance of the equilibrium in the Mediterranean and in the Adriatic. In regard to the Mediterranean he established an Italo-French agreement, by which France undertook to leave Italy a free hand in Tripoli, and Italy not to interfere with French policy in the interior of Morocco. Prudence and sagacity, coupled with unequalled experience of foreign policy, enabled him to assure to Italy her full portion of influence in international affairs, and secured for himself the unanimous esteem of European cabinets. In recognition of his services he was created Knight of the Annunziata by Victor Emmanuel III. on the occasion of the birth of Princess Yolanda Margherita of Savoy (June 1, 1901). In Feb. 1906 he was Italian delegate to the Morocco conference at Algeciras. After this he retired into private life. He died in Rome on Nov. 28, 1914.

An account of Visconti-Venosta's early life (down to 1859) is given in an interesting volume by his brother Giovanni Visconti-Venosta, *Ricordi di Gioventù* (Milan, 1904).

VISCOSE RAYON. In 1938, 83% of the world output of continuous-filament rayon and an even higher percentage of rayon staple fibre were produced by the viscose process. For particulars of the process *see* SYNTHETIC FIBRES.

VISCOSITY. All bodies, whether solids, liquids or gases, oppose a resistance to deformation or relative displacement of portions of the body against one another. This resistance may be of different kinds; it may, for instance, increase as the velocity with which parallel planes a fixed distance apart are displaced relatively to each other increases, and in that case, which is of great importance in nature, it is said to be due to viscosity. The definition will become clearer when we consider the viscosity of liquids, which is readily observed and was the first in point of time to be investigated both mathematically and experimentally.

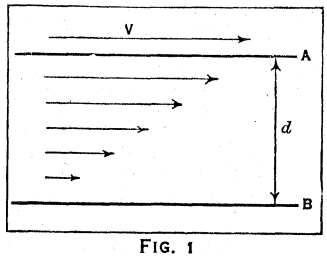


FIG. 1

The Viscosity of Liquids.—We imagine two indefinitely extended parallel plates A and B (fig. 1) between which a liquid is contained, and keep plate A moving in its own plane with a constant velocity v, indicated by the length of the arrow, while plate B remains at rest. The liquid in contact with A moves with it, while that in contact with B stands still; as the velocity in the liquid changes continuously, we can imagine it to consist of thin sheets or laminae, each moving with the velocity indicated by the arrows in fig. 1. A certain force must be applied to A to keep the velocity v constant, and Newton made the assumption that this force was proportional to the area of the plates and to the velocity with which adjoining laminae passed over each other, in other words to the velocity gradient, v/d. These assumptions are purely intuitive, but all subsequent investigations have fully confirmed them. Other things being equal, the force varies greatly in different liquids, and to make comparison possible, it is usual to state the force required per unit area to keep A moving with unit velocity when d = unit distance and the space between the plates is filled with a particular liquid; this quantity is called the coefficient of viscosity of the liquid. The units generally employed in physics for force, length and time are used to express viscosity coefficients, viz., the dyne, centimetre and second.

Two parallel plates with a liquid between them constitute an arrangement from which we can easily deduce a definition of the viscosity coefficient, but one which cannot be realized experimentally. Arrangements are, however, possible which fulfil the essential condition that the liquid should behave as if it consisted of thin laminae each moving with a constant velocity—a type of motion which is, for that reason, called "laminar." We can, for instance, "roll up" the two parallel planes of fig. 1 into two concentric cylinders and rotate the outer one with constant velocity, while the inner one is at rest (fig. 3). Each circle in the ring of liquid then rotates with a constant velocity; the inner cylinder tends to follow the motion and from the torque exerted on it the coefficient of viscosity can be deduced.

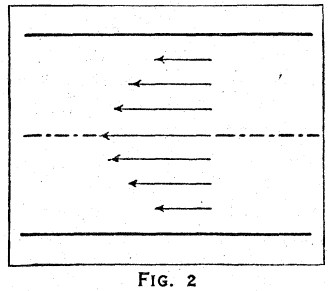


FIG. 2

Laminar motion is also set up when a liquid flows through a cylindrical tube of small bore and sufficient length, as long as the velocity does not exceed a certain limit. The liquid flows as if it consisted of thin concentric tubes, each moving with a constant velocity which increases from the wall towards the axis (fig. 2). The coefficient of viscosity can be deduced from the dimensions of the tube and the quantity of liquid forced through it in unit time by a known pressure.

It is, finally, possible to determine the coefficient of viscosity of a liquid by observing the velocity with which a small sphere of known diameter and mass falls in it. It was shown by Stokes that a small sphere falling in a viscous medium soon attains a constant velocity (in a medium offering no resistance its velocity is uniformly accelerated) given by the following equation:

$$v = \frac{2r^2(\rho - \rho')g}{9\eta}$$

in which the symbols mean: v the velocity of fall per second, r the radius of the sphere, ρ and ρ' the density of the sphere and of the liquid respectively, g the acceleration of gravity = 981 cm/sec^2 and η the coefficient of viscosity. Other things being equal, the coefficient of viscosity and the velocity of fall are inversely proportional.

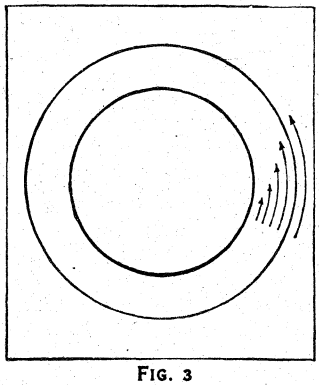


FIG. 3

Measuring the flow through a capillary tube was the first method used for determining viscosities, and is still the most generally employed. The law governing the flow through capillaries was found experimentally by Poiseuille in a classical investigation published in 1842. He found that the volume of liquid which passed through a capillary in unit time was (1) proportional to the pressure, (2) proportional to the fourth power of the radius and (3) inversely proportional to the length of the tube. In symbols, if Q = volume discharged in unit time, P = pressure, R = radius and L = length of the tube:

$$Q = C\frac{PR^4}{L}$$

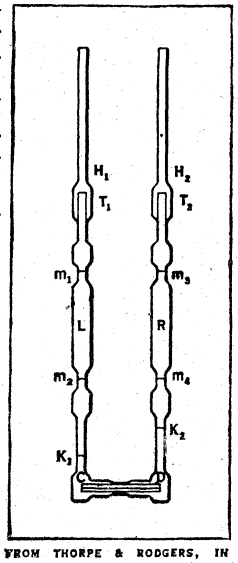
where C is a constant characteristic for each liquid, which always increases with rising temperature. Poiseuille did not deduce coefficients of viscosity, but this was done by several physicists who treated the problem mathematically by working out the conditions of flow for one of the elementary tubes described above and integrating; the equation thus obtained is known as Poiseuille's formula:

$$Q = \frac{\pi PR^4}{8\eta L}$$

where η is the coefficient of viscosity, which can therefore be calculated from Poiseuille's experimental data. As has been mentioned, the coefficient of viscosity is expressed in cm-gm-sec units; the coefficient η = 1·000 in these units is called a *poise* (in honour of Poiseuille) and its hundredth part a *centipoise*. The viscosity coefficient of water at 20° C. is almost exactly a centipoise.

A convenient alternative method of expressing the viscosity η_1 of a liquid is to state the ratio η_1/η_0, where η_0 is the viscosity of a suitably chosen standard liquid; this ratio is called the relative viscosity.

Capillary Viscometers.—A number of instruments have been designed for measuring viscosity by means of the flow through a capillary; they all have this in common, that a constant volume, defined by suitable marks, is forced through a capillary by a known pressure. A type of historical interest is that used by Thorpe and Rodger in a famous investigation on a large number of pure organic liquids (fig. 4). CD is the capillary, the bore and length of which are accurately known. A definite volume of liquid is introduced into the right hand limb with a fine pipette reaching down to R; air pressure is then applied to the left hand limb, until the liquid stands at K, any excess at the same time overflowing into the trap T_2. A known pressure, measured by a water manometer, is then applied to the right limb, and the time which the liquid takes to fall from the mark m_3 to the mark m_4 measured by a stop watch reading to $\frac{1}{5}$ second. The liquid is then forced up the opposite limb, the procedure reversed and the time from m_1 to m_2 taken; the two times are averaged. The volumes L and R between the marks are accurately known, and from them, the times, pressures and dimensions of the capillary; the viscosity coefficients in absolute measure are calculated by Poiseuille's formula.



FROM THORPE & RODGERS, IN "PHILOSOPHICAL TRANSACTIONS" (COUNCIL OF THE ROYAL SOCIETY)

FIG. 4

In another instrument, designed by Wilhelm Ostwald and called after him, which is very generally used, the pressure producing the flow is produced simply by the column of liquid itself (fig. 5). A constant volume of liquid is charged into the wide limb from a pipette and is drawn through the capillary into the bulb well above the mark A; it is then allowed to flow out and the time between the marks A and B is taken with a stop watch. This is done once and for all for a standard liquid, the viscosity η_0 and density ρ_0 of which, at a convenient temperature, are accurately known; the time t_0 is found as the average of several determinations.

As the same volume of liquid is always used, the effective column of liquid is always of the same height, so that the pressures producing the flow are directly proportional to the densities. If therefore the time of efflux for another liquid of density ρ_1 is found to be t_1 its viscosity η_1, is, by Poiseuille's formula:

$$\eta_1 = \eta_0 \frac{\rho_1 t_1}{\rho_0 t_0}.$$

As has been mentioned, and will be discussed more fully below, the viscosity of all liquids decreases with rising temperature, and measurements are therefore carried out in a thermostat, *i.e.*, a bath of suitable liquid, the temperature of which is kept constant by a regulating device. The viscosity coefficients of a number of pure liquids are given in Table I, and those of a number of liquids of technical interest, which are not so well defined, in Table II.

TABLE I. *Viscosity Coefficients of Pure Liquids in Centipoises Temperature 20° Unless Otherwise Stated*

Water at 0°	1·7921	Carbon disulphide	0·367
,, ,, 10°	1·3077	Acetone	0·3225
,, ,, 20°	1·0050	Formic acid	1·782
,, ,, 50°	0·5494	Acetic ,,	1·219
,, ,, 100°	0·2838	Propionic acid	1·099
Ethyl alcohol	1·192	Benzene	0·649
Methyl ,,	0·591	Toluene	0·586
Chloroform	0·564	O-xylene	0·897
Carbon tetrachloride	0·969		

TABLE II. *Viscosity Coefficients of Technical Liquids in Centipoises Temperature 20° Unless Otherwise Stated*

100% Sulphuric acid	24·2	Shale oil	7·70
Olive oil	80·8	Spindle oil	92·0
Glycerin at 25°	735·0	Rumanian fuel oil at 25°	515·0
Castor oil at 25°	621·0		
Turpentine	1·46		
"Standard White" paraffin	2·375		

Viscosity and Temperature.—Two fairly typical examples of the variation of viscosity with temperature are given in fig. 6, in which the viscosity coefficients of water and of mercury are plotted against the temperatures (lower scale for water, upper for mercury). The viscosity decreases throughout the whole range, but the decrease per degree is much greater at low than at high temperature. The viscosity of water decreases by about 2·7% per degree between 0° and 10°, by about 2% per degree between 10° and 20°, etc., while the decrease is much more uniform for mercury.

No general law connecting viscosity with temperature has yet been found, although for any given liquid the variation can be represented with fair accuracy by one of a number of interpolation formulae.

Viscosity and Pressure.—The viscosity of all liquids so far examined, except water, increases with pressure and may attain enormous values when the pressure becomes very high. This has been demonstrated by Bridgman, who investigated over 40 liquids at pressures up to 12,000 atmospheres and at two temperatures,

30° and 75°. Earlier workers had examined a few liquids at pressures up to 3,000 atmospheres. Up to this limit the viscosity generally increases in approximately linear ratio with the pressure, but beyond it the increase becomes much more rapid. This is well shown in fig. 7, in which the relative viscosities (the viscosity at atmospheric pressure being taken as unity) of (A) ether and (B) carbon disulphide are plotted against the pressures: at 12,000 atmospheres the viscosity of ether is about 46 times, and that of carbon disulphide about 15 times that at atmospheric pressure. These are, however, liquids in which the effect of pressure is comparatively small; in many others the viscosity at the highest attainable pressures is many hundred and even thousand times as high as at atmospheric pressure.

As mentioned, Bridgman determined the viscosities at 30° and at 75°; at the same pressure the viscosity at the higher temperature is always smaller than at the lower. The liquid at the higher temperature, however, occupies a greater volume than at the lower, when the pressures are equal, and since it is very natural to assume that the change in viscosity caused by either temperature or pressure is merely a consequence of the accompanying change in volume, it is of great interest to compare the viscosities at equal volumes. The volumes corresponding to different pressures up to 12,000 atmospheres were determined by Bridgman in an earlier investigation; they are plotted in fig. 8 as abscissae and the viscosities at 30° and 75° corresponding to them as ordinates. The viscosity at 30° is always higher than that at 75° and at the same volume; in other words, the viscosity is not determined by the volume alone, as has been assumed in several theories. The point is of fundamental importance and still awaits explanation.

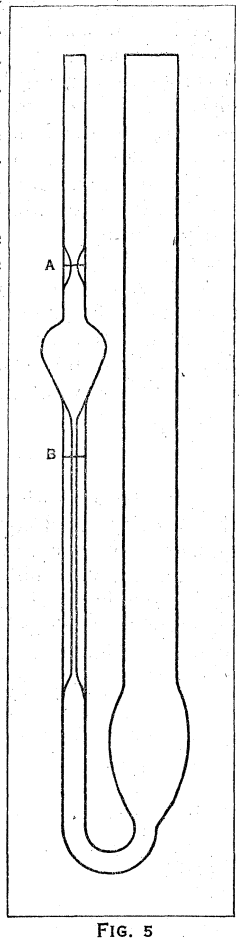


FIG. 5

Water behaves anomalously, as it does in respect of other physical properties. At temperatures below about 30° the viscosity at first decreases with increasing pressure and shows a minimum at about 1,000 atmospheres, which is the more marked the lower the temperature. At temperatures above 30° water behaves like other liquids, *i.e.*, the viscosity increases with the pressure throughout the whole range.

Viscosity and Chemical Constitution.—Thomas Graham, the founder of colloid chemistry, who carried out a great number of viscosity measurements by Poiseuille's method, was the first to suggest that the viscosity of compounds of similar constitution might increase in a regular manner with the number of molecules or groups contained in them. Several investigations have been directed towards establishing such a connection, the best known of which was carried out by Thorpe and Rodger. They found that in any homologous series the viscosity increased with the molecular weight, the increase being fairly regular with the higher members, while the first two or three behaved anomalously—as they do in regard to other physical properties. Series like the alcohols and the fatty acids show considerable irregularities which are ascribed to association, *i.e.*, to their consisting, not of single molecules, but of complexes of such, which break up with rising temperature. There is other evidence of association, and the anomalies of water are ascribed to the same cause.

Viscosity of Solutions and Mixtures.—The investigations on both these have been extremely numerous. Solutions of all non-electrolytes and of electrolytes with certain well-known exceptions have viscosities higher than that of the solvent, the increase for equal increments of dissolved substance becoming higher at high concentrations. The exceptions are solutions of certain salts of potassium, ammonium, rubidium and caesium in water or alcohol, which, between certain limits of temperature and concentration, have viscosities lower than that of the solvent.

The viscosity of all solutions, like that of pure liquids, decreases with rising temperature; the effect is even more marked than in the latter, especially at high concentration. This is well shown in fig. 9, in which the viscosities of 40 and 60% cane sugar solutions are plotted against the temperature; the viscosity of the 60% solution at 0° is over 70 times, and that of the 40% solution about 15 times the respective values at 100°; for water this ratio is about 6·3.

It has so far been impossible to find the law connecting the viscosity of a solution with its concentration, and none of the empirical formulae which have been proposed fits more than a limited number of solutions. There are hardly any mixtures the viscosity of which is the mean calculated from the viscosities and percentages of the two components; if the viscosity of a mixture of chemically quite indifferent liquids is plotted against the percentage of one component, a slightly sagged curve (fig. 10) is the nearest approach to the straight line (dotted) which would represent the viscosity of the "ideal" mixture. It frequently happens, however, that the curve has a maximum (fig. 11) or a minimum (fig. 12); in other words, the viscosity of the mixture, at certain ratios of the components, is greater or smaller than the viscosity of either alone. The maximum or minimum may occur at the same concentration at all temperatures (fig. 11) or it may shift with changing temperature (fig. 12). Maxima and minima frequently occur at ratios, at which other physical constants, like the specific volume or the boiling point, also show extreme values; thus Poiseuille and Graham already observed, that the viscosity-maximum of the alcohol-water mixture occurred at the same ratio as the greatest contraction on mixing.

It has not so far been possible to formulate any molecular theory of the viscosity of liquid which accounts even qualitatively

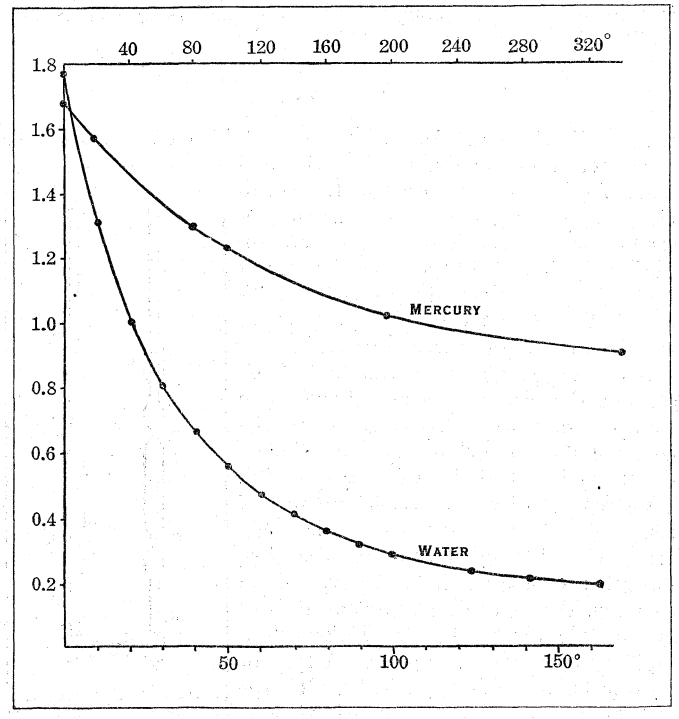


FIG. 6

for the variations with temperature and pressure. The kinetic theory of gases, on the other hand, led to some very striking conclusions regarding the viscosity of gases, which were subsequently verified by experiment and must now be described briefly.

The Viscosity of Gases.—A few years after the publication of Poiseuille's paper Thomas Graham investigated very carefully the flow of gases through capillaries. The times in which equal volumes of different gases passed through the same tubes under

the same pressure were different and were expressed as "transpiration coefficients," the time for oxygen being taken as unity. Graham found the same transpiration coefficients with different tubes, so that they represented a constant characteristic of the gas itself. Maxwell in developing the kinetic theory of gases deduced an expression from which it follows immediately that (1) the viscosity of a gas is independent of the pressure, and (2)

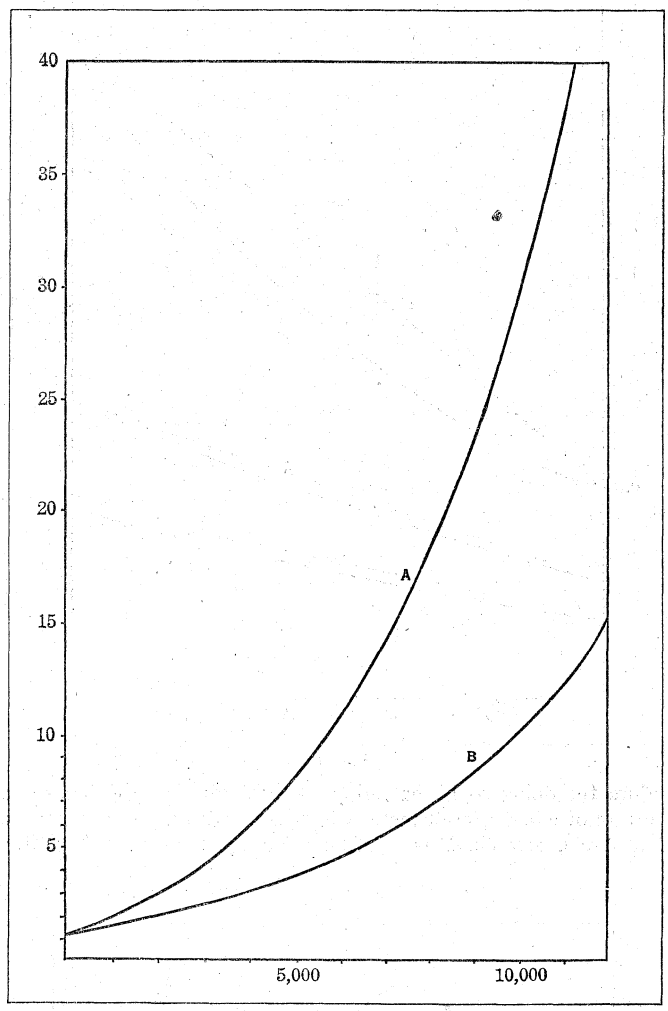


FIG. 7

it increases with rising temperature in linear ratio with the square root of the absolute temperature. (*See* KINETIC THEORY OF MATTER.)

The first of these very striking and unexpected conclusions was verified experimentally by O. E. Meyer and subsequently with improved apparatus by Maxwell himself. The method used was one which had been applied to liquids before: a set of three circular discs A (fig. 13) suspended from a fine wire was made to oscillate round its axis between four fixed discs A′; the viscosity of the air damps the oscillations and can be deduced from the decrease in their amplitudes. The viscosity of air was in this way found to be constant between pressures of 760 mm. of mercury (normal barometric pressure) and 1 millimetre. There are considerable deviations from this law at high pressures, and at very low pressures, when the mean free path of the molecules becomes comparable to the dimensions of the vessel, the viscosity diminishes very considerably. This property has been utilized in the construction of gauges for extremely low pressures. (*See* VACUUM.)

Meyer also deduced from the kinetic theory that the flow of gases through capillaries followed Poiseuille's law, and calculated from Graham's "transpiration coefficients" and the dimensions of his tubes the viscosity coefficients of a number of gases. The capillary method has also been used very generally by later investigators. The viscosity coefficients of a few gases at 0° are given below in centipoises; it will be noticed that the viscosity coefficient of air at that temperature is almost exactly $\frac{1}{100}$ of that of water at 0°.

TABLE III. *Viscosity Coefficients of Gases in Centipoises Temperature 0°*

Atmospheric air.	0·01719	Carbon dioxide .	0·01382
Oxygen . .	0·01973	Sulphur dioxide .	0·01168
Hydrogen . .	0·00849	Ammonia . .	0·00957
Carbon monoxide	0·01665		

It has also been shown that Stokes's formula applies to the fall of spheres in gases as well as in liquids, provided the spheres are not small compared with the mean free path. It is a matter of common experience that very finely divided matter stays suspended in air for a considerable time, and Stokes's formula can be used to calculate the size of particles of a given material, *e.g.*, droplets of water, which will sink at a given rate. If this is to be say 1 cm. per hour, the diameter of the globule must not exceed $1{\cdot}38\mu$ ($1\ \mu = \frac{1}{1000}$ mm.).

The striking prediction that the viscosity of gases, unlike that of liquids, increases with rising temperature, has also been verified experimentally. The viscosity is not, however, proportional to the square root of the absolute temperature, as theory requires, but increases much more rapidly. The discrepancy has been

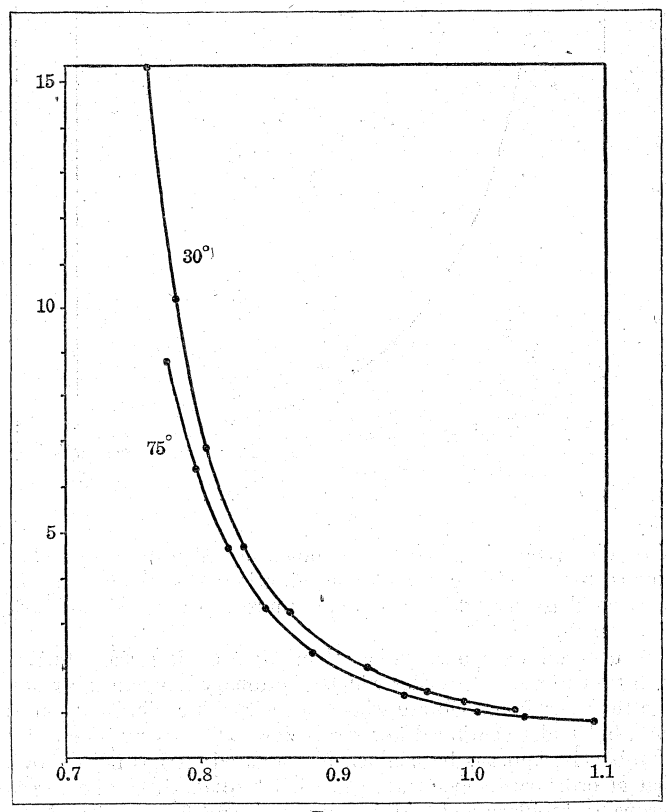


FIG. 8

explained by Sutherland, who found the actual law of the variation with absolute temperature to be

$$\eta = A\frac{\sqrt{T}}{1+C/T}$$

where C is a constant for each gas, known as Sutherland's constant.

The Viscosity of Solids.—The first physicist to put forward and to define the concept of viscosity in solids, more especially in "highly elastic solids within the limits of high elasticity" was Sir William Thomson (afterwards Lord Kelvin); he did so in a paper published in the *Proceedings* of the Royal Society in 1865 and afterwards included in the article "Elasticity" in the 4th edition of the *Encyclopædia Britannica*. The concept is a difficult one,

but the difficulty is not so much that of defining viscosity or viscous flow as that of defining a solid. Stokes, *e.g.*, suggested that "there seems no line of demarcation between a solid and a viscous fluid"; Maxwell, on the other hand, considered any body which exhibited flow at all stresses as a liquid, whereas bodies which did not flow until a certain minimum stress had been exceeded, were plastic solids. It has become quite usual to describe, in accordance with

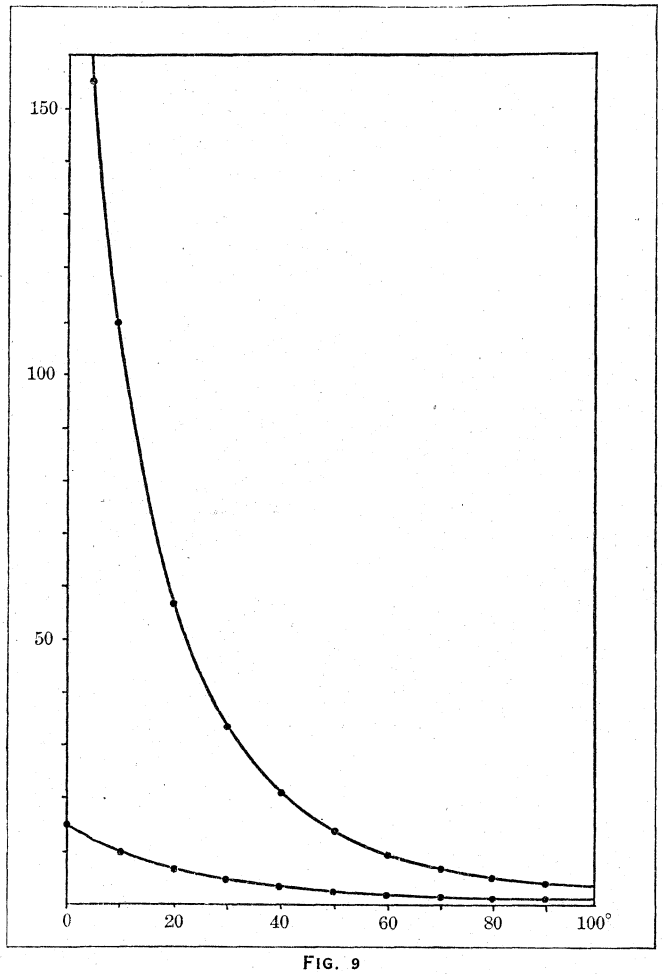


FIG. 9

Maxwell's view, glass as a "supercooled liquid" (although, unlike liquids, it is capable of transverse vibrations) and to confine the term solid to crystalline bodies or, more strictly still, to single crystals.

If one follows Stokes rather than Maxwell it is easy to find such transitions, viz., bodies which at ordinary temperature maintain their shape and vibrate when touched with a vibrating tuning fork, but under continued low stress flow. Pitch is representative of this class and has been much investigated; it has been shown that at ordinary temperature, when it is "solid," it can be forced through a capillary and exhibits purely viscous flow in accordance with Poiseuille's law. At 13·3° the coefficient of viscosity is about 5,000 million poises, and at 99·9° about 120 poises; the decrease in viscosity is quite continuous.

The viscosity coefficient of substances like pitch, which at low temperatures keep their shape, can be determined by methods not applicable to liquids; it can, for example, be deduced from the rate at which a cylinder, to one end of which a constant torque is applied, is twisted. The method was used by Trouton and Andrews, who found that even in pitch there were some elastic effects, the cylinder untwisting to a small extent when the torque was removed. Thomson studied the decrement of the amplitude of torsional oscillations performed by wires from which heavy masses were suspended, with a view to finding whether the damping could be completely accounted for by an internal resistance of the nature of viscosity, but arrived at a negative result.

The difficulty encountered in studying viscous flow in solids is, in fact, that of separating it from other types of deformation, which may precede or accompany it. The most successful pro-

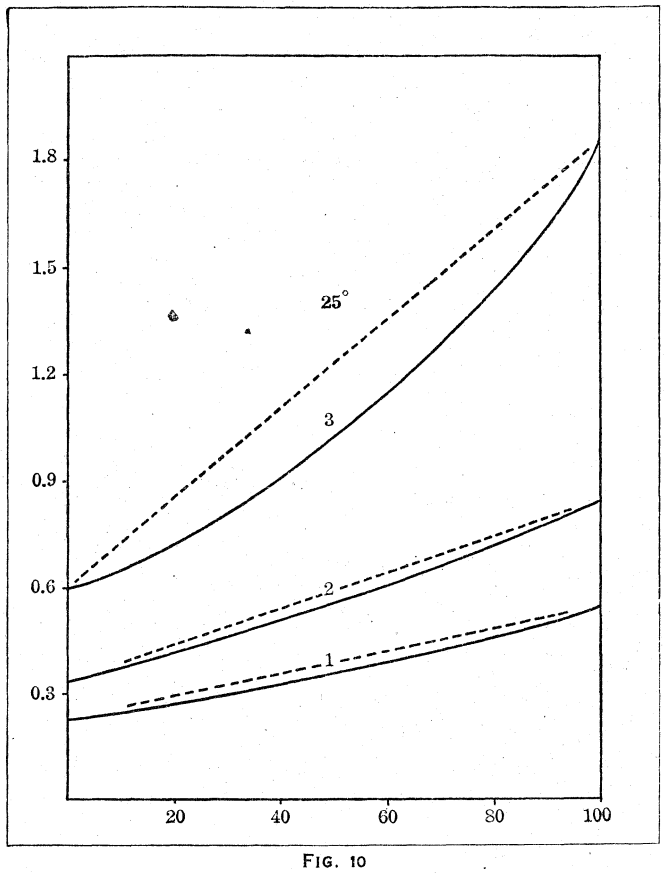


FIG. 10

cedure for doing so is that adopted by Andrade, who measured the rate of elongation of metal wires stretched by constant stress. If a wire is stretched, as is often done, by a constant load, the

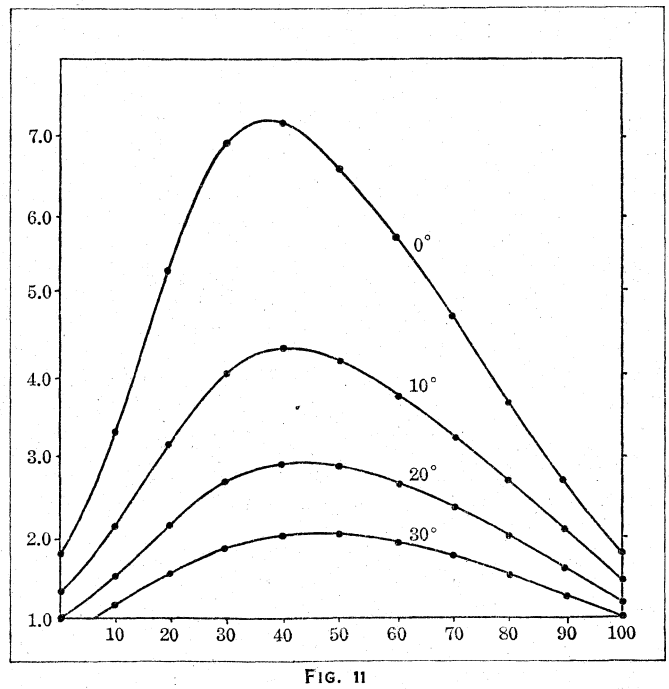
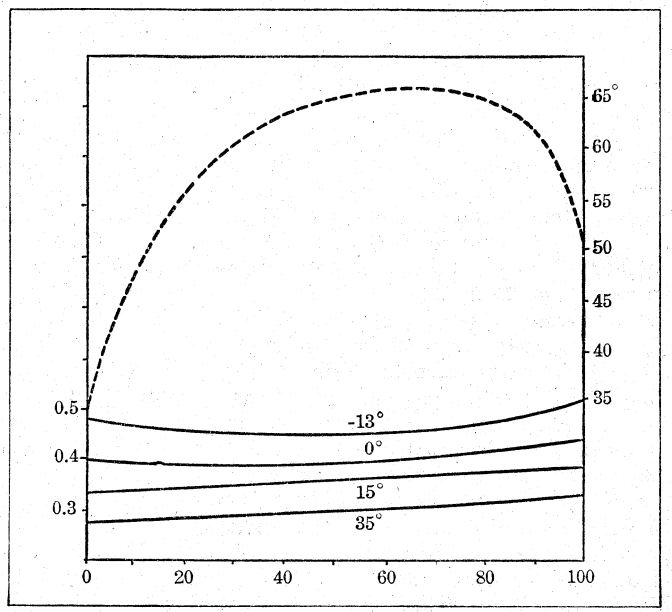


FIG. 11

stress, *i.e.*, the load per unit area, keeps increasing, as the cross-section becomes smaller when the wire becomes longer. Andrade decreased the load in the same ratio in which the cross-section was reduced by giving the weight, which stretched the wire, a

suitable profile and allowing it to sink into a liquid, as the wire became longer. He found in this way that the elongation could be divided into three parts: an immediate extension on loading, an initial flow which decreases with time and is therefore not



FROM FAUST, IN "ZEITSCHRIFT FUR PHYSIKALISCHE CHEMIE" (AKADEMISCHE VERLAGSGESELLSCHAFT, LEIPZIG)

FIG. 12

viscous, and then a constant flow, during which the rate of elongation per unit length is constant up to the breaking point; this is the purely viscous flow. A wide region of viscous flow was found with lead, copper and fuse (lead-tin alloy) wire at ordinary temperature. Other metals were found to behave like lead when a suitable temperature was chosen: a wire of frozen mercury at −78° gave time-extension curves intermediate between those of lead at 160° and 17° while iron wire at 444° behaved like lead at 16°. The higher the temperature the more does viscous flow predominate. No viscosity coefficients have been deduced from the experiments just described.

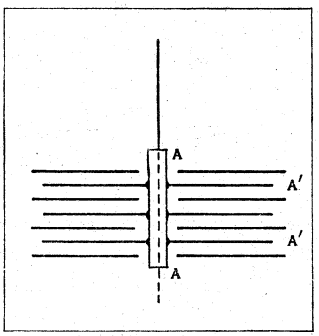


FIG. 13

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VISCOUNT, the title of the fourth rank of the European nobility. In the British peerage it intervenes between the dignities of earl and baron. The title is now purely one of honour, having long been dissociated from any special office or functions.

In the Carolingian epoch the *vice-comites,* or *missi comitis,* were the deputies or vicars of the counts, whose official powers they exercised by delegation, and from these the viscounts of the feudal period were undoubtedly derived. Soon after the counts became hereditary the same happened in the case of their lieutenants; *e.g.,* in Narbonne, Nîmes and Alby the viscounts had, according to A. Molinier, acquired hereditary rights as early as the beginning of the 10th century. Viscountcies thus developed into actual fiefs. Viscounts, however, continued for some time to have no more than the status of lieutenants, either calling themselves simply *vice-comites,* or adding to this title the name of the countship from which they derived their powers. It was not till the 12th century that the universal tendency to territorialize the feudal dominions affected the viscountcies with the rest, and that the viscounts began to take the name of the most important of their domains. Thus the viscounts of Poitiers called themselves viscounts of Thouars, and those of Toulouse viscounts of Bruniquel and Montelar. From this time the significance of the title was extremely various. Some viscounts, notably in the duchy of Aquitaine and the county of Toulouse, of which the size made an effective centralized Government impossible, were great barons, whose authority extended over whole provinces, and who disputed for power with counts and dukes. Elsewhere, on the other hand, *e.g.,* in the Ile de France, Champagne, and a great part of Burgundy, the *vicomtes* continued to be half feudatories, half officials of the counts, with the same functions and rank in the feudal hierarchy as the chatelains; their powers were jealously limited and, with the organization of the system of *prévôts* and *baillis* in the 12th century, practically disappeared. In the royal domains especially, these petty feudatories could not maintain themselves against the growing power of the Crown, and they were early assimilated to the *prévôts.*

In Normandy *vicomtes* appeared at a very early date as deputies of the counts (afterwards dukes) of the Normans. When local Norman counts began in the 11th century, some of them had *vicomtes* under them, but the normal *vicomte* was still a deputy of the duke, and Henry I. largely replaced the hereditary holders of the *vicomtés* by officials. "By the time of the Conqueror the judicial functions of the viscount were fully recognized, and extended over the greater part of Normandy." Eventually almost the whole of Normandy was divided into administrative viscountcies or bailiwicks by the end of the 12th century. When the Normans conquered England, they applied the term *viscounte* or *vicecomes* to the sheriffs of the English system, whose office, however, was quite distinct and was hardly affected by the Conquest.

Nearly four centuries later "viscount" was introduced as a peerage style into England, when its king was once more lord of Normandy. John, Lord Beaumont, K.G., who had been created count of Boulogne in 1436, was made Viscount Beaumont, Feb. 12, 1440, and granted precedence over all barons, which was doubtless the reason for his creation. The oldest viscountcy now on the roll is that of Hereford, created in 1550; but the Irish viscountcy of Gormanston is as old as 1478. *See* FORMS OF ADDRESS.

VISHNU [Sanskr. the "active one"], in the Indian *Rig-Veda* a minor deity, who takes three strides, *vi-kram,* the last and highest beyond mortal ken; these probably denote the three divisions of the universe. Closely allied with Indra in his fight with Vritra, the drought-dragon, and against the Dāsas, the dark aborigines, Vishnu in the Epic mythology developed into the Preserver god, one of the Hindu triad with Brahma, the creator; and Siva, the destroyer; and as such he has saved mankind in ten incarnations. His special devotees, the Vaishnavas, have evolved numerous sects.

VISION or **SIGHT,** the function, in physiology, of the organ known as the eye (*q.v.*). The sense of vision is excited by the influence of light on the retina, the special terminal organ connected with the optic nerve. By excitation of the retina, a change is induced in the optic nerve fibres, and is conveyed by these to the brain, the result being a luminous perception, or what we call a sensation of light or colour. If light were to act uniformly over the retina, there would be no image of the source of the light formed on that structure, and consequently there would be only a general consciousness of light, without reference to any particular object. One of the first conditions, therefore, of vision for useful purposes is the formation of an image on the retina. To effect this, just as in a photographic camera, refractive structures must be placed in front of the retina which will so bend luminous rays as to bring them to a focus on the retina, and thus produce an image. Throughout the animal kingdom various arrangements are found for this purpose; but they may

be all referred to three types, namely—(1) eye-specks or eye-dots, met with in Medusae, Annelidae, etc.; (2) the compound eye, as found in insects and crustaceans; and (3) the simple eye, common to all vertebrates. The *eye-specks* may be regarded simply as expansions of optic nerve filaments, covered by a transparent membrane, but having no refractive media, so that the creature would have the consciousness of light only, or a simple luminous impression, by which it might distinguish light from darkness. The *compound eye* consists essentially of a series of transparent cone-like bodies, arranged in a radiate manner against the inner surface of the cornea, with which their bases are united, while their apices are connected with the ends of the optic filaments. As each cone is separated from its neighbours, it admits only a ray of light parallel with its axis, and its apex represents only a portion of the image, which must be made up, like a mosaic-work, of as many parts as there are cones in the eye. The size of the visual field will depend on the size of the segment of the sphere forming its surface.

The eyes of many insects have a field of about half a sphere, so that the creature will see objects before and behind it as well as those at the side. On the other hand, in many the eyes have scarcely any convexity, so that they must have a narrow field of vision.

For numerous anatomical details, and various diseases connected with the eye, *see* EYE; the pathological aspects of vision itself are treated at the conclusion of this article.

1. PHYSICAL CAUSES OF VISION

A luminous sensation may be excited by various modes of irritation of the retina or of the optic nerve. Pressure, cutting or electrical shocks may act as stimuli, but the normal excitation is the influence of light on the retina. From a physical point of view, light is a mode of movement occurring in a medium, termed the aether, which pervades all space; but the physiologist studies the operation of these movements on the sentient organism as resulting in consciousness of the particular kind which we term a luminous impression. Outside of the body, such movements have been studied with great accuracy; but the physiological effects depend upon such complex conditions as to make it impossible to state them in the same precise way. Thus, when we look at the spectrum, we are conscious of the sensations of red and violet, referable to its two extremities: the physicist states that red is produced by 392 billions of impulses on the retina per second, and that violet corresponds to 757 billions per second; but he has arrived at this information by inductive reasoning from facts which have not at present any physiological explanation. Below the red and above the violet ends of the spectrum there are vibrations which do not excite luminous sensations. In the first case, below the red, the effect is to raise the temperature; and above the violet the result is to cause chemical activity in the substance by which the radiation is absorbed. Thus the method of dispersion of light, as is followed in passing a ray through a prism, enables us to recognize these general facts: (1) rays below the red excite thermal impressions; (2) from the lower red up to the middle of the violet, the thermal rays become gradually weaker until they have no effect; (3) from the lower red to the extreme violet, they cause luminous impressions, which reach their greatest intensity in the yellow; and (4) from about the end of the yellow to far beyond the extreme violet, the rays have gradually a less and less luminous effect, but they have the power of exciting such chemical changes as are produced in photography. In general terms, therefore, the lower end of the spectrum may be called thermal, the middle luminous, and the upper actinic or chemical; but the three merge into and overlap one another. It may be observed that the number of vibrations in the extreme violet is not double that of the low red, so that the sensibility of the eye to vibrations of light does not range through an octave. The ultra-violet rays may act on the retina in certain conditions, as when they are reflected by a solution of sulphate of quinine, constituting the phenomenon of fluorescence. Far above the violet are the Röntgen radiations, γ rays, etc.

2. OPTICAL ARRANGEMENTS OF THE EYE

1. **General.**—When light traverses any homogeneous transparent medium, such as the air, it passes on in a straight course with a certain velocity; but if it meet with any other transparent body of a different density, part of it is reflected or returned to the first medium, whilst the remainder is propagated through the second medium in a different direction and with a different velocity. Thus we may account for the phenomena of reflection of light and of refraction (*q.v.*).

Before a ray of light can reach the retina, it must pass through a number of transparent and refractive surfaces. The eye is a nearly spherical organ, formed of transparent parts situated behind each other, and surrounded by various membranous structures, the anterior part of which is also transparent. The transparent parts are—(1) the *cornea;* (2) the *aqueous humour,* found in the anterior chamber of the eye; (3) the *crystalline* lens, formed by a transparent convex body, the anterior surface of which is less convex than the posterior; and (4) the *vitreous humour,* filling the posterior chamber of the eye. The ray must therefore traverse the cornea, aqueous humour, lens and vitreous humour. As the two surfaces of the cornea are parallel, the rays practically suffer no deviation in passing through that structure, but they are bent during their transmission through the other media.

2. **The Formation of an Image on the Retina.**—This may be well illustrated with the aid of a photographic camera. If properly focused, an inverted image will be seen on the glass plate at the back of the camera. It may also be observed by bringing the eyeball of a rabbit near a candle flame. The action of a lens in forming an inverted image is illustrated by fig. 1, where the pencil of rays proceeding from a is brought to a focus at a', and those from b at b'; consequently the image of ab is inverted as at $b'a'$. The three characteristic features of the retinal image are: (1) it is reversed; (2) it is sharp and well defined if it be accurately focused on the retina; and (3) its size depends on the visual angle. If we look at a distant object, say a star, the rays reaching the eye are parallel, and in passing through the refractive media they are focused at the posterior focal point—that is, on the retina. A line from the luminous point on the retina passing through the nodal point is called the *visual line.*

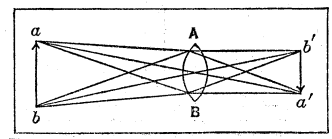


FIG. 1.—INVERSION BY ACTION OF A LENS

If the luminous object be not nearer than, say, 60 yd. the image is still brought to a focus on the retina without any effort on the part of the eye. Within this distance, supposing the condition of the eye to be the same as in looking at a star, the image would be formed somewhat behind the posterior focal point, and the effect would be an indistinct impression on the retina. To obviate this, for near distances, accommodation, so as to adapt the eye, is effected by a mechanism to be afterwards described.

When rays, reflected from an object or coming from a luminous point, are not brought to an accurate focus on the retina, the image is not distinct in consequence of the formation of *circles of diffusion,* the production of which will be rendered evident by fig. 2. From the point A luminous rays enter the eye in the form of a cone, the kind of which will depend on the pupil. Thus it may be circular, or oval, or even triangular. If the pencil is focused in front of the retina, as at d, or behind it as at f, or, in other words, if the retina, in place of being at F, be in the positions G or H, there will be a luminous circle or a luminous triangular space, and many elements of the retina will be affected. The size of these diffusion circles depends on the distance from the retina of the point where the rays are focused: the greater the distance, the more extended will be the diffusion circle. Its size will also be affected by the greater or less diameter of the pupil. Circles of diffusion may be

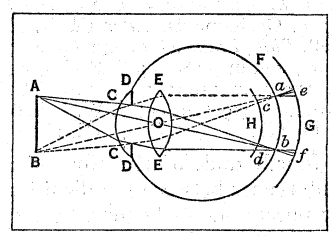


FIG. 2.—FORMATION OF CIRCLES OF DIFFUSION

studied by the following experiment, called the experiment of Scheiner, fig. 3:

Let C be a lens, and DEF be screens placed behind it. Hold in front of the lens a card perforated by two holes A and B, and allow rays from a luminous point *a* to pass through these holes. The point *o* on the screen E will be the focus of the rays emanating from *a;* if *a* were removed farther from the lens, the focus would be on F, and if it were brought near to C, the focus would then be on D. The screens F and D show two images on the point *a*. If, then, we close the upper opening in AB, the *upper* image *m* on F and the *lower* image *n* on D disappear. Suppose now that the retina be substituted for the screens D and F, the contrary will take place, in consequence of the reversal of the retinal image. If the eye be placed at *o,* only one image will be seen; but if it be placed either in the plane of F or D, then two images will be seen, as at *mm,* or *nn;* consequently, in either of these planes there will be circles of diffusion and indistinctness, and only in the plane E will there be sharp definition of the image.

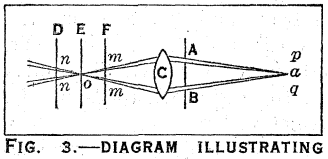


FIG. 3.—DIAGRAM ILLUSTRATING THE EXPERIMENT OF SCHEINER

Owing to the optical conditions and defects of the eye (*vide infra*) a mathematically punctate image is never formed upon the retina, even in a normal eye. To understand the formation of an image on the retina, suppose a line drawn from each of its two extremities to the nodal point and continued onwards to the retina, as in fig. 4, where the visual angle is *x*. It is evident that its size will depend on the size of the object and the distance of the object from the eye. Thus, also, objects of different sizes, *c, d, e* in fig. 4, may be included in the same visual angle, as they are at different distances from the eye. The size of the retinal image may be calculated if we know the size of the object, its distance from the nodal point *o,* and the distance of the nodal point from the posterior focus. The smallest visual angle in which two distinct points may be observed is approximately 60 seconds; below this, the two sensations fuse into one; and the size of the retinal image corresponding to this angle is ·004 mm., about the diameter of a single retinal rod or cone. The images of two luminous points, *e.g.,* stars, must therefore be separated by the diameter of one cone, *i.e.,* the two cones stimulated must be separated by one unstimulated cone. A very minute image, if thrown on a single retinal element, is sufficient to excite it if the illumination is sufficiently intense.

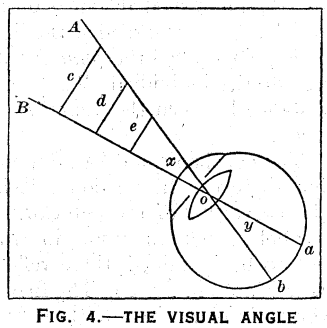


FIG. 4.—THE VISUAL ANGLE

3. **The Optical Defects of the Eye.**—As an optical instrument; the eye is defective. These defects are chiefly of two kinds—(1) those due to the curvature of the refractive surfaces, and (2) those due to the dispersion of light by the refractive media.

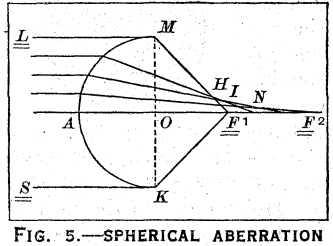


FIG. 5.—SPHERICAL ABERRATION

(*a*) *Aberration of Sphericity.*—Suppose, as in fig. 5, M A K to be a refractive surface on which parallel rays from L to S impinge, it will be seen that those rays passing near the circumference are brought to a focus at F^1, and those passing near the centre at F^2—intermediate rays being focused at N. Thus on the portion of the axis between F^1 and F^2 there will be a series of focal points, and the effect will be a blurred and bent image. In the eye this defect is to a large extent corrected by the following arrangements: (1) the iris cuts off the outer and more strongly refracted rays; (2) the curvature of the cornea is flatter at the periphery, and consequently those farthest from the axis are least deviated; (3) the anterior and posterior curvatures of the lens are such that the one corrects, to a certain extent, the action of the other; and (4) the structure of the lens is such that its power of refraction diminishes from the centre to the circumference, and consequently the rays farthest from the axis are less refracted.

(*b*) *Astigmatism.*—Another common defect of the eye is due to different meridians having different degrees of curvature. This defect is known as *astigmatism.* It may be thus detected.

In the cornea the vertical meridian has generally a shorter radius of curvature, and is consequently more refractive than the horizontal. The meridians of the lens may also vary; but, as a rule, the asymmetry of the cornea is greater than that of the lens. The optical explanation of the defect will be understood with the aid of fig. 6. Thus, suppose the vertical meridian C A D to be more strongly curved than the horizontal F A E, the rays which fall on C A D will be brought to a focus, G, and those falling on F A E at B. If we divide the pencil of rays at successive points, G, H, I, K, B, by a section perpendicular to A B, the various forms it would present at these points are seen in the figures underneath, so that if the eye were placed at G, it would see a horizontal line *a a′*; if at H, an ellipse with the long axis *a a′* parallel to A B; if at I, a circle; if at K, an ellipse, with the long axis, *b c,* at right angles to A B; and if at B, a vertical line *b c*. The degree of astigmatism is ascertained by measuring the difference of refraction in the two chief meridians; and the defect is corrected by the use of cylindrical glasses, the curvature of which, added to that of the minimum meridian, makes its focal length equal to that of the maximum meridian.

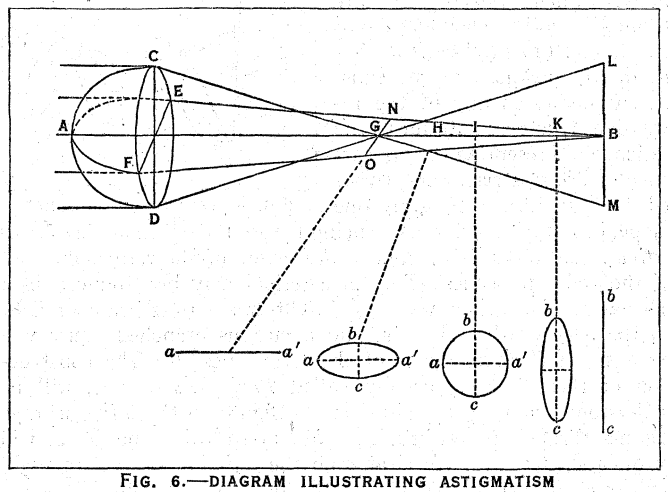


FIG. 6.—DIAGRAM ILLUSTRATING ASTIGMATISM

(*c*) *Chromatic Aberration.*—When a ray of white light traverses a lens, the different rays composing it, being unequally refrangible, are dispersed: the violet rays (*see* fig. 7), the most refrangible, are brought to a focus at *e,* and the red rays, less refrangible, at *d*. If a screen were placed at *e,* a series of concentric coloured circles would be formed, the central being of a violet, and the circumference of a red colour. The reverse effect would be produced if the screen were placed at *d*. Imagine the retina in place of the screen in the two positions, the sensational effects would be those just mentioned. Under ordinary circumstances, the error is not observed, as for vision at near distances the interval between the focal point of the red and violet rays is very small. If, however, we look at a candle flame through a bit of cobalt blue glass, which transmits only the red and blue rays, the flame may appear violet surrounded by blue, or blue surrounded by violet, according as we have accommodated the eye for different distances. Red surfaces appear nearer than violet surfaces situated in the same plane.

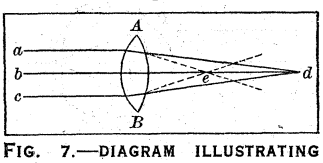


FIG. 7.—DIAGRAM ILLUSTRATING THE DISPERSION OF LIGHT BY A LENS

(*d*) *Diffraction.*—The rays are best at the edge of the pupil, breaking up the light into a series of concentric spectra. This

contributes to the imperfection of the image. The effect is greatest with a small pupil, but is practically negligible with a pupil of 3 mm. diameter or more. Chromatic aberration and diffraction tend to counteract each other.

(*e*) *Defects Due to Opacities, etc., in the Transparent Media.*— When small opaque particles exist in the transparent media, they may cast their shadow on the retina so as to give rise to images which are projected outwards by the mind into space, and thus appear to exist outside of the body. Such phenomena are termed entoptic. They may be of two kinds: (1) *extra-retinal,* that is, due to opaque or semi-transparent bodies in any of the refractive structures anterior to the retina, and presenting the appearance of drops, striae, lines, twisted bodies, forms of grotesque shape, or minute black dots dancing before the eye; and (2) *intra-retinal,* due to opacities, etc., in the layers of the retina, in front of the rods and cones. The intra-retinal may be produced in a normal eye in various ways. (1) Throw a strong beam of light on the edge of the sclerotic, and a curious branched figure will be seen, which is an image of the retinal vessels. The construction of these images, usually called *Purkinje's figures,* will be understood from fig. 8. Thus, in the figure to the left, the rays passing through the sclerotic at *b″*, in the direction *b″ c,* will throw a shadow of a vessel at *c* on the retina at *b′*, and this will appear as a dark line at B. If the light move from *b″* to *a″*, the retinal shadow will move from *b′* to *a′*, and the line in the field of vision will pass from B to A. It may be shown that the distance *c b′* corresponds to the distance of the retinal vessels from the layer of rods and cones. If the light enter the cornea, as in the figure to the right, and if the light be moved, the image will be displaced in the same direction as the light, if the movement does not extend beyond the middle of the cornea, but in the opposite direction to the light when the latter is moved up and down. Thus, if *a* be moved to *a′*, *d* will be moved to *d′*, the shadow on the retina from *c* to *c′*, and the image *b* to *b′*. If, on the other hand, *a* be moved above the plane of the paper, *d* will move below, consequently *c* will move above, and *b′* will appear to sink. (2) The retinal vessels may also be seen by looking at a strong light through a minute aperture, in front of which a rapid to-and-fro movement is made. Such experiments prove that the sensitive part of the retina is its deepest and most external layer (the rod and cone layer).

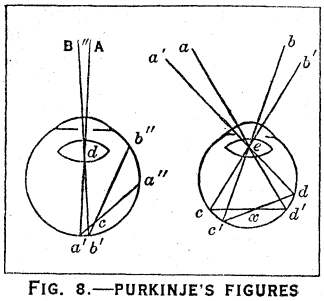


FIG. 8.—PURKINJE'S FIGURES

4. **Accommodation, or the Mechanism of Adjustment for Different Distances.**— When a camera is placed in front of an object, it is necessary to focus accurately in order to obtain a clear and distinct image on the sensitive plate. This may be done by moving either the lens or the sensitive plate backwards or forwards so as to have the posterior focal point of the lens corresponding with the sensitive plate. For similar reasons, a mechanism of adjustment, or accommodation for different distances, is necessary in the human eye. In the normal eye, any number of parallel rays, coming from a great distance, are focused on the retina. Such an eye is termed *emmetropic* (fig. 9). Another form of eye (B) may be such that parallel rays are brought to a focus *in front of* the retina. This form of eye is *myopic* or short-sighted, inasmuch as, for distinct vision, the object must be brought nearer to the eye. A third form is seen in C, where the focal point, for ordinary distances, is *behind* the retina, and consequently the rays must be made more convergent by accommodation. This kind of eye is called *hypermetropic,* or far-sighted. For ordinary distances, at which objects must be seen distinctly in everyday life, the fault of the myopic eye may be corrected by the use of concave and of the hypermetropic by convex glasses. In the first case, the concave glass will move the posterior focal point a little farther back, and in the second the convex glass will bring it farther forward; in both cases, however, the glasses may be so adjusted, both as regards refractive index and radius of curvature, as to bring the rays to a focus on the retina, and consequently secure distinct vision.

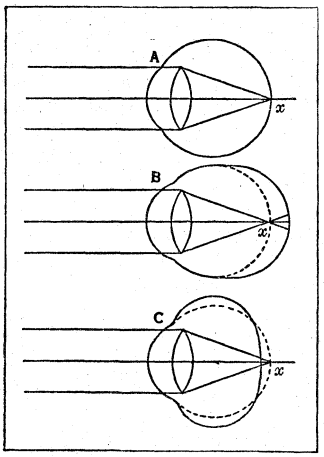


FIG. 9.—A. EMMETROPIC OR NORMAL EYE; B. MYOPIC OR SHORT-SIGHTED EYE; C. HYPERMETROPIC OR LONG-SIGHTED EYE

From any point 65 metres distant, rays may be regarded as almost parallel, and the point will be seen by the emmetropic eye without any effort of accommodation. This point, either at this distance or in infinity, is called the *punctum remotum,* or the most distant point seen without accommodation. In the myopic eye it is much nearer, and for the hypermetropic there is really no such point, and accommodation is always necessary. If an object were brought too close to the eye for the refractive media to focus it on the retina, such circles of diffusion would be formed as to cause indistinctness of vision, unless the eye possessed some power of adapting itself to different distances. That the eye has some such power of accommodation is proved by the fact that, if we attempt to look through the meshes of a net at a distant object, we cannot see both the meshes and the object with equal distinctness at the same time. Again, if we look continuously at very near objects, the eye speedily becomes fatigued. Beyond a distance of 65 metres, no accommodation is necessary; but within it, the condition of the eye must be adapted to the diminished distance until we reach a point near the eye which may be regarded as the limit of clear vision for near objects. This point, called the *punctum proximum,* varies according to the age of the individual. The range of accommodation is thus the distance between the *punctum remotum* and the *punctum proximum.*

The mechanism of accommodation has been much disputed, but there can be no doubt it is chiefly effected by a change in the curvature of the anterior surface of the crystalline lens. If we hold a lighted candle in front and a little to the side of an eye to be examined, three reflections may be seen in the eye, as represented in fig. 10. The first, *a,* is erect, large and bright, from the anterior surface of the cornea; the second, *b,* also erect, but dim, from the anterior surface of the crystalline lens; and the third, *c,* inverted, and very dim, from the posterior surface of the lens, or perhaps the concave surface of the vitreous humour to which the convex surface of the lens is adapted. Suppose the three images to be in the position shown in the figure for distant vision, it will be found that the middle image *b* moves towards *a,* on looking at a *near* object. The change is due to an alteration of the curvature of the lens, as shown in fig. 11. The changes occurring during accommodation are: (1) the curvature of the anterior surface of the crystalline lens increases, the radius of curvature changing from 10 mm. to a minimum of 6 mm., and (2) the pupil contracts. An explanation of the increased curvature of the anterior surface of the lens during accommodation has been thus given by H. von Helmholtz. In the normal condition, that is, for the emmetropic eye, the crystalline lens is flattened anteriorly by the pressure of the anterior layer of the capsule; during accommodation, the radiating fibres of the ciliary muscles pull the ciliary processes forward, thus relieving the tension of the anterior layer of the capsule, and the lens at once bulges forward by its elasticity.

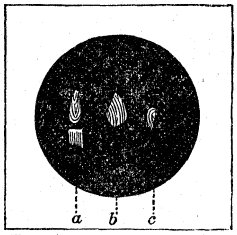


FIG. 10.—REFLECTED IMAGES IN THE EYE

By this mechanism the radius of curvature of the anterior surface of the lens, as the eye accommodates from the far to the near point, may shorten from 10 mm. to 6 mm. The ciliary muscle, however, contains two sets of fibres, the outer, longi-

tudinal or meridional, which run from before backwards, and the inner, circular or equatorial (Müller's muscle). Direct observation on the eye of an animal immediately after death shows that stimulation of the ciliary nerves actually causes a forward movement of the ciliary processes, and there can be little doubt that the explanation above given applies to man.

There is still some difficulty in explaining the action of the equatorial (circular) fibres. Some have found that the increased

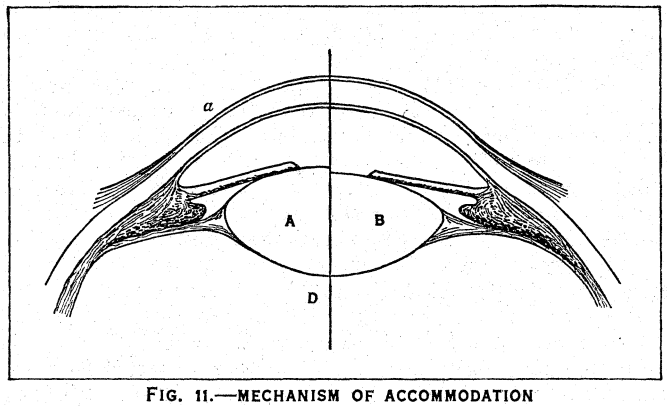


FIG. 11.—MECHANISM OF ACCOMMODATION

convexity of the anterior surface of the lens takes place only in the central portions of the lens, and that the circumferential part of the lens is actually flattened, presumably by the contraction of the equatorial fibres. Seeing, however, that the central part of the lens is the portion used in vision, as the pupil contracts during accommodation, a flattening of the margins of the lens can have no optical effect. During accommodation the pupil contracts, and the pupillary edge of the iris, thinned out, spreads over the anterior surface of the capsule of the lens, which it actually touches, and this part of the iris, along with the more convex central part of the lens, bulges into the anterior chamber, and must thus displace some of the aqueous humour. To make room for this, however, the circumferential part of the iris, related to the ligamentum pectinatum, moves backwards very slightly, while the flattening of the circumferential part of the lens facilitates this movement.

Helmholtz succeeded in measuring with accuracy the sizes of the reflected images by means of an instrument termed an *ophthalmometer,* the construction of which is based on the following optical principles:

5. **Absorption and Reflection of Luminous Rays from the Eye.**—When light enters the eye, it is partly absorbed by the black pigment of the retina and choroid and partly reflected. The reflected rays are returned through the pupil, not only following the same direction as the rays entering the eye, but uniting to form an image at the same point in space as the luminous object. The pupil of an eye appears black to an observer, because the eye of the observer does not receive any of these reflected rays. If, however, we illuminate the retina by a mirror held close to the eye the retina can be seen through a hole in the mirror. This is the *principle* of the ophthalmoscope originally invented by Babbage in 1848, and re-discovered by Helmholtz in 1851. Eyes deficient in pigment, as in albinos, appear luminous, reflecting light of a red or pink colour; but if we place in front of such an eye a card perforated by a round hole of the diameter of the pupil, the hole will appear quite dark, like the pupil of an ordinary eye. In many animals a portion of the fundus of the eyeball has a special reflecting membrane, which presents an iridescent appearance. This is called a *tapetum.* It probably renders the eye more sensitive to light of feeble intensity.

6. **Functions of the Iris.**—The iris constitutes a diaphragm which regulates the amount of light entering the eyeball. The aperture in the centre, the *pupil,* may be dilated by contraction of a system of radiating fibres of involuntary muscle, or contracted by the action of a circular system of fibres, forming a sphincter, at the margin of the pupil. The radiating fibres are controlled by the sympathetic, while those of the circular set are excited by the third cranial nerve. The variations in diameter of the pupil are determined by the greater or less intensity of the light acting on the retina. A strong light causes contraction of the pupil; with light of less intensity, the pupil will dilate. In the human being, a strong light acting on one eye will cause contraction of the pupil, not only in the eye affected, but in the other eye. These facts indicate that the phenomenon is of the nature of a reflex action, in which the fibres of the optic nerve act as sensory conductors to a centre in the brain, whence influences emanate which affect the pupil. The centre is in the neighbourhood of the nucleus of the third nerve, beneath the anterior pair of the corpora quadrigemina. On the other hand, the dilating fibres are derived from the sympathetic; and it has been shown that they come from the lower part of the cervical, and upper part of the dorsal, region of the cord. The iris in some animals is directly susceptible to the action of light.

The pupil *contracts* under the influence—(1) of an increased intensity of light; (2) of convergence of the two eyes, as in accommodating for a near object; and (3) of such active substances as nicotine, morphia and physostigmine. It *dilates* under the influence—(1) of a diminished intensity of light; (2) of vision of distant objects; (3) of a strong excitation of any sensory nerve; (4) of dyspnoea; and (5) of such substances as atropine and hyoscyamine. The chief function of the iris is so to moderate the amount of light entering the eye as to secure sharpness of definition of the retinal image. This it accomplishes by (1) cutting off the more divergent rays from near objects and (2) preventing the error of spherical aberration by cutting off divergent rays which would otherwise impinge near the margins of the lens, and would thus be brought to a focus in front of the retina.

3. SPECIFIC INFLUENCE OF LIGHT ON THE RETINA

The retina is the terminal organ of vision, and all the parts in front of it are optical arrangements for securing that an image will be accurately focused upon it. The natural, so-called adequate, stimulus of the retina is light. It is also excited by mechanical and electrical stimuli. It is said that such stimuli applied to the optic nerve behind the eye produce a luminous impression, but the evidence on this point is not conclusive. Pressure or electrical currents acting on the eyeball stimulate the retina and cause the sensation of flashes of light (phosphenes). The stimulus acts primarily upon the rods and cones (*vide supra* Purkinje's experiment), where it sets up nervous impulses which traverse successively the layers of the retina and the optic nerve fibres.

1. **Adaptation.**—We are all familiar with the experience that when we pass from a brightly-lighted room into a dimly-lighted one, we are unable for a time to distinguish the objects in the room. After a few minutes the brighter objects emerge and as time goes on, more and more can be distinguished. This is due to the fact that the sensitivity of the retina increases. It becomes maximal after the eyes have been kept completely shaded from all light for 30–40 minutes. This adaptation to dim light is called *dark adaptation.* If the sensitivity is accurately measured by determining the feeblest illumination which is capable of arousing the visual sensation, it is found that the rise is very rapid during the first 5 to 10 minutes and ultimately becomes many thousand times greater than that of the eye adapted to strong daylight illumination (*light adaptation*).

If the spectrum produced by a very feeble illumination is viewed by the dark adapted eye it is seen to be colourless. The neutral grey band, however, varies in brightness, the brightest part corresponding to about 530 $\mu\mu$, a part which under ordinary illumination appears green. Vision under these conditions has been called *scotoptic* or *twilight vision.* If the illumination is increased the eye rapidly becomes light adapted, and the colours appear in the spectrum (*photoptic vision*). The brightest part of the spectrum is then found to be about 580 $\mu\mu$ in the yellow.

If in a similar manner one takes a monochromatic light, say in the green or blue, and gradually increases the intensity from zero there is a considerable range of intensity before the colour appears. This is called the *photochromatic interval,* and it varies according to the wave-length of the light. It is so small at the red end of the spectrum that it is very difficult to prove its existence.

The shift of brightness, which is so striking, from the green region of the achromatic scotoptic spectrum to the yellow of the chromatic photoptic spectrum manifests itself throughout the spectrum. For instance, a red of 670 $\mu\mu$ viewed under conditions of light adaptation with moderate intensity of illumination may be ten times as bright as a blue of 480 $\mu\mu$ whereas if the illumination is decreased and the eye dark adapted there is a reversal of the relative brightnesses, and the blue is now 16 times as bright as the red. This phenomenon was discovered by Purkinje, and is known as *Purkinje's phenomenon.*

These are the changes which account for the difference in appearance of the colours in the landscape when twilight falls, or at dawn. As the light fails the reds disappear first, and geraniums and other red flowers look black, while violet and blue flowers retain some colour and appear relatively brighter than in daylight. Next, the greens fade away and the fields and hedges look grey.

The facts already mentioned suggest that vision under low illumination is carried out by a mechanism which differs from that of vision under higher illumination: and this view is supported by other facts.

Thus, we have seen that under ordinary illumination stimulation of the central part of the retina, especially the fovea and the surrounding macula lutea, gives rise to by far the most acute visual impressions. The reverse is the case under dim illumination and dark adaptation. The macular region becomes the least sensitive, and is indeed "night blind." This fact was discovered by astronomers long ago. If one looks directly at the Pleiades only four or five stars can be seen, but if one fixes a point a little to one side a number of weaker stars become visible. One can easily see on any starlight night that any star becomes unmistakably brighter if one looks at it slightly eccentrically. The famous French astronomer, Arago, expressed the fact paradoxically by saying that "in order to perceive a very dimly lighted object it is necessary not to look at it."

This phenomenon has a very important bearing upon the picking up of lights at sea at night, as was shown by some experiments of the late Prof. Gotch. Thus he found that "in the dark adapted eye red light is recognized as red over an area whose radius is three or four times that observed with green light; yet the red light is not seen at all outside this larger area. On the other hand, green (or blue) light, whilst it is only recognizable as green over the much more restricted central area, is seen as a bright light of a dazzling white type over a very extensive area."

If the mechanism which subserves scotoptic vision is different from that subserving photoptic the night blindness of the macular region should afford some clue as to its nature. Now the macular region is characterized by the absence of rods from the neuro-epithelium. It seems probable, therefore, that dim illumination excites the rods but fails to excite the cones, and that it is only when the intensity of the light is increased that the cones respond. If this be so, then the rods are the organs of scotoptic and the cones of photoptic vision. This is the so-called *Duplicity Theory.* It is further supported by some facts of comparative anatomy. In fact, it was first suggested by Schwalbe as the result of observations on the eyes of nocturnal animals, such as owls, which he found to have only rods in their retinae.

The rate at which the eyes become adapted to dim light varies somewhat in normal people, and there are diseased conditions in which it is very slow or almost absent. Such people are night-blind. They are practically incapacitated in dull lights, and cannot get about after dark. In one rare group the eyes appear to be otherwise normal and the disease is transmitted from one generation to another. The most famous and most extensive pedigree of any diseased condition is that of some congenitally night-blind people in the Montpellier district in the south of France. The pedigree was started by Cunier in 1838 and brought up to date in 1907 by Nettleship. It consists of ten generations of 2,121 persons, 135 of whom were night-blind. Much commoner is the night-blindness associated with the disease of the retina called retinitis pigmentosa.

An interesting antithesis to night-blindness is found in the rare cases of congenital total colour-blindness. As already mentioned, for the normal sighted the colourless grey spectrum of scotoptic vision becomes suffused with all the colours of the rainbow as the intensity of the light is increased. For the totally colour-blind, although the brightness increases under these conditions, no colours are seen. Moreover, there is no shift of the maximum brightness from the green to the yellow region of the spectrum, such as occurs in the normal.

On the Duplicity theory the congenital night-blind may be regarded as having only cone vision, and the totally colour-blind only rod vision. There are, however, difficulties in accepting this simple explanation.

2. **The Visual Purple.**—The facts relating to dark adaptation and the alteration in sensitivity of the retina on exposure to light throw some glimmer of light on the fascinating question how the physical stimulus is transformed into a physiological impulse which gives rise to the visual sensation. The obvious analogy of the photographic film predisposes one to the hypothesis that the radiant energy is absorbed by chemical substances in the retina, the alteration in these substances causing a transformation of energy into the physiological impulse—in other words, that the first step in the process is photo-chemical.

In 1851 H. Müller found a remarkable purple substance in the rods of the frog's retina which had been protected from the influence of light. In 1876 Boll discovered that this substance was bleached when exposed to light. Kühne, in 1878 and the succeeding years, investigated the substance exhaustively, and it was shown that after bleaching it became regenerated if the eye was again protected from light, but only if the retina was kept in contact with the still living or "surviving" cells of the retinal pigment epithelium. It would appear, therefore, that the substance is formed—or at any rate certain necessary precursors of the substance are formed—by the activity of the pigment cells, and that it is then absorbed by the rods.

More minute investigation of the process of bleaching of this so-called visual purple or rhodopsin has proved to be of great theoretical interest. It is found that the rate of bleaching varies with the nature of the light, so that if samples are bleached by monochromatic light of different wave-lengths the relative bleaching values can be determined. The wave-length 530 $\mu\mu$ is the most active, the values falling off on each side. We have already found that this wave-length is significant in another respect. It is the brightest part of the achromatic scotoptic luminosity curve; and if this curve is similarly plotted it is found that the two curves are identical within the limits of experimental error. It is impossible to resist the conclusion that so striking a coincidence must have a very definite meaning, viz., that the stimulation of the retina which gives rise to scotoptic vision is the result of the bleaching of the visual purple.

We have seen that when the intensity of the light is increased the eye becomes light adapted and the spectral colours appear; further, that the brightest part shifts to the yellow. These facts are less easily explained on the basis of a photo-chemical reaction in the visual purple, although such an explanation is not impossible. If the indications which give rise to the duplicity theory are correct, photoptic vision is carried out by the cones. Kühne and most other observers have failed to find any evidence of visual purple in the cones, and it is a striking fact that the part of the retina which contains only cones, viz., the rod-free macular area, is "night-blind," *i.e.*, it shows little power of adaptation to low illumination. Moreover, most observers agree that Purkinje's phenomenon is absent when the stimuli are confined to the rod-free area of the macula. The macular region, however, is not completely irresponsive to adaptation. It may be that the cones contain only a small amount of visual purple or that some more complex reactions occur in it when strong light stimuli are applied. It is highly improbable that rod and cone responses are fundamentally different in their mechanism. Both are doubtless photo-chemical reactions, but the exact explanation has not yet been satisfactorily elicited.

3. **Electrical Changes.**—Granted, however, that a photo-chemical change is the first step in the production of the physiological impulse, we are not much farther advanced in our knowl-

edge of that impulse. We know that nerve impulses in other nerves, both motor nerves, the stimulation of which sets muscles in activity, and other sensory nerves, such as those which subserve touch, are accompanied by a change in electrical potential which sets up electrial currents. These have been very thoroughly investigated by Keith Lucas and Adrian, who have proved that a stimulus either produces no electrical response at all or else the maximum response—the so-called "all-or-none principle." Recently Adrian has investigated the optic nerve of the conger eel in the same manner, and has shown that so far as the electrical response is concerned it agrees with that of other nerves. So that we now know something about the photo-chemical change and something about the changes which occur in the optic nerve. Interposed between them, however, is the very complex nervous mechanism of the retina, and it was long ago shown by Holmgren that the stimulus of light on the eye causes electrical changes of a complex nature in the retina.

Holmgren, Dewar, M'Kendrick, Gotch and others, have shown that when light falls on the retina it excites a variation of the electrical current obtained from the eye when placed on the cushions of a sensitive galvanometer. One electrode touches the vertex of the cornea and the other the back of the eyeball. The corneal vertex is positive to the back of the eye, or to the transverse section of the optic nerve. Consequently a current passes through the galvanometer from the cornea to the back. Then the *impact* of light causes an increase in the natural electrical current—during the *continuance* of light the current diminishes slowly and falls in amount even below what it was before the impact—and the *withdrawal* of light is followed by a rebound, or second increase, after which the current gradually returns to normal.

It was also observed in these researches that the amount of electrical variation produced by light of various intensities corresponded pretty closely to the results expressed by Fechner's law, which regulates the relation between the stimulus and the sensational effect in sensory impressions. This law is, that the sensational effect does not increase proportionally to the stimulus, but as the logarithm of the stimulus. Thus, supposing the stimulus to be 10, 100 or 1,000 times increased, the sensational effect will not be 10, 100 or 1,000 times, but only 1, 2 and 3 times greater.

4. **Regional Effects.**—The retina is not equally excitable in all its parts. At the entrance of the optic nerve, as was shown by E. Mariotte in 1668, there is no sensibility to light. Hence, this part of the retina is called the *blind spot.* If we shut the left eye, fix the right eye on the cross seen in fig. 12, and move the book towards and away from the eye, a position will be found when the round spot disappears, that is, when its image falls on the entrance of the optic nerve. There is also complete insensibility to colours at that spot. The diameter of the optic papilla is about 1·8 mm., equivalent to a visual angle of 6°; this angle determines the apparent size of the blind spot in the visual field, and it is sufficiently large to cause a human figure to disappear at a distance of 25 metres.

The *yellow spot* or *macula lutea* in the centre of the retina is the most sensitive to light, and it is chiefly employed in direct vision. Thus, if we fix the eye on a word in the centre of this line, it is distinctly and sharply seen, but the words towards each end of the line are vague. If we wish to see each word distinctly, we "run the eye" along the line—that is, we bring successive words on the yellow spot.

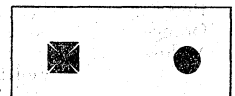


FIG. 12.—DIAGRAM FOR THE STUDY OF THE BLIND SPOT

5. **Persistence of Retinal Impressions.**—To excite the retina, a feeble stimulus must act for a certain time; when the retina is excited, the impression lasts after the cessation of the stimulus; but if the stimulus be strong, it may be of very short duration. Thus the duration of an electrical spark is extremely short, but the impression on the retina is so powerful, and remains so long, as to make the spark visible. If we rotate a disk having white and black sectors we see continuous dark bands. Even if we paint on the face of the disk a single large round red *spot,* and rotate rapidly, a continuous red *band* may be observed. Here the impressions of red on the same area of retina succeed each other so rapidly that before one disappears another is superadded, the result being a fusion of the successive impressions into one continuous sensation. This phenomenon is called the *persistence of retinal impressions.* An impression lasts on the retina from $\frac{1}{50}$ to $\frac{1}{30}$ of a second. The cinematograph owes its effects to persistence of retinal impressions.

The macular region is oval in shape, the vertical axis being about 1 mm. and the horizontal 3 mm., corresponding to visual angles of 4° and 12°. In the centre of it is a pit, the *fovea centralis,* which is the point of most distinct vision. It is 0·3 mm. in diameter, equal to a visual angle of 1°, and in it the layers of the retina are reduced to little but the neuroepithelium, which here consists only of slender elongated cones. Around the fovea is a rod-free area of about 0·8 mm. diameter, equal to a visual angle of 3°.

Visual acuity is sharpest at the point of fixation of the eye, the image of which falls upon the fovea. Here two mathematical points of light, such as two stars, can be discriminated as separate points if they subtend a visual angle of about 50 seconds of arc. This is equivalent to a retinal image of about $3{\cdot}2\mu$, which is the mean diameter of the foveal cones. Good visual acuity therefore agrees with the theoretical resolving power of the eye as an optical instrument and the fineness of grain of the recipient screen.

This is, however, not the maximum power of discrimination of the eye, for contours, such as the appreciation of difference of breadth of two bright lines, may be discriminated to about 10 seconds ($=0{\cdot}73\mu$) or less. Contour discrimination is used in physical measurements in the vernier. With binocular vision a break in the contour separating white and black surfaces can be discriminated if it subtends only 2 or 3 seconds of arc. The explanation is to be found in the greater sensitivity to change or difference in brightness of the parts of the diffusion circles which are always formed. These account also for *irradiation,* whereby a white square on a black background looks larger than the same sized black square on a white background.

The *field of vision* around the point of fixation extends more than 90° outwards, 70° downwards, 60° inwards and 50° upwards. It is smaller for colours of ordinary intensities, but the colour fields can be increased almost to the limits of the white field by suitable increase in the intensity of the light. With ordinary illumination and patches of coloured paper of 20 sq.mm. the blue field is about 10° smaller than the white, yellow rather smaller than blue, red 20° smaller than white, and green smaller still. Most colours change in hue as they pass from the fixation point towards the periphery; but certain spectral colours can be found which merely become paler or less saturated. These were called by Hess invariable colours. With them the blue and yellow are complementary colours (*vide infra*), and have the same sized field; and similarly the red and green.

6. **Recurrent Vision and Flicker.**—Not only is the response to an instantaneous flash of light longer than the stimulus, but it is often recurrent. In 1872 C. A. Young noticed that when a discharge from a powerful electric machine momentarily illuminates a room the objects may be seen not once only, but two or even three or four times in rapid succession, although the spark is single and instantaneous. The stimulus gives rise to series of pulses of sensation of diminishing intensity rapidly succeeding one another. They have been specially studied by William McDougall and others. The curves of sensation differ somewhat in time relations, which accounts for the occasional sensations of colour derived from pure black and white stimuli, as in Benham's top.

If the oscillations produced by intermittent stimulation are not sufficiently rapid to cause complete fusion, a sensation of flickering is felt. If black and white sectors are rotated with gradually increasing velocity there is first separate vision of the individual sectors. This is followed by a peculiarly unpleasant coarse flickering, which passes into a fine tremulous appearance, after which complete fusion occurs.

A large amount of work has been done upon flicker. Among the earlier researches the work of an Eton schoolmaster, T. C. Porter (1898) may be mentioned. With simple apparatus he

showed conclusively that what is called the critical frequency, *i.e.*, the rate of alternation of two lights of different intensity at which the sensation of flickering just disappears, is dependent entirely upon the luminosities of the lights and is independent of their colours or wave-lengths. This fact has been fully confirmed by Ives and many other observers, and is accepted as the principle of the flicker photometer. For obviously we have here an excellent method of hetero-chromatic photometry. It is much easier to say when flickering disappears than it is to say when two colours of different hue reach the same brightness—the so-called equality of brightness method. Moreover, each coloured light can be separately flickered against a known white light.

7. **Induction.**—The sensitivity of an area of the retina which is stimulated by light is thereby altered, so that a second stimulus applied to the same area does not have the same effect as it otherwise would have (*successive contrast*). Thus, if a square patch of red paper lying on a grey background is viewed for a few seconds and the gaze is then directed to a white surface a greenish patch will appear on the white surface. It follows that the stimulation with one colour makes the area less sensitive to that colour and more sensitive to the complementary colour. In fact, if the retina is stimulated with the purple light which is complementary to a particular green wave-length of the spectrum and is then stimulated with that green, an extremely vivid green—much greener than is ever experienced by any other means—is seen.

If the eye is kept closed in a dark room the sensation is not that of utter darkness, but a kind of very dark grey, due to what is called "the intrinsic light of the retina." If now a bright patch is looked at for a few seconds and the eyes then closed, an after-image of the same brightness as the original presentation may be seen, but is usually transitory (*positive after-image*). It is followed, or entirely replaced by a *negative after-image,* which appears as a much blacker patch in the midst of the surrounding grey. If the stimulus is coloured the positive after-image is of the same, the negative of the complementary hue.

The effects of induction are not limited to the area of retina stimulated. The sensitivity of the surrounding areas, and especially of those contiguous, are altered, and that in the opposite direction to that of the area stimulated. Hence a white patch on a black background looks brighter than when it is surrounded by grey, and the black itself looks blacker than if there were no white patch. Similarly, a red patch on a grey background causes the grey to look greenish. These effects, from the physiological point of view, are analogous to the reciprocal innervation of muscles which was discovered by Sir Charles Sherrington. He found that when a movement is made, *e.g.*, with the arm or eyes, the muscles which, when stimulated, cause the opposite movement are not merely passively relaxed but are actually inhibited, so that they become slacker than usual.

It is clear that this reciprocal action of one area of retina upon the neighbouring areas will facilitate the discrimination of contours. It will, in fact, have the same practical effect as if the retinal image were very much more sharply defined than it really is.

4. SENSATIONS OF COLOUR

1. **General Statement.**—Colour (*q.v.*) is a special sensation excited by the action on the retina of rays of light of a definite wave-length. On the most likely hypothesis as to the physical nature of light, colour depends on the rate of vibration of the luminiferous aether, and white light is a compound of all the colours in definite proportion. When a surface reflects solar light into the eye without affecting this proportion, it is white, but if it absorbs all the light so as to reflect nothing, it appears to be black. If a body held between the eye and the sun transmits light unchanged, and is transparent, it is colourless, but if translucent it is white. If the medium transmits or reflects some rays and absorbs others, it is coloured. Thus, if a body absorbs all the rays of the spectrum but those which cause the sensation of green, we say the body is green in colour; but this green can only be perceived if the rays of light falling on the body contain rays having the special rate of vibration required for this special colour. The part played by the light illuminating the surface and the way in which the colours of mixed pigments are produced are discussed under COLOUR.

Every colour has three qualities: (1) *hue,* or tint, such as red, green, violet; (2) *degree of saturation,* or purity, according to the amount of white mixed with the tint, as when we recognize a red or green as pale or deep; and (3) *luminosity,* or brightness as when we designate the tint of a red rose as dark or bright. Two colours are said to be identical when they are in agreement as to these three qualities.

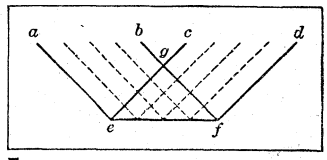


FIG. 13.—DIAGRAM OF DOUBLE SPECTRUM PARTIALLY SUPERPOSED

When we examine a spectrum, we see a series of colours merging by insensible gradations the one into the other, thus: Red, orange, yellow, green, blue and violet. These are termed *simple* colours. If two or more coloured rays of the spectrum act simultaneously on the same spot of the retina, they may give rise to sensations of *mixed colours.* These mixed colours are of two kinds: (1) those which do not correspond to any colour in the spectrum, such as purple and (2) those which do exist in the spectrum. White may be produced by a mixture of two simple colours, which are then said to be *complementary.* Thus, red and greenish blue, orange and cyanic blue, yellow and indigo blue, and greenish yellow and violet all produce white. Purple is produced by a mixture of red and violet, or red and bluish violet.

If we mix two simple colours not so far separated in the spectrum as the complementary colours, the mixed colour contains more white as the interval between the colours employed is greater, and if we mix two colours farther distant in the spectrum than the complementary colours, the mixture is whiter as the interval is smaller.

2. **Modes of Mixing Colour Sensations.**—Various methods have been adopted for studying the effect of mixing colours.

(*a*) *By Superposing Parts of Two Spectra,* fig. 13.

(*b*) *By Method of Reflection.*—Place a red wafer on *b,* in fig. 14, and a blue wafer on *d,* and so angle a small glass plate *a* as to transmit to the eye a reflection of the blue wafer on *d* in the same line as the rays transmitted from the red wafer on *b.* The sensation will be that of purple; and by using wafers of different colours, many experiments may thus be performed.

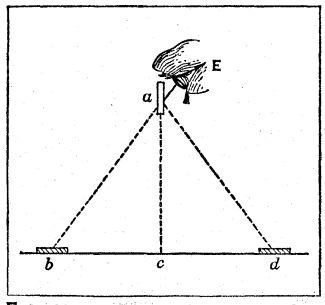


FIG. 14.—DIAGRAM SHOWING LAMBERT'S METHOD OF MIXING SENSATIONS OF COLOUR

(*c*) *By Rotating Discs Which Quickly Superpose on the Same Area of Retina the Impressions of Different Wave-lengths.*—Such discs may be constructed of cardboard, on which coloured sectors are painted, representing diagrammatically the arrangement attributed to Sir Isaac Newton. The angles of the sectors were thus given by him:

Red	60° 45·5′	Green	60° 45·5′
Orange	34° 10·5′	Blue	54° 41′
Yellow	54° 41′	Indigo	34° 10·5′
Violet	60° 45·5′		

With sectors of such a size, grey will be produced on rotating the disc rapidly. This method has been carried out with great efficiency by the colour-top of J. Clerk-Maxwell. It is a flat top, on the surface of which discs of various colours may be placed. Dancer has added to it a method by which, even while the top is rotating rapidly and the sensation of a mixed colour is strongly perceived, the eye may be able to see the *simple* colours of which it is composed. This is done by placing on the handle of the top, a short distance above the coloured surface, a thin black disc, perforated by holes of various size and pattern, and weighted a little on one side. The disc vibrates to and fro rapidly, and breaks the continuity of the colour impression; and thus the constituent colours are readily seen.

3. **The Laws of Colour Mixtures.**—The mixture of pure, *i.e.*, spectral, colour stimuli has been exhaustively studied by Newton, Grassmann, Clerk-Maxwell and many others, and has elicited the fact that *normal colour vision is trichromatic.* Thus, if three spectral hues are chosen, so far apart in the spectrum that neither can be reproduced by admixture of the other two, every conceivable light or light mixture gives rise to a sensation which can be accurately matched by the sensation produced by the mixture of suitable amounts of these three hues. The only exceptions to this law are that brown and olive green cannot be so reproduced without the assistance of successive contrast, which is equivalent to a mixture with black. And further, although accurate matches of *hue* are produced the hue produced by the admixture of the three lights is generally less saturated, in other words, a perfect match is only obtained by adding white to the comparison light.

It is thus possible to obtain innumerable *colour equations* representing accurately the results of such admixtures with a given spectrum. Hence, various methods for representing colours geometrically can be devised.

4. **The Geometric Representation of Colours.**—Colours may be arranged in a linear series, as in the solar spectrum. Each point of the line corresponds to a determinate impression of colour; the line is not a straight line, as regards luminous effect, but is better represented by a curve, passing from the red to the violet. This curve might be represented as a circle in the circumference of which the various colours might be placed, in which case the complementary colours would be at the extremities of the same diameter. Sir Isaac Newton arranged the colours in the form of a triangle (fig. 15). If we place three of the spectral colours at three angles—green, violet and red—the sides of the triangle include the intermediate colours except purple.

The point S corresponds to white. Any straight line drawn through S cutting the sides of the triangle represents the proportions of the two spectral colours which, when mixed, produce white (complementary colours). Thus, the line RB indicates that the quantities (*e.g.* slit-widths) of R and B required to make white are in the proportion of BS to RS. In the case of GP we see that there is no complementary colour to G in the spectrum, but that its complementary colour is the purple which is represented by the mixture of PV spectral red and PR spectral violet, the proportions of G and this purple, P, being PS:GS. Similarly, any point, M, on the surface of the triangle, represents a colour which can be formed by the mixture of violet and yellow in the proportions MY:MV or by the mixture of R and the spectral blue-green, D, in the proportions MD:MR. The distance of a point on the triangle from S indicates the saturation of the colour represented by the given point: the farther the point is from S the more saturated it is, and vice versa.

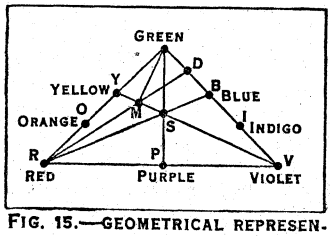


FIG. 15.—GEOMETRICAL REPRESENTATION OF THE RELATIONS OF COLOURS AS SHOWN BY NEWTON

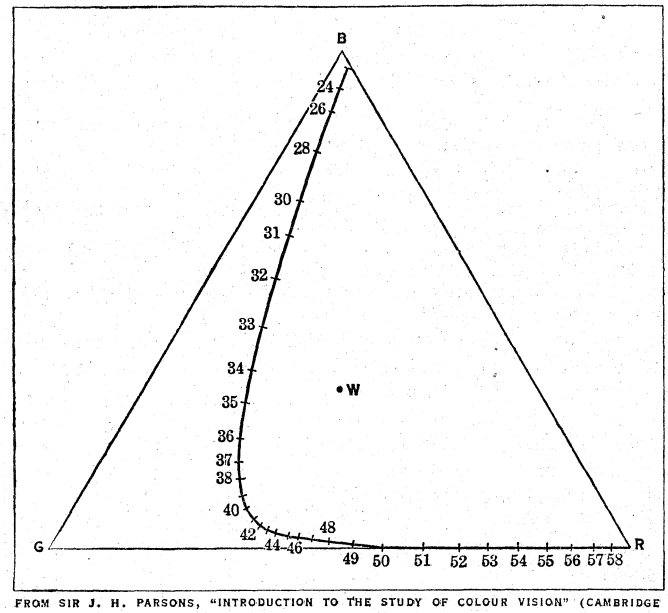
The triangle shown is purely diagrammatic. If measurements are made with any given spectrum the general form of the curve is triangular, the purples being strictly rectilinear. The lines from red to green and from green to violet, however, will be curved as in fig. 16.

The following list shows characteristic complementary colours, with their wave-lengths (λ) in millionths of a millimetre:

Red, λ656.	Blue-green, λ492.
Orange, λ608.	Blue, λ490.
Gold-yellow, λ574.	Blue, λ482.
Yellow, λ567.	Indigo-blue, λ464.
Greenish yellow, λ564.	Violet, λ433.

By combining colours at opposite ends of the spectrum, the effect of the intermediate colours may be produced; but the lowest and the highest, red and violet, cannot thus be formed. These are therefore fundamental or primary colours, colours that cannot be produced by the fusion of other colours. If now to red and violet we add green, which has a rate of vibration about midway between red and violet, we obtain a sensation of white. Red, green and violet are therefore regarded as the three fundamental colours.

5. **Physiological Characters of Colours.**—Colour physiologically is a sensation, and it therefore does not depend only on the physical stimulus of light, but also on the part of the retina affected. The power of distinguishing colours is greatest when they fall on, or immediately around, the yellow spot, where the number of cones is greatest. In these regions more than two hundred different tints of colour may be distinguished. As already mentioned, outside of this area lies a middle zone, where fewer tints are perceived, mostly confined to shades of yellow and blue. If intense coloured stimuli are employed, colours may be perceived even to the margin of the periphery of the retina, but with weak stimuli coloured objects may seem to be black, or dark like shadows. In passing a colour from the periphery to the centre of the yellow spot, remarkable changes in hue may be observed. Orange is first grey, then yellow, and it only appears as orange when it enters the zone sensitive to red. Purple and bluish green are blue at the periphery, and only show the true tint in the central region. Four tints have been found which do not thus change: a red obtained by adding to the red of the spectrum a little blue (a purple), a yellow of 574·5 λ, a green of 495 λ and a blue of 471 λ.



FROM SIR J. H. PARSONS, "INTRODUCTION TO THE STUDY OF COLOUR VISION" (CAMBRIDGE UNIVERSITY PRESS)

FIG. 16.—COLOUR TRIANGLE; W. WHITE, R. RED, G. GREEN, B. BLUE
The numbers are those of an arbitrary scale of the spectrum of the Arc Light (Abney & Watson)

The question now arises, How can we perceive differences in colour? We might suppose a molecular vibration to be set up in the nerve-endings synchronous with the undulations of the luminiferous aether, without any change in the chemical constitution of the sensory surface, and we might suppose that where various series of waves in the aether corresponding to different colours act together, these may be fused together, or to interfere so as to give rise to a vibration of modified form or rate that corresponded in some way to the sensation. Or, to adopt another line of thought, we might suppose that the effect of different rays (rays differing in frequency of vibration and in physiological effect) is to promote or retard chemical changes in the sensory surface, "which again so affect the sensory nerves as to give rise to differing states in the nerves and the nerve centres, with differing concomitant sensations." The former of these thoughts is the foundation of the Young-Helmholtz theory, while the latter is applicable to the theory of E. Hering.

6. **The Young-Helmholtz Theory.**—A theory widely accepted by physicists was first proposed by Thomas Young and

afterwards revived by Helmholtz. It is based on trichromatism of normal colour vision and the assumption that three kinds of nervous elements exist in the retina, the excitation of which give respectively sensations of red, green and violet. These may be regarded as fundamental sensations. Homogeneous light excites all three, but with different intensities according to the length of the wave. Thus long waves will excite most strongly fibres sensitive to red, medium waves those sensitive to green, and short waves those sensitive to violet. Fig. 17 shows diagrammatically the irritability of the three sets of fibres. Helmholtz thus applies the theory:

1. Red excites strongly the fibres sensitive to red and feebly the other two—sensation: *Red.*
2. Yellow excites moderately the fibres sensitive to red and green, feebly the violet—sensation: *Yellow.*
3. Green excites strongly the green, feebly the other two—sensation: *Green.*
4. Blue excites moderately the fibres sensitive to green and violet, and feebly the red—sensation: *Blue.*
5. Violet excites strongly the fibres sensitive to violet, and feebly the other two—sensation: *Violet.*
6. When the excitation is nearly equal for the three kinds of fibres, then the sensation is *White.*

According to the Young-Helmholtz theory, there are three fundamental colour sensations, red, green and violet, by the combination of which all other colours may be formed, and it is assumed that there exist in the retina three kinds of nerve elements, each of which is specially responsive to the stimulus of waves of a certain frequency corresponding to one colour, and much less so to waves of other frequencies and other colours. If waves corresponding to pure red alone act on the retina, only the corresponding nerve element for red would be excited, and so with green and violet. But if waves of different frequencies are mixed (corresponding to a mixture of colours), then the nerve elements will be set in action in proportion to the amount and intensity of the constituent excitant rays in the colour. Thus if all the nerve elements were simultaneously set in action, the sensation is that of white light; if that corresponding to red and green, the resultant sensation will be orange or yellow; if mainly the green and violet, the sensation will be blue and indigo. No such nerve fibres or elements are known, but the theory is equally valid if the stimuli affect three photo-chemical substances, etc.

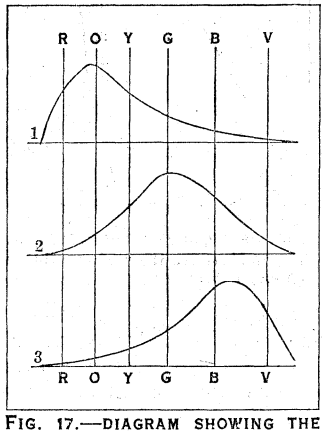


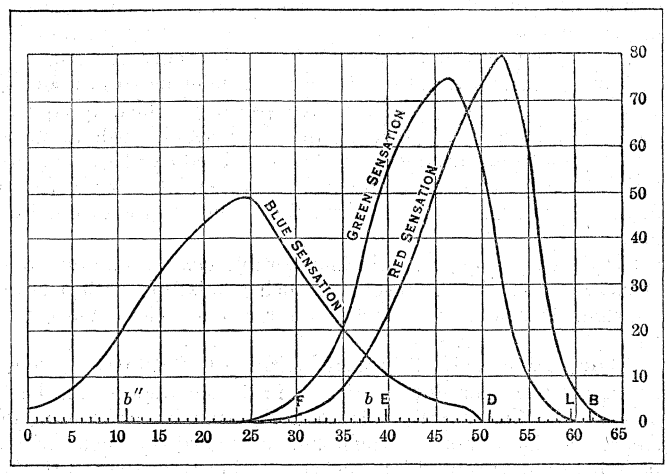
FIG. 17.—DIAGRAM SHOWING THE IRRITABILITY OF THE THREE KINDS OF RETINAL ELEMENTS

Seeing that the Trichromatic theory or Three Components theory, as the Young-Helmholtz theory is better termed, depends upon the trichromatism of normal colour vision it is clear that the three so-called *sensation curves* can be deduced from colour equations. This was first done by Clerk-Maxwell, and at a later date by König, an assistant of Helmholtz. They have since been worked out by Abney by a different method, dependent upon the fact that the brightness of the unanalysed white light is equal to the sum of the brightnesses of all the individual wave-lengths of the spectrum. Abney's curves are shown in fig. 18.

None of the curves extends at both ends to the limits of the spectrum, as is demanded by the theoretical curves; but it must be remembered that at the ends of the spectrum it is extremely difficult to make accurate matches, owing to the low luminosity.

7. **The Opponent Colours Theory.**—If one regards the spectrum psychologically and independent of any physical preconceptions one notes that there are only four fundamentally unique colour sensations, viz., red, yellow, green and blue. The intermediate spectral colours partake of the nature of each of their neighbours, *e.g.*, orange, which manifestly arouses a sensation reminiscent of both red and yellow; yellowish-green; greenish-blue; etc. Violet to most people resembles blue mixed with a tinge of red, and the purples outside the spectrum are all mixtures of red and blue or violet. From the psychological point of view, therefore, there appear to be four, rather than three, fundamental colours.

Moreover, these four are two pairs of complementary colours, and may therefore be regarded as in some sense opposed to each other. Psychologically, black is opposed to white, but whereas the greys form a continuous series from white to black, no such continuous series links red with green, or yellow with blue.



FROM ABNEY, "RESEARCHES IN COLOUR VISION" (LONGMANS GREEN & CO.)

FIG. 18.—ABNEY'S R G & B EQUAL AREA SENSATION CURVES
The sums of equal ordinates of the three curves at any point represent the sensation of the unanalysed white light

The facts of induction—simultaneous and successive contrast—elicit the opponent effects of these pairs of toned or coloured and untoned or colourless sensations. On grounds of this nature, Hering propounded his theory of colour vision, which may be called the Opponent Colours theory. It is really a part of a more general metabolic theory of physiological processes. Hering hypothecates three different visual substances, white-black, red-green, and yellow-blue substances, which exist somewhere in the sub-cortical visual paths. He supposes that when a living substance is protected from external stimuli it undergoes spontaneous *autonomous* metabolic changes. Some molecules break down or undergo dissimilation (or katabolism), fresh ones are built up or undergo assimilation (or anabolism). When the two processes balance each other the substance is in a state of *autonomous equilibrium.* It is to be noted that autonomous equilibrium does not necessarily mean physiological inactivity. Fresh formative matter may be brought from the blood in the exact quantity necessary to replace the formed matter which is poured out into the blood. If the substance is acted upon by an external stimulus *allonomous* metabolic changes are set up. They may be either anabolic or katabolic, but they induce a spontaneous tendency in the opposite direction so as to reproduce autonomous equilibrium, *i.e.,* allonomous katabolism, for example, induces autonomous anabolism. With constant stimulation the autonomous anabolism becomes equal to the allonomous katabolism, and a new condition of equilibrium at a lower potential is set up, which is called *allonomous equilibrium.* Upon removal of the stimulation autonomous anabolism will prevail for a time until autonomous equilibrium is again set up.

Hering supposes that when rays of a certain wave-length fall on visual substances assumed to exist in the retina, katabolic changes occur, while rays having other wave-lengths cause constructive or anabolic changes. Suppose that in a red-green substance katabolic and anabolic changes occur in equal amount, there may be no sensation, but when waves of a certain wave-length or frequency cause katabolic changes in excess, there will be a sensation of red, while shorter waves and of greater frequency, by exciting anabolic changes, will cause a sensation of green: and so on.

8. **The Two Theories Compared.**—Hering's theory accounts satisfactorily for the formation of coloured after-images. Thus, if we suppose the retina to be stimulated by red light, katabolism takes place, and if the effect continues after withdrawal of the red

stimulus, we have a positive after-image. Then anabolic changes occur under the influence of nutrition, and the effect is assisted by the anabolic effect of shorter wave-lengths, with the result that the negative after-image, green, is perceived. Perhaps the distinctive feature of Hering's theory is that white is an independent sensation, and not the secondary result of a mixture of primary sensations, as held by the Young-Helmholtz view. The greatest difficulty in the way of the acceptance of Hering's theory is with reference to the sensation of black. Black is held to be due to anabolic changes occurring in the white-black substance. Suppose that anabolism and katabolism of the white-black substance are in equilibrium, unaccompanied by stimulation of either the red-green or the yellow-blue substances, we find that we have a sensation of darkness, but not one of intense blackness. This "darkness" has still a certain amount of luminosity, and it has been termed the "intrinsic light" of the retina. Sensations of black differing from this darkness may be readily experienced, as when we expose the retina to bright sunshine for a few moments and then close the eye. We then have a sensation of intense blackness, which soon, however, is succeeded by the darkness of the "intrinsic light." The various degrees of blackness, if it is truly a sensation, are small compared with the degrees in the intensity of whiteness. In the consideration of both theories changes in the cerebral centres have not been taken into account, and of these we know next to nothing.

It is, perhaps, natural that the three components theory has always appealed most strongly to physicists, while physiologists have in the past been inclined most to support the opponent colours theory. The latter can be made to explain the facts of induction; but, even though it is obviously founded largely upon these facts, it has to be strained considerably to account for their details. It does not, however, so satisfactorily explain the facts of colour mixture. On the other hand, the Young-Helmholtz theory accounts admirably for the facts of colour mixture, upon which it was founded, whereas Helmholtz had to resort to psychological illusions of "judgment" to make it account for the facts of induction. As McDougall, however, has shown, it accounts quite well for most of these facts also.

Space does not permit of a description of the many other theories of colour vision which have been brought forward. (*See* Parsons, *An Introduction to the Study of Colour Vision*, 2nd ed., Cambridge, 1924).

9. **Colour-blindness.**—It has long been known that many persons show peculiarities of colour vision distinguishing them from the normal. The earliest reference in the literature is that of Turberville in the *Transactions* of the Royal Society (1684). The first case exhaustively studied was that of John Dalton, the chemist, and colour-blindness was long known as "Daltonism."

Nearly all these people have difficulty in discriminating between reds and greens and other colours at this end of the spectrum. The most pronounced cases fall into two groups: in one vivid reds are confused with dark greens; in the other greens are confused with red, orange and yellow of more equivalent brightness.

In 1881 Lord Rayleigh discovered that many people with apparently normal colour vision require different amounts of red or green in making colour matches. His crucial test was the matching of the yellow of the sodium lime (589 $\mu\mu$) with a mixture of lithium red (670 $\mu\mu$) and thallium green (527 $\mu\mu$). This is the test used in Nagel's Anomaloscope.

All these varieties, and possibly some others, are of congenital origin and incurable. The statistics are very unreliable, but the grosser cases affect about 4% of males and 0·4% of females. The disease is hereditary and generally transmitted through the female, who is herself not usually affected.

Owing to the use of red, green and white lights for signalling on railways, ships, etc., the elimination of the colour-blind from candidates for posts of engine driver, navigating officers, and so on, is of the utmost importance.

Defects of colour vision—acquired colour-blindness—occur in various diseases of the visual apparatus, notably in toxic amblyopia produced by tobacco and other drugs. In these cases the defect is often limited to the area around the fixation point—central colour scotoma—and in all cases differs materially from congenital colour-blindness.

A few cases of uniocular congenital colour-blindness have been described, but none is sufficiently well authenticated to decide the question as to exactly what are the sensations which the colour-blind experience. We have no means of discovering the sensations of other people except by comparison with our own responses and inferences derived therefrom. We are all equipped with an extensive vocabulary of colour names, and the colour-blind, guided by shapes, variations in brightness, and other adventitious aid, often call objects by their right colours. They never call a strawberry green, but they may have the greatest difficulty in finding the strawberries on the plants, and they find it more economical to use yellow pegs to tee their ball at golf than red ones. Hence, in the investigation of the nature of the defect in any individual, little credence is to be attached to the colour nomenclature they employ, though the expert examiner will obtain some evidence from it. On the other hand, in determining the fitness of sailors and railway men colour naming is important, for a man who calls a red light green is obviously unfit to be an engine driver.

One of the most efficient means of testing the sensations of the colour-blind is to compare their matching of colours with that of the normal person. Owing to the complexity of the light reflected from different coloured objects false deductions are easily made if these are used. They will suffice to discover colour-blindness in bad cases, but may fail to reveal it in others. Hence, no examination is exhaustive unless spectral colours are employed.

10. **Dichromatic and Trichromatic Vision.**—If a large number of cases is examined in this manner a group of very bad cases can be segregated which have this common characteristic:—Two monochromatic lights can be found such that, mixed in various proportions, the mixtures will match every wave-length throughout the spectrum and also the unanalysed white light. In order to get perfect matches it will be necessary only to alter the relative brightnesses of the pure and the mixed stimuli. In this group two well-marked sub-groups can be distinguished, as was discovered by Seebeck (1837). They differ in the proportions of the two mixed lights which are required for the matches. Since normal individuals require three colours to make such matches, and are hence called trichromatic, these colour-blind people are aptly called *dichromats*. As much confusion has arisen from the names applied to the two groups, we will temporarily call them *A* and *B*.

Since white light can be matched by the dichromat with a suitable mixture of two monochromatic lights, and since all spectral colours can be matched by mixing the same two colours in various proportions, it follows that there is some spectral colour which will match white. This is called the *neutral point* of the dichromatic spectrum. In group *A*, it is at about 489 $\mu\mu$, in group *B* at about 500 $\mu\mu$: both neutral points are therefore in the bluish green region of the spectrum. Since there is a purple, outside the spectrum and composed of a suitable mixture of red and violet, which is complementary to this green, it is obvious that there must be a neutral point in the purples; and such is found to be the case.

A further discovery of profound theoretical importance was made by Seebeck, viz., that all colour equations valid for normal vision are also valid for dichromatic vision, or colour matches which are valid for the trichromatic are also valid for the dichromatic eye. Hence it follows that the dichromat possesses no variable which the trichromat lacks, but lacks a variable which the trichromat possesses. In other words, dichromatic vision is a *reduction form* (von Kries) of normal vision, and not a fundamentally different kind of vision.

If the spectral matches of dichromats with mixtures of red (645 $\mu\mu$) and blue (461 $\mu\mu$) are plotted with the spectral wave-lengths as abscissae and the amounts required (on an arbitrary scale) as ordinates, it is found that no blue is required on the red side of 530 $\mu\mu$ (von Kries). The two groups are sharply distinguished. In the *A* group the red maximum is at 571 $\mu\mu$ and falls rapidly towards the red end, showing the low stimulus value for long-wave light. This is shown in many cases by an actual

inability to see the red end of the spectrum as seen by the normal —*shortening of the red end of the spectrum.* In the *B* group the red maximum is at 603 $\mu\mu$ and falls more slowly towards the red end. Hence Rivers (1900) introduced the terms *scoterythrous* and *photerythrous* to distinguish the *A* and *B* groups. It is unfortunate that these terms have not been generally adopted, since they are purely descriptive and are independent of any theory. It follows, and has been amply confirmed by experiment, that the luminosity curve of the spectrum of the *B* group resembles nearly that of the normal trichromat, whereas the maximum of the luminosity curve of the *A* group is displaced towards the green.

11. **Theories of Colour-blindness.**—Most investigators of colour-blindness have been imbued with some particular theory of colour vision and have expressed their views in terms of the theory. Thus, Helmholtz, deeply impressed by the fact that dichromatic vision is a reduction form of trichromatic and that trichromatic colour equations are valid for the dichromats, concluded that this form of colour-blindness could be explained by the absence of one of the three components. The sensation curves are usually denominated by the colour region of their maximum effects—red, green and blue. Hence he concluded that in the *A* group the red component was absent, in the *B* group the green. If this were the case, there might theoretically be two other forms of colour-blindness. In one the blue curve would be absent (*C* group), and in the other all the three curves might be fused in a central curve (*D* group). If such were the case, the *C* group would have relatively normal colour reactions as regards the red and green parts of the spectrum, but would confuse blues and yellows. In the *D* group the individuals would merely have varying sensations of brightness and no capacity for distinguishing colours at all. Now, there is a well known group of people who are *totally colour-blind,* and these fit in well with the theory. More recent research tends to show that they cannot all, at any rate, be explained in this manner. A relatively small number of cases has been described which conform to the requirement of the *C* group.

It was, perhaps, natural that the three groups of partial colour-blinds should be denominated red-blind, green-blind and blue-blind by upholders of the Young-Helmholtz theory. It has, however, had the most disastrous results and has led to endless ambiguity. For in the obvious meaning of the terms these people are not red-, green- or blue-blind. They simply have different responses from the normal when their retinae are stimulated with these particular regions of the spectrum. The attempt of von Kries to eliminate the ambiguity by calling the conditions *protanopia, deuteranopia* and *tritanopia* failed in its object, and seems only to have infuriated opponents of the Young-Helmholtz theory.

The explanation of the ordinary cases of partial colour-blindness on the Hering theory is that both groups, *A* and *B,* are due to absence of the red-green substance, the differences in the groups being attributed to differences in macular pigmentation. It is easy to prove that physical absorption by a pigment in the retina could not account for the facts, and no satisfactory explanation in terms of this theory has yet been brought forward.

There is no doubt that wide variations in the degree of partial colour-blindness occur, and the majority of the colour-blind people cannot make perfect matches of monochromatic spectral hues with only two fundamental colours. In other words, they are not completely dichromatic. Most fall into the category of those discovered by Lord Rayleigh, but it is highly probable that this group is really composite. They are obviously trichromatic, but most of them show, on exhaustive examination reactions which approximate them to one or other group of dichromats, chiefly to group *B.* They also can be found to have no new variable, and normal trichromatic matches are valid for them. They can therefore be explained on the Young-Helmholtz theory on the hypothesis that their responses to one or other of the fundamental components are less intense than normal; *i.e.,* while two of the sensation curves are normal, the third, either the "red" or the "green" is abnormally low. These cases are aptly called *anomalous trichromats,* and are sub-divided, in the terminology of von Kries, into *protanomalous* and *deuteranomalous.*

Abney and Watson have described a group of anomalous trichromats which differs fundamentally from all other cases of colour-blindness described above, in that they are not a reduction form. All the comparatively small number of cases hitherto investigated can be explained by a shift of the normal "green" sensation curve 2 or 3 $\mu\mu$ towards the red end of the spectrum.

It is beyond the scope of this article to discuss the many other theories of colour vision and their relation to colour-blindness. The Young-Helmholtz theory has fulfilled the essential function of a scientific hypothesis in inspiring new modes of investigation. Whether it be ultimately proved to embody the fundamental truth or not it possesses the merit of having elicited more knowledge on the subject than any other theory. Other theories must be evaluated in the light of those facts.

12. **Tests for Colour-blindness.**—These should be considered according to their aim, whether it be that of defining accurately the scientific nature of the type of colour-blindness, or merely to determine whether the individual is suited for a particular occupation. In most cases they are designed for the latter purpose, but it cannot be too strongly insisted that, though many cases of colour-blindness are easy to detect, others, which are equally dangerous, may need the most exhaustive investigation.

The matching of pigments in the form of coloured skeins of wool (Holmgren's test), etc., will often reveal bad cases, and in the hands of an expert examiner will raise suspicions in milder cases which further tests will confirm. The prejudice against Holmgren's wools is to some extent justified. Sailors object to a test so "unpractical" and savouring of effeminacy. Moreover, as already mentioned, pigments do not provide very satisfactory test objects.

Lantern tests have found greater favour, but may easily prove fallacious. The chief adventitious aid to the discrimination of colours by the colour-blind is their relative brightness. Thus, if a red light is shown amongst others to a member of group *A,* it will appear to him very dull, and he will probably name it correctly. In the Board of Trade lantern this adventitious aid was eliminated by *making all the lights of the same luminosity.* A similar effect can be produced in the Edridge-Green lantern by combining the coloured glasses with dimming glasses.

Stilling's isochromatic plates are a useful rough test. Ishiwara's are interesting in that they have designs which can be discriminated by the colour-blind but not by the normal.

Nagel's anomaloscope is a convenient method of applying Lord Rayleigh's test. It is liable to give erroneous results with people who are not accustomed to looking through a telescope.

In difficult cases—and there are many such—examination with various spectral tests is necessary. These may fittingly begin by the candidate delimiting with shutters the number of monochromatic patches in the spectrum, as advocated by Edridge-Green. More detailed tests by various spectral matches are best carried out by a projection method, such as Abney's, which eliminates the errors liable to arise with telescopic observation.

(X.; J. H. P.)

5. THE MOVEMENTS OF THE EYE

1. **General Statement.**—The globe of the eye has a *centre of rotation,* which is not exactly in the centre of the optic axis, but a little behind it. On this centre it may move round *axes of rotation,* of which there are three—an antero-posterior, a vertical and a transverse. In normal vision, the two eyes are always placed in such a manner as to be fixed on one point, called the *fixed point* or the *point of regard.* A line passing from the centre of rotation to the point of regard is called the *line of regard.* The two lines of regard form an angle at the point of regard, and the base is formed by a line passing from the one centre of rotation to the other. A plane passing through both lines of regard is called the *plane of regard.* With these definitions we can now describe the movements of the eyeball, which are of three kinds: (1) *First position.* The head is erect, and the line of regard is directed towards the distant horizon. (2) *Second position.* This indicates all the movements round the transverse and horizontal axes. When the eye rotates round the first, the line of regard is displaced

above or below, and makes with a line indicating its former position an angle termed by Helmholtz the angle of vertical displacement, or the *ascensional angle;* and when it rotates round the vertical axis, the line of regard is displaced from side to side, forming with the median plane of the eye an angle called the *angle of lateral displacement.* (3) *Third order of positions.* This includes all those which the globe may assume in performing a rotatory movement along with lateral or vertical displacements. This movement of rotation is measured by the angle which the plane of regard makes with the transverse plane, an angle termed the *angle of rotation* or of *torsion.*

The two eyes move together as a system, so that we direct the two lines of regard to the same point in space.

The eyeball is moved by six muscles, which are described in the article EYE (*Anatomy*).

The term *visual field* is given to the area intercepted by the extreme visual lines which pass through the centre of the pupil, the amount of dilatation of which determines its size. It follows the movements of the eye, and is displaced with it. Each point in the visual field has a corresponding point on the retina, but the portion, as already explained, which secures our attention is that falling on the yellow spot.

2. **Simple Vision with Two Eyes.**—When we look at an object with both eyes, having the optic axes parallel, its image falls upon the two yellow spots, and it is seen as one object. If, however, we displace one eyeball by pressing it with the finger, then the image in the displaced eye does not fall on the yellow spot, and we see two objects, one of them being less distinct than the other. It is not necessary, however, in order to see a single object with two eyes that the two images fall on the two yellow spots; an object is always single if its image falls on *corresponding points* in the two eyes.

The eye may rotate round three possible axes, a vertical, horizontal and antero-posterior. These movements are effected by four straight muscles and two oblique. The four straight muscles arise from the back of the orbit, and pass forward to be inserted into the front part of the eyeball, or its equator, if we regard the anterior and posterior ends of the globe as the poles. The two obliques (one originating at the back of the orbit) come, as it were, from the nasal side—the one goes above the eyeball, the other below, while both are inserted into the eyeball on the temporal side, the superior oblique above and the inferior oblique below. The six muscles work in pairs. The internal and external recti turn the eye round the vertical axis, so that the line of vision is directed to the right or left. The superior and inferior recti rotate the eye round the horizontal axis, and thus the line of vision is raised or lowered. The oblique muscles turn the eye round an axis passing through the centre of the eye to the back of the head, so that the superior oblique muscle lowers, while the inferior oblique raises, the visual line. It was also shown by Helmholtz that the oblique muscles sometimes cause a slight rotation of the eyeball round the visual axis itself. These movements are under the control of the will up to a certain point, but there are slighter movements that are altogether involuntary. Helmholtz studied these slighter movements by a method first suggested by F. C. Donders. By this method the apparent position of after-images produced by exhausting the retina, say with a red or green object, was compared with that of a line or fixed point gazed at with a new position of the eyeball. The ocular spectra soon vanish, but a quick observer can determine the coincidence of lines with the spectra. After producing an after-image with the head in the erect position, the head may be placed into any inclined position, and if the attention is then fixed on a diagram having vertical lines ruled upon it, it can easily be seen whether the after-image coincides with these lines. As the after-image must remain in the same position on the retina, it will be evident that if it coincides with the vertical lines there must have been a slight rotation of the eyeball. Such a coincidence always takes place, and thus it is proved that there is an involuntary rotation. This minute rotation enables us to judge more accurately of the position of external objects.

3. **The Horopter.**—This is the locus of those points of space which are projected on retinal points. While geometrically it may be conceived as simple, as a matter of fact it is generally a line of double curvature produced by the intersection of two hyperboloids, or, in other words, it is a twisted cubic curve formed by the intersection of two hyperboloids which have a common generator. The curves pass through the nodal point of both eyes. An infinite number of lines may be drawn from any point of the horopter, so that the point may be seen as a single point, and these lines lie on a cone of the second order, whose vertex is the point. When we gaze at the horizon, the horopter is really a horizontal plane passing through our feet. The horopter in this instance is the ground on which we stand. Experiments show "that the forms and the distances of these objects which are situated in, or very nearly in, the horopter, are perceived with a greater degree of accuracy than the same forms and distances would be when not situated in the horopter" (M'Kendrick, *Life of Helmholtz,* 1899, p. 172 *et seq.*).

An object which is not found in the horopter, or, in other words, does not form an image on corresponding points of the retinae, is seen double. When the eyeballs are so acted upon by their muscles as to secure images on non-corresponding points, and consequently double vision, the condition is termed *strabismus,* or squinting, of which there are several varieties treated of in works on ophthalmic surgery. It is important to observe that in the fusion of double images we must assume, not only the correctness of the theory of corresponding points of the retina, but also that there are corresponding points in the brain, at the central ends of the optic fibres. Such fusion of images may occur without consciousness—at all events, it is possible to imagine that the cerebral effect (except as regards consciousness) would be the same when a single object was placed before the two eyes, in the proper position, whether the individual were conscious or not. On the other hand, as we are habitually conscious of a single image, there is a psychical tendency to fuse double images when they are not too dissimilar.

4. **Binocular Perception of Colour.**—This may be studied as follows. Take two No. 3 eye-pieces of a Hartnack's microscope, or two eye-pieces of the same optical value from any microscope, place one in front of each eye, direct them to a clear window in daylight, keep them parallel, and two luminous fields will be seen, one corresponding to each eye. Then converge the two eye-pieces, until the two luminous circles cross, and the central part, like a bi-convex lens, will appear clear and bright, while the outer segments will be much less intense, and may appear even of a dim grey colour. Here, evidently, the sensation is due to a fusion of impressions in the brain. With a similar arrangement, blue light may be admitted by the one eye-piece and red by the other; and on the convergence of the two, a resultant colour, purple, will be observed. This may be termed the binocular vision of colours. It is remarkable that by a mental effort this sensation of a compound colour may be decomposed into its constituents, so that one eye will again see blue and the other red.

(X.; C. Go.)

6. VISUAL PERCEPTION

Visual impressions play a more important part than sensations of any other mode in guiding our interpretations of the external world and our orientation therein.

(a) **Visual Perception of Movement.**—Response to movement is the most primitive of all visual reactions. An observer may respond to visually presented movement, with only the vaguest apprehension of the direction and extent of the movement, and with no appreciation of the size, contours or colour of the moving object.

The visual appreciation of movement probably depends primarily upon the setting up of specific functional relationships between two or more groups of retinal sensory elements. If a retinal area is stimulated by a stationary point source, and thereafter a neighbouring area is similarly stimulated, and if the time and space relations between the two stimuli are suitably arranged, there results an impression, not of two stationary points, but of a single point in motion.

Most of the other functions of vision, the "object" reference, the localisation of objects, the attribution of size, contour and distance may be regarded as in some way bound up with the response to movement. In the course of development, however, they come to have independent status.

(b) **The "Object" Reference in Vision.**—When we see anything, normally a large number of visual impressions are involved. These are synthesised, or integrated, treated as having some common origin, and referred to an external source which we call the "object." There is no real explanation of this "object" reference which appears to be inherent in visual response; it is bound up with the ultimate "projicient" character of all visual experience.

(c) **Visual Localisation.**—In general visual impressions are interpreted as referring outward to some position in space. There are three principal directions, the transverse, giving us breadth, the vertical, giving us height, and the sagittal, giving us depth or distance. Broadly speaking localisation in any of these directions is possible only when the point or area localised has a background out of which other points may be selected and used as points of reference. Some of the data for such localisation are given by the afferent sensations which arise as the eyes move from one point to another over this background, or the lens is accommodated for nearer or farther points in the field of view. Such movements and accommodation are automatic and practically reflex; but if they are to be made at all accurately there must be some retinal, or at least visual, cue to them. Thus it is often assumed that for each point or group of points of retinal stimulation there must be a "local sign," by virtue of which any stimulus affecting them is at once given a position above or below, to the right or to the left, and, in reference to some point of fixation, forward or backward. Obviously this affords no explanation of visual localisation, but is only a way of stating how fundamental is such "positional" reference in vision.

A single luminous point exposed in a dark room can still to some extent be localised. For all of such observations every adult observer has a more or less definite preformed visual "scheme," and this may give him his necessary points of reference even though the latter are not, strictly speaking, visually presented.

Monocular perception of depth, distance or solidity is in any case exceedingly faulty. It is here that the development of binocular vision has its most important function. The data are given by sensations of convergence and divergence of the two eyes, by accommodation of the lens, and by the "local sign" system in relation to a point of fixation. For anything but fairly near distances, however, it is inaccurate to speak of perception. Judgment then comes into play, based upon all sorts of facts such as the clearness of the atmosphere, the apparent size of objects, the nature of intervening objects, the knowledge that we have already gained in other ways as to the spatial characteristics of whatever is being localised.

(d) **Apparent Size in Vision.**—For small objects apparent size depends in part, though less than might be expected, upon the size of the retinal image, as determined by the visual angle. Accommodation factors come in also, and normally contrast effects, derived from the relation of the object to its surroundings, are important. In the case of larger objects, eye movements may help to determine apparent size, together with contrast effects, and with complex psychological effects of the "schematic" order.

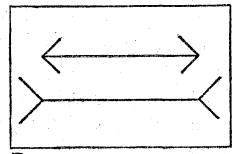


FIG. 19.—THE MULLER-LYER ILLUSION

(e) **Contour or Form Perception.**—Reaction to contour, or to form tends to become by far the most striking and persistent function of developed vision. In fact nearly all the common methods of measuring visual "acuity" applied to the adult human subject are tests of the capacity to distinguish the forms of objects. Usually this is held at bottom to rest upon the power of the eye to discriminate two points of light as distinct one from the other. But as a matter of fact the response to shape depends upon a most complex mass of physical, physiological and psychological factors. Very important indeed in this connection are the phenomena of simultaneous contrast by means of which contours may be differentiated from the background upon which they appear. Perception of form is an outstanding illustration of how a complex biological function cannot be explained in terms simply of the various unitary reactions by the combination of which it has been made possible.

(f) **Colour Perception.**—Colour perception, like that of form, is mainly a function of highly-developed and complex visual response. The various theories which have been put forward to account for the perception of colour are discussed elsewhere, but it should here be noted that in everyday life our perception, or judgment, of the colour of objects depends as much upon representational as upon immediate sensory effects. Thus snow may continue to look white even when, from a purely sensory point of view, it should be more red than other objects which are simultaneously seen as red.

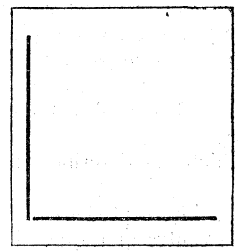


FIG. 20.—ZOLLNER'S FIGURE

(g) **Optical Illusions.**—An enormous literature has grown up around the detailed investigation of optical illusions. Some of the commonest are:

Of two equal horizontal lines, one terminated by arrow heads and the other by feather heads, the second appears longer than the first (fig. 19).

Of two equal lines, one vertical and the other horizontal, the vertical appears the longer (fig. 20).

Two parallel lines may be made to appear to converge or diverge by a series of short lines crossing the parallels at an acute angle (fig. 21).

A filled distance appears longer than an equal unfilled distance.

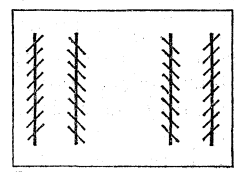


FIG. 21.—THE HORIZONTAL-VERTICAL ILLUSION

There are many other visual illusions of form, direction, distance and movement. No single explanation of them all is possible and perhaps the most valuable conclusion that can be drawn from their investigation is a further reinforcement of the truth that visual perception is a highly complex integration, many of the properties of which it is wholly impossible to state in terms of the relatively simple physiological mechanisms out of whose combination it has developed.

See also J. H. Parsons: *Introduction to the Theory of Perception* (Cambridge, 1927), which contains numerous footnote references to the relevant literature. (F. C. BA.)

7. ERRORS OF REFRACTION AND ACCOMMODATION

The following is a classification of errors of refraction from the medical point of view (*see* EYE):

a. Errors of refraction—
Hypermetropia, Myopia, Astigmatism, Anisometropia, Aphakia.
b. Failure of accommodation—
Presbyopia,
Paralysis of Accommodation due to
Drugs (Atropine and its derivatives);
Toxic Diseases—
Diphtheria, Encephalitis, Lethargica, etc.

The eye as an optical apparatus is very much like a camera obscura, consisting of a lens system and a sensitive screen, the retina, upon which an inverted image of an object may be formed.

The length of the eye is roughly 23 mm., which means that the retina is placed about 23 mm. behind the anterior surface of the cornea. Parallel rays entering the eye come to a focus upon the retina, so that the eye, at rest, is focused for infinity, and the retina is placed at the principal focus of the lens system of the eye: thus an object placed at infinity will cause an image to be formed upon the retina.

In optics the path of rays is reversible, so that, in the case of the eye, an object at infinity will give an image upon the retina, and an object upon the retina will give an image at infinity. These two points are called conjugate foci, and infinity is spoken of as the punctum remotum of the eye. Such an eye is called an *emmetropic* eye.

Not all eyes are exactly 23 mm. in length, but in all eyes the power of the refractive apparatus is roughly the same. The result is that if the eye be shorter than usual the image will fall behind the retina, and a condition of *hypermetropia* is said to exist, and when the eye exceeds 23 mm. in length, the image is formed in front of the retina and a condition of *myopia* is the result.

1. **Hypermetropia (Hyperopia, Far Sight).**—This is the form of ametropia in which, with the accommodation at rest, parallel rays come to a focus behind the retina. The result is that the retina cuts the path of rays, before the focus is reached, and as a result an indistinct image is formed.

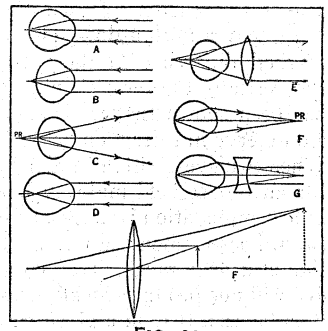


FIG. 22

A. Emmetropic eye, with parallel rays coming to a focus upon the retina. B. Hypermetropic eye showing how parallel rays form a circle of diffusion upon the retina. C. Position of the punctum remotum in Hypermetropia. D Myopic eye, showing how parallel rays form a circle of diffusion upon the retina. E. A convex lens causing parallel rays to come to a focus upon the retina. F. Position of punctum remotum of the Myopic eye. G. Concave lens enabling parallel rays to focus upon the retina. H. Simple lens system comparable to the arrangement of refracting system and retina of hypermetropia. F. Position of principal focus

In emmetropia the retina is placed at the principal focus of the lens system of the eye, in hypermetropia it is placed nearer to the lens system than its principal focus. Compare this with the formation of an image by a simple convex lens. If an object be placed at the principal focus of the lens an image is formed at infinity, a condition comparable to emmetropia, but if the object is placed nearer to the lens than its principal focus the rays will be divergent as they leave the lens and so will never come to a focus to form an image: they will have been made to appear to diverge from a second point on the same side of the lens as the object so that there will be formed a virtual image, a condition comparable to the one of a convex lens as a single magnifying glass. This means that rays proceeding from an object upon the retina of a hypermetropic eye will leave the eye in a divergent direction so that they appear to originate at a point behind the eye, the conjugate focus of the retina, the punctum remotum, whose distance behind the eye will vary inversely with the length of the eye. So that rays may come to a focus upon the retina of the eye, they must diverge from or converge towards the punctum remotum of the eye and it will be seen that only convergent rays can come to a focus upon the retina of the hypermetropic eye. Convergent rays do not occur in nature, so that one who suffers from hypermetropia is unable to receive a sharp image of any object in space when the eye is at rest.

2. **The Correction and Measure for Hypermetropia.**—A convex lens has the power of rendering parallel rays convergent so that an image is formed at the principal focus (*q.v.*). In ophthalmology lenses are considered, not in relation to the curvature of their surface, but to their focal length. A lens which causes parallel rays to come to a focus at a distance of one metre, is said to have a focal power of one dioptre, and this is the standard adopted. Thus a lens which has a focal power of two dioptres has twice the power of a one dioptre lens, and so will have a focal length of half a metre. (*See* OPHTHALMOLOGY.)

To relieve the condition of hypermetropia parallel rays before they reach the eye must be rendered convergent so that they will come to a focus at the punctum remotum of the eye. If therefore a convex lens is placed close to the cornea so that its principal focus coincides with the punctum remotum of the eye, then parallel rays will come to a focus upon the retina. The dioptric value of the lens that fulfills this condition is the measure of the hypermetropia and an eye is spoken of as having 2 or 3 dioptres of hypermetropia as the case may be.

3. **Visual Disturbances Produced by Hypermetropia.**—From an earlier paragraph it might be inferred that the hypermetropic individual was only able to see distinctly with a correcting lens. This of course is contrary to usual experience, and it will be noted that only the condition of the eye at rest was referred to —what is known as the *static* refraction of the eye.

The eye possesses the power of altering its focus so that an emmetropic eye can see perfectly well in the distance when in a condition of static refraction, and may also see small objects quite near at hand by making a suitable effort. This is known as the *accommodation of the eye for distance.* This is brought about by an alteration in the crystalline lens and is equivalent to the addition of a convex to the eye: consequently the eye has the power of correcting hypermetropia by an effort of accommodation. Thus it is that the inconveniences of hypermetropia are not only dependent upon the inherent defect of its optical apparatus but also upon the extra strain placed upon the muscular effort needed to focus the eye.

If the amount of hypermetropia is very high, it will be found that both distant and near vision is imperfect, and often the possessor suffers little other disability because any effort to correct the error is of little use and so no attempt is made. In the lesser degrees, an effort is made, often with success, so as to give quite acute distant and near vision. In youth, when the power of accommodation is ample (*vide* Presbyopia) the complaint is not so much of indistinct vision as of pain in the forehead and eye, due to the excessive strain upon the function of accommodation, and often it is only upon enquiry that the information is obtained that print held at the ordinary reading distance occasionally blurs, especially as the day progresses, and the muscle of accommodation tires.

These symptoms are collected together under the name of *accommodative asthenopia.*

4. **The Treatment of Hypermetropia.**—This consists essentially of ordering suitable spectacles with convex lenses which are the measure of the defect. It may be found to be the case that it is necessary to paralyse the accommodation with either atropine or homatropine, so that the whole of the hypermetropia may be discovered. This is often necessary because the sufferer has become so accustomed to a continuous effort for accommodation that he is unable to relax this effort, even when convex lenses are placed before the eyes. As a result glasses that correct only a part of the hypermetropia may be prescribed. In children, glasses are often prescribed for constant use, whereas in adults, provided the distant vision is good with the naked eye, the spectacles are only needed for near work.

5. **Myopia.**—This is the form of ametropia in which with the accommodation at rest, parallel rays come to a focus in front of the retina. The result is that the retina cuts the parallel rays after a focus is reached and so an indistinct image is formed.

Compare this with the formation of an image by a simple convex lens. Myopia is similar to the arrangement of an object placed further from the lens than its principal focus (but less than twice that distance). The image in this circumstance is formed upon the other side of the lens, inverted and real, nearer to the lens than infinity. Thus an object upon the retina of a myopic eye gives rise to a real inverted image in front of the eye at a distance less than infinity: this point is the punctum remotum of the myopic eye and is conjugate to the retina. It is seen that only divergent rays can come to a focus upon the retina and that with the accommodation at rest, only objects placed at the punctum remotum can be seen clearly.

6. **The Correction and Measure of Myopia.**—A concave lens has the power of rendering parallel rays divergent so that a virtual image is formed on the principal focus. In dealing with the correction for Hypermetropia the measure dioptre has been explained.

To relieve the condition of myopia, parallel rays before they reach the eye must be rendered divergent so that they appear to come from the punctum remotum of the eye. If therefore a concave lens is placed close to the cornea so that its principal focus coincides with the punctum remotum of the eye, the parallel rays will come to a focus upon the retina, and the lens is the measure in dioptres of the myopia.

7. **Visual Disturbances Produced by Myopia.**—Hypermetropia need not necessarily reduce the acuity for distant vision,

but the smallest amount of myopia will always cause a reduction. The defect is revealed therefore by an inability to see distant objects, and in children a difficulty in seeing writing upon the black-board. There is however no difficulty with near vision provided the object is held at the punctum remotum of the eye.

In low degrees the only disability will be a reduction of distant visual acuity, but in the high degrees there will be difficulty in maintaining clear vision at close range owing to the amount of convergence that must be used to obtain simultaneous vision with each eye. In the high degrees of myopia, vision after correction with a suitable glass is often lower than standard, owing to the stretching of the retina which frequently leads to various diseased conditions causing serious loss of sight.

8. **Development and Course of Myopia.**—Myopia is almost exclusively an acquired condition, in contrast to hypermetropia, which is congenital. The eye has usually fully developed by the tenth year when it should be practically emmetropic. It is between ten and twelve years that so many cases of myopia arise. The proportion of patients that are myopic increases gradually until the twentieth year, by which time above 20 per cent. of the population are myopic, a figure that remains constant for all ages, so that at the seventy-fifth year the number of patients that suffer from myopia is still 20 per cent.

In the towns, myopia is more common than in the country, and the prevalence of myopia among those who use their eyes for near objects (scholars, embroiderers, tailors, compositors) lends weight to the view that myopia is due to the strain imposed upon the eyes by such occupations. It is however doubtful if the use of the eyes for near work is the cause of myopia, although the eyes that are already myopic are affected adversely by occupations needing the use of the eyes at a close range.

9. **Treatment of Myopia.**—This consists essentially in ordering suitable spectacles with concave lenses which are the measure of the defect. Care must be exercised lest a lens be prescribed of higher dioptric value than that which corrects the myopia; consequently the weakest lenses that give the highest visual acuity are given to the patient, and he is encouraged to use them constantly, as the correction that renders the eye as physiologically perfect as is possible is the chief means available for holding in check the increase of myopia.

10. **Astigmatism.**—Simple hypermetropia and myopia are due, as we have seen, to a disproportion between the dioptric value of the refracting media and the length of the eye, and since the dioptric value of the eye in either state is the same, these errors are due to an undue shortness or length of the eye.

An error may presumably be due to some fault in the refracting media, either abnormal curvative or index of refraction, and there is one common error of refraction due to a curvature defect called astigmatism. In this condition the radius of curvature of the cornea is not the same in all meridians and consequently rays of light entering the eye in one meridian will not come to a focus at the same plane as rays entering in some other meridian, and the result is defective vision owing to the blurred image formed upon the retina. This error differs essentially from simple hypermetropia or myopia in which the refracting surfaces focus rays of light equally in all meridians, constituting spherical errors.

11. **Visual Disturbances Produced by Astigmatism.**—In all forms of astigmatism the visual acuity is reduced, and when associated with a spherical error the reduction is greater. When testing the visual acuity by test types certain letters are confused, namely, those whose constituent parts are formed of lines inclined to one another such as Z, X, M, N; and if a system of lines radiating from a common centre be used as a test object, certain of the lines will appear more sharply in focus than others. It will be noticed that the most sharply defined line and the least sharply defined are at right angles one to the other. This form of astigmatism, which is called *regular astigmatism*, is the only form which may be satisfactorily corrected by lenses; astigmatism produced by disease of the cornea is always *irregular* and can only be partially corrected by spectacles.

12. **The Correction and Measure of Astigmatism.**—This consists essentially in placing before the eye another astigmatic refracting medium which if properly chosen and adjusted will neutralize the distortion produced by the astigmatic surface of the eye. Such a correcting glass contains a cylinder combined or not with a spherical lens. The measure of the astigmatism is the difference between the dioptric value of the lens which corrects the axis of least and that which corrects the axis of greatest ametropia; thus if a+2 D spherical lens corrects the axis of least and a+4 D spherical lens corrects the axis of greatest ametropia, the eye is said to suffer from 2 D of astigmatism.

13. **Anisometropia.**—This is the condition in which there is a marked difference in the refraction of the two eyes, although theoretically the term should apply to the slightest difference. It has been shown that we cannot, by a voluntary effort, overcome a difference in refraction between the two eyes of more than ·12 D. When two eyes, with a similar static refraction, are accommodated for an object held mid-way between the two eyes, no difference in accommodation is necessary in the two eyes to produce equally sharp images upon the retinae, but when the object is held to one side at a near range, an equal amount of accommodation in each eye will not produce equally sharp images in the two eyes. It will thus be seen that in a given case of anisometropia an object held in the mid line between the two eyes will not produce sharp images in each eye when equal degrees of accommodation are exerted in the two eyes.

It is found that the eye which is properly focused is the one which requires the less accommodative effort for the distance at which the object is held, so that when one eye is myopic, and the other emmetropic, the myopic eye is correctly focused and so on.

14. **Aphakia.**—This is an error of refraction produced by absence of the crystalline lens from its usual position behind the pupil, and it is the condition regularly produced by the operation for removal of a cataract. The result is that the eye has lost one of its most important refracting media and so is rendered highly hypermetropic.

The condition is corrected by the use of a high power convex lens, often as high as +11 or 12 D.

Owing to the absence of the lens the eye is deprived of all power of focusing for distances; it has lost its function of accommodation.

15. **Presbyopia.**—It is a matter of common experience that an eye is capable of focusing itself for a variety of distances from infinity to within a short distance of the eye (at least in young individuals) and this function is spoken of as that of *accommodation for distances*.

This power of accommodation varies with age and is found to diminish as the individual grows older, starting in quite early life. Thus at 10 years of age, 14 D can be added to the intraocular lens by an extreme effort of accommodation whereas by the age of 20 years, this is reduced to 10 D, by 30 years to 7 D, and by 40 years to 4·5 D. By 45 years of age, the amount that can be added is only 3·5 D, which means that in the emmetropic individual clear vision for small objects is only possible at 28 cm. When in these circumstances the nearest point for which the eye can accommodate has receded to 28 cm., the eye is said to suffer from presbyopia.

We usually hold small objects such as printed letters at 25 cm., and books are printed with letters of such a size that they are capable of being read comfortably at about 25 cm.; the consequence is that the presbyopic individual has to hold his book at 28 cm. which makes reading difficult, and in the evening when he is tired, and the illumination is less good, reading becomes very difficult. As this change is progressive, it is found that all power of accommodation for practical purposes has been lost by 70 years of age. To read comfortably at 25 cm. it is necessary to possess not only 4 D of accommodation, but a minimum of reserve of 0·5 D, and we therefore aim to give the sufferer a lens of such a strength that together with his own power of accommodation the total amounts to 4·5 D. Thus in an emmetropic individual of 45, with 3·5 D of accommodation, the prescription of a spectacle containing a+1 D lens will bring the total up to 4·5 D, and the nearest point for which he can focus to 22 cm. (C. Go.)

VISIT AND SEARCH, a term for the procedure adopted by a belligerent warship to ascertain whether a vessel is enemy or neutral, and if neutral whether it is carrying contraband. If upon visitation the vessel proves to be the former she may be seized and sent into a port of the belligerent; if the latter, the visiting officer first examines the ship's papers and if these upon examination prove unsatisfactory, he may then proceed to search both vessel and cargo. If the vessel has been guilty of unneutral conduct, if bound for a blockaded port, or if the cargo is contraband, the neutral vessel may also be seized and sent into a port of the belligerent; if innocent she must be released, the fact of visitation being previously entered in her log book. If the court is satisfied that the capture has been made without probable cause, the captor is held responsible in damages and costs, and even if there was probable cause he may be held liable for any loss or damage due to his default or that of his subordinates.

In World War I, British and Allied commanders directed their captures to proceed to designated ports.

If resistance to visit and search is made by an enemy or neutral vessel, it may be attacked and even destroyed by the belligerent. By Art. 63 of the Declaration of London "Forcible resistance to the legitimate exercise of the right of stoppage, search and capture involves in all cases the condemnation of the vessel. The cargo is liable to the same treatment as the cargo of an enemy vessel.

"Goods belonging to the master or owner of the vessel are treated as enemy goods."

It has been suggested that passports or certificates issued by the authorities of the neutral vessel's State, certifying its nationality and destination, and containing a specification of the cargo would "afford such reasonable guarantees as to cause the exercise of the belligerent right of search to sink into a much-desired desuetude."

(H. H. L. B.; X.)

The instruction for the U.S. navy issued in June 1917, stated:—

"42. The belligerent right of visit and search may be exercised outside of neutral jurisdiction upon private vessels, unless under convoy, after the beginning of war in order to determine their nationality, the port of destination and departure, the character of their cargo, the nature of their employment, or other facts which bear on their relation to the war."

Visit and search may be carried out on the high seas or in belligerent waters. Before proceeding to visit and search the vessel should be summoned to stop and to lie to. When the vessel has come to, an officer and two unarmed men usually constitute the visiting party and the instructions of many States prescribe that the visit and search shall be carried out with courtesy. The ship's papers are first examined and if suspicious or defective the vessel may be seized or further investigation may be made. If a vessel does not come to when summoned, force may be used. Some States exempt from visit and search neutral vessels under neutral convoy. The right of visit and search continues during the whole period of the war even during an armistice unless otherwise specifically provided. (*See* NEUTRALITY.) (G. G. W.)

VISITATION, an act of visiting, a formal visit; also, from Biblical phraseology, an act of divine retributive justice.

There are three classes of official visitations: ecclesiastical, charitable and heraldic. Ecclesiastical visitations, originally the periodical journeys of personal inspections to ascertain the temporal and spiritual condition of each parish, form part of the functions of an archbishop, bishop, or archdeacon.

In Great Britain, all charitable corporations are at law subject to visitation. If no visitor has been appointed by the founder, the king or his representative is the visitor of all lay, and the Church of all ecclesiastical charitable corporations. Under the Charitable Trust Acts and the Endowed Schools Acts, the board of charity commissioners and the board of education have certain visitorial powers.

Heraldic visitations (which ceased about 1686) were perambulations made by a king-at-arms, or other heraldic official with a commission under the Great Seal, to examine into pedigrees and claims to bear arms. The results of these visitations were entered in "visitation books"; their admissibility as judicial evidence, however, is questioned, on the ground that they merely contain statements obtained from the families to whom they refer (*cf.* D'Arcy de Knayth case, 1901).

VISITING CARDS. The use of cards of identification for social purposes is generally supposed to have had its origin at the court of Louis XIV. of France. But in a ruder form, this mark of intercourse dates from much earlier times; the Chinese in bygone ages employed such mediums of communication on calling at the houses of absent friends. They were used in Germany as early as the 16th century. Strips of paper were first employed for the purpose; but gradually they attained a more elaborate finish. Ladies seem to have been the pioneers in this direction, and to have embellished their cards with hand drawings. Under Louis XV. visiting cards were furnished with delicate engravings, showing some fanciful landscape, or a view of the town or place where the person resided.

VISOKO, a town of Bosnia, Yugoslavia. Pop. (1931) 4,706. It is connected by rail with Sarajevo, and has a brisk trade in leather, carpets, sugar beet and tobacco. Between the 16th and 17th centuries it was second only to Jajce as a stronghold of the Bosnian rulers. It was occupied by Italians in World War II.

VISTULA, a river of Europe, which rising in Polish Silesia runs through Poland, along the frontier of East Prussia, and debouches through the territory of the Free City of Danzig. Its situation fits it to be a waterway of the first importance, although it is liable to floods and frozen over for three months in the year. It must be made navigable for river-craft at their full capacity during a sufficiently long period of the year; and must be open to international shipping on a footing of equality. At present it is navigable up to Przemsza, but there is no regular traffic above Warsaw, although it is largely used for timber-floating.

Before World War I conservancy works had only been carried out on the German part of the river, 222 km. in length; spur and longitudinal dykes were built to maintain the water level, thereby facilitating the flow of water at flood-time and also improving navigability. After the war Poland was too occupied to carry out improvement works, or even much in the way of upkeep. Traffic has greatly decreased.

Under Article 18 of the Treaty concluded at Versailles on June 28, 1919, between Poland and the Allied and Associated Powers (the so-called "Minorities Treaty") Poland undertook to apply to the river system of the Vistula (including the Bug and the Narew), pending the conclusion of a general convention on the international régime of waterways, the régime set out in Articles 332–337 of the Treaty of Versailles, that is to say, the régime applicable to International Waterways.

Serious differences of opinion arose as to the interpretation of the legal status of the Vistula. It has been asserted that Article 18 should be held to provide for the possibility of the Vistula being subject to the régime of the Barcelona Convention (*see* INLAND WATER TRANSPORT), once that Convention has been ratified by Poland, and should the Vistula come under the general definition contained in the said Convention. But those who urge this theory do not consider that the Vistula comes under this definition, since the criterion therein accepted is that the part of the river which is naturally navigable should traverse or separate several States. As the right bank of the Vistula in Eastern Prussia has been given to Poland to a depth of 50 metres in land, Germany is not a riparian State; and the Free City of Danzig should not in law be considered as a State.

On the other hand it has been urged that the words "pending the conclusion" mean that the régime of Articles 332 to 337 will be automatically superseded by the régime of the General Convention as soon as the latter has been concluded, and this regardless of the fact whether the Vistula will, or will not, eventually come under whatever general definition is established by the General Convention given in the said Convention. Those who put forward this second argument assert that the Minorities Treaty certainly did not contemplate a temporary international régime for the Vistula, since such an arrangement would have been contrary to all ideas of an international régime. They maintain that, if it is to the interest of international shipping to have certain guaran-

tees of freedom of navigation and equality of treatment, that interest does not cease with the conclusion of an international convention. Further, they are of opinion that the Vistula is included in the category of navigable waterways referred to in paragraph 2 of Article 1 of the Barcelona Statute. A solution to this acute legal controversy will hardly be found unless the dispute becomes an inter-State one and comes before the Permanent Court of International Justice.

See *Vistula: Traité des Minorités entre les principales Puissances alliées et associées et la Pologne du 28 juin, 1919* (Great Britain, Treaty Series, 1919, No. 8). (J. M. F. R.)

VISTULA-SAN, BATTLES OF THE. The middle of Sept. 1914 marked a distinct stage in the World War, both in the western and eastern theatres. The victories over Samsonov and Rennenkampf in East Prussia (*see* MASURIAN LAKES, BATTLES OF THE) had rendered that province secure from invasion, but these battle-fields were too far distant from Galicia for success to bring relief to the Austrians. Direct assistance was required. Accordingly, 5½ corps, the bulk of the forces in East Prussia, were transferred by rail to the Cracow-Częstochowa area in the latter half of September.

This move required some 750 trains and was completed between the night of Sept. 16–17, when the troops began to entrain about Königsberg and Lötzen, and Sept. 28, when they were deployed on the frontier of south Poland ready to advance. They were formed into the 9th Army under Hindenburg, with Ludendorff as his chief of staff. The 8th Army was left in East Prussia with much reduced forces. The plan was for Hindenburg's army to advance against the stretch of the Vistula between Zawichost and Deblin (Iwangórod), with the intention of turning the northern flank of the main Russian forces, which were at this time concentrated in Eastern Galicia. A part of the Austrian 1st Army (Dankl) was to advance on the north bank of the Vistula to the right of the Germans, while the main Austrian forces moved to the attack south of the Vistula, the 4th Army (Grand Duke Josef Ferdinand) and 3rd Army (Boroevich) towards the lower San and Przemyśl, while the 2nd Army (Bohm-Ermolli) from the Carpathians moved in the direction of Chyrow and Sambor, south of Przemyśl.

Russian Problems.—On the Russian side, at the same period of mid-September, the most urgent tasks of the commander-in-chief were to reconstitute his north-western front, shattered by the defeats of the 1st and 2nd Armies in East Prussia, and to build up a central force in Poland about Warsaw. First-line troops from Siberia and Turkistan, which had not been available for the opening engagements, had now arrived, and a large number of additional reserve divisions were in the field. The 9th Army, which was originally to have formed the nucleus of the central force, had been despatched south in the early days of September to the rescue of the hard-pressed 4th Army (*see* LEMBERG, BATTLES OF), and was now with four other Russian armies (4th, 5th, 3rd, 8th) in eastern Galicia, on the line of the San and Dniester. The supply of these five armies, comprising some 18 or 19 corps, crowded on a comparatively narrow front, was extremely difficult. As early as Sept. 22 three corps were ordered to move north to relieve the congestion. Shortly afterwards, information was received of the enemy concentration and advance, and a rapid change in the disposition of the armies became necessary to meet this threat. The question arose whether a line could be built up in Poland west of the Vistula with sufficient speed to render it safe to accept battle in advance of the river, or whether the change of front should be carried out behind the shelter of the river barrier. The safer course was chosen; and the principal masses moved to the north in rear of the Vistula, only cavalry forces being left to oppose the hostile advance in trans-Vistula Poland. The decision was undoubtedly wise, but it involved certain grave disadvantages. It meant the surrender of the whole of south-west Poland to the enemy, severe hardships to the troops in traversing the almost roadless region south of Lublin, and the eventual forcing of passages over the Vistula. Three armies, the 4th, 9th and 5th, moved north, while the 3rd Army took over the line of the San. The great wheel was completed by the third week in October, by which time the 5th, 4th and 9th Armies, in that order from north to south, lined the Vistula from about Gura Kalvarya (south of Warsaw) to Zawichost. Meanwhile a new 2nd Army had been formed round Warsaw.

Austro-German Offensive Fails.—The Austro-German advance, which began at the end of September, met only slight opposition till the lines of the Vistula and the San were reached. During the advance, however, the regrouping of the Russian forces became evident and showed that the original German plan was no longer applicable. The main weight of the offensive of Hindenburg's army was therefore shifted northwards against Warsaw, the whole of the Austrian 1st Army being moved to the left bank of the Vistula and extended from Sandomierz to below Deblin. By Oct. 12 fighting was general on the whole front. Hindenburg's army was within a few miles of Warsaw, but had greatly superior Russian forces against it; while all along the river from Warsaw to Zawichost the Russian counter-offensive was battling for passages to the left bank. South of the Vistula, the Austrian 4th and 3rd Armies had driven in light Russian forces and reached the line of the San by Oct. 10, causing Radko-Dimitriev's 3rd Army to raise the siege of Przemyśl. But they could make no headway in their efforts to force the line of the San. Nor did the 2nd Army, advancing from the Carpathians towards Sambor and Chyrow, meet with any greater success.

By Oct. 17 it was clear to Hindenburg that his offensive could not succeed. North of the Vistula, the German 9th Army and Austrian 1st Army were now assailed from Warsaw, from Deblin and from Zawichost by four Russian armies; while south of the Vistula the three Austrian armies could make no progress against the Russian 3rd and 8th Armies. The Austro-German attacks were, however, continued till the 21st. They were succeeded by violent Russian counter-attacks, which lasted till the 27th. Hindenburg then broke off the battle and led his 9th Army rapidly back to the frontier, destroying all communications as he retired. Dankl's Austrian 1st Army withdrew in more leisurely fashion. Between Oct. 31 and Nov. 2 it held the Russian pursuit at arm's length in the Kielce-Opatów region; and then retired behind the Nida. On the San, fighting continued till the end of October, without marked advantage to either side. But early in November, the Austrian armies broke off the battle and withdrew.

Hindenburg's first invasion of Poland had only relieved the pressure on Austria for a time. Its failure left Germany's ally still further exhausted. It was a bold move, typical of Ludendorff's strategy. But he seems to have under-rated the Russian leadership and to have over-rated the fighting powers of the Austrians.

See E. Ludendorff, *My War Memories* (trans. 1919); E. von Falkenhayn, *General Headquarters 1914–1916 and its Critical Decisions* (trans. 1919); A. W. F. Knox, *With the Russian Army, 1914–17* (1921); J. Daniloff, *Russland im Weltkriege, 1914–15* (1925). (*See* also WORLD WAR: BIBLIOGRAPHY.) (A. P. W.)

VISUAL EDUCATION, a term used in the United States to designate those forms of instruction in which use is made of prepared visual aids, such as models, maps and charts, mounted pictures, lantern slides, films for the projection of still pictures, stereographs and motion picture films. Visual education is a method of instruction which may be used at all ages or levels of schooling and is equally appropriate in teaching geography, history, nature study, physics, physiology, agriculture, astronomy and several other subjects. The most important of the visual aids are lantern slides, stereographs, films for the projection of still pictures and motion picture films.

Motion pictures have been tried in schools ever since they came into wide use for entertainment, but their full possibilities have not been realized. Efforts are being made to facilitate their use by producing narrow width and hence cheaper films, printed on non-inflammable stock, and by manufacturing simpler and more easily handled machines. Efforts are also being made to supply, on a larger scale, informational films, made to fit into the courses of study of the schools.

Organizations for the Promotion of Visual Education.—The first national organization for the promotion of visual education was the National Academy of Visual Instruction. This

society consisted chiefly of members of extension divisions of State universities. The second was the Visual Instruction Association of America, organized not only to hold meetings and disseminate information but also to produce motion picture films. In 1923, the department of visual instruction of the National Education Association was formed.

Psychology of Visual Education.—The spread of visual education, as is often the case with new movements, has been accompanied by extravagant claims on the part of some of its advocates and by a certain amount of loose thinking concerning the psychological basis for the use of visual methods. Visual education is frequently advocated on the supposed ground that the sense of sight is a better avenue for the acquirement of experience than are the other senses, particularly hearing. Psychological studies consisting of careful experimental comparisons have led to sounder theory and a more moderate estimate of the essential place and value of the visual method.

The essential contrast is not between the senses of vision and hearing. It is rather between the direct experience, which consists of the perception of material objects on the one hand, and the indirect experience, which consists of abstract or generalized thought on the other hand. Direct perception is carried on by means of the various senses—not vision alone—while thought is carried on largely by means of language. The contrast, then, is between sense perception and language. But, properly regarded, the two are not opposed to one another. They rather supplement one another. Sense perception or concrete experience alone has little meaning or significance, while an over-emphasis on verbalism without sufficient concrete experience leads to error and confusion of thought. Doubtless education has tended too much to verbalism and needs from time to time to be brought back to a closer contact with the world of physical objects.

The sense of vision is a particularly valuable source of educative experience. First, besides furnishing distinctive qualities of its own it serves to represent or suggest many qualities which are given directly by other senses, such as hardness, smoothness and weight. Second, it is especially adapted to exhibit relationships of a very definite and exact nature. The chief of these is space. On the other hand, hearing yields the sensations which are peculiarly adapted to serve as the means to the development of language. A well rounded education employs each for its proper purpose.

BIBLIOGRAPHY.—J. J. Weber, *Comparative Effectiveness of Some Visual Aids in Seventh Grade Instruction* (1922); Frank N. Freeman, *Visual Education* (1924); A. V. Dorris, *Visual Instruction in Public Schools* (1928); A. P. Hollis, *Motion Pictures for Instruction* (1926). Current information is given in the annual reports of the National Academy of Visual Instruction, the Visual Instruction Association of America and the department of visual instruction of the National Education Association. The chief periodical in the field is the *Educational Screen*. Besides its monthly numbers, this journal publishes a valuable annual supplement entitled, *One Thousand and One Films*.

(F. N. F.)

VISUAL SENSATION. The problem of visual sensation has to do with the dependence of visual experience upon certain features of the physiological visual process which lie on the so-called "afferent" side of the nervous arc. These features include the elementary properties of (1) the stimulus (light or electromagnetic radiation having appropriate wave-lengths), (2) the retinal excitation, (3) the conduction along the optic nerves, and (4) certain aspects of cerebral activity. The boundary line between sensation and perception is somewhat vague. From the classical standpoint, perception is concerned with the manner in which various constituent factors are put together to form distinct psychical patterns, these patterns being regarded in general as representations of objects which are actually before the eyes. Sensation, on the other hand, is considered as furnishing the materials for such perceptual syntheses, and as being concerned more with the stimulus energy and the sense organ response than with either the brain processes or the object. However, modern studies of the manner of dependence of experience upon cerebral conditions have made rather free use of the concept of sensation.

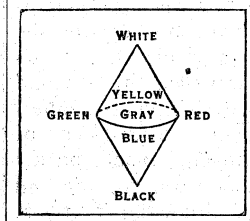
If we regard visual sensation, from the introspective standpoint, as a subjective material, out of which complex visual perceptions are compounded, the substance of such sensation appears to be reducible to two kinds, *colour* and *depth*. Colour characterizes object surfaces, while depth constitutes the spatial medium which intervenes between these surfaces and the empirical eye. These elementary factors can be arranged, at various times, so as to form an indefinitely large number of characteristic perceptual patterns, to constitute the phenomena of visual experience.

Introspective Properties of Colour.—The concept of colour is here used broadly to include all elementary visual qualities, whether they belong to the chromatic or to the achromatic classification. The latter comprises a scale of greys, extending between black and white, while the former includes a cycle of hues at various saturation values. The outstanding or *psychologically primary hues,* are red, yellow, green and blue, but these have many intermediates, of which the typical ones are orange, yellow-green, blue-green and purple. The total number of possible achromatic colours has been estimated at between 600 and 800, of discriminable hues at about 150, and of different saturation values of each hue, at approximately 20. According to Titchener, the total number of discriminable colours is about 35,000, but this number must vary widely with conditions.

The *achromatic colours,* or greys, can be arranged in linear order, so as to form a system which has only a single dimension. This dimension has been variously designated as one of brightness, luminosity, value, or tint, but the term *brilliance* is to be preferred because of its freedom from disturbing connotations. Brilliance is at a minimum for an ideal black and is at a maximum for an ideal white. Intervening greys can be designated numerically by counting the number of just noticeably different achromatic colours which separate them from the ideal black. The chromatic colours may also differ from one another in brilliance, although if they differ in this only they will have identical *chromas*.

If we consider all *chromatic colours* which are possible of the same brilliance, we find that they can be ordered to form a surface, or a two-dimensional figure. This figure will automatically include the single achromatic colour which is of the given brilliance. Any colour within this surface can evidently be specified in terms of values along each of the two dimensions. The axes for the latter are best chosen in accordance with a system of polar coördinates, with its centre at the grey point. Radial values, measured in just noticeable steps from the centre, then represent the *saturations* of the colours, whereas circumferential values designate the *hues*.

These two systems, the chromatic and the achromatic, can obviously be combined to form a three-dimensional figure which embraces, simultaneously, the properties of brilliance, saturation and hue. The resulting scheme, as diagrammed in fig. 1, provides locations for all conceivable colours, and thus enables us to specify any colour numerically in terms of three determinants or *attributes*. Chromatic colours exist, or are conceivable, at all levels of brilliance, so that the figure becomes a *psychological colour solid*. The exact boundaries of this solid cannot be specified at the present time, although we may safely affirm a tendency for the number of possible chromatic colours to show a maximum in the middle range of brilliance, and to be reduced practically to zero at the ideal black and white.



FROM TROLAND, "THE MYSTERY OF MIND" (VAN NOSTRAND)

FIG. 1.—THE PSYCHOLOGICAL COLOUR SOLID

The Psychophysiology of Colour.—Experimental studies of visual sensation have been concerned, for the most part, with the laws which connect brilliance, saturation and hue with features of the stimulus and sense organ process. The electromagnetic waves which constitute the stimulus impinge upon the corneas of the eyes, pass through the pupils, and are refracted by the various ocular media so as to form images upon the retinas. The elementary properties of the stimulus, from the physical standpoint, are its intensity and its relative wave-length composition. The latter can be subdivided into two features, such as dominant wave-length and purity. The simplest psychophysiological relations are found when homogeneous, or single wave, stimuli are

employed, and, in this case, the stimulus is specified by its wave-length and intensity.

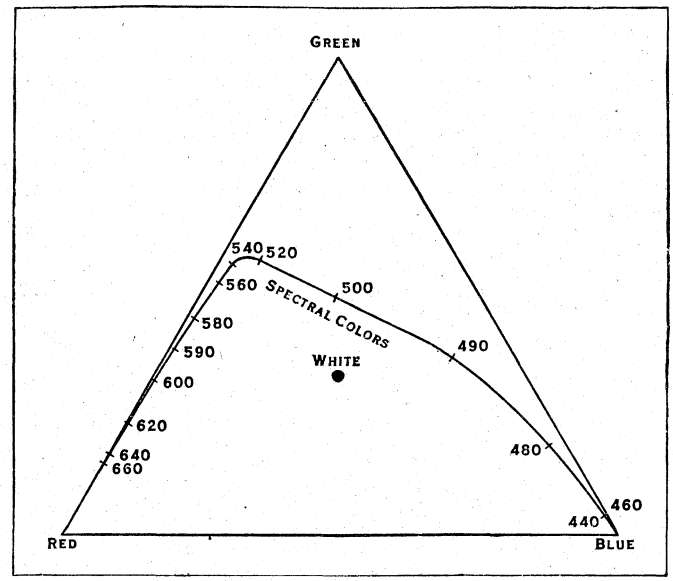
It is found that all three attributes of colour depend upon each possible aspect of the stimulus. Beginning with the relationships of brilliance, we note, firstly, that at constant intensity this attribute varies with wave-length, in accordance with a function which is approximately of the probability integral type. This symmetrical, single maximum curve corresponds in general form with the so-called *visibility function,* although, strictly speaking, the latter represents the reciprocal intensities which are required at different wave-lengths, to yield equal brilliances, rather than delineating a direct psychophysical relationship. The visibility curve gives values by which *radiometric intensities* must be multiplied in order to secure the corresponding *photometric or light intensities.*

The position of the maximum of the function which connects brilliance with wave-length varies with the stimulus intensity and with the state of adaptation of the eye. At intensities corresponding to daylight, the maximum lies at about 554 mμ, but under twilight illumination it shifts to the neighbourhood of 511 mμ. The exact limits of the curve, which determine the extremes of the visible spectrum, naturally vary with the intensity level, but may be taken as 400 mμ and 760 mμ for daylight conditions, shifting with the maximum at lower intensities. The high intensity curve is characteristic of *photopic* (or cone) vision, while the low intensity one features *scotopic* (or rod) vision. The transition from the former to the latter is responsible for the Purkinje and other similar phenomena.

When a stimulus, of fixed wave-length composition, is varied in *intensity,* the brilliance is found to be a logarithmic function of the latter in the range of ordinary daylight intensities. At both higher and lower intensities, the brilliance changes less rapidly with respect to the intensity than is characteristic of the logarithmic section of the law. The total law may be designated as the Fechner function. In the logarithmic region, the just noticeable increment of intensity is approximately one one-hundredth part, depending upon conditions. The Fechner function is substantially independent of wave-length composition, if intensities are expressed in photometric terms, *i.e.,* if the physical intensities are multiplied by the corresponding visibility values. This is true for either homogeneous or heterogeneous stimuli, and in the latter case implies the principle that the light values of the components in a mixture add arithmetically.

Hue is determined primarily by the wave-length of the stimulus, when the latter is homogeneous, and by a quantitative balance between component wave-lengths and intensities, when it is heterogeneous. The hue changes progressively from one end of the visible spectrum to the other, although at a variable rate. Maximal rates of change of hue with respect to wave-length are found at 589 mμ, 507 mμ and 489·5 mμ, at each of which points a difference of 1 mμ is just noticeable. At the long-wave (red) end of the spectrum, there is no change of hue beyond about 700 mμ and there is only one just noticeable step between 700 mμ and 678 mμ. The psychologically primary hues, within the spectrum, are the yellow at 574·5 mμ, the green at 505·5 mμ and the blue at 478·5 mμ, the primary red requiring the admixture of a small quantity of short-wave radiation to the spectral rays between 700 mμ and the long-wave end. *Saturation* also varies with the wave-length of a homogeneous stimulus. It shows maxima at either end of the spectrum, with a minimum at about 575 mμ.

When the stimulus is heterogeneous, the hue and saturation are determined by rather complex principles, known as the *laws of colour-mixture.* The simplest case is that of two-component mixtures, involving pairs of homogeneous stimuli. If the wave-lengths and relative intensities are properly chosen, the result can be an achromatic colour or white, and in this case the stimuli (and the colours which they would separately evoke in isolation) are said to be *complementary.* If the wave-lengths of such complementary stimuli are held constant, and the intensities are varied from those required to yield white, a hue appears which is normal to the stimulus that is in excess, the saturation increasing with augmented unbalance. When the wave-lengths depart from those of complementary stimuli, the hue is intermediate, on the shortest arc of the hue cycle, between the hues normal to the two stimuli. The exact position of the hue on the arc is determined by the balance of intensities, naturally being near to that normal to the component which is intensively predominant, in proportion to the degree of predominance. The saturation is greater the more



FROM IVES, JOURNAL OF THE FRANKLIN INSTITUTE

FIG. 2.—THE COLOUR-MIXTURE TRIANGLE

the two stimuli depart from the complementary relationship, either as regards wave-lengths or intensities.

One of the most interesting cases of two-component mixture is that which involves the two extremes of the visible spectrum, yielding a series of *purples,* of which there are approximately 20, determined by the intensity ratios of the two components. The purples furnish the complementaries for colours or stimuli in the middle region of the spectrum, which find no homogeneous complementaries. The *three-component system,* thus generated, consisting of two extreme spectral stimuli and a mid-spectral stimulus, provides the most important of all cases of colour-mixture. It is found that variation of the intensity proportions of such stimuli, of fixed wave-lengths, permits the matching of all possible hues at a wide variety of saturations. This fact underlies the technique of three-colour reproduction and analysis. The laws which are involved are most simply represented by means of a colour-mixture triangle, such as is shown in fig 2, where the three primary components are symbolized by the vertices of the equilateral figure.

The units of measurement in this triangle are so chosen that equal quantities of the three primaries yield white. The brilliance value of the blue or violet, thus required, is only about 1% of that of the red or green. The composition of any colour, in these terms, is found by locating it within the triangle and then dropping perpendiculars to each of the three sides. The length of the perpendicular opposite each primary indicates the proportion of the latter which is involved. The consequences of mixing any two colours can be determined, in this system, by drawing a straight line between the points which represent them, and then finding the centre of gravity of the line, treating the mixture intensities of the components as masses. Mixtures of any number of components can be handled in this way by successive combinations in pairs. Thus the triangle provides a universal method for dealing with the hue and saturation aspects of stimulus mixtures. The colours of the spectrum can be represented by a linear locus, and in order that this should fall inside rather than outside of the triangle, the latter is ordinarily reconstructed on the basis of an ideal, supersaturated, green primary.

Hue and saturation also vary with the absolute intensity of the stimulus. At both low and extremely high intensities there is a loss of saturation, which may be complete. There is also a change of hue, with increasing intensity, such that all colours,

except primary red and green, tend to become more yellowish or bluish, according as they lie on the yellow or the blue side of red or green, respectively. This is known as the Bezold-Brücke effect.

The relations of colour to retinal conditions can best be discussed in connection with spatial and temporal effects, although in only a few cases are we sure that such effects are retinally rather than cerebrally determined. Among *temporal phenomena,* we may mention those of *adaptation,* according to which continued exposure to any stimulus brings about changes in sensitivity which tend to neutralize the characteristic effect of the stimulus. Brilliance adaptation is apparently of two kinds, scotopic, involving a changing ratio between rod and cone vision, and photopic, depending upon changes within the cone system *per se.* The latter may be selective, as regards hue and saturation, reducing the latter and rendering the retinal system temporarily more sensitive to the complementary. Local alterations in sensitivity yield so-called negative and complementary after-images which can be used to demonstrate the rate at which recovery, or counter-adaptation takes place.

Other temporal effects include positive after-images, which appear to represent a continuation of the original excitation process for a short time after the removal of a stimulus; rhythmic alternations between positive and negative conditions, giving rise to such phenomena as Charpentier's bands and "recurrent vision"; and fusion, with intermittent stimuli presented at a sufficiently high rate, resting upon the so-called "persistence of vision."

Spatial dependencies are represented by the variation of hue and saturation with the position of the stimulus on the retina, the partial dependence of all of the colour attributes upon the size of the retinal image, and by the phenomena of contrast. In general, chromatic differentiation is at a maximum in the centre of the visual field and falls off towards the periphery in accordance with the same qualitative law which characterizes the Bezold-Brücke effect (*vide supra*). Brilliance shows a maximum in the centre of the field under photopic conditions, but a powerful minimum in the same position under scotopic adaptation. This is attributable to the absence of rods in the retinal centre or "fovea." Intensity thresholds for hue and brilliance are raised by decreasing the retinal size of the stimulus below a certain value, and at very small sizes the threshold is determined by the total energy striking the retina, regardless of its distribution between intensity and area. Contrast (*q.v.*) involves a change in the colour evoked by a given stimulus, because of the simultaneous action of another stimulus (or condition) on an adjoining visual area. The change is in the direction of the opposite of the contrast-inducing colour, being a darkening effect when the latter is bright, and a shift towards the complementary of the latter when it is of chromatic quality.

The most reliable conclusions regarding the dependency of visual experience upon the retinal mechanism are comprised in the so-called *duplicity theory,* according to which the two histologically differentiable types of receptors, the rods and the cones, have psychophysically distinct functions. The cones are supposed to have a relatively low degree of sensitivity and to subserve photopic or day vision, with chromatic discrimination. The rods, on the other hand, are characterized by a sensitivity which, at its maximum, is about 10,000 times as great as that of the cones, but by an absence of chromatic response. At high intensities of stimulation, they are practically eliminated by adaptation, but at low intensities, they entirely replace the cones. A multitude of spatial and temporal effects can be explained in terms of the differences in retinal distribution, spectral sensitivity and inertia between the rod and cone systems.

Depth.—The remaining factor in visual sensation, the depth impression, can be disposed of quite briefly, since it is customary to discuss its conditions in detail in connection with binocular visual perception. Depth elements seem introspectively to be all of the same kind, differing only in location within subjective visual space. They must be regarded as being determined directly by processes in the visual areas of the cerebral cortex, although their number and locations are regulated by a complex assembly of peripheral factors, the so-called primary and secondary criteria of depth. The most important among these factors consist in the disparations of the images of identical object points upon the two retinas. Hering treated such disparation as a sensory variable, having positive and negative values, corresponding with crossed and uncrossed relations of the corresponding lines of view, respectively.

(*See* VISION OR SIGHT.) (L. T. T.)

VITACEAE, a characteristic family of dicotyledonous plants, all tendril bearing vines, except *Leea,* of world-wide distribution, with 12 genera and about 650 species. The largest genus, which is pantropic, is *Cissus,* containing about 250 species. *Vitis,* with about 60 species, is its one genus of great economic importance, including as it does the European wine grape (*Vitis vinifera*), and the North American fox grape (*Vitis labrusca*), the parent species of most of the cultivated "slip skin" American grapes. The Boston ivy is *Parthenocissus tricuspidata,* native of China and Japan. *Leea* is an Indo-Malaysian genus of about 100 species, some erect shrubs, others vines, all without tendrils.

VITALIANUS, bishop of Rome from 657 to 672, succeeded Eugenius I and was followed by Adeodatus. In the monothelite controversy then raging he refrained from express condemnation of the *Type* of Constans II. The chief episode in his pontificate was the visit of Constans to Rome; the pope received him "almost with religious honours," a deference which he requited by stripping all the brazen ornaments of the city—even to the tiles of the Pantheon—and sending them to Constantinople.

VITAL STATISTICS. This important subject is treated in a number of articles in this work, including POPULATION; CENSUS; BIRTH-RATE; DEATH-RATE; MARRIAGE-RATE; ILLEGITIMACY; SEX-RATIO AT BIRTH AND DEATH; BIRTH CONTROL.

VITAMINS are specific organic compounds which occur in foods and which are required in the diet in very small amounts in order to maintain life and health. All dietary essentials are not vitamins. For example, some of the amino acids are necessary in the food if life is to be maintained, but the quantities needed are so large (usually of the order of 1% of the ration) that these dietary components are not considered to be vitamins. By contrast, the daily human requirement for various vitamins ranges from 0.005% to 0.000002% of the diet. Certain mineral salts, such as those of copper and iron, are also required in the food in minute amounts, but these are distinguished from the vitamins (which are organic chemical compounds), because of their inorganic nature. A vitamin is said to be specific because only one chemical compound, or at most a few compounds closely related to it in structure, have the ability to function as the nutritive essential. In addition, the designation of a substance as a vitamin implies that it is rather widely distributed in foods. If this were not so, then quinine might be classed as a vitamin, because under certain conditions (*i.e.,* contact with malaria) this drug, which occurs in a few natural products, may be necessary to the animal for life and health.

Deficiency Diseases.—The concept that there are specific and necessary chemical entities, needed only in traces to maintain health, became established at the opening of the 20th century. Prior to this time, it had been recognized by some that a disease such as scurvy resulted when nothing except dried rations was eaten by men for long periods, but the idea of diseases resulting from deficiencies of the diet did not become established until experiments with animals were devised, which showed conclusively that dietary deficiencies could be causative agents of disease. The recognition of the existence of most of the vitamins, and the isolation and clarification of the nature of all of them, has resulted from experiments with animals and with microorganisms.

One of the first demonstrations that disease resulted from dietary deficiency of a constituent of certain foods was made by Christiaan Eijkman in 1897 in the Dutch East Indies. In those parts of the world where polished rice is the dietary staple (such as in southern China, the Philippine Islands and the Dutch East Indies) a disease known as beriberi is prevalent. A condition similar to beriberi was produced experimentally in animals by

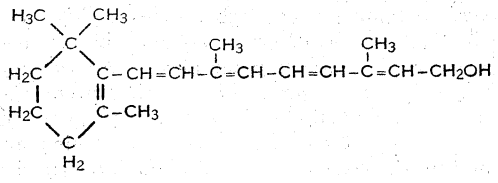
feeding them a ration composed mainly of polished rice. This experimental disease was cured by administering, in addition to the rice, an extract of rice polishings. Such extracts owed their potency primarily to a substance which later came to be known as thiamine or vitamin B_1, which was not present in polished rice in amounts sufficient for the maintenance of health. Although this substance is contained in whole grains of rice, it is concentrated in the outer coverings which are removed in the polishing process. Beriberi in man is caused by a deficiency of thiamine in the diet.

Following the demonstration that beriberi is caused by a dietary deficiency, other diseases which resembled certain naturally occurring disorders of mankind and of animals were produced experimentally by feeding various deficient diets. Thus, A. Holst and T. Fröhlich (1912) were able to produce scurvy in guinea pigs by withholding from them fresh plant materials, and by feeding them only dried hay and oats. By the use of such a ration it was possible to determine which foods contained the antiscorbutic vitamin (vitamin C or ascorbic acid). If it was present, scurvy was prevented when the food under examination was fed as a supplement to this ration. If the vitamin was absent or present in insufficient amounts, scurvy resulted. In this way the presence of the vitamin in fractions prepared from lemon juice was traced, and the isolation of the antiscorbutic compound, ascorbic acid, was eventually accomplished (C. G. King and W. A. Waugh, 1932).

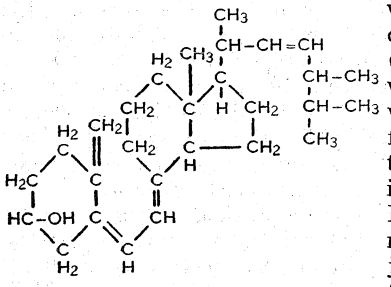
A similar pattern of events led to the recognition of most of the other vitamins, to their isolation in pure form from suitable rich sources, and to the use of the pure synthetic compounds in the treatment of naturally occurring deficiency diseases.

The need for vitamins is found among all classes of living things. Not only do man and other mammals demand these important factors, but birds, fishes, insects and even the unicellular organisms such as the yeasts and bacteria also require them. Green plants do not need an external supply of vitamins, for these species are able to synthesize all that they require from carbon dioxide and water. Nevertheless, fragments of the plants such as the roots must have certain vitamins when they are cultured apart from the intact organism.

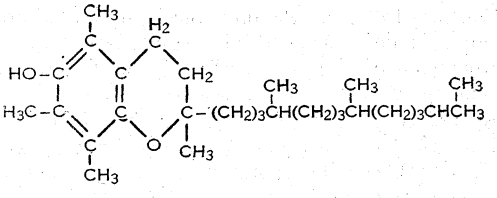
Although all animal species examined require various vitamins, the particular needs of each species differ considerably. Thus, although man and guinea pigs require a dietary source of ascorbic acid, dogs, rats and many other species do not; for such animals ascorbic acid is not a vitamin. Nevertheless, ascorbic acid is still very important to these latter types, for they have the ability to synthesize it, and thus to be independent of a supply in their food. The situation is similar with other vitamins. For each one there are a great many species which require it in their diets, and there are some which do not. These latter usually are able to synthesize it themselves. However, in the case of certain vitamins some living things seem to have no need for them in their economy, and hence dispense with them entirely. This is the case for example, with vitamin A which is essential to the life of many types of animals, but is not required by, nor even contained in, the cockroach.



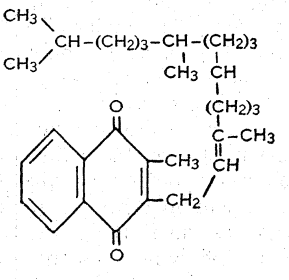
VITAMIN A



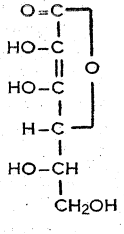
VITAMIN D_2



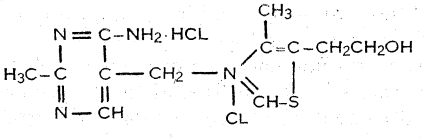
VITAMIN E (ALPHA-TOCOPHEROL)
BETA- AND GAMMA-TOCOPHEROLS DIFFER IN HAVING ONE LESS METHYL GROUP IN THE BENZENE RING



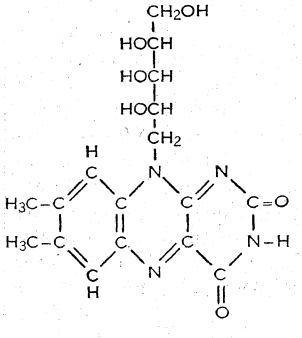
VITAMIN K_1



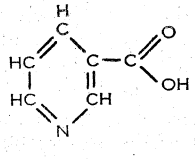
ASCORBIC ACID



THIAMINE



RIBOFLAVIN



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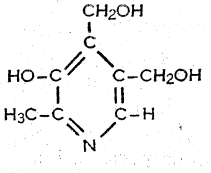

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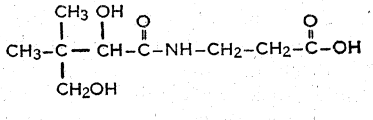

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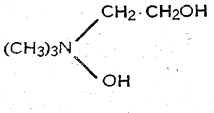

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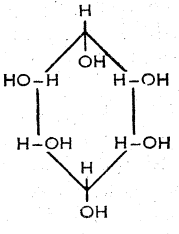

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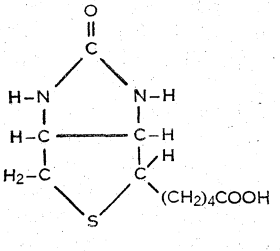

BIOTIN

CHEMICAL FORMULAE OF THE VITAMINS

Each of the vitamins, with the possible exception of vitamin D, is found widely distributed in nature, although natural materials vary greatly in the quantities which they contain. Some foodstuffs may be rich sources of one or more vitamins and poor sources of others. When these natural foodstuffs are subjected to manufacturing processes such as the milling of cereal grains or the cooking of vegetables or the curing and storage of hay, the content of certain vitamins may be diminished. Illustrations of this are the loss of thiamine during the polishing of rice and the destruction of ascorbic acid when foods are dried and stored (*see* above).

Deficiency diseases are slow to develop because time is required to deplete bodily stores of the vitamins. Adult animals may ingest a deficient diet for a number of months or even years before signs of disease appear. This time required for development of the disorder varies for different vitamins. Manifestations of a lack of thiamine develop relatively soon, whereas those of tocopherol or vitamin A deprivation may require a major fraction of the life span to become noticeable. Although this is the case with adult animals, in very young individuals signs of deficiency diseases may develop in a shorter time of dietary restriction.

Lack of any one or of a group of vitamins leads to the appearance of rather typical changes in an animal, and in general these aberrations are different for each vitamin deficiency. Furthermore, the picture of disease which results from the lack of a nutritive essential is usually similar whether a rat or a mouse or a man is involved. For example, vitamin A deficiency causes changes in the eyes and alterations of the mucous membranes of a great variety of animal species. Despite this fact, any given species may exhibit certain signs of deficiency which other types of animals fail to show. Knowledge is much more complete for vitamins in relation to experimental animals than it is for man. As an example, the amounts of each of the several vitamins required to assure maximal effect are known for the rat, but for man only approximations are available.

The quantities which will be mentioned below for human requirements should be viewed in this light. They are probably too high rather than too low.

Vitamins have been classified arbitrarily into fat-soluble and water-soluble groups. The fat-soluble ones are represented by vitamins A, D, E and K, while the water-soluble group consists of the remainder. The water-soluble vitamins other than ascorbic acid are sometimes known collectively as the B-complex.

Determination of the Vitamins in Foods.—Because of the fact that individual foods differ widely in their content of the several vitamins, it is a matter of practical importance to be able to estimate accurately how much of each is present in a foodstuff. By knowing the intake of each vitamin and comparing this to the amount required to maintain health, we can determine the nutritional adequacy of a diet. The definition of the quantitative needs for the several vitamins is fraught with some difficulty because of the uncertainty of measuring what is health, and because of the influence one constituent of the diet may have on the requirement for another. Nevertheless, it is possible to determine with some considerable precision the amounts of each vitamin in the food ingested. This may be done in different ways.

The oldest method for the quantitative determination of a given vitamin is an animal assay. In the making of such an assay, a ration is devised which lacks that vitamin, but is otherwise quite adequate. This basal ration plus graded amounts of the material to be tested is fed to some animals (white rats are usually used) while others receive the basal diet plus graded amounts of the pure vitamin. By comparison of the performance of the former with that of the latter, a value for the quantity of vitamin in the unknown can be calculated. Such methods are cumbersome, time-consuming, and costly. For these reasons they are supplanted by the following procedures whenever the latter are proved to have sufficient specificity, *i.e.*, when it becomes evident that there are no other materials in foods which would be determined as the vitamin.

The second general method for the determination of vitamin content of foods is based on the fact that various microorganisms need the same vitamins as do the higher animals. The procedure is then the same as in the first general method of assay. The only difference is that some suitable microorganism is used in place of the rats or other animals. These microbiological methods recommend themselves because they allow the determination of exceedingly minute amounts of the various vitamins, because they are rapid and inexpensive to conduct, and because they are generally more precise than animal assays.

A third general method of quantitative determination of a vitamin becomes possible when the chemical structure is elucidated. Then a procedure may be devised which takes advantage of some distinctive chemical property of the vitamin, which sets it apart from other constituents of foodstuffs. Chemical analyses recommend themselves because of their precision, speed and ease of operation.

Vitamin A.—Vitamin A is a fat-soluble alcohol of the formula shown in the diagram. Because of its chemical nature it is readily destroyed by exposure to air and light. It occurs most abundantly in fish-liver oils, and to a considerable extent in butter and in the liver fat of various animals. Vitamin A does not occur in plants, but many vegetables and fruits possess potency because they contain carotenoid pigments which are converted to the vitamin in the body. Most of these yellow or red pigments do not possess this property, but one called β-carotene can serve as a good source of the vitamin. The yellow colour of carrots is caused largely by β-carotene.

Lack of vitamin A in the diet leads to poor growth in young animals, to inability of the eyes to adapt normally to dim light (night blindness), and as the deficiency progresses, to xerophthalmia and eventual loss of the lens of the eye. The vitamin is known to function directly in vision as a component of the pigment, visual purple, in the retina. Changes in the skin and in the mucous membranes of the body, best described in general terms as keratinization, are characteristic. Alterations in the growth of bones occur, and these may lead to manifestations such as blindness in calves or deafness in dogs. The reproductive process is specifically interfered with, and this is possibly associated with the alteration which occurs in mucous membranes.

Several closely-related compounds which have vitamin A potency are found in animal fats. For example, fresh-water fish-oils contain in addition to vitamin A, a vitamin A_2 which is possibly a homolog of the former, and merely contains a few more carbon atoms.

Vitamin A is required in very small amounts. For example 4,000 international units of the vitamin, or 2.4 milligrams of β-carotene per day are said to be sufficient for man.

The existence of vitamin A was first clearly recognized by E. V. McCollum and M. Davis in 1913 and by T. B. Osborne and L. B. Mendel in 1913; its chemical nature was established by P. Karrer and his associates in 1933.

Vitamin D.—Vitamin D is a fat-soluble alcohol which occurs only in animals, but which may arise in dead plant-materials when they are exposed to ultra-violet light. The action of such light on ergosterol, on 7-dehydrocholesterol, or on certain other sterols leads to the formation of vitamin D. As with vitamin A, so also with this vitamin there are several closely related compounds which possess potency, and any one of these may predominate, or be present exclusively, in a given source. Since the active substance arises by irradiation of various sterols with ultra-violet light, it is not essential that the vitamin be taken in the food because the irradiation of the animal will allow the activation of its sterols. Without such irradiation, the animal must receive food which contains the vitamin. The food may in turn have acquired its vitamin as a result of exposure to light of suitable wave length. Now, although tropical sunlight contains light of the proper wave length to produce activation of sterols, winter sunshine in northern regions of the world, or sunlight which has passed through certain glasses or through clouds may lack sufficient ultra-violet rays to bring about adequate production of the vitamin in the animal.

Lack of vitamin D leads to the appearance of rickets. In this disease, calcification of bone is retarded, and as a result, such

abnormalities as grotesquely bowed legs are produced.

Vitamin D is one of the most active of vitamins from the point of view of the amount required per day. About 10 micrograms (400 international units) are considered adequate for a growing child.

Vitamin E or the Tocopherols.—Vitamin E is a fat-soluble phenol found principally in certain plant oils. Wheat germ oil is a particularly rich source. This vitamin was recognized first by H. M. Evans and K. S. Bishop in 1922, obtained in pure form by H. M. Evans, O. H. and G. A. Emerson in 1936, and identified chemically by P. Karrer, H. Salomon and H. Fritzsche in 1938. Three quite similar compounds, α-, β-, and γ-tocopherol, each with vitamin E activity, have been found in nature. Of these, the α-isomer is the most active.

In several species of rodents and in dogs, lack of vitamin E leads to muscular dystrophy. Furthermore, in rats a deficiency results in sterility in the male, and to failure to bear young in the female. This failure is caused by the death and resorption of the embryos in the later part of the gestational period. In addition to these functions in animals, tocopherols also play a role as antioxidants which retard the rancidification of fats. If these compounds were not present, many vegetable oils would become rancid very rapidly.

Vitamin K.—In 1934 H. Dam showed that when chickens were fed a modified ration they developed spontaneous haemorrhages. This condition subsequently was found to be due to the lack of a naphthoquinone which is known as vitamin K. The vitamin present in green leaves was isolated and shown to have the structure represented in the diagram (R. W. McKee, S. B. Binkley, D. W. MacCorquodale, S. A. Thayer and E. A. Doisy; 1940). Related compounds, both naturally occurring and synthetic, may have activity.

Lack of vitamin K leads to increased clotting time of the blood because of a reduction in the amount of prothrombin. Conditions which lead to diminished secretion of bile into the intestine markedly accentuate the need for vitamin K. For this reason it is believed that the absorption of the vitamin is dependent on bile.

Ascorbic Acid or Vitamin C.—Vitamin C is a water-soluble, easily oxidizable, carbohydrate-like lactone which is necessary in the diet of some animals in order to prevent scurvy. Its structure is shown in the diagram. Only a relatively few species (man, monkeys and guinea pigs) need this vitamin, since most animals can synthesize it themselves. Those which require it in the food depend primarily on fresh fruits, vegetables or other plant materials for their supply of this factor.

Although scurvy was recognized for many centuries, little progress was made in its treatment until the production of the disease in guinea pigs (A. Holst and T. Fröhlich, 1912), the isolation of the curative agent, ascorbic acid (C. G. King and W. A. Waugh, 1932), and the elucidation of its nature. A. Szent-Györgyi in 1927 isolated ascorbic acid inadvertently without recognizing its vitamin character. Relatively large amounts of this vitamin are required, *i.e.*, an adult man is said to need about 30 milligrams per day. The ease of destruction of ascorbic acid by oxidation, especially in neutral or alkaline solution, or at elevated temperatures, makes its preservation in foods difficult.

Thiamine, or Vitamin B_1.—Thiamine is a water-soluble nitrogenous basic alcohol which is necessary in the food in order to prevent beriberi. Although this disease results from severe deficiency, less drastic restriction of the vitamin may lead to failure of appetite and to certain types of neuritis. This is the substance for which the word vitamin was first coined (C. Funk, 1912), but the original definition has been broadened to include many other nutritive essentials because, contrary to the ideas prevalent at the beginning of the 20th century, there are several nutritive factors, rather than one, needed in small quantities. The isolation of thiamine absorbed the attention of biochemists for many years until it was finally achieved by B. C. P. Jansen and W. F. Donath in 1927. However, several years elapsed before an improved method of isolation was developed (R. R. Williams and associates) which allowed adequate study of the substance. The problems involved were common to the isolation of many of the vitamins, but were magnified by the fact that experience in such matters was lacking since thiamine was the first one to be obtained in pure form. These problems revolve about the exceedingly small amounts present in even the richest sources, and the ease of destruction of some of the vitamins.

Thiamine occurs most abundantly in cereal grains and in certain other seeds. Pork is one of the richest animal sources. About 1 milligram per day will meet all the needs of an adult human.

Thiamine functions in some of the enzyme systems by means of which the body converts carbohydrates into energy. In these functions it acts in the form of its ester with pyrophosphoric acid.

Riboflavin.—Riboflavin is a yellow nitrogenous polyhydroxy alcohol which occurs abundantly in whey or in egg white. Indeed, the greenish-yellow fluorescence of these materials is caused by the presence of this pigment. It was recognized as a vitamin in 1933 (R. Kuhn, P. György and T. Wagner-Jauregg).

In addition to failure of growth, the lack of riboflavin leads to changes in the skin and tongue. The eyes frequently are involved. The vitamin is known to function as part of enzyme systems which are concerned with the metabolism of carbohydrates and of amino acids.

Slightly more riboflavin than thiamine is required for the well-being of several species of animals, and it is said that 2 milligrams per day will meet the needs of an adult human adequately. It is widely distributed in both plants and animals, but the richness of diverse materials varies considerably.

Nicotinic Acid.—This nitrogenous acid (or its amide), frequently referred to as niacin, is the water-soluble pellagra-preventative vitamin. J. Goldberger's demonstration that pellagra was a deficiency disease (1925) was followed in 1937 by the isolation and identification of nicotinic acid (or its amide) as the vitamin involved (C. A. Elvehjem, R. J. Madden, F. M. Strong and D. W. Woolley). Pellagra is a disease primarily seen among people who eat large quantities of corn. The dogs and cats owned by pellagrous families may show a similar deficiency disease which may be cured with the vitamin. Nicotinic acid is one of the most stable of the vitamins, and resists well most cooking or preserving processes. It is widely distributed among plants and animals, but, just as with riboflavin, some materials are rich in it while others are poor. It is a relatively inactive vitamin as may be judged by the estimate that a man requires about 5 to 15 milligrams of it per day.

Like thiamine and riboflavin, nicotinic acid is also a part of enzyme systems concerned with the metabolism of carbohydrates. In these systems, it acts (when combined as cozymase) in catalyzing the oxidation of sugar derivatives.

Pyridoxine (Vitamin B_6).—The existence of a dietary essential which appeared to be an organic base was established in 1935 by P. György in experiments with rats. In these animals the deficiency of vitamin B_6 led to a disease characterized by failure of growth and subsequently by severe reddening and erosion of the skin on the ears, nose and paws. The vitamin which prevented or cured these manifestations was isolated almost simultaneously in several independent laboratories in 1938, and its structure was shown to be that in the diagram. It is a water-soluble nitrogenous alcohol. The vitamin B_6 activity of natural products is not caused solely by pyridoxine, for the closely related pyridoxal and pyridoxamine have vitamin potency and probably occur widely distributed in nature. Indeed, pyridoxal as a phosphorylated derivative is a part of certain enzyme systems which decarboxylate amino acids. This vitamin may therefore be viewed as having a function in the metabolism of amino acids.

Up to 1946—no human disease had been found to be caused specifically by a deficiency of pyridoxine in the food, although certain human ailments of obscure origin had been shown to respond to administration of this substance. When such responses have been observed, the lack of sufficient vitamin in the food has not been demonstrated. Furthermore, although the production of pyridoxine deficiency in animals such as rats, mice, dogs and

chickens is readily accomplished, the signs of deficiency depend to some extent on the other constituents of the diet; *i.e.*, the skin lesions in rats may not appear if certain fats are present in the ration. This situation is not unique for pyridoxine deficiency, because a similar dependence of pathology on other constituents of the food is found with several vitamins.

Pyridoxine is of the same order of potency as thiamine. Like many other water-soluble vitamins it is found widely distributed in living things.

Pantothenic Acid.—Pantothenic acid is a nitrogenous hydroxy acid which is soluble in water but very insoluble in oils. Although R. J. Williams and coworkers (1933) first recognized the existence of this vitamin as a nutritive requirement of yeast, its role in the nutrition of animals was demonstrated independently. The isolation and determination of the chemical structure of this vitamin was accomplished simultaneously in several laboratories in 1940 (R. J. Williams and R. T. Major and D. W. Woolley).

Experimental animals which are made deficient in this vitamin may show such signs of disease as failure to grow, lesions of the skin, hyperirritability, paralysis of the hind limbs (probably associated with damage to the nerves), and alteration in the colour of the hair. Black animals frequently turn quite gray when they are deprived of pantothenic acid. The original colour may be restored by administration of the vitamin. Nevertheless, most cases of graying of the hair in humans are not influenced by giving pantothenic acid. In fact, up to 1946 no human disease had been found to respond to administration of this vitamin. This fact of course does not mean that humans may not require pantothenic acid since the foods eaten by man may never lack it. Indeed, as its name implies, this vitamin is very widespread in nature.

Pantothenic acid is not as active, weight for weight, as most other vitamins. For example, a rat needs about ten times as much pantothenic acid as it does of thiamine or of pyridoxine.

Biotin.—This water-soluble nitrogenous acid was first discovered as a nutritive requirement of yeast. Indeed, it was one of the first vitamins to be isolated solely because it was a microbial growth factor, and subsequently to be found necessary for animals. However, after the years 1937–40, the use of bacteria and yeasts in the discovery of new vitamins, and as an aid in their isolation, has become common. Biotin was isolated in pure form in 1936 by F. Kögl and B. Tönnies, and its structure was established by V. du Vigneaud and his collaborators in 1943, after they had shown that it is required by animals.

The demonstration that biotin is required by certain animals was dependent on the fact (M. A. Boas, 1927) that the addition of uncooked egg white to a diet which is otherwise adequate leads to the production of a disease. This malady is due to the presence in egg white of a specific protein which combines with biotin and thus effectively prevents its utilization.

A human need for biotin was not known by 1946, possibly for reasons similar to those discussed under previous vitamins. It is a relatively stable substance which is found rather widely distributed in nature. Judged on a weight basis, biotin is one of the most active of the water-soluble vitamins (about 20 times as potent as thiamine for rats or chickens).

Folic Acid.—The existence of a new vitamin which was necessary for growth, and for the prevention of anaemia, in monkeys and chicks, and for the growth of various bacteria, was demonstrated independently in 1938 by P. L. Day and in 1940 by A. G. Hogan and E. M. Parrott, and by E. E. Snell and W. H. Peterson. It is a nitrogenous acid the nature of which was established in 1946 to be xanthopterylmethyl para-aminobenzoyl glutamic acid. The name for it had not been established, but the designation folic acid was proposed in 1941. Several related substances with folic-acid activity occur in diverse natural products, and the relative potency of these compounds may differ for various living things. Folic-acid activity is present in both plant and animal tissues. As with most vitamins, liver is a particularly rich source.

The lack of folic acid in various animal species may lead to the appearance of anaemia and to a marked reduction in the number of certain white blood cells. Some types of anaemia found in human populations are benefited by the administration of this vitamin. No data were available by 1946 to indicate the human requirement, but in the case of chickens and of guinea pigs the amounts needed are of the same order of magnitude as of thiamine.

Choline.—Although this water-soluble nitrogenous alcohol is required as a specific dietary essential for several species of animals and other organisms, its claim to classification as a vitamin may raise some question since it is needed in comparatively large amounts. However, as we have seen above, the quantitative requirements for vitamins range all the way from microscopic amounts as in the case of vitamin D, to considerable ones as in the case of vitamin C. Choline (and inositol) may be viewed as vitamins for which quantitative requirements are greater than for vitamin C.

Where to draw the line between vitamins and other nutritive essentials is no more easy than the setting of any boundary in nature.

In the absence of choline in the diet, various animals may show pathology of the kidneys which is most pronounced in the very young. In addition, excessive amounts of fat may be deposited in the liver. This phenomenon may be related to the fact that choline is a constituent of lecithin, a metabolically important fatty substance. Choline is also known to take part in the transfer of methyl groups from one substance to another in the course of metabolism. In birds, choline deficiency may manifest itself by the slipping of the tendons from their normal position on the back of the leg bones, so that the animal develops grotesquely bowed legs.

Inositol.—Inositol is a water-soluble cyclic alcohol similar in some respects to the sugars. Its presence in plants and animals has been known since the middle of the 19th century, but its role in nutrition was not demonstrated until E. V. Eastcott (1927) showed that it was needed for the growth of yeast, and D. W. Woolley (1940) demonstrated that animals required it. Several closely related substances occur naturally, but only meso-inositol and its esters have biological potency. Like choline, inositol is needed in amounts large enough to make its classification as a vitamin debatable. Also like choline, inositol plays a role in the deposition of fat in the liver, and is part of the molecule of lipositol, a fatty constituent of brain and certain other tissues.

It is not known whether humans need a source of inositol in their food.

Para-Aminobenzoic Acid.—Although no animal species has been shown to require para-aminobenzoic acid in the food, several bacteria and other microorganisms do need it. Therefore, some mention of it in a discussion of the vitamins is in order. This is especially so since the action of the sulfonamide drugs is in some way bound up with the functioning of this compound (D. D. Woods, 1940). Although para-aminobenzoic acid is not known to be needed by animals, it is an integral part of folic acid and in this combined form it is necessary (*see* above). Little is known of its significance beyond these facts.

Unknown Vitamins.—All the vitamins may not be known at the time of this writing in 1946. For example, dietary factors have been demonstrated which stimulate growth or improve health of experimental animals and which are different from known vitamins. These substances, when they are isolated and characterized, may possibly be included among the vitamins.

Certain other chemically unknown constituents of foods have been claimed to exert a beneficial effect on animals, but have not been shown to be necessary for life or for some measure of health. Therefore, it is not clear whether such materials should be called vitamins. Such is the case with the so-called vitamin P which favourably influences the strength of capillary blood vessel walls. However, as knowledge increases the boundary between vitamins and drugs may shift considerably from its position in 1946.

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VITEBSK, a town of the Belorussian S.S.R. (White Russia), on both banks of the western Dwina (Daugava), and on the railway, in 55° 10′ N., 30° 11′ E. Pop. (1939) 167,424. Industries include the manufacture of glass, agricultural machinery, boots and shoes, sewn goods, sewing needles, spectacles and bristles. There is a large Jewish element in the town.

Vitebsk (*Dbesk, Vitbesk* and *Vitepesk*) is mentioned for the first time in 1021, when it belonged to the Polotsk principality. Eighty years later it became the chief town of a separate principality, and so continued until 1320, when it came under the dominion of the Lithuanians. In the 16th century it fell to Poland. Under the privileges granted to the city by the Polish sovereigns it flourished, but it soon began to suffer from the wars between Russia and Poland, during which it was thrice taken by the Russians and burned. Russia annexed it finally in 1772.

During World War II Vitebsk was captured by the Germans in 1941 and recaptured by soviet troops in the summer of 1944.

VITELLI, VITELLOZZO (?–1502), Italian *condottiere*. Together with his father, Niccolò, tyrant of Città di Castello, and his brothers, who were all soldiers of fortune, he instituted a new type of infantry armed with sword and pike to resist the German men-at-arms, and also a corps of mounted infantry armed with arquebuses. Vitellozzo took service with Florence against Pisa, and later with the French in Apulia (1496) and with the Orsini faction against Pope Alexander VI. In 1500 Vitellozzo and the Orsini made peace with the pope, and the latter's son Cesare Borgia, being determined to crush the petty tyrants of Romagna and consolidate papal power in that province, took the *condottieri* into his service. Vitellozzo distinguished himself in many engagements, and in 1501 he advanced against Florence, moved as much by a desire to avenge his brother Paolo, who while in the service of the republic had been suspected of treachery and put to death (1499), as by Cesare's orders. In fact, while the latter was actually negotiating with the republic, Vitelli seized Arezzo.

Forced by Borgia and the French, much against his will, to give up the city, he began from that moment to nurture hostile feelings towards his master and to aspire to independent rule. He took part with the Orsini, Oliverotto da Fermo and other captains in the conspiracy of La Magione against the Borgia; but mutual distrust and the incapacity of the leaders before Cesare's energy and the promise of French help, brought the plot to naught, and Vitelli and other *condottieri,* hoping to ingratiate themselves with Cesare once more, seized Senigallia in his name. There they were decoyed by him and arrested while their troops were out of reach, and Vitelli and Oliverotto were strangled that same night (Dec. 31, 1502).

See vol. iii of E. Ricotti's *Storia della compagnie di ventura* (Turin, 1845), in which Domenichi's MS. *Vita di Vitellozzo Vitelli* is quoted; C. Yriarte, *César Borgia* (Paris, 1889); P. Villari, *Life and Times of N. Machiavelli* (English ed., London, 1892); *see* also under ALEXANDER VI and CESARE BORGIA.

VITELLIUS, AULUS, Roman emperor Jan. 2–Dec. 22, A.D. 69, was born on Sept. 24, A.D. 15. He was the son of Lucius Vitellius, who had been consul and governor of Syria under Tiberius. Aulus was consul in 48, and (perhaps in 60–61) proconsul of Africa. Under Galba, to the general astonishment, at the end of 68 he was chosen to command the army of Lower Germany. His good nature, which was fatal to discipline, made him popular, but he was not himself ambitious, and was raised to the throne by Valens and Caecina, two commanders of legions on the Rhine. They contrived a military revolt, and early in 69 Vitellius was proclaimed Emperor of the armies of Germany at Cologne. He was accepted by the senate but never by the whole empire. As soon as it was known that the armies of the east, Dalmatia and Illyricum had declared for Vespasian, Vitellius would have resigned the title of emperor, but the praetorians refused to allow him to do so. On the entrance of Vespasian's troops into Rome he was dragged out of some miserable hiding-place, driven to the fatal Gemonian stairs, and there struck down. "Yet I was once your emperor," were the last words of Vitellius. During his brief administration Vitellius showed indications of a desire to govern wisely. He has a deserved reputation as one of the greatest eaters and drinkers known to history.

See Tacitus, *Histories;* Suetonius, *Vitellius;* Dio Cassius lxv; Merivale, *Hist. of the Romans under the Empire,* chs. 56, 57; H. Schiller, *Geschichte der römischen Kaiserzeit,* i, pt. 1; W. A. Spooner's ed. of the *Histories* of Tacitus (Introduction); B. W. Henderson, *Civil War and Rebellion in the Roman Empire,* A.D. *69–70* (1908).

VITERBO, a provincial capital and episcopal see of the district of Lazio (Latium), Italy, 54 mi. by rail N.N.W. of Rome, 1,073 ft. above sea-level. Pop. (1936) 21,281 (town), 36,123 (commune). A line (25 mi.) runs northeast to Attigliano, on the railway from Rome to Florence. It is surrounded by gardens, and enclosed by walls and towers which date partly from the Lombard period. The streets are paved with large lava blocks, of which the town is also built. The Piazza S. Pellegrino is said to be the best example in the country of a 13th-century piazza. The citadel (Rocca) itself, erected by Cardinal Albornoz in 1345, is now a barrack.

The cathedral, a fine basilica, of the 12th (?) century, with columns and fantastic capitals of the period, originally flat-roofed and later vaulted, with 16th-century restorations, contains the tomb of Pope John XXI, and has a Gothic campanile in black and white stone. Here Pope Adrian IV (Nicholas Breakspear) compelled the emperor Frederick I to hold his stirrup as his vassal. The church of S. Rosa exhibits the embalmed body of that saint, a native of Viterbo, who died in her 18th year, after working various miracles and having distinguished herself by her invectives against Frederick II (1251), some ruins of whose palace, destroyed after his death, exist. S. Francesco, a Gothic church (1236), contains the fine Gothic tombs of Popes Clement IV and Adrian V, and has an external pulpit of the 15th century. S. Maria della Cella is noteworthy for one of the earliest campanili in Italy (9th century). The town hall, with a mediaeval tower and a 15th-century portico, contains some Etruscan sarcophagi and a few paintings. Close by is the elegant Gothic façade of S. Maria della Salute, in white and red marble with sculptures. The Gothic cloisters of S. Maria in Gradi and of S. Maria della Verità just outside the town are strikingly beautiful. The latter church contains frescoes by Lorenzo da Viterbo (1469) and an interesting museum.

Viterbo is by some identified with *Surrina nova,* which is only mentioned in inscriptions, while some place this to the west of Viterbo on the line of the Via Cassia, which was joined here by the Via Ciminia, passing east of the Lacus Ciminius, while a road branched off to Ferentum. It is not an unlikely assumption that here, as elsewhere, the mediaeval town occupies an Etruscan site. It was fortified by the Lombard king Desiderius. It is the centre of the territory of the "patrimony of Peter," which Countess Matilda of Tuscany gave to the papal see in the 12th century; in the 13th century it became a favourite papal residence. (T. A.)

VITÓRIA, a city and port of Brazil, capital of the state of Espírito Santo, on the west side of an island at the head of the bay of Espírito Santo. Pop. of the city was (1940) 42,873. The principal streets follow the water line, rising in terraces from the shore, and are crossed by narrow, steep, roughly paved streets. The buildings are old and of the colonial type. The entrance to the bay is rather tortuous and difficult, but is sufficiently deep for the largest vessels. The harbour is not large, but is safe and deep, being completely shut in by hills. Large quays, piers, warehouses, etc., facilitate the handling of cargoes. Vitória is a port of call for coasting steamers and a shipping port in the coffee trade. The other exports are lumber, sugar, rice and mandioca to home ports. A railway starting at Vitória connects with Río de Janeiro, 270 mi. to the southwest. Another line runs north and west into the important mineral region of Minas Gerais, for which it provides an outlet.

Vitória was founded in 1535 by Vasco Fernandes Coutinho, on the south side and nearer the entrance to the bay, and received the name of Espírito Santo. The old site is still occupied, and is known as Vila Velha (Old Town).

VITORIA, an episcopal city of N. Spain, capital of Álava

province; on the Miranda de Ebro-Alsasua section of the Northern railways, among the southern outliers of the Cantabrian mountains, and on the left bank of the river Zadorra, a left-hand tributary of the Ebro. Pop. (1940) 44,341 (mun., 49,752). Vitoria was founded in 581 by Leovigild, king of the Visigoths; but its importance dates from the 10th century. In 1181 Sancho the Wise of Navarre granted it a charter and fortified it. The city is built on a hill 1,750 ft. high, and overlooks the plain of Álava. The cathedral of Santa Maria dates from 1181, but has been considerably spoiled by late additions: the church of San Miguel also dates from the 12th century; it has a beautiful altar, carved in wood by J. Velazquez and G. Hernandez, in the 16th century. Vitoria, from its favourable position on the main lines from Madrid to France and to the port of San Sebastian, is an important centre of trade in wine, wool, horses, mules and hardware. Nationalists captured it in the civil war of 1936–39.

Battle of Vitoria.—For the operations which preceded the battle of Vitoria *see* PENINSULAR WAR. On June 21, 1813, the French army in Spain (about 65,000 men with 150 guns), under King Joseph Bonaparte, held an extended position in the basin of Vitoria, south (with the exception of the extreme right) of the river Zadorra. The left rested on the heights of Puebla, north of the Puebla Pass, and Puebla de Arganzon, through which ran the Miranda-Vitoria-Bayonne road, Joseph's line of communication with France. Thence the line stretched to the ridge of Margarita, the troops so far being under General Gazan, with a second supporting line under D'Erlon between Arinez and Hermandad and a reserve behind Arinez. The right under Reille guarded the Bilbao-Vitoria road.

There were no troops between Hermandad and Ariaga, except a mass of cavalry near Ali. The Zadorra, fordable in certain spots only, was spanned by bridges at Puebla de Arganzon, Nanclares, Villodas, Tres Puentes, Mendoza, Abechuco and Gamarra Mayor, which French guns commanded; but, for some reason, none of these had been destroyed. The faults of the French position and their occupation of it were its extension; that it was in prolongation of and (on the right especially) very close to their line of retreat, so that if the right were driven back this line could be at once seized; that the centre was not strongly held; and that all bridges were left intact.

The Allies (nearly 80,000, with 90 guns), under Wellington, had moved from the river Bayas at daylight to attack Joseph, in

four columns, the right being under Hill (20,000, including Morillos's Spaniards), the right centre and left centre under Wellington (30,000) and the left under Graham (20,000, including Longa's Spaniards). As the columns marched across the intersected country between the Bayas and Zadorra, extending from near Puebla de Arganzon to the Bilbao-Vitoria road, they kept touch with each other; and as they neared the Zadorra the battle opened all along the line soon after 10 A.M. Wellington's instructions to Graham were to undertake no manoeuvre which would separate his column from those on the right; but, with this proviso, to seize the Vitoria-Bayonne road if the enemy appeared decidedly in retreat. Hill after a sharp contest gained the Puebla heights, too weakly held; and pushing through the pass carried the village of Subijana de Álava. The right centre column having reached Villodas, was waiting for Hill to gain further ground, when the bridge at Tres Puentes was observed to be unguarded, probably because it was commanded from the south bank; and, the French attention being now turned towards their flanks, it was surprised and rushed by Wellington with the Light division, supported quickly by cavalry and other troops, who maintained themselves on the south bank. Joseph's centre was partially forced, while his left was hard pressed by Hill; and, fearing that Gazan and D'Erlon might be cut off from Reille, he ordered them to withdraw to a ridge farther back, which they did, holding Arinez in front. Here there was no hard fighting; but, as Wellington had now passed three divisions, many guns and the cavalry (which, however, from the nature of the ground could be but little used) across the Zadorra, Margarita, Hermandad and Arinez soon fell to the Allies.

On the left, Graham, having turned the heights north of the Zadorra with Longa's Spaniards, seized Gamarra Menor close to the Bayonne road. He also with heavy loss carried Gamarra Mayor and Abechuco, but the bridges south of these villages, though more than once taken, were always recaptured by Reille. At length, when a brigade from the Allied centre had been pushed up from Hermandad against Reille's flank, he withdrew from the obstinately defended bridges, and before this Gazan and D'Erlon had also fallen back, fighting, to a third position on a ridge between Armentia and Ali west of Vitoria. Here, at about 6 P.M., they made a last stand, being compelled in the end to yield; and as Graham, having now crossed the bridges, was close to the Bayonne road, the main body of Joseph's army fled by a bad cross-road towards Pampeluna, abandoning artillery, vehicles and baggage (of which an enormous quantity was parked near Vitoria), Reille afterwards joining it through Betonia. The Allies then occupied Vitoria and pursued the French until nightfall. All Joseph's equipages, ammunition and stores, 143 guns, a million sterling in money, and various trophies fell into Wellington's hands, the French loss in men being nearly 7,000, that of the Allies over 5,000, of whom 1,600 were Portuguese and Spaniards. This decisive victory practically freed Spain from French domination.

(C. W. Ro.)

VITRÉ, a town of northwestern France, in the department of Ille-et-Vilaine, on a hill above the left bank of the Vilaine, 24 mi. E. of Rennes by rail. Pop. (1936) 7,298. Vitré belonged in the 10th century to the younger branch of the counts of Rennes. In 1295 it passed to Guy IX, baron of Laval, on his marriage with the heiress, and afterwards successively belonged to the families of Rieux, Coligny and La Trémoille. It was seized by Charles VIII in 1488. Protestantism spread under the rule of the houses of Rieux and Coligny; Vitré became a Huguenot stronghold; and a Protestant church was established, which was suppressed at the revocation of the edict of Nantes in 1685. The estates of Brittany, over which the barons of Vitré and of Léon alternately presided, met here several times. The town largely retains its mediaeval aspect. The ramparts on the north side and on the west, consisting of a machicolated wall with towers at intervals, are still standing. Only one gateway remains of the original 11th century castle; the rest was rebuilt in the 14th and 15th centuries and restored in recent times.

VITRIFIED FORTS, the name given to certain hill-forts of which the defenses consist entirely or to some extent of walls which have been subjected in a greater or less degree to the action of fire. Their form is determined by the contour of the summits which they enclose and generally the plan is simple. The walls vary in size, the vitrified portion being usually confined to a core extending from the top downward, though vitrifaction has been met with on the sides of the wall only, and in one known instance a narrow wall consolidated by vitrifaction was found in the heart of an earthen rampart. As a rule the vitrified mass appears to have been supported by a wall of unvitrified stone built up on one

or both faces. No lime or cement has been found in any of these structures, all of them presenting the peculiarity of being consolidated to a greater or less extent by the fusion of the rocks of which they are built. This fusion, caused by the application of intense heat, is not equally complete in the various forts, or even in the walls of the same fort. In some cases the stones are only partially melted and calcined; in others their adjoining edges are fused so that they are firmly cemented together. In many instances pieces of rock are enveloped in a glassy enamel-like coating which binds them into a uniform whole; and at times, though rarely, the entire length of the wall presents one solid mass of vitreous substance.

Some 50 examples have been discovered in Scotland widely distributed. They are also found in Ireland, Lusatia, Bohemia, Silesia, Saxony and Thuringia; in the provinces on the Rhine, especially in the neighbourhood of the Nahe; in the Ucker Lake, in Brandenburg, where the walls are formed of burnt and smelted bricks; in Hungary; and in several places in France. They have not been found in England or Wales.

The following facts may be noted:—(1) The idea of strengthening walls by means of fire is not singular, or confined to a distinct race or area, as is proved by the burnt-earth enclosure of Aztalan, in Wisconsin, and the vitrified stone monuments of the Mississippi valley. (2) Many of the Primary rocks, particularly the schists, gneisses and traps, which contain large quantities of potash and soda, can be readily fused in the open air by means of wood fires—the alkali of the wood serving in some measure as a flux. (3) The walls are chiefly vitrified at the weakest points, the naturally inaccessible parts being unvitrified. (4) When the forts have been placed on materials practically infusible, as on the quartzose conglomerates of the old red sandstone, as at Craig Phadraic, and on the limestones of Dun Mac Uisneachain, pieces of fusible rocks have been selected and carried to the top from a considerable distance. (5) Many of the continental forts are so constructed that the fire must have been applied internally, and at the time when the structure was being erected. (6) Daubrée, in an analysis of vitrified materials taken from four French forts, which he submitted to the Academy of Paris in Feb. 1881, found the presence of natron in such abundance that he inferred that sea-salt was used to facilitate fusion. (7) In Scandinavia, where there are hundreds of ordinary forts, and where for centuries a system of signal fires was enforced by law, no trace of vitrifaction has yet been detected.

Great antiquity has been assigned to these forts, but tool marks indicating the use of iron implements have been found, which would suggest that the structures were in use as late as the early centuries of the Christian era. It has been suggested that they were built as refuges against the Norsemen, and much in the situation and character of the forts favours this supposition. The sites of the Scottish forts are so selected that they not only command what were the favourite landing-places of the vikings, but are the best natural defenses against attacks from the direction of the seacoast. In Saxony and Lusatia the forts are known as *Schwedenburgen,* and in the Highlands of Scotland as the fortresses of the *Feinne*—designations which also seem to point to an origin dating back to the times of the vikings.

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VITRIOL, a name given to certain hydrated sulphates and to sulphuric acid. Blue or Roman vitriol is cupric sulphate; green vitriol is ferrous sulphate or copperas; red or rose vitriol is cobaltous sulphate; uranvitriol is a native uranium sulphate and white vitriol is zinc sulphate. Oil of vitriol is concentrated sulphuric acid (*q.v.*). (J. B. Ps.)

VITRUVIUS (MARCUS VITRUVIUS POLLIO), Roman architect and engineer, author of a celebrated work on architecture. Nothing is known of him except what can be gathered from his writings. Owing to the discovery of inscriptions relating to the *gens* Vitruvia at Formiae in Campania (Mola di Gaeta), it has been suggested that he was a native of that city, and he has been less reasonably connected with Verona on the strength of an arch of the 3rd century, which is inscribed with the name of a later architect of the same family name—"Lucius Vitruvius Cerdo, a freedman of Lucius." Vitruvius himself says that he was appointed, in the reign of Augustus, a superintendent of *balistae* and other military engines (*De Architectura,* i pref.). In another passage (v. 1) he describes a basilica and adjacent *aedes Augusti,* of which he was the architect. To a great extent the theoretical and historical parts of his work are compiled from earlier Greek authors, of whom he gives a list at i, 1 and viii, 3. The practical portions are evidently the result of his own professional experience, and are written with much sagacity, and in a far clearer style. Vitruvius's name is mentioned by Frontinus in his work on the aqueducts of Rome; and most of what Pliny says (*Hist. Nat.* xxxv and xxxvi) about methods of wall-painting and practical details in building is taken from Vitruvius, though without any acknowledgment.

The treatise *De Architectura Libri Decem* is dedicated to Augustus. Lost for a long time, it was rediscovered in the 15th century at St. Gall; the oldest existing ms. dates from the 10th century. Throughout the period of the classical revival Vitruvius was the chief authority studied by architects, and in every point his precepts were accepted as final. Bramante, Michelangelo, Palladio, Vignola and earlier architects were careful students of the work of Vitruvius.

The best edition of the *De Architectura* is by Rose (2nd ed., Leipzig, 1899); *see* also Nohl, *Index Vitruvianus* (1876); Jolles, *Vitruvs Aesthetik* (1906); Sontheimer, *Vitruv und seine Zeit* (1908). For translations, *see* that by Gwilt (1826; reprinted 1874); and by M. H. Morgan, with illustrations (Cambridge, U.S.A., 1914).

VITRY-LE-FRANÇOIS, a town of northeastern France, capital of an arrondissement in the department of Marne, on the right bank of the Marne, 20 mi. S.E. of Châlons, on the railway from Paris to Strasbourg. Pop. (1936) 9,061. The Marne-Rhine canal, the Haute-Marne canal, and the lateral canal of the Marne unite at Vitry. The present town was built in 1545 on a uniform plan by Francis I to replace the older one of Vitry-en-Perthois, 2½ mi. to the northeast, burned in the previous year by Charles V. During the early weeks of World War I Joffre had his headquarters at Vitry-le-François, and it was taken and retaken in the battle of the Marne (1914).

VITTEL, a watering-place of northeastern France, in the department of Vosges, 31 mi. W. of Epinal by rail. Pop. (1936) 3,555. The cold saline and chalybeate waters are bottled and exported in large quantities. They are prescribed in cases of arthritis, dyspepsia, etc. Vittel is a fashionable resort.

VITTORIA, a town of Sicily in the province of Ragusa, 95 mi. W.S.W. of Syracuse by rail (42 mi. direct), founded in the 17th century. It is a prosperous town in the centre of a fertile district, with the largest wine trade in Sicily. Pop. (1936) 34,769 (town), 37,575 (commune).

VITTORIO VENETO, a town and episcopal residence of the province of Treviso, Venetia, Italy, 25 mi. by rail N. of Treviso, 466 ft. above sea level. Pop. (1936) 12,034 (town), 23,475 (commune). It is a summer resort, with sulphur and saline springs (51.8° to 59° F), and was formed in 1879 by the union of Ceneda (the episcopal see) and Serravalle. The cathedral contains paintings by Pomponio Amalteo (a pupil of Pordenone) and Tiepolo. At Serravalle is a church with a fine altar-piece (1547) by Titian and a number of Gothic and Renaissance houses. It is a seat of the silkworm breeding and silk-throwing industries. To the north are important hydroelectric plants.

VITTORIO VENETO, BATTLE OF. This is the title given to the battle or, more truly, campaign in which the Austrian forces on the Italian front were finally overthrown in Oct. 1918. Diaz's plan for the bigger offensive finally decided upon was to concentrate on the Piave front between Pederobba and Fagaré (east of Treviso), to cross the river and break through by way of Conegliano to Vittorio Veneto, dividing the Austrian V. and VI. Armies which held the river line from the sea to Valdobbiadene. The attack was fixed for Oct. 16, but bad weather and a rise of the Piave caused a delay.

Italian Plans.—It was decided to open the action with an attack by the IV. Army (nine divisions) in the Grappa sector, with the double object of drawing the enemy reserves from the Feltre sector and of breaking through in this direction. The attack on the Piave was to be carried out by three armies, the XII., VIII. and X., of which the first and last had been formed specially for this offensive. The XII. Army (one French division and three Italian) was commanded by Gen. Graziani, the commander of the French troops in Italy; and the X. Army (two British divisions and two Italian) by Lord Cavan.

The main drive was to be made by the VIII. Army (14 divisions), attacking from below Pederobba to Ponte della Priula. The XII. Army was to advance northward outside the Piave, while the X. Army was to attack the right wing of the Austrian V. Army and form "a defensive flank to cover and protect the principal manoeuvre of the VIII. Army" (Gen. Diaz's report). On the battle front from the Brenta to Fagaré were massed 41 divisions, 22 in line and 19 in reserve. Against this force the Austrians had 23 divisions in line and immediate reserve, and 10 more divisions within reach. The Piave-Grappa front was divided between two army groups: Boroević's Piave Group (V. and VI. Armies), from the sea to Valdobbiadene, and the newly formed Belluno Group, under Gen. Goglia, from Valdobbiadene to the Brenta. The disposition of the Austrian troops and guns showed a fear for the Grappa positions and a failure to divine the direction of the main Italian attack. In the Grappa sector the Belluno Group had eight divisions in line and three in immediate reserve, while the infantry was backed by some 1,200 guns. The Austrian VI. Army, on the other hand, with seven divisions in line and two in support, had only about 500 guns against a mass of over 2,000. Opposite Lord Cavan's X. Army the right wing of the Austrian V. Army had three divisions in line and one in support.

Allied Attack Opens.—The Italian IV. Army, under Gen. Giardino, attacked at dawn on Oct. 24, and though some headway was made the enemy put up a very stubborn resistance. Already a very fine piece of work had been carried out by British troops of the X. Army, who in the early hours of the same day occupied the northern part of the long shoal island of the Grave di Papadopoli, crossing the main channel in small flat-bottomed boats punted by Italian specialist troops (*pontieri*), and driving back or capturing the enemy outposts. The general attack should have followed the next night, but a sudden rise in the river, which was coming down in heavy flood at 7m. an hour, counselled delay. It was not until the night of Oct. 26, when the southern part of the Grave di Papadopoli had also been occupied by Italian troops of the X. Army, that the bridges began to be thrown across the river for the main attack.

The Crossing of the Piave.—Eleven crossing points were selected, one at Pederobba for the right wing of the XII. Army, seven on the VIII. Army front, and three for the X. Army, at the Grave di Papadopoli. The XII. and X. Armies threw their bridges successfully, but on the VIII. Army front only two of the seven sets of bridges could be established, both on the north of the Montello. Next day three bridgeheads were established: opposite Pederobba, north of the Montello, and opposite the Grave di Papadopoli. The most important advance was made in the latter sector, where the X. Army succeeded in advancing to a depth of over 2m. on a front of about 4m. The British XIV. Corps took 3,500 prisoners and 2,100 were captured by the Italian VI. Corps.

This was the most successful advance of the day. The bridges of the VIII. and XII. Armies were all destroyed during the day. At Pederobba some headway was made, and the troops of the VIII. Army, who attacked towards Sernaglia, gained about a mile. But the right wing of the Army (VIII. Corps) was unable to throw its bridges, and only a detachment of storm-troops reached the left bank. There was a gap of some 6m. between the left wing of the VIII. Army and the British XIV. Corps, which formed the left wing of the X. Army, and the chief move in the general manoeuvre was checked. The VIII. Corps had been detailed to push straight for Vittorio Veneto, and the fact that it had been unable even to start its advance threatened to throw the whole battle out of gear.

No better fortune attended the efforts made on the following night to bridge the river east of the Montello. The swift current and the enemy guns defied all attempts to establish the bridges, and the engineers suffered very heavy casualties. In spite of the initial successes, the situation was unsatisfactory, but after the first failure to cross the river east of the Montello, Gen. Caviglia, who commanded the VIII. Army and had the general direction of the attack, had detached the XVIII. Corps from his reserves to pass under the command of Lord Cavan, cross by the X. Army bridges, push north and clear the front of the troops who were held up. The move was entirely successful. The XVIII. Corps under Gen. Basso crossed the river in the early hours of Oct. 28 and attacked northward, while the rest of the X. Army continued its advance.

Position on Oct. 29.—At the close of Oct. 28 the XVIII. Corps had gained nearly 4m. and had crossed the railway north of the Priula bridges. The British XIV. Corps had gone right through the Austrian positions and had patrols out on the Monticano, while the Italian XI. Corps was threatening the enemy troops on the Lower Piave. The bridgehead was 10m. wide and 4m. deep. The XII. Army and the left wing of the VIII. had also made good progress, and at last the VIII. Corps was crossing the river, between Nervesa and Ponte di Priula. The prospects of the following day were bright, for the separation of the Austrian V. and VI. Armies was effected; and the VI. Army, heavily attacked in front, was seriously threatened on its left by Basso's XVIII. Corps.

On the evening of Oct. 29 an Italian flying column entered the town of Vittorio Veneto. The attacking armies had already taken 33,000 prisoners, and the situation of the Austrian troops on the Piave was hopeless. Next day resistance broke down, and the general retirement ordered on the 29th became a complete rout. The troops on Monte Grappa had hitherto held firm against the repeated attacks of the IV. Army, and had made many counter-attacks. But here too, on the night of Oct. 30, a retreat began that was to turn into a flight.

Austrian Collapse and Armistice.—Late on the evening of Oct. 30 the Austrian command announced that in view of the discussions regarding an armistice which were being conducted between Germany and the United States, "our troops fighting on Italian soil will evacuate the occupied region." On the same day the order for a general retreat was given, and that evening, in the Val Lagarina, Gen. Weber von Webernau, commander of the Austrian VI. Corps, made a formal demand for an armistice. Next day he and his staff were taken to the Villa Giusti, near Padua, and discussions were begun. It was, of course, necessary to communicate with Versailles, where the Allied War Council was discussing a reply to Germany's demand for an armistice.

Meanwhile the fighting continued, and the Austrian armies crumbled away. The Italian VI. and I. Armies attacked in the Trentino, and the III. Army, which had crossed the Piave two days before, was already taking part in the pursuit of Boroević's broken divisions. On the night of Nov. 2–3, although the Armistice was not yet signed, the Austrian command issued an order for the cessation of hostilities. It was at first revoked by the Emperor Charles, but was reissued and reached the front on the morning of Nov. 3. The terms were only agreed on verbally on the afternoon of Nov. 3, and signed at 6.30 P.M.

Conclusion.—When hostilities ceased at 3 P.M. on Nov. 4, Italian troops were far up the Trentino and into Cadore, and to the east the line of the old frontier was passed and the middle waters of the Isonzo were reached. On Nov. 3 Trieste had been

occupied from the sea, and half an hour before the expiration of the term fixed by the Armistice an Italian force was landed at Zara. More than 300,000 prisoners had already been counted by the Italians, and the total figure was in the region of 500,000. A number of troops who had been cut off were allowed to pass the frontier after being disarmed, but not much more than half of the Austro-Hungarian troops on the Italian front reached the territory of the crumbling empire. All material was left behind, including some 7,000 guns.

The Austro-Hungarian armies, in spite of bad food and growing depression, began by putting up a stout resistance. The troops in the Grappa sector in particular not only resisted firmly but counter-attacked with great vigour, and punished the Italian IV. Army very heavily. Giardino lost over 23,000 men, more than three-fifths of the total casualty list, which exceeded 35,000.

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VITUS, ST. (German, Veit; French, Guy). According to the legend, where he is associated with Modestus and Crescentia, by whom he had been brought up, St. Vitus suffered martyrdom at a very early age under the emperor Diocletian. Son of a Sicilian nobleman who was a worshipper of idols, Vitus was converted to the Christian faith without the knowledge of his father, was denounced by him and scourged, but resisted all attacks on his profession. Admonished by an angel, he crossed the sea to Lucania and went to Rome, where he suffered martyrdom. His festival is celebrated on June 15. The *Passion* of St. Vitus has no historical value, but his name occurs in the *Martyrologium hieronymianum.* In 836 the abbey of Corvey, in Saxony, received his relics, and became a very active centre of his cult. In the second half of the 9th century, the monks of Corvey, according to Helmold's *Chronica Slavorum,* evangelized the island of Rügen, where they built a church in honour of St. Vitus. The islanders soon relapsed, but they kept up the superstitious cult of the saint (whom they honoured as a god), returning to Christianity three centuries later. At Prague, too, there are some relics of the saint, who is the patron of Bohemia and also of Saxony, and one of the fourteen "protectors" (*Nothelfer*) of the church in Germany. Among the diseases against which St. Vitus is invoked is chorea, also known as St. Vitus' Dance.

See *Acta sanctorum,* June, iii. 1013–42 and vi. 137–140; *Bibliotheca hagiographica Latina* (Brussels, 1899), n. 8711–23; J. H. Kessel, "St. Veit, seine Geschichte, Verehrung und bildliche Darstellungen," in *Jahrbücher des Vereins von Alterthumsfreunden im Rheinlande* (1867), pp. 152–183. (H. De.)

VIVALDO, UGOLINO and **SORLEONE DE** (*fl.* 1291–1315), Genoese explorers, connected with the first known expedition in search of an ocean way from Europe to India. Ugolino, with his brother Guido or Vadino Vivaldo, was in command of this expedition of two galleys, which he had organized in conjunction with Tedisio Doria, and which left Genoa in May 1291 with the purpose of going to India "by the Ocean Sea" and bringing back useful things for trade. Planned primarily for commerce, the enterprise also aimed at proselytism. With two Franciscan friars and well-armed galleys, Ugolino sailed down the Morocco coast to Gozora (Cape Nun), in 28° 47′ N., after which nothing more was heard of him. Early in the next (14th) century, Sorleone de Vivaldo, son of Ugolino, undertook a search for his father, and even penetrated, it is said, to Magadoxo on the Somali coast. In 1455 another Genoese seaman, Antoniotto Uso di Mare, sailing with Cadamosto in the service of Prince Henry the Navigator of Portugal, claimed to have met, near the mouth of the Gambia, the last descendant of the survivors of the Vivaldo expedition.

See Jacopo Doria, "Annales" (under A.D. 1291) in Pertz, *Monumenta Germaniae historica. Scriptores,* xviii. 335 (1863); the "Conoçimiento de todos los Reinos," ed. Marcos Jimenez de la Espada in the *Boletin* of the Geographical Society of Madrid, vol. ii., No. 2, pp. 111, 113, 117–118 (Madrid, Feb. 1877); Canale, *Degli antichi navigatori e scopritori Genovesi* (Genoa, 1846); G. H. Pertz, *Der älteste Versuch zur Entdeckung des Seeweges nach Ostindien* (1859); *Annali di Geografia e di Statistica composti . . . da Giacomo Grâberg* (Genoa, 1802); Belgrano, ". . . Annali . . . di Caffaro," in *Archiv. Stor. Ital.,* 3rd series, ii. 124, etc., and in *Atti della Soc. Lig. di Storia Patria,* xv. 320 (1881); W. Heyd, *Histoire du commerce du Levant* (the improved French edition of the *Geschichte des Levantehandels*), ii. 140–143 (1886); C. R. Beazley, *Dawn of Modern Geography,* iii. 413–419, 551 (Oxford, 1906).

VIVARINI, the surname of a family of painters of Murano (Venice), who worked in Venice in the 15th century and played an important part in the development of the Venetian school. The family appears to have come to Murano from Padua.

ANTONIO VIVARINI (1415–1484) worked at first in conjunction with his brother-in-law, Johanes Alamanus, who appears to have been a German by birth. They were the founders of the school of Murano. The Venice academy contains their chief joint work, "The Madonna Enthroned with the Doctors of the Church," painted for the Scuola della Carità in 1446. Other works are in the churches of S. Zaccaria (1443) and S. Pantaleone (1444). In 1447 they worked in Padua on paintings no longer extant, and in the following year undertook the decoration of the ceiling of the Ovetari chapel in the Eremitani church in that city. The National Gallery has two wings with "Saints" of an altarpiece of which the central panel is now in the Poldi Pezzoli collection, Milan. On the death of Johanes (*c.* 1450) Antonio worked with his younger brother, Bartolommeo on the altarpiece now in the Gallery of Bologna (1450).

BARTOLOMMEO VIVARINI (active 1450–1499), was a pupil of his brother Antonio and of Johanes Alamanus. He also studied in Padua, and Paduan influences appear in the altarpiece at Bologna mentioned above, which he executed with his brother in 1450. But he soon outstripped his elder brother and became the head of the school of Murano. His earliest work extant is "The Virgin and Child" of the Hugh Lane collection, signed and dated 1448. The St. John Capistrano of 1459 in the Louvre displays the statuesque qualities typical of his style. The ornate character of the settings, the gold work and the festoons which he often introduces, recall the school of Padua, and in the '60s he seems to have come under Mantegna's influence (altarpiece in the Venice academy [1464] and the "Virgin Enthroned" in the Naples museum [1465]). He reached his height in the stern and majestic "St. Augustine" (1473) in SS. Giovanni e Paolo, Venice.

ALVISE VIVARINI (*c.* 1446–1503) was a pupil of his uncle, Bartolommeo, whose influence is evident in his early work the polyplyth of 1475 at Montefiorentino. His style, however, is more elegant and refined. He learned much from Antonello da Messina, as is evident in the exceedingly plastic male portraits in the Carrara collection at Bergamo and in the National Gallery, London. The most important work of his earlier years is "The Virgin Enthroned and Saints" (*c.* 1485) in the Berlin museum. His later paintings imitate Giovanni Bellini, as for instance the Madonnas in the Vienna museum (1489) and in the churches of the Redentore and S. Giovanni in Bragora, Venice. In the latter church is a "Resurrection," interesting for its unusual and decorative composition.

See L. Testi, *Storia della Pittura Veneziana* (Bergamo, 1909–15). (I. A. R.)

VIVERO, a town of N.W. Spain, in Lugo province; on the Ria de Vivero, an estuary formed by the river Landrove, which here enters the Bay of Biscay. Pop. (1940) 3,529 (mun., 13,930). Vivero is an old-fashioned town, connected with the opposite bank of the estuary by a bridge of 12 arches and a causeway. Its fishing fleet, coasting trade and the agricultural products of the fertile country around are important.

VIVES, JUAN LUIS (1492–1540), Spanish scholar, was born at Valencia on March 6, 1492. He studied at Paris from 1509 to 1512, and in 1519 was appointed professor of humanities at Louvain. At the instance of his friend Erasmus he published in 1522 an elaborate commentary on Augustine's *De Civitate Dei* with a dedication to Henry VIII. Soon afterwards he was invited to England, and is said to have acted as tutor to the princess Mary, for whom he wrote *De ratione studii puerilis epistolae duae* (1523). He resided at Corpus Christi college, Oxford, where he was made doctor of laws and lectured on philosophy. Having declared himself against the king's divorce from Catherine

of Aragon, he lost the royal favour and was confined to his house for six weeks. On his release he withdrew to Bruges, where he wrote numerous works, chiefly directed against scholasticism and the preponderant authority of Aristotle. His chief work is the *De Causis corruptarum artium,* which has been ranked with Bacon's *Organon.* In 1538 Vives published the *De anima et vita,* one of the first modern works on psychology. Neither Descartes (1596–1650), nor Francis Bacon (1561–1626), were the first Renaissance writers to give their attention to psychological theory, as is commonly supposed. Bacon, it is true, was the most influential advocate of the empirical scientific method of the 17th century, but Vives preceded him in emphasizing induction as a method of philosophical and psychological discovery. In his preface to the *De anima,* Vives accuses the ancients of having involved themselves in great absurdities; and in the first book he abjures the traditional manner of asking the metaphysical question, "What is the soul?" by saying, "What the soul is, is of no concern for us to know. What its manifestations are, is of great importance." And in his discussion of the mind he continued his point of view; he did not refer to the essence of mind but concerned himself with the actions of the mind. His central idea is that knowledge is of value only when it is put to use. He then discusses association of ideas, the nature of memory, a proposed law of forgetfulness, the method of recall of an idea; he explained the principle of mnemonics, and even touched on animal psychology. In the second book he describes in detail the functions of the *simplex intelligentia* (simple apprehension); and in the third book, he examines the emotions or passions. The *De disciplinis* (1531), and the *Linguae latinae exercitatio* (1539), are the great pedagogical works of Vives, the former probably the greatest Renaissance book on education. Juan Luis Vives died at Bruges on May 6, 1540.

A complete edition of his works was published by Gregorio Mayáns y Siscar (Valencia, 1782). Adolfo Bonilla y San Martin's *Luis Vives y la filosofía del renacimiento* (Madrid, 1903) is a valuable study with an exhaustive bibliography. *See* also G. Hoppe, *Die Psychologie von Juan Luis Vives* (1901).

VIVIANI, RENÉ (1863–1925), French politician, was born at Sidi-bel-Abbès, Algeria, on Nov. 8, 1863. While still a young man, he made a considerable reputation as a lawyer, and in 1893 was elected Socialist deputy for Paris. It was not until the close of his life that he left the Chamber to enter the Senate. In Oct. 1906 he was placed by Clemenceau at the head of the recently-created ministry of labour. In the following month he made a famous speech in the Chamber, in which he affirmed his atheistic belief. For these views he was often severely criticized subsequently. "We have put out the lights of heaven," he said, "and they will never be lit again." Viviani was responsible for the law with regard to workmen's pensions. In July 1909 when Briand succeeded Clemenceau as premier, Viviani continued to be minister of labour. In Oct. 1910, in consequence of the attitude adopted by the Government in regard to the threatened railway strike, he tendered his resignation. In Dec. 1913 he became minister of public instruction in the Doumergue cabinet.

In June 1914 Viviani became premier and minister for foreign affairs. He was on his way back from Russia with Poincaré when the Austrian ultimatum was issued against Serbia on July 23. He immediately withdrew the French troops 10 km. behind the frontier to prove France's pacific attitude. When Germany declared war he made a magnificent speech in the chamber which had an electrifying effect on his audience. On Oct. 29, 1915 he was succeeded as premier by Briand, in whose Government he became minister of justice. After the fall of the Briand cabinet in March 1917 he lived in retirement, but he accompanied M. Briand to the Washington Conference in 1921 as one of the leading French delegates. He died at Clamart (Seine) on Sept. 7, 1925, after a long and painful illness. Viviani's eloquence, with its wealth of imagery and brilliant metaphor, has seldom if ever been equalled in the French Parliament. But it was, above all, the rôle he played during the tragic events of July and Aug. 1914 which caused his name to go down to history. (P. B.)

VIVIANITE, a mineral consisting of hydrated iron phosphate $Fe_3(PO_4)_2+8H_2O$, crystallizing in the monoclinic system. The crystals possess a perfect cleavage parallel to the plane of symmetry and are usually bladed in habit; they are very soft, flexible and sectile. When unaltered and containing no ferric oxide, the mineral is colourless, but on exposure to the light it very soon becomes of a characteristic indigo-blue colour. Crystals were first found in Cornwall by J. G. Vivian, after whom the species was named in 1817. The mineral had, however, been earlier known as a blue powdery substance, called "blue iron-earth," met with in peat-bogs, in bog iron-ore, or with fossil bones and shells.

VIVISECTION. The term popularly applied to experiments on animals (*see* ANIMALS, EXPERIMENTS ON). Even in the early days of legislation on the subject when physiology was in its infancy, the name was only in a measure accurate, as cutting experiments formed but a portion of the experiments on animals. Investigations on body temperature, respiration, digestion, the action of drugs, in many instances involved no cutting operation of any kind; still they were included under the general name of vivisection because they were carried out on living animals. At the present time, though the number of animal experiments in Great Britain and the civilized world generally has increased proportionately with the modern greater pursuit of medical knowledge in all its branches, cutting experiments form an insignificant proportion of the whole. Probably it is true to say that the procedure in over 90% of so-called vivisection experiments consists in nothing more formidable than a prick with a hypodermic needle and the injection of a small quantity of fluid or of solid tissue beneath the skin of a mouse, rat, guinea-pig or rabbit. That, in some instances, a disease is thereby conveyed to the animal, is true, but this is only a stage in the endeavour to elucidate the nature of the disease in question and to devise a means for combating it whether the disease be one affecting man or one of the domestic animals.

That experiment in the broadest sense is necessary to the advancement of knowledge, cogitation alone being insufficient, has been shown by every branch of science. Indeed, it has been said that without experiment no substantial advance in knowledge of the physical sciences has occurred and the example of volcanic action has been adduced. We know, to-day, little more concerning volcanoes than was known centuries ago because we cannot experiment with volcanoes; such additional knowledge as we possess depends upon experiments on explosives conducted on a small scale. In the case of medical science living men and animals are concerned. In the case of human disease an earlier investigation has almost always been carried out on lower animals. As examples may be given the antitoxin treatment of diphtheria, the prophylactic vaccine inoculation for typhoid and paratyphoid fevers, the insulin treatment of diabetes. By most persons it is held that the testing of a hypothesis in medicine should, in the first instance, be carried out on lower animals. By some it is considered that the attainment of manual dexterity in the performance of surgical operations should also be carried out by practice on lower animals, but this is forbidden by law in Great Britain. The essence of "vivisection" consists in the fact that the experiment is conducted in the pursuit of knowledge and the term has lost, to a large extent, its etymological meaning of *cutting with a knife* and, in general, implies experiments on living animals carried out for the advancement of *medical* knowledge. Breeding and feeding experiments carried out by the farmer for the improvement of his stock, operations such as gelding, docking and de-horning are not included under the term.

The extent to which the British law on animal experiment is applicable is shown by the following example. In the bacterial treatment of sewage at a certain town the effluent was so clear that an ornamental pool was made and some goldfish were placed therein. It was held that this constituted an animal experiment under the act inasmuch as it was not known that the fish would not be injured thereby. The example is useful as showing the vigilance of the authorities over the unquestioned rights of lower animals as determined by law.

No account of animal experiment would be complete without reference to the opposition that such experiments have aroused in

certain countries. In England "anti-vivisectionists" have formed a society and published a journal. There are two lines of thought, one that aims at total abolition, another that wishes experiments on dogs to be prohibited. To combat these views the Research Defence Society was founded in 1908 and issues literature on the subject from time to time. The main argument of anti-vivisectionists is that man is not morally justified in profiting by experiments at the expense of lower animals. Arising from this principle it is contended (1) that the friendship of the dog and the cat for man and their trustfulness render experiments on them particularly undesirable; (2) that such experiments tend to injure the moral character of the operator; (3) that many of the beneficial results ascribed to animal experiments have been dependent upon other causes than the experiments; (4) that in numerous instances there is difference of opinion even amongst experimenters; and (5) that lower animals and man differ so greatly that application of results obtained in lower animals to man is unjustifiable. These contentions are controverted by the other party. Probably natural mental attributes ultimately determine whether animal experiment is viewed with approval or disapproval, but either view to be respected must be based upon extensive and accurate knowledge, accurate statement and sincerity. Unfortunately these are not always manifested by protagonists. (W. S. L-B.)

VIZAGAPATAM, a town and district of British India, in the Madras presidency. The town stretches along the coast, and has a station on a short branch of the East Coast railway, 484 mi. N.E. of Madras. Pop. (1941) 70,243. It lies on a small bay. The town or fort, as it is called, is separated from the southern promontory, the Dolphin's Nose, by a small river, which forms a bar where it enters the sea. The port is growing in importance, as the only protected harbour on the coast, though large vessels have to lie 1 mi. off shore. A harbour was in course of construction in 1929. It will be developed by the Bengal-Nagpur railway company, under government control, to supply an outlet for the fertile east coast area. An English factory was established here early in the 17th century, which was captured by the French in 1757, but shortly afterwards recovered. The town owes much to the munificence of the neighbouring raja of Vizianagram. A water supply has been provided. Waltair at the north end of the bay is the European quarter and a health resort. The exports by sea include manganese ore, ground nuts and sugar.

The DISTRICT OF VIZAGAPATAM has an area of 9,107 square miles. It is a picturesque and hilly country, but for the most part unhealthy. The main portion is occupied by the Eastern Ghats, whose slopes are clothed with luxuriant vegetation and forest trees. The drainage on the east is carried by numerous streams direct to the sea, and that to the west flows into the Godavari through the Indravati or through the Sabari and Siller rivers. To the west of the range is situated the greater portion of the extensive zamindari of Jaipur, which is for the most part very hilly and jungly. In the extreme north a remarkable mass of hills, called the Nimgiris, rise to a height of 5,000 ft. There are great varieties of climate. The average annual rainfall at Vizagapatam exceeds 40 inches. Pop. (1941) 3,845,944. The principal crops are rice, millets, pulses and oil-seeds, with some sugar-cane, cotton, spices and tobacco. Manganese is largely mined, and a little bauxite worked.

On the dissolution of the Mogul empire Vizagapatam formed part of the territory known as the Northern Circars, which were ceded to the East India Company by treaties in 1765 and 1766. The Agency, a hilly inland tract which formed more than two-thirds of the district, has recently been incorporated with the agencies of Ganjam and Godavari into a new division.

VIZETELLY, HENRY (1820–1894), English publisher, was born in London on July 30, 1820, the son of a printer. He was early apprenticed as a wood engraver, and one of his first blocks was a portrait of "Old Parr." Vizetelly started and conducted several illustrated papers, and then acted as correspondent of the *Illustrated London News* in Paris and then in Berlin. In 1887 he established a publishing house in London, issuing numerous translations of French and Russian authors. In 1888 he was prosecuted for publishing a translation of Zola's *La Terre,* and was fined £100; and when he reissued Zola's works in 1889 he was imprisoned for three months. He died on Jan. 1, 1894.

See his *Glances Back Through Seventy Years* (1893).

VIZEU or VISEU, a Portuguese episcopal city at the terminus of a branch of the Figueira da Foz-Guarda railway. Pop. (1940) 13,876. The city stands near the ruins of the ancient *Vacca,* or *Cava de Viriato,* a Roman military colony founded by Decius Brutus and captured by Viriathus (2nd century B.C.). The administrative district of Vizeu coincides with the central and northern parts of the ancient province of Beira (*q.v.*). Pop. (est. 1935) 444,778; (1940) 465,563; area, 1,932 sq.mi.

See A. de Amorin Girão, *Viséu, Estudo de Uma Aglomeração Urbana* (Coimbre, 1925).

VIZIANAGRAM, a town of British India, in the Vizagapatam district of Madras, 17 mi. from the seaport of Bimlipatam, on the East Coast railway, 522 mi. N.E. of Madras. Pop. (1941) 51,749. It has a small military cantonment. It contains the residence of a *zamindar* of the same name, who ranks as the first Hindu nobleman of Madras. His estate covers about 3,000 sq.mi., with a population of 900,000.

VIZIER, more correctly VIZIR (Arabic *Wazīr*), literally "burden-bearer" or "helper," originally the chief minister or representative of the Abbasid caliphs (*see* ISLAMIC INSTITUTIONS; CALIPHATE; and BARMECIDES).

VLAARDINGEN, a river port of the Netherlands, in the province of South Holland, on the Maas, 6 mi. W. of Rotterdam by rail. Pop. (1940), 30,695. An old town and the seat of a former margraviate belonging to the counts of Holland, Vlaardingen is the centre of the great herring and cod fisheries of the North Sea.

VLACHS. The Vlach (Wallach) or Ruman race constitutes a distinct division of the Latin family of peoples, widely disseminated throughout south-eastern Europe, both north and south of the Danube, and extending sporadically from the Bug to the Adriatic. The total numbers of the Vlachs may be approximately estimated at from 9,000,000 to 11,000,000. Of these the vast majority reside in the kingdom of Rumania, as enlarged by World War I. South of the Danube, a now diminishing number are scattered over northern Greece under the name of Kutzo ("lame")-Vlachs, Tzintzars or Aromani. In Serbia this element is preponderant in the Timok valley, while in Istria it is represented by the Cici, at present largely Slavonized, as are now entirely the kindred Morlachs of Dalmatia. In Bulgaria Vlachs are found chiefly in the western Rhodopes.

A detailed account of the physical, mental and moral characteristics of the Vlachs, their modern civilization and their historical development, will be found under the headings RUMANIA and MACEDONIA. All divisions of the race, whether inhabitants of the kingdom of Rumania or not, prefer to style themselves *Romani, Romeni, Rumeni* or *Aromani.* The name "Vlach" (Slav *Volokh* or *Woloch,* Greek *Vlachoi,* Magyar *Olóh,* Turkish *Ifflók*), which is now used by the Rumans themselves, represents a Slavonic adaptation of a generic term applied by the Teutonic races to all Roman provincials during the 4th and 5th centuries.

The Vlachs claim to be a Latin race in the same sense as the Spaniards or Provençals—Latin by language and culture, and, in a smaller degree, by descent. This claim is generally accepted by ethnologists. The language of the Vlachs is Latin in structure and to a great extent in vocabulary; their features and stature would not render them conspicuous as foreigners in south Italy; and that their ancestors were Roman provincials is attested not only by the names "Vlach" and "Ruman" but also by popular and literary tradition. In their customs and folk-lore both Latin and Slavonic traditions assert themselves. Of their Roman traditions the Trajan saga, the celebration of the Latin festivals of the Rosalia and Kalendae, the belief in the *striga* (witch), the names of the months and days of the week, may be taken as typical examples. Some Roman words connected with the Christian religion, like *biserica* (*basilica*)=a church, *botez=baptizo, duminica*=Sunday, *preot* (*presbyter*)=priest, point to a continuous tradition of the Illyrian church, though most of their ecclesiastical terms, like their liturgy and alphabet, were derived from the Slavonic. In most that concerns political organization the

Slavonic element is also preponderant, though there are words like *impărat=imperator,* and *domn=dominus,* which point to the old stock. Many words relating to kinship are also Latin, some, like *vitrig* (*vitricus*)=father-in-law, being alone preserved by this branch of the Romance family.

The centre of gravity of the Vlach race is at present unquestionably north of the Danube in the almost circular territory between the Danube, Theiss and Dniester; and corresponds roughly with the Roman province of Dacia, formed by Trajan in A.D. 106. From this circumstance the popular idea has arisen that the race itself represents the descendants of the Romanized population of Trajan's Dacia, which was assumed to have maintained an unbroken existence in Walachia, Transylvania and the neighbouring provinces, under the dominion of a succession of invaders. The Vlachs of Pindus, and the southern region generally, were regarded as later immigrants from the lands north of the Danube. In 1871, E. R. Roesler published at Leipzig his *Romänische Studien,* in which he absolutely denied the claim of the Rumanian Vlachs to be regarded as autochthonous Dacians. He laid stress on the statements of Vopiscus and others as implying the total withdrawal of the Roman provincials from Trajan's Dacia by Aurelian, in A.D. 272, and on the non-mention by historians of a Latin population in the lands on the left bank of the lower Danube, during their successive occupation by Goths, Huns, Gepidae, Avars, Slavs, Bulgars and other barbarian races. He found the first trace of a Ruman settlement north of the Danube in a Transylvanian diploma of 1222. His conclusions had to a great extent been already anticipated by F. J. Sulzer in his *Geschichte des Transalpinischen Daciens,* published at Vienna in 1781, and at a still earlier date by the Dalmation historian Lucius of Traü in his work *De Regno Dalmatiae et Croatiae* (Amsterdam, 1666). They found a determined opponent in Dr. J. Jung, of Innsbruck, who upheld the continuity of the Roman provincial stock in Trajan's Dacia, disputing from historic analogies the total withdrawal of the provincials by Aurelian; and the reaction against Roesler was carried still farther by J. L. Pič, Prof. A. D. Xenopol of Jassy, B. P. Hasdeu, D. Onciul and many other Rumanian writers, who maintain that, while their own race north of the Danube represents the original Daco-Roman population of this region, the Vlachs of Greece are similarly descended from the Moeso-Roman and Illyro-Roman inhabitants of the provinces lying south of the river. On this theory the entire Vlach race occupies almost precisely the same territories today as in the 3rd century.

On the whole it may be said that the truth lies between the two extremes. Roesler is no doubt so far right that after 272, and throughout the early middle ages, the bulk of the Ruman people lay south of the Danube. Pič's view that the population of the Roman provinces of Moesia and Illyria were Hellenized rather than Romanized, and that it is to Trajan's Dacia alone that we must look for the Roman source of the Vlach race, conflicts with what we know of the Latinizing of the Balkan lands from inscriptions, martyrologies, Procopius's list of Justinian's Illyrian fortresses and other sources. This Roman element south of the Danube had further received a great increase at the expense of Trajan's colonial foundation to the north when Aurelian established his New Dacia on the Moesian side of the river. On the other hand, the analogy supplied by the withdrawal of the Roman provincials from Riparian Noricum tells against the assumption that the official withdrawal of the Roman colonists of Trajan's Dacia by Aurelian entailed the entire evacuation of the Carpathian regions by their Latin-speaking inhabitants. As on the upper Danube the continuity of the Roman population is attested by the *Vici Romanisci* of early mediaeval diplomas and by other traces of a Romanic race still represented by the Ladines of the Tirol, so it is reasonable to suppose a Latin-speaking population continued to exist in the formerly thickly colonized area embracing the present Transylvania and Little Walachia, with adjoining Carpathian regions. Even as late as Justinian's time (483–565), the official connection with the old Dacian province was not wholly lost, as is shown by the erection or restoration of certain fortified posts on the left bank of the lower Danube.

Early Migrations.—We may therefore assume that the Latin race of eastern Europe never wholly lost touch with its former trans-Danubian strongholds. It was, however, greatly diminished there. The open country, the broad plains of what is now Rumania and the Banat were in barbarian occupation. The centre of gravity of the Roman or Romance element of Illyricum had now shifted south of the Danube. By the 6th century a large part of Thrace, Macedonia and even of Epirus had become Latin-speaking.

What had occurred in Trajan's Dacia in the 3rd century was consummated in the 6th and 7th throughout the greater part of the South-Illyrian provinces, and the Slavonic and Avar conquests severed the official connection with eastern Rome. The Roman element was swept hither and thither by the barbarian flood. Nomadism became an essential of independent existence, while large masses of homeless provincials were dragged as captives to be distributed in servile colonies. They were thus in many cases transported by barbarian chiefs—Slav, Avar and Bulgarian—to trans-Danubian and Pannonian regions.

In the *Acts* of St. Demetrius of Thessalonica (d. A.D. 306) we find an account of such a Roman colony, which, having been carried away from South-Illyrian cities by the Avar *khagan* (prince), and settled by him in the Sirmian district beyond the Save, revolted after 70 years of captivity, made their way once more across the Balkan passes, and finally settled as an independent community in the country inland from Salonica. Others, no doubt, thus transported northwards never returned. The earliest Hungarian historians who describe the Magyar invasion of the 9th century speak of the old inhabitants of the country as Romans, and of the country they occupied as *Pascua Romanorum;* and the Russian Nestor, writing about 1100, makes the same invaders fight against Slavs and Vlachs in the Carpathians. So far from the first mention of the Vlachs north of the Danube occurring only in 1222, it appears from a passage of Nicetas of Chonae that they were to be found already in 1164 as far afield as the borders of Galicia; and a passage in the *Nibelungenlied,* which mentions the Vlachs, under their leader Râmunc, in association with the Poles, cannot well be later than 1200.

Nevertheless, through the early middle ages the bulk of the Ruman population lay south of the Danube. It is here that this new Illyrian Romance race first rises to historic prominence. Already in the 6th century, as we learn from the place-names, such as Sceptecasas, Burgualtu, etc., given by Procopius, the Ruman language was assuming, so far as its Latin elements were concerned, its typical form. In the later campaigns of Commentiolus (587) and Priscus, against the Avars and Slavs, we find the Latin-speaking soldiery of the eastern emperor making use of such Romance expressions as *torna frate!* (turn, brother!), or *sculca* (out of bed) applied to a watch (*cf.* Ruman *a se culca*=Italian *coricarsi*+*ex*-[*s*-] privative). Next we find this warlike Ruman population largely incorporated in the Bulgarian kingdom, and, if we are to judge from the names Paganus and Sabinus, already supplying it with rulers in the 8th century. The blending and close contact during this period of the surviving Latin population with the Slavonic settlers of the peninsula impregnated the language with its large Slavonic ingredient. The presence of an important Latin element in Albanian, the frequent occurrence of Albanian words in Rumanian, and the remarkable retention by both languages of a suffix article, may perhaps imply that both alike took their characteristic shapes in the same region. The fact that these peculiarities are common to the Rumans north of the Danube, whose language differs dialectically from that of their southern brothers, shows that it was this southern branch that throughout the early periods of Ruman history was exercising a dominating influence. Migrations, violent transplantation, the intercourse which was kept up between the most outlying members of the race, at a later period actual colonization and the political influence of the Bulgaro-Vlachian empire, no doubt contributed to propagate these southern linguistic acquisitions throughout that northern area to which the Ruman race was destined almost imperceptibly to shift its centre of gravity.

Byzantium, which had ceased to be Roman, and had become Romanic, renewed its acquaintance with the descendants of the

Latin provincials of Illyricum through a Slavonic medium, and applied to them the name of Vlach, which the Slav himself had borrowed from the Goth. The first mention of Vlachs in a Byzantine source is about the year 976, when Cedrenus (ii, 439) relates the murder of the Bulgarian tsar Samuel's brother "by certain Vlach wayfarers," at a spot called the Fair Oaks, between Castoria and Prespa. From this period onwards the Ruman inhabitants of the Balkan peninsula are constantly mentioned by this name, and we find a series of political organizations and territorial divisions connected with the name of *Vlachia*. A short synopsis may be given of the most important of these, outside the limits of Rumania itself.

Political and Territorial Divisions.—1. *The Bulgaro-Vlach Empire.*—After the overthrow of the older Bulgarian tsardom by Basil "the Bulgar-slayer" (976–1025), the Vlach population of Thrace, Haemus and the Moesian lands passed once more under Byzantine dominion; and in 1185 a heavy tax, levied in kind on the cattle of these warlike mountain shepherds, stirred the Vlachs to revolt against the emperor Isaac Angelus, and under the leadership of two brothers, Peter and Asen, to found a new Bulgaro-Vlachian empire, which ended with Kaliman II in 1257. The dominions of these half-Slavonic half-Ruman emperors extended north of the Danube over a great deal of what is now Rumania, and it was during this period that the Vlach population north of the river seems to have been most largely reinforced. The 13th-century French traveller Rubruquis speaks of all the country between the Don and Danube as *Asen's land* or *Blakia*.

2. *Great Walachia* (Μεγάλη Βλαχία).—It is from Anna Comnena, in the second half of the 11th century, that we first hear of a Vlach settlement, the nucleus of which was the mountainous region of Thessaly. Benjamin of Tudela, in the succeeding century, gives an interesting account of this Great Walachia, then completely independent. It embraced the southern and central ranges of Pindus, and extended over part of Macedonia, thus including the region in which the Roman settlers mentioned in the *Acts* of St. Demetrius had fixed their abode. After the Latin conquest of Constantinople in 1204, Great Walachia was included in the enlarged despotat of Epirus, but after passing under the yoke of the Serb emperor Dushan and other Serbian rulers in the 14th century, was finally conquered by the Turks in 1393. Many of their old privileges were accorded to the inhabitants, and their taxes were limited to an annual tribute. Since this period the Megalovlachites have been largely Hellenized, but they are still represented by the flourishing Tzintzar settlements of Pindus and its neighbourhood (*see* MACEDONIA).

3. *Little Walachia* (Μικρὰ Βλαχία) was a name applied by Byzantine writers to the Ruman settlements of Aetolia and Acarnania, and with it may be included "Upper Walachia," or Ἀνω-βλαχία. Its inhabitants are still represented by the Tzintzars of the Aspropotamo and the Karaguni (Black Capes) of Acarnania.

4. *The Morlachs* (*Mavrovlachi*) *of the West.*—These are already mentioned as *Nigri Latini* by the presbyter of Dioclea (*c.* 1150) in the old Dalmatian littoral and the mountains of Montenegro, Herzegovina and North Albania. Other colonies extended through a great part of the old Serbian interior, where is a region still called Stara Vlaška or "Old Walachia." The great commercial staple of the east Adriatic shores, the republic of Ragusa, seems in its origin to have been a Ruman settlement, and many Vlach traces survived in its later dialect. Philippus de Diversis, who described the city as it existed in 1440, says that "the various officers of the republic do not make use either of Slav or Italian, with which they converse with strangers, but a certain other dialect only partially intelligible to us Latins," and cites words with strong Ruman affinities. In the mountains above Ragusa a number of Vlach tribes are mentioned in the archives of that city, and the original relationship of the Ragusans and the nomadic Alpine representatives of the Roman provincials, who preserved a traditional knowledge of the old lines of communication throughout the peninsula, explains the extraordinary development of the Ragusan commerce. In the 14th century the Mavrovlachi or Morlachs extended themselves towards the Croatian borders, and a large part of maritime Croatia and northern Dalmatia began to be known as *Morlacchia*. A *Major Vlachia* was formed about the triple frontier of Bosnia, Croatia and Dalmatia, and a "Little Walachia" as far north as Požega. The Morlachs have now become Slavonized (*see* DALMATIA).

5. *Cici of Istria.*—The extreme Ruman offshoot to the north-west is still represented by the Cici of the Val d'Arsa and adjoining Istrian districts. They represent a 15th-century Morlach colony from the isle of Veglia, and had formerly a wider extension to Trieste and the counties of Gradisca and Görz. The Cici have almost entirely abandoned their native tongue, which is the last remaining representative of the old Morlach, and forms a connecting link between the Daco-Roman (or Rumanian) and the Illyro- or Macedo-Roman dialects.

6. *Rumans of Transylvania and Hungary.*—As already stated, a large part of the Hungarian plains were, at the coming of the Magyars in the 9th century, known as *Pascua Romanorum*. At a later period privileged Ruman communities existed at Fogaras, where was a *Silva Vlachorum*, at Marmaros, Deva, Hatzeg, Hunyad and Lugos, and in the Banat were seven Ruman districts. Two of the greatest figures in Hungarian history, the 15th-century rulers John Corvinus of Hunyad and his son King Matthias, were due to this element. For its later history *see* TRANSYLVANIA.

See J. L. Pič, *Über die Abstammung der Rumänen* (Leipzig, 1880); A. D. Xenopol, *Les Roumains au moyen âge* (Jassy, 1886); B. P. Hasdeu, "Stratŭ şi Substratŭ: Genealogia poporelorŭ balcanice," in *Annalele Academieĭ*, ser. II, vol. 14 (Bucharest, 1893); D. Onciul, "Românii in Dacia Traiana," etc., in *Enciclopedia Româna*, vol. iii (Bucharest, 1902); A. J. B. Wace and M. S. Thompson, *The Nomads of the Balkans* (1914).

VLADIKAVKAZ, Russian S.F.S.R.: *see* ORJONIKIDZE.

VLADIMIR, ST. (*c.* 956–1015), grand duke of Kiev and of all Russia, was the youngest son of Svyatoslav I and his mistress Malushka. In 970 he received Great Novgorod as his appanage. On the death of Svyatoslav in 972, a long civil war took place between his sons Yaropolk and Oleg, in which Vladimir was involved. From 977 to 984 he was in Scandinavia, collecting as many of the viking warriors as he could to assist him to recover Novgorod, and on his return marched against Yaropolk. On his way to Kiev he sent ambassadors to Ragvald, prince of Polotsk, to sue for the hand of his daughter Ragnilda. The haughty princess refused to affiance herself to "the son of a bondswoman," but Vladimir attacked Polotsk, slew Ragvald and took Ragnilda by force. Subsequently (980) he captured Kiev also, slew Yaropolk by treachery, and was proclaimed prince of all Russia. In 981 he conquered the Chervensk cities, the modern Galicia; in 983 he subdued the heathen Yatvyags, whose territories lay between Lithuania and Poland; in 985 he led a fleet along the central rivers of Russia to conquer the Bulgars of the Kama, planting numerous fortresses and colonies on his way. At this time Vladimir was a thoroughgoing pagan. He increased the number of the *trebishcha*, or heathen temples; offered up Christians (Theodore and Ivan, the protomartyrs of the Russian Church) on his altars; had eight hundred concubines, besides numerous wives; and spent his whole leisure in feasting and hunting. He also formed a great council out of his boyars, and set his twelve sons over his subject principalities.

In the year 987, as the result of a consultation with his boyars, Vladimir sent envoys to study the religions of the various neighbouring nations whose representatives had been urging him to embrace their respective faiths. The result is amusingly described by the chronicler Nestor. Of the Moslem Bulgarians of the Volga the envoys reported "there is no gladness among them; only sorrow and a great stench; their religion is not a good one." In the temples of the Germans they saw "no beauty"; but at Constantinople, where the full festival ritual of the Orthodox Church was set in motion to impress them, they found their ideal. "We no longer knew whether we were in heaven or on earth, nor such beauty, and we know not how to tell of it." If Vladimir was impressed by this account of his envoys, he was yet more so by the offer of the emperor Basil II to give him his sister Anna in marriage. In 988 he was baptized at Kherson in the Crimea, taking the Christian name of Basil out of compliment to his imperial brother-in-law; the sacrament was followed by his marriage with the Roman princess. Returning to Kiev in triumph, he converted his

people to the new faith with no apparent difficulty. Crypto-Christians had been numerous in Kiev for some time before the public recognition of the Orthodox faith.

The remainder of the reign of Vladimir was devoted to good works. He founded numerous churches, including the splendid *Desyatinnuy Sobor* or "Cathedral of the Tithes" (989), established schools, protected the poor and introduced ecclesiastical courts. With his neighbours he lived at peace, the incursions of the savage Petchenegs alone disturbing his tranquillity. His nephew Svyatpolk, son of his brother and victim Yaropolk, he married to the daughter of Boleslaus of Poland. He died at Berestova, near Kiev, while on his way to chastise the insolence of his son, Prince Yaroslav of Novgorod. The various parts of his dismembered body were distributed among his numerous sacred foundations and were venerated as relics. The university of Kiev has rightly been named after the man who both civilized and Christianized ancient Russia. His memory was also kept alive by innumerable folk ballads and legends. With him the Varangian period of Russian history ceases and the Christian period begins.

See *Memorials* (Rus.) published by the Commission for the examination of ancient documents (Kiev, 1881, etc.); I. Komanin and M. Istomin, *Collection of Historical Materials* (Rus.) (Kiev, 1890 etc.); O. Partitsky, *Scandinavianism in Ancient Russia* (Rus.) (Lemberg, 1897); A. Lappo-Danilevsky, *Scythian Antiquities* (Rus.) (St. Petersburg, 1887); J. Macquart, *Osteuropäische u. ostasiatische Streifzüge* (Leipzig, 1903); L. C. Goetz, *Das Kiever Höhlenkloster als Kulturzentrum des vormongolischen Russlands* (Passau, 1904). (R. N. B.)

VLADIMIR, a chief town in the Ivanovo division of Russian S.F.S.R. known in history as Vladimir-on-the-Klyazma, to distinguish it from Vladimir in Volhynia. It is picturesquely situated on the Klyazma and Lybed, in 56° 8′ N., 40° 20′ E. Pop. (1939) 66,761. The town is a trading centre on the railway and river between Moscow and Gorki. There are factories for knitted goods, fruit juice and bricks, and there are oil-pressing and saw-milling industries. Extensive cherry orchards occupy the surrounding slopes, and in each is a small watch-tower, with cords drawn in all directions to be shaken by the watcher when birds alight. The citadel stands on a hill and contains two very old cathedrals—the Uspenskiy (1150; restored in 1891), where all the princes of Vladimir have been buried, and the Dmitrievskiy (1197; restored in 1834–35). Several churches date from the 12th century.

Vladimir first comes into notice in 1151, when Andrei Bogolyubskiy secretly left Vyshgorod—the domain of his father in the prinicipality of Kiev—and migrated to the newly settled land of Suzdal, where he became (1157) grand prince of the principalities of Vladimir, Suzdal and Rostov. Although Ivan Kalita (1328–41) made Moscow the real head of the *Rus* states, Vladimir remained the coronation city of the grand princes until 1431, and Simeon the Proud, Ivan the Good, Dmitri of the Don and Vasili I were crowned here.

VLADIMIR, a former province of the Russian S.F.S.R., was divided among the Moscow, Yaroslavl, Ivanovo, Gorki and Ryazan regions. It did not coincide with the pre-1917 province of the same name.

VLADIMIRESCU, TUDOR (?–1821), Rumanian leader, is first heard of leading a corps of Rumanian volunteers against the Turks in the wars of 1812. For his services he received a Russian decoration and the rank of major. After the war the privileges of the Pandours whom Vladimirescu had led were annulled; but he retained his influence as a national leader. In 1820 he was approached by Georgaki, the assistant of Prince Alexander Ypsilanti (*q.v.*) with a request to organize a rebellion to assist the Greek rising. Vladimirescu raised a Rumanian irregular force, and although he led this to join Ypsilanti, he preached a Rumanian national crusade, directed precisely against the Phanariot Greek priests and *boyars*. The Rumanian peasantry flocked round him. By Jan. 1821 he was master of all Oltenia, and marched to Bucharest. Russia, however, failed to support Ypsilanti; instead, the Turks moved against him. Ypsilanti, finding that Vladimirescu was aiming at anything rather than a pro-Greek movement, had him arrested and allowed him to be assassinated at Târgoviste.

VLADIMIR VOLHYNSKIY: *see* WŁODZIMIERZ-WOLYNSKI, a town in the province of Volhynia, Poland.

VLADIVOSTOK (vlah-dē-vŏs-tŏk′), a port of Asiatic Russia, in 43° 11′ N., 131° 53′ E. It stretches along the northern shore of the Golden Horn, on the slope of a ridge of hills extending westwards to the shore of Amur bay. It is the most important town in the Far Eastern Area, though not the administrative centre, and its easily accessible harbour 4 mi. long by 1 mi. broad, kept open all the winter by ice breakers, has made it the most important naval and commercial centre on the Russian Pacific coast. Pop. (1939) 206,432. The commercial port occupies the western part of the Golden Horn and there is a stone mole about 5,200 ft. long for berthing and unloading ships; the pontoon stages are 6,300 ft. long; there is storage capacity for 340,000 tons. The docks include two dry and a floating one and there are nine floating cranes (30 to 150 tons), one bridge crane and engineering and repairing yards for ships. Soybean oil is an important export, and a tank oil storehouse (capacity 1,900 tons), with four conveyers, each having a capacity of 50 tons per hour, has been constructed. The cargo turnover of the port is between 2,000,000 and 3,000,000 tons; the exports are mainly soybeans, soybean oil, bean cake, seeds, timber and fish. Much of both import and export trade is of a transit character to and from Manchuria, notably soybeans, tea and salt. Efforts have been made to develop the fishing industry and a hydrobiological station was established at Basargin peninsula in 1925. On some islands near Vladivostok breeding grounds for reindeer, elk, roebuck and other animals have been established.

Muraviev selected the site after the Treaty of Aigun (1858) by which the district was ceded to Russia: a railway via Manchuria and the Trans-Baikal district reached the town in 1897, though the final link with the Trans-Siberian was not completed till 1917. Wireless stations and cable connection to Japan were established.

The opening of the Odessa to Vladivostok sea route gave a marked impetus to colonization, which still goes on via this route to the eastern parts of Siberia.

Vladivostok is the administrative centre of the Maritime region of the R.S.F.S.R.

VOCATIONAL TRAINING. Logically, the term vocational training should include preparation for the practice of medicine, law and other professions; but it is convenient to restrict it to courses of regular instruction intended to fit boys and girls for commerce, domestic life or some branch of industry. The rapidly growing complexity of industry and commerce and the intensity of international competition compelled all the progressive nations to consider the provision of vocational training, in this sense, to replace or to supplement the methods of apprenticeship (*q.v.*) which sufficed in simpler times. It is, moreover, widely held that under the conditions of modern life, especially in great cities, some form of education, continued through the critical years of adolescence, is needed to preserve the physical, intellectual and moral health of the masses of the people; and vocational training, with its appeal to the practical interests of young wage-earners, is regarded as particularly effective.

Administration.—In some countries vocational schools are administered as part of the general educational system. In England, for instance, they are provided by the ordinary local authorities for education and subsidized through the board of education. In other countries vocational training is treated rather as a distinct educational function.

Types of Courses.—In the chief countries many large cities provide vocational schools offering "all-day" courses lasting from two to four years, sometimes in combination with a modified form of trade apprenticeship. These prepare pupils for office, business and other commercial activities, or serve industries such as agriculture, engineering, furniture making, upholstery, dressmaking (*see* TECHNICAL EDUCATION; CONTINUATION SCHOOLS), which offer scope for highly trained skill or taste, scientific or technical knowledge and capacity for leadership. But by far the greatest amount of vocational training is given everywhere in part-time continuation classes: *i.e.*, classes which provide a few hours of instruction per week for boys and girls who have left the elementary schools and have already entered upon some occu-

pation. In parts of Germany and Czechoslovakia attendance at continuation classes, generally in the evening and on Sundays, was long ago imposed upon elementary school leavers; but the modern tendency, largely influenced by the pioneer work of Kerschensteiner at Munich, is to require employers to release their young employees for instruction during working hours. In England and Germany laws making this system universal and compulsory have been adopted since World War I, but financial difficulties in both countries retarded the development.

In some countries "works schools," maintained by employers for the training of their employees, are an important supplement to the public provision for vocational education. They are especially numerous and well-organized in Germany, but in England met with some disfavour on political and educational grounds.

Finally, it should be noted that programmes of vocational training almost always include some teaching intended to continue and widen the student's general education. Instruction in the duties of citizenship is common, and in many cases attention is given to physical training and hygienic teaching. (T. P. N.)

UNITED STATES

Trade and industrial training is secured by workers in various ways: (1) learning on the job by the pick-up method without educational supervision, (2) learning in shop-training departments or vestibule schools maintained by employers, (3) learning as indentured apprentices, (4) learning in trade, technical high, continuation or evening schools and (5) learning in shops and schools according to some co-operative arrangement between industrial establishments and the schools.

Vocational education received its first great stimulation in 1906 when the National Society for the Promotion of Industrial Education was organized for the purpose of extending vocational education throughout the United States. This society was very influential and succeeded within a decade of years in marshalling sufficient legislative support for a national law (the Smith-Hughes Act passed Feb. 23, 1917), fostering and aiding vocational education. Under the terms of this act, Federal financial aid is granted to public schools offering approved vocational, agricultural, home economics and trade and industrial education courses of less than college grade to pupils 14 years of age and older. Support is also given to teacher-training institutions preparing vocational teachers, to civilian rehabilitation training and to special vocational researches. The law gives no aid to commercial education.

The law is administered by a Federal Board for Vocational Education, which includes representatives of labour, agriculture, manufacturing and commerce. This board operates through State boards designated by the respective State legislatures to prepare and develop vocational education programmes which meet with Federal approval. The passage of the act greatly extended vocational education throughout the United States as may be noted from the following table:

Date	Number of reimbursement units	Number of teachers	Number of pupils enrolled	Federal aid
1927 . .	8,696	18,900	784,986	$6,730,305.25
1918 . .	1,741	5,257	164,186	832,426.82
Increase .	6,955	13,643	620,800	5,897,878.43

A significant trend in trade and industrial education is the growing interest in trade apprenticeship. While the old craft apprenticeship no longer exists, there is a very marked increase in the number of indentured apprentices learning trades. Apprenticeship conforming to modern conditions has been best developed in the State of Wisconsin, where it has had a legal status since 1915. Here a contract must be entered into between the employer and the apprentice whenever employment of a minor 16 to 21 years of age is undertaken with the definite understanding that learning the trade is one of the benefits to be conferred upon the employee. In such cases the employer agrees to furnish the practical instruction. The contracts always state what must be taught to the apprentice; how much time is to be given to each unit of instruction; what compensation and bonus, if any, are to be paid, and the length of the apprenticeship. The State industrial commission supervises all apprentice relationships, and no contracts may be broken except by State consent.

Wisconsin's successful experience with this form of trade training may be gleaned from the fact that Milwaukee, the metropolis of the State, with 763 indentured apprentices in Jan. 1922, had 1,532 in Jan. 1926.

The vocational guidance movement has gradually extended until it is now recognized in the United States as a responsibility by nearly all the schools and colleges and many organizations such as the Young Men's and Young Women's Christian Associations, Boy Scouts and Girl Scouts, as well as many business organizations.

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VODENA, a city of Greek Macedonia in the province of Pella on the railway from Salonika to Monastir. Population 13,115. It is the ancient *Edessa* (*q.v.*). The town stands on a rocky height commanding views of Pindus and Olympus and is the see of an archbishop. It was taken by Germany in World War II.

VODEYSHANKAR, GOWRISHANKAR (1805–1892), native minister of the state of Bhaunagar in Kathiawar, Bombay, was born on Aug. 21, 1805, of a family of Nagar Brahmans. He rose from being a revenue officer to be state minister in 1847. His success in this capacity was such that on the death of the reigning chief, in 1870, he was appointed joint administrator in concert with a British official. The experiment was in every respect successful. Gowrishankar received the C.S.I. in 1877. He helped to establish the Rajkumar College at Rajkot, for the education of native princes, and also the Rajasthanik Court, which, after settling innumerable disputes between the land-owning classes and the chiefs, has since been abolished. In 1879 Gowrishankar resigned office, and devoted himself to the study of the Vedanta philosophy which had been his constant solace and guide. In 1884 he wrote a work called *Svarupanusandhan,* on the union of the soul with Deity. He died, much revered, in December 1892.

See Javerital U. Yajnik, *Gowrishankar Udayashankar* (Bombay, 1889).

VODKA, VODKI or **WODKY,** the Russian national spirituous beverage. Originally vodka was made almost entirely from rye, barley malt to the extent of 15 to 20% being used to effect saccharification (*see* SPIRITS), but at the present day potatoes and maize are the staple raw materials from which this spirit is manufactured, and, as a rule, green rye malt is now used instead of barley. During World War I the sale of vodka was prohibited, and after the revolution of Nov. 1917, the soviets made an attempt to enforce general prohibition, but failed.

VOGAU, BORIS ANDREEVICH: *see* PILNYAK.

VOGEL, SIR JULIUS (1835–1899), British colonial statesman, son of Albert Leopold Vogel, was born in London on Feb. 24, 1835, was educated at University College school, London, and emigrated to Victoria during the exciting years which followed the discovery of goldfields there. He became editor of a newspaper at Maryborough, stood for the Legislative Assembly and was defeated, and in 1861 left Victoria, carried in the mining rush to Otago, New Zealand, where much gold had just been found. Settling in Dunedin, he bought a half-share in the *Otago Daily Times,* and was soon its editor and a member of the Otago Provincial Council. He made his paper the most influential in the colony, and was returned to the House of Representatives. In 1866 he was head of the Otago Provincial Executive; by 1869 he had made his mark in the New Zealand parliament, and was treasurer in the ministry of Sir William Fox. He brought forward schemes for the construction of trunk railways and other public works, the purchase of land from the Maori tribes, and the introduction of immigrants, all to be done with money borrowed in London. For the next six years he was the most powerful man in the colony. In 1875 he was knighted.

In 1874 Vogel, until that time a supporter of the Provincial

system, decided to abolish it. In this, with the aid of Sir E. W. Stafford and Sir H. A. Atkinson, he succeeded. In the struggle, however, he broke with many of his old allies, and in 1876 suddenly quitted New Zealand to take the post of agent-general in London. The last years of his life were spent in England. He died there, at East Molesey, on March 13, 1899.

VOGHERA (anc. *Iria*), a town of Lombardy, Italy, in the province of Pavia, and 19 m. by rail S.S.W. of that city, 305 ft. above sea-level, on the Staffora (a tributary of the Po). Pop. (1936) 23,562 (town); 30,180 (commune). It is on the old main line from Genoa to Milan via Novi (though the direct line from Arquata Scrivia to Tortona does not touch it) and a branch diverges here to Piacenza.

VOGLER, GEORG JOSEPH (1749–1814), usually known as Abbé or Abt (Abbot) Vogler, German organist and composer, was born at Pleichach in Würzburg on June 15, 1749. His father, a violin maker, while educating him in the Jesuit college, encouraged his musical talent, and at ten years old he could play the organ, the violin and other instruments. In 1771 he went to Mannheim, where he composed a ballet for the elector Karl Theodor, who sent him to Bologna in 1774 to study under the Padre Martini. He soon left Martini and went to Valotti and Padua for five months, after which he proceeded to Rome. There he became a priest, was admitted to the famous academy of Arcadia and was made a knight of the Golden Spur.

On his return to Mannheim in 1755 Vogler was appointed court chaplain and second "maestro di cappella."

In 1778 the elector removed his court to Munich. Vogler followed in 1780, but presently went to Paris, where his new system was eventually recognized as a continuation of that started by Rameau. His organ concerts at St. Sulpice attracted considerable attention. For the queen, he composed the opera *Le Patriotisme,* which was produced before the court at Versailles. His travels were wide, and extended over Spain, Greece, Armenia, remote districts of Asia and Africa, and even Greenland, in search of uncorrupted forms of national melody. In 1786 he was appointed Kapellmeister to the king of Sweden, founded his second music school at Stockholm, and attained extraordinary celebrity by his performances on an instrument called the "orchestrion"—a species of organ invented by himself. In 1790 he brought this instrument to London, and performed upon it with great effect at the Pantheon, for the concert-room of which he also constructed an organ upon his own principles. The abbé's pedal-playing excited great attention. His most popular pieces were a fugue on themes from the "Hallelujah Chorus," composed after a visit to the Handel festival at Westminster abbey, and *A Musical Picture for the Organ,* by Knecht, containing the imitation of a storm. Browning's poem has made his name familiar. He continued to work hard to the last, and died suddenly of apoplexy at Darmstadt on May 6, 1814.

VOGT, HANS (1890–), German inventor, was born on Sept. 25, 1890, at Wörlitz, Bavaria, Germany. He began his career as an inventor in the sphere of high frequency technology, telephone research and earth current telegraphy. In 1918 he began to collaborate with Joseph Massolle and Dr. Engl, and this led to the formation of the Triergon-Arbeitsgemeinschaft, which aimed at the creation of the speaking film. On Sept. 17, 1922, the first public exhibition of the speaking film was held at the Alhambra in Berlin. The voice is photographed directly on to the film band after conversion of the acoustic oscillations, which are taken with an inertialess microphone (kathodophone), and are changed by a photoelectric cell into light pulsations. Reproduction is effected by an electrostatic telephone with mica membrane (statophone).

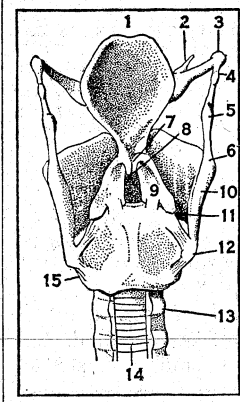
VOGTLAND or **VOIGTLAND,** a district of Germany, forming the south-west corner of the *Land* of Saxony, and also embracing parts of Thuringia. It is bounded on the north by the former principalities of Reuss, on the southeast by Bohemia, and on the southwest and west by Bavaria. Its character is generally mountainous, and geologically it belongs to the Erzgebirge range. It is extremely rich in mineral ores—silver, copper, lead and bismuth. The name denoted the country governed for the emperor by a *Vogt* (bailiff or steward), and was, in the middle ages, known as *terra advocatorum.*

VOGÜÉ, EUGENE MELCHIOR, COMTE DE (1848–1910), French author, was born at Nice on Feb. 25, 1848. He served in the campaign of 1870, and on the conclusion of the war entered the diplomatic service, being appointed successively attaché to the legations at Constantinople and Cairo and secretary at St. Petersburg (Leningrad). He was almost the first to draw French attention to Dostoievski and his successors. He became a member of the French Academy in 1888. He died in Paris on March 24, 1910.

His works include: *Histoires orientales* (1879); *Portraits du siècle* (1883); *Le Fils de Pierre le Grand* (1884); *Histoires d'hiver* (1885); *Le Roman russe* (1886); *Regards historiques et littéraires* (1892); *Coeurs russes* (1894); *Devant le siècle* (1896); *Jean d'Agrève* (1898); *Le Rappel des ombres* (1900); *Le Maître de la mer* (1903); *Maxime Gorky* (1905).

VOICE is the sound produced by the vibrations of the vocal cords, two ligaments or bands of fibrous elastic tissue situated in the larynx. It is to be distinguished from speech, which is the production of articulate sounds intended to express ideas. (*See* SINGING; and for speech *see* PHONETICS.)

Physiological Anatomy.—The larynx is a valve guarding the entrance to the trachea. In man it is used as the organ of voice. It is situated in the neck, where it forms a well marked prominence in the middle line (*see* details under RESPIRATORY SYSTEM). It consists of a framework of cartilages, connected by elastic membranes or ligaments, and it contains two important structures known as vocal cords. The latter, if brought into apposition can be blown apart by an expiratory blast of air; there is consequently a fall in pressure in the trachea, which allows the cords to come into contact again; repetition of this action allows puffs of air to escape rhythmically from the larynx into the pharynx and out by the mouth or nose with the production of a note.



BY COURTESY OF THE CONSERVATOR OF THE ROYAL COLLEGE OF SURGEONS

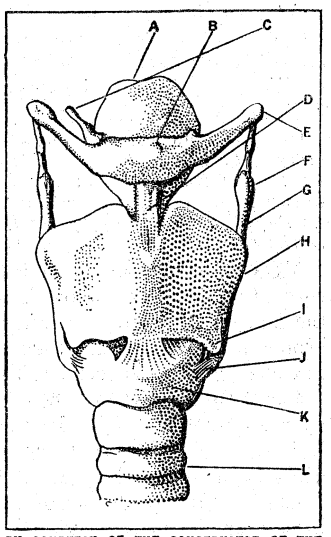
FIG. 1.—CARTILAGES AND LIGAMENTS SEEN FROM BEHIND, ½ NAT. SIZE
1. Epiglottis; 2. lesser cornu of hyoid bone; 3. greater cornu of hyoid; 4. lateral thyro-hyoid ligament; 5. cartilago triticea; 6. upper cornu of thyroid; 7. thyro-epiglottic ligament; 8. cartilages of Santorini; 9. arytenoid cartilages; 10. left lamina of thyroid; 11. muscular process of arytenoid cartilage; 12. inferior cornu of thyroid; 13. first ring of trachea; 14. posterior membranous wall of trachea; 15. lamina of cricoid cartilage

The *cartilages* form the framework of the larynx. They consist of three single pieces (the thyroid, the cricoid and the cartilage of the epiglottis) and of three pairs (two arytenoids, two cornicula laryngis or cartilages of Santorini, and two cuneiform cartilages or cartilages of Wrisberg), *see* figs. 1 and 2. The epiglottis, the cornicula laryngis, the cuneiform cartilages and the apices of the arytenoids are composed of yellow or elastic fibro-cartilage, whilst the cartilage of all the others is of the hyaline variety, resembling that of the costal or rib cartilages. These cartilages are bound together by ligaments, some of which are seen in figs. 1 and 2, whilst the remainder are represented in fig. 3. The structures specially concerned in the production of voice are the *inferior thyro-arytenoid folds,* or true vocal cords. These are composed of fine elastic fibres attached behind to the anterior projection of the base of the arytenoid cartilages, *processus vocalis, see* fig. 3, and in front to the middle of the angle between the wings or laminae of the thyroid cartilage. They are continuous with the lateral cricothyroid ligaments which form the conus elasticus, *see* fig. 3.

The *cavity* of the larynx is divided into an upper and lower portion by the narrow aperture of the *glottis* or chink between the edges of the true vocal cords, the *rima glottidis.* Immediately above the true vocal cords, between these and the false vocal cords, there is on each side a recess or pouch termed the *ventricle* of Morgagni, and opening from each ventricle there is a still smaller recess, the *laryngeal saccule,* which passes for the space of half an inch between the superior vocal cords inside and the

thyroid cartilage outside, reaching as high as the upper border of that cartilage at the side of the epiglottis. The upper aperture of the larynx is bounded in front by the epiglottis, behind by the summits of the arytenoid cartilages and on the sides by two folds of mucous membrane, the aryteno-epiglottic folds.

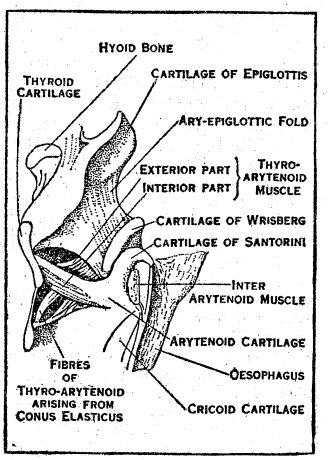
The *rima glottidis*, between the true vocal cords, in the adult male measures about 23 mm., or nearly an inch from before backwards, and from 6 to 12 mm. across its widest part, according to the degree of dilation. In females and in males before puberty the antero-posterior diameter is about 17 mm. and its transverse diameter about 4 mm. The vocal cords of the adult male are in length about 15 mm., and of the adult female about 11 mm. The larynx is lined with a layer of epithelium, which is closely adherent to underlying structures, more especially over the true vocal cords. The cells of the epithelium, in the greater portion of the larynx, are of the columnar ciliated variety, and by the vibratory action of the cilia mucus is driven upwards, but over the true vocal cords the epithelium is squamous. Numerous mucous glands exist in the lining membrane of the larynx, more especially in the epiglottis. In each laryngeal pouch there are from sixty to seventy such glands.



BY COURTESY OF THE CONSERVATOR OF THE ROYAL COLLEGE OF SURGEONS

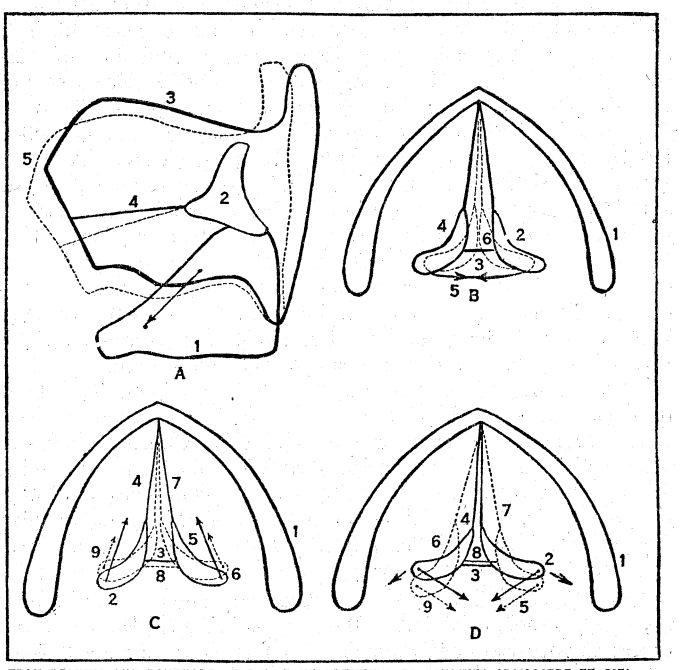
FIG. 2.—CARTILAGES AND LIGAMENTS OF THE LARYNX (Front), (A) epiglottis; (B) hyoid bone; (C) small cornu of hyoid bone; (D) middle thyro-hyoid ligament; (E) great cornu of hyoid bone; (F) small nodules of cartilage (cartilago triticea); (G) lateral thyro-hyoid ligament; (H) left lamina of thyroid-cartilage; (I) cricoid cartilage; (J) lower cornu of thyroid-cartilage; (K) part of cricoid united to thyroid by middle crico-thyroid ligament; (L) second ring of trachea

The Muscles of the Larynx.—We are now in a position to understand the action of the *muscles* of the larynx by which the vocal cords, forming the *rima glottidis*, can be tightened or relaxed, and by which they can be approximated or separated. Besides certain extrinsic muscles—sterno-hyoid, omohyoid, sterno-thyroid and thyro-hyoid—which move the larynx as a whole, there are *intrinsic* muscles which move the cartilages on each other. These muscles are (*a*) the crico-thyroid, (*b*) the posterior crico-arytenoid, (*c*) the lateral crico-arytenoid, (*d*) the thyro-arytenoid, (*e*) the arytenoid, and (*f*) the aryteno-epiglottidean. Their actions will be readily understood with the aid of the diagrams in fig. 4. (1) The *crico-thyroid* is a short thick triangular muscle, its fibres passing from the cricoid cartilage obliquely upwards and outwards to be inserted into the lower border of the thyroid cartilage and to the outer border of its lower horn. When the muscle contracts, the cricoid and thyroid cartilages are approximated. (2) The *thyro-arytenoid* has been divided by anatomists into two parts—one, the internal, lying close to the true vocal cord, and the other, external, immediately within the ala of the thyroid cartilage. Many of the fibres of the anterior portion pass from the thyroid cartilage with a slight curve (concavity inwards) to the processus vocalis at the base of the arytenoid cartilage. They are thus parallel with the true vocal cord, and when they contract the arytenoids are drawn forwards if the postreus muscles are relaxed; but if the arytenoid cartilages are braced back contraction of the muscle increases the elasticity of the margins of the glottis. (3) The *posterior* and *lateral crico-arytenoid* muscles have antagonistic actions, and may be considered together. The *posterior* arise from the posterior surface of the cricoid cartilage, and passing upwards and outwards are attached to the outer angle of the base of the arytenoid. On the other hand, the *lateral* arise from the upper border of the cricoid as far back as the articular surface for the arytenoid, pass backwards and upwards, and are also inserted into the outer angle of the base of the arytenoid before the attachment of the posterior crico-arytenoid. Imagine the pyramidal form of the arytenoid cartilages. To the inner angle of the triangular base are attached, as already described, the true vocal cords; and to the outer angle the two muscles in question. The posterior crico-arytenoids draw the outer angles backwards and inwards, thus rotating the inner angles, or processus vocalis, outwards; the innermost fibres of the muscles draw the arytenoids away from one another and widen the rima glottidis. This action is opposed by the lateral crico-arytenoids, which draw the outer angle forwards and outwards, rotate the inner angles inwards, and thus approximate the cords. (4) The *arytenoids* pass from the one arytenoid cartilage to the other, and in action these cartilages will be approximated and slightly depressed. (5) The *aryteno-epiglottidean* muscles arise near the outer angles of the arytenoid; their fibres pass obliquely upwards, decussate and are inserted partly into the outer and upper border of the opposite cartilage, partly into the aryteno-epiglottic fold, and partly join the fibres of the thyro-arytenoids. In action they assist in bringing the arytenoids together, whilst they also constrict the upper aperture of the larynx.



FROM KRAUSE, "HANDBUCH DER MENSCHLICHEN ANATOMIE"

FIG. 3.—RIGHT HALF OF LARYNX Slightly oblique, vertical section



FROM BEAUNIS AND BOUCHARD, "PRINCIPAUX ELEMENTS D'ANATOMIE" (BAILLIERE ET CIE)

FIG. 4.—DIAGRAMS OF LARYNX Dotted lines show position taken by cartilages and true vocal cords, arrows show general direction in which the muscular fibres act. (A) Action of crico-thyroid: 1, cricoid cartilage; 2, arytenoid cartilage; 3, thyroid cartilage; 4, true vocal cord; 5, thyroid cartilage; 6, true vocal cord; (B) Action of arytenoid: 1, section; 2, arytenoid; 3, posterior border epiglottis; 4, true vocal cord; 5, direction of muscular fibres; 6, arytenoid; 7, true vocal cord; (C) Action of lateral crico-arytenoid: same description as A and B; 8, posterior border of epiglottis; 9, arytenoid; (D) Action of posterior crico-arytenoid; same description

The Voice Registers.—The voice may be divided into the lower or chest register, the higher or head register, and the small or falsetto register. In singing, the voice changes in volume and in quality in passing from one register into another. There is remarkable diversity of opinion as to what happens in the larynx when the voice passes through the various registers. There has also been much discussion as to the production of

falsetto tones. In the lower registers the membranous vocal cords vibrate, while the arytenoids remain stationary and in apposition. The whole mass of inferior thyro-arytenoids fold—consisting of mucous membrane, fatty elastic connective tissue and underlying muscle—vibrates. In the falsetto voice the vocal cords are blown apart and the rima glottis is of an elliptical shape; only the margins of the inferior thyro-arytenoid folds vibrate. The small register is a variant of the falsetto; in it only a part of the membranous glottis is blown open.

The pitch of the voice appears to depend on the relation of the elasticity of the glottal margins—as determined by the degree of contraction of the thyro-arytenoid muscles—to the pressure of air expelled from the trachea. The pitch can be raised by an increase of the former while the latter remains almost unchanged or vice-versa; probably an increase of elasticity is accompanied by slightly raised air pressure in the changes of pitch in the chest register. In the head register it appears that the innermost fibres only of the thyro-arytenoid muscles are in contraction, rise of pitch being produced principally by rise of air pressure.

The Laryngoscope.—By means of the laryngoscope it is possible to see the condition of the rima glottidis and the cords in passing through all the ranges of the voice. In 1807 Bozzini first showed that it was possible to see into the dark cavities of the body by illuminating them with a mirror, and in 1829 W. Babington first saw the glottis in this way. In 1854 Garcia investigated his own larynx and that of other singers, and three years later Türck and especially J. N. Czermak, perfected the construction of the laryngoscope. In 1883 Lennox Browne and Emil Behnke obtained photographs of the glottis in the living man. By using the stroboscope Oertel, Musehold, Flatau, Hegener and Panconcelli-Calzia have in recent years enormously improved the technique of laryngoscopy. The endoscope devised by Flatau and the autophonoscope originated jointly by Panconcelli-Calzia enable one to carry out extensive observations on the larynx while the mouth is closed.

Other apparatus employed for investigating the mechanism of the voice includes the breathing flask of Gutzmann, the spirometer, the stethograph and pneumograph (used in connection with the manometer and the phonetic kymograph), all of which are employed for investigating breathing. For observing the action of the vocal cords there are employed, in addition to the laryngoscope, the strobolaryngoscope and the endoscope, manometric flames, the Polsterpfeife of Wethlo, resonators, gramophones, microphones and oscillographs. For studying the supraglottal resonators radiograms are taken.

Action of the Vocal Cords.—The best view of the larynx is obtained with the tongue flat, while attempting to sing the vowel "ee," for this opens out the cavity immediately above the larynx. Now suppose the larynx is examined stroboscopically. The vocal cords are seen to be alternately opening and closing along the ligamentous portions in the chest notes. In falsetto the glottis is permanently open with the edges of the cords vibrating. In whisper the space between the arytenoids is open. Should this occur during phonation, it constitutes a faulty mechanism producing what is called breathy voice, which is particularly to be avoided in singing.

J. Wyllie showed in 1865 that the false vocal cords play the chief part in the closure of the glottis during expiration. Lauder, Brunton and Cash confirmed J. Wyllie's results and further thought that the function of the false vocal cords was to close the glottis and thus fix the thorax for muscular effort. From the evidence of comparative anatomy, and from observations made on men, it has been demonstrated in recent years that in fixation of the thorax, the vocal cords are the important factor. By means of their closure air is prevented from entering the lungs and as the thorax is to a certain extent unable to expand, because of this obstructive mechanism, the ribs tend to come to rest whereby a fixed origin is afforded to the various groups of muscles which move the arms.

The conditions that define the attributes of the human voice are in essentials similar to those of musical instruments in general. The source of energy is the lungs. By them the air is forced under pressure through the glottis causing the vocal cords to move rhythmically, thereby producing a musical note. This musical note is a tone-complex of simple harmonic vibrations some of which are modified by the supraglottal cavities acting as resonators. It is the train of sound waves thus modified, issuing from the mouth, which gives rise to those elements of speech termed vowels and voiced consonants. Such sound waves can be, and sometimes are produced to a limited extent by an in-drawn current of air actuating the vocal cords.

To what extent the infraglottal cavities, *e.g.*, the trachea and chest cavity, influence the quality of the glottal note has not been determined, but they certainly do affect it. Investigators are however agreed that among the supraglottal cavities the effect of the sinuses, *e.g.*, the maxillary sinus, the ethmoidal cells, sphenoidal sinus and frontal sinus, is negligible owing to their small size, unfavorable positions, and minute openings. The expression "sinus tone production" would thus appear to be devoid of justification. Nor can there be any question of directing the voice to a definite point in the buccal cavity, as the dimensions of the mouth cavity, in comparison with the wave-length of sound, are too small for reflexion to be possible.

Attributes of Voice.—Voice may be defined in terms of certain attributes, *i.e.*, (1) duration, (2) pitch, (3) quality or timbre, (4) loudness.

Duration.—The duration of voice in vowels varies with the speed of utterance. In words of two or more syllables, results show that for English spoken at an average speed, the duration of so-called short vowels may vary from ·047 to ·095 of a second, while that of so-called long vowels may vary from ·12 to ·255 of a second.

Pitch.—The pitch of the glottal note, *i.e.*, the lowest tone of the complex, is determined by the frequency, or number of cycles the vocal cords execute in one second, frequency and pitch being physical and sensory aspects of the same thing. The conditions determining pitch are the mass, length and elasticity of the cords, and the pressure actuating them. Increase of pressure in the expiratory current leads to a raising of pitch, but the pitch of the resonance cavities appears to have no effect on the pitch of the glottal note.

The vocal cords are tightened if the arytenoid cartilages be braced back by contraction of the crico-thyroid, and posterior thyro-arytenoids will then give elasticity to the margins of the glottis so that they will recoil after being blown apart. The greater the degree of contraction the higher will this elasticity become. All the muscles except the thyro-cricoid (which is inervated by the superior laryngeal) receive nerve filaments from the inferior laryngeal branch of the vagus, the fibres being derived from the accessory roots. Both the abductor and adductor nerves come therefore from the inferior laryngeal.

In men, by the development of the larynx the cords become more elongated than in women, in the ratio of 3 to 2, so that the male voice is of lower pitch and is usually stronger. At the age of puberty the larynx grows rapidly, and the voice of a boy breaks in consequence of the lengthening of the cords, generally falling an octave or so in pitch. A similar change but less in amount occurs at the same time in the female.

The pitch compass of the human voice generally ranges from E to e′ (80 ~ to 320 ~) in Bass voices and c to a″ (256 ~ to 853 ~ in Soprano voices. (The sign ~ is used to denote the number of cycles a second. This unit is sometimes called a "hertz" after the great German physicist.) These limits are greatly exceeded by many singers. Réthi and Fröschels report the abnormal case of a singer with a compass of five octaves, i.e., F (42 ~) to f‴ (1,408 ~).

Timbre.—As has already been stated above, the voice is composed of a fundamental and a series of over-tones in harmonic relation to it. The quality or timbre is determined by the relative strength of these overtones. The phase relationship between them appears to be of little importance for quality. Difference between vowels is essentially a difference of quality. Thus when speaking the vowel [a] certain partials in the region g″ (767 ~) and d⁗ (1,147 ~) receive preferential treatment from the supra-

glottal cavities while the prominent partials in [i] are in the region f′ (342 ~) and f′′′′ (1,579 ~).

The decay in intelligibility of vowels on the suppression of certain partials, has been investigated by Stumpf and Fletcher. A quotation from the latter relating to this is illuminating. Incidentally it shows also that the fundamental may be only subjective. "The vowel 'ah' sung on a pitch d′ (145 ~) is affected only slightly in either pitch or quality when the fundamental and first two overtones are eliminated. Even with the fundamental and first six overtones eliminated, the pitch still very definitely corresponds to the pitch of a pure tone with the frequency of the fundamental, namely, 145~. The harmonic analysis of this filtered tone shows no frequencies below 1,000~. Eliminating all the overtones above the sixth changes the quality by about the same amount as eliminating the fundamental and first and second overtones. The data also indicate that if the fundamental and all of the upper and lower harmonics except the third, fourth and fifth, are eliminated, the remaining compound tone has the same pitch as the fundamental, although the quality of the sound is very different from that of the sound 'ah.'" A rich baritone or contralto appears to be affected neither in pitch nor in quality by eliminating the fundamental and first two or three overtones. The filtering out of higher partials, even of those above the 15th, however, noticeably affects the musical quality of the voice. High harmonics do not appear to be so essential to good quality in sopranos, as in bass, baritone and contralto.

Loudness.—Loudness, which is the sensory relation to the physical property of intensity, depends on the energy in its various component partials. The rate of energy output in the case of an ordinary voice is extremely small, being about 125 ergs per second, *i.e.*, less than a fiftieth of a millionth of a horse-power. Loudness is a function of pitch and the amplitude of the movements of the vocal cords. If the response of the ear were of a linear character, the intensity of the auditory impressions would be proportional to the square of the product of the amplitude and pitch, to which the term "physiological intensity" has been applied. But at intensities considerably above minimum audibility, there is no proportionality between sound pressure and aural response, for effects are produced in the ear which are not present in the voice which excites them. This degree of non-linearity varies with different persons. Moreover there occurs a masking of one tone by another. A loud tone of low pitch can obscure a weak high tone, but an intense high tone has but little masking effect on low ones.

Methods of Investigation.—Among the methods and apparatus for investigating the attributes of voice, the following may be mentioned. For *duration* and *pitch,* a phonetic kymograph with tambours and an electrically-driven tuning fork of 100~ are the instruments generally employed. *Relative loudness* can also be investigated by these, although electric methods of measuring the energy output are far more effective.

For the investigation of quality, methods may be classified under three heads according to the apparatus employed. (a) *Those using resonators for picking out the component partials.* Helmholtz (1862) determined the maximal response (subjectively) by the ear. König (1868) employing his manometric flames in conjunction with resonators, showed the response objectively. Resonators in conjunction with a hot-wire microphone have been employed by Tucker and Paris (1921). Garten (1921) used a variable resonator where maximal response was registered on a soap-film recorder. Stumpf (1922) used tuning forks as resonators. (b) *Those depending on subjective observations on the changes of quality which the voice undergoes when certain tones are eliminated.* Stumpf employed interference tubes, while Fletcher, Crandall, Wegel, and others, have used the electric wave filter invented by Dr. Campbell for cutting out frequencies. (c) *For objective measurements of quality,* curve-tracings or oscillograms of air vibrations produced by the voice are obtained. They are then submitted to harmonic analysis to obtain the component partials. Several instruments have been devised. Those used by the Bell Telephone Laboratories and research laboratories of the American Telephone Company in their magnificent work on speech should be first mentioned. F. Trendelenburg used the "condenser microphone" of Riegger. Miller in his "phonodeik" used a glass membrane. The "cathode-ray oscillograph" and "Hilger's audiometer" should also be mentioned. Hermann and Scripture in their researches enlarged the curves of phonograph and gramophone records.

"Sonance."—The beauty of the voice is mainly determined by its quality, but there is another condition which influences the artistic effectiveness of it. Metfessel, of the University of Iowa, has examined minutely records of songs sung by some famous singers, and has found in every case a certain periodic departure from true pitch, accompanied by a periodic change in amplitude. There is every reason to suppose that much of the aesthetic value of a great singer's voice is attributable to these fluctuations, on the principle that art consists of rhythmic deviations from regularity. To the perceptive fusion of the successive changes in tone-attributes, Metfessel has given the name "sonance." Popular appreciation of voice-quality in singers, denoted by the term "quality," is as Metfessel states, a combination of "quality or timbre" and "sonance" although the two things should not be confused.

Substitutes for the Larynx.—Laryngectomized subjects have been known to develop a capacity for producing sounds which in essentials resemble normal voice. Burger and Kaiser of Amsterdam report a case where a pseudo-larynx has been developed in the oesophagus. The vicarious lung was the stomach, and the lips of the pseudo-glottis were actuated by ejecting air which had previously been swallowed. It is reported that the subject could sing, speak and use the telephone. Indeed, vocally, he carried on like a normal person.

Attempts have also been made with more or less success to supply the voice element in speech by means of vibrating reeds of rubber or thin metal. The best known of these devices is the "MacKenty-Western Electric Artificial Larynx." By using it the subject is able to direct the expiratory current on to a rubber reed when voicing is required.

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VOICE SOUNDS, sound made by the human voice, which—as used in English and other European speech—can be produced in two different forms, namely (*a*) unvoiced, *i.e.,* breathed or whispered speech, and (*b*) voiced speech.

In unvoiced speech the vocal chords are more or less separated so that the air from the lungs passes continuously between them. In voiced speech the vocal chords are brought closely together so that the forcible passage of the air between them sets up a rhythmical vibration of the chords which causes the air to enter the vocal cavities in correspondingly rhythmical puffs.

Vowel Sounds.—Until recently the accepted theory was that sounds like i as in eat, ɛ as in men, æ as in hat, were each due to two separate resonances, that a as in calm, was produced in some voices by a single resonance, and in others by two resonances, and that ɔ as in all, ou as in no, u as in who, were all due to single resonance (1). According to Helmholtz's theory (2) the lower series of double resonances is set up in the cavity behind the tongue, and the upper in a tubular neck formed by the tongue and

lips, while in the case of the single resonant sounds, the whole oral cavity is supposed to act as a single resonator. Graham Bell, the inventor of the telephone, and K. J. Lloyd, both held that all vowel sounds were due to double resonance (3).

Recent observations (4) have confirmed the views of Graham Bell and Lloyd, and shown that all the English vowel sounds depend primarily on two characteristic resonances—the one formed in the cavity in front of the tongue—*i.e.*, between the point of nearest approach of the tongue to the palate and the lips—and the other in the cavity behind the tongue—*i.e.*, between the same point and the vocal chords. Both cavities behave as Helmholtz resonators connected in series. Each can be independently tuned, by varying its capacity or by varying the size of its orifice to air and (or) to the adjoining resonator. Increase of capacity lowers the resonant pitch; of orifice raises it.

The following table shows typical resonances observed by ear in the whispered vowel sounds of the writer's voice, using the Southern English "Public School" pronunciation.

Vowel Resonances

Vowel Symbol	As in	Upper Resonance	Lower Resonance	Vowel Symbol	As in	Upper Resonance	Lower Resonance
i	eat	♯d′′′′ 2,434	f′ 342	ʌ	up	♯g′′′ 1,625	♯a′′ 912
ɪ	it	♯c′′′′ 2,169	♯f′ 362	a	calm	♯d′′′ 1,217	♯g′′ 812
ei	hay	♯c′′′′ 2,169	d′′ 574	ɐ	not	♯c′′′ 1,084	♯g′′ 812
ɛ	men	c′′′′ 2,048	♯d′′ 608	ɔ	all	b′′ 966	♯f′′ 724
æ	hat	a′′′ 1,722	♯g′′ 812	ov	know	♯a′′ 912	b′ 483
ɘ	earth	♯g′′′ 1,625	e′′ 645	u	who	♯f′′ 724	♯f′ 362
ə	sofa	g′′′ 1,534	e′′ 645	v	put	♯a′′ 912	♯d′ 304

The resonances are given in musical notation and in number of complete vibrations per second (c′ = middle c on the pianoforte, about 256 vibrations per second). In the series from ɘ to v inclusive, an additional high frequency component between 2,169 and 2,732 appears. The upper resonance of i to ov can be varied over a range of 5 to 8 semitones, and u and v by 10 semitones, while the lower resonances can all be similarly varied over a range of about 8 semitones (the other resonance, in each case, being kept nearly constant) without losing the vowel character. Comparable resonances have been found—using purely instrument methods—by Crandall and Sacia (5).

ARTIFICIAL PRODUCTION OF VOWEL SOUNDS

Potter (6) experimentally reproduced the English vowel sounds by a reed attached to a spherical indiarubber resonator of suitable aperture which was appropriately compressed (while sounding the reed) so as to produce approximately the form of the human mouth cavity. All the English vowel sounds have recently been produced by combining two suitably tuned Helmholtz resonators in series and energising them by a continuous current of air, for unvoiced sound, or by a pulsating current produced by a vibrating reed or equivalent for voiced sounds (7). The material of the resonators does not appreciably affect the vowel character. The additional high resonances are of secondary importance, since recognisable reproduction may be made without them. Artificial vowels have also been produced by J. Q. Stewart (8) and by Dr. Eccles (9), substituting electrical resonating circuits for acoustic resonators.

Diphthongs differ only from vowels in that their resonances change progressively from those of the initial to those of the terminal vowel which together form the diphthong. They can be reproduced by resonators of progressively variable pitch. Consonants also are produced in speech by resonance in the vocal cavities (10) (11). They differ from the vowel in that 1. they depend essentially on more than two resonances—due to the functioning of more than two cavities; 2. they depend (like the diphthongs) on characteristic movements of the vocal organs which produce corresponding changes of resonance and of amplitude (loudness); 3. the orifices of the resonators (or some of them) are more constricted than those in the case of the vowels, or are temporarily closed altogether, and suddenly released as in forming the so-called plosives, p, b, t, d, k, g and the nasal consonants m, n and ŋ (ng); 4. the resonators are not always in series with the air current which energises them. Thus they may be in parallel—as when the air is passed simultaneously through both mouth and nose; or a resonator may be lateral to the air current, as when passage through the mouth is closed by the tongue or lips and the air passes behind the soft palate into the nasal cavity and out at the nostrils. In such cases the air current flows past the inner orifice of a lateral single-orificed resonator formed inside the mouth. Closure of the tongue against the back or the front of the palate produces a lateral resonator of high or medium pitch characteristic of the nasal consonants ŋ (ng as in hung); closure of the lips produces a lateral resonator of the maximum capacity and lowest pitch, characteristic of m.

The consonants can be artificially produced, like the vowels and diphthongs, by passing air (vibrating or not as the case may be) through resonators of variable number and capacity and (or) orifice (10). In the cheirophone the variable multiple resonator is formed by the hands of the operator, so as to produce recognisable sentences (12). (*See* SOUND.) Certain consonants have also been reproduced by electrical resonance (8).

In the natural production of vowel sounds, the soft palate may be closed against the back of the throat so as to close the passage to the nasal cavity, or it may be drawn forward so as to open that passage more or less. The best quality of voice production appears to be obtained by avoiding nasal resonance, except in connection with the nasal consonants m, n, and ŋ (ng). In the French nasal vowels ɛ̃ (pain), ã (temps), ɔ̃ (bon), œ̃ (un) the nasal resonance is characteristic. The so-called nasal quality heard in English speech in parts of the North American continent appears mainly to depend on the formation of an additional resonator of high pitch by (unconscious) constriction of the pharynx (13). Broadly speaking, the voice sounds of human speech are due to characteristic postures (for vowel sounds) and gestures (for diphthongs and consonants) of the vocal organs—the tongue, lips and soft palate.

The function of the larynx, in voiced speech, is to increase the range of audibility (from about 10 to 20 times) by increasing the resonance of the cavities through or past which the air current flows. It also gives to speech the power of inflection—*i.e.*, of variation of the musical pitch of the voice, as in song. The unvoiced consonants s, *ʃ* (sh), f, and *θ* (th as in thigh) and the unvoiced aspirate, all of which carry no laryngeal energy and are incapable of emotional or musical inflexion, are inferior to all other voice sounds. (*See* SINGING.) *See* also VOICE; PHONETICS; PHILOLOGY; PHARYNX, and RESPIRATORY SYSTEM.

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VOILE, a term applied to a distinctive type of fabrics comprising a variety of different textures produced from wool, cotton and silk, and possessing the same general features. It is characterized by a light, open and net-like structure based essentially on the principle of the plain calico weave, and produced from warp and weft yarns with an abnormal degree of twist, irrespective of the class of material from which it is spun. The yarn employed may be either single or folded in the warp series or in the weft series, or in both series of threads; and it may be spun with a greater or lesser amount of twist. (*See* also *Voile* under COTTON: *Varieties of Cotton Fabrics.*)

VOIRON, a town of France in the department of the Isère. Pop. (1936) 9,590. It stands at a height of 950 ft., on the Morge (a tributary of the Isère). Voiron long formed part of Savoy, but

in 1355 was exchanged (with the rest of the region between the Rhône and the Isère, watered by the Guiers Mort) by the count with France for Faucigny and Gex.

VOIVODE, a title in use among certain Slavonic peoples, meaning literally "leader of an army" (Sl. *voi,* host, army; *voiditi,* to lead); also *Vaivode, Vayvode, Wayvode,* etc., Med. Gr. *boebodos,* and so applied at various periods and in various eastern European countries to rulers, governors or officials of varying degree. It is best known as the title of the princes of Moldavia and Walachia. In Poland the title (which appears in history as palatinus) is still used of certain administrative officials. A province of northern Yugoslavia is known as the "Voivodina."

VOLAPÜK: *see* UNIVERSAL LANGUAGE.

VOLCAE, an ancient Celtic people in the province of Gallia Narbonensis, who occupied the district between the Garumna (Garonne), Cerbenna mons (Cévennes), and the Rhodanus, corresponding roughly to the old province of Languedoc. They were divided into the Arecomici on the east and the Tectosages on the west, separated by the river Arauris (Hérault). The Volcae were free and independent, had their own laws, and possessed the *ius Latii.* The chief town of the Tectosages was Tolosa (Toulouse); of the Arecomici, Nemausus (Nîmes); the capital of the province was Narbo Martius (Narbonne).

BIBLIOGRAPHY.—*See* A. Holder, *Altceltischer Sprachschatz,* i. ii. (1896, 1904), s.vv. "Arecomici" and "Tectosagi"; T. R. Holmes, *Caesar's Conquest of Gaul* (1899) p. 513.

VOLCANO, an opening in the earth's crust, through which heated matter is brought to the surface, where it usually forms a hill, more or less conical in shape, and generally with a hollow or crater at the top. This hill, though not an essential part of the volcanic mechanism, is what is commonly called the volcano. The name seems to have been applied originally to Etna and some of the Lipari Islands, which were regarded as the seats of Hephaestus, a Greek divinity identified with Vulcan, the god of fire in Roman mythology. All the phenomena connected with volcanic activity are comprised under the general designation of *vulcanism* or *vulcanicity;* whilst the study of the phenomena forms a department of natural knowledge known as *vulcanology.*

Volcanic Phenomena.—A volcanic eruption is usually preceded by certain symptoms, of which the most common are local earthquakes, subterranean noises, changes in the flow and temperature of springs and evolution of various gases in and near the crater. Where a crater has been occupied by water, forming a crater-lake, the water becomes warm, and may even boil.

Emission of Vapour.—Of all volcanic phenomena the most constant is the emission of vapour. It is one of the earliest features of an eruption; it persists during the paroxysms, attaining often to prodigious volume; and it lingers as the last relic of an outburst. The well-known "pine-tree appendage" of Vesuvius (*pino vulcanico*), noted by the younger Pliny in his first letter to Tacitus on the eruption in A.D. 79, is a vertical shaft of vapour terminating upwards in a canopy of cloud, and compared popularly with the trunk and spreading branches of the stone-pine. During the eruption of Vesuvius in April 1906 the steam and dust rose to a height of from 6 to 8 miles, while at Krakatoa in 1883 the column reached an altitude of nearly 20 miles.

Volcanic Rain and Mud.—The steam given out from the crater soon condenses to rain which mixes with the ashes and loose material to form mud, which may rush down the cone and spread far and wide. Herculaneum was buried beneath a flood of mud swept down from Vesuvius during the eruption of 79, and the hard crust which thus sealed up the city came in turn to be covered by lava-flows from subsequent eruptions.

It sometimes happens that volcanic mud is formed by the mingling of hot ashes not directly with rain but with water from streams and lakes, or even, as in Iceland, with melted snow. A torrent of mud was one of the earliest symptoms of the violent eruption of Mont Pelée in Martinique in 1902.

Ejected Blocks.—When a volcano after a long period of repose starts into fresh activity, the materials which have accumulated in the crater are ejected, often mixed with blocks from the walls of the volcanic pipe, or from the older rocks on which the volcano stands. Masses of limestone ejected from Somma are scattered through the tuffs on the slopes of Vesuvius and contain many interesting minerals due to heating of the limestone. Similarly at Etna blocks of sandstone are changed to quartzite. A rock consisting of an aggregation of coarse ejected materials, including many large blocks, is known as a "volcanic agglomerate."

Cinders, Ashes and Dust.—After the throat of a volcano has been cleared out and a free exit established, the copious discharge of vapour is generally accompanied by the ejection of fresh lava in a fragmentary condition. If the ejected masses bear obvious resemblance to the products of the hearth and the furnace, they are known as "cinders" or "scoriae," whilst the small cinders not larger than walnuts often pass under their Italian name of "lapilli" (*q.v.*). When of globular or ellipsoidal form, the ejected masses are known as "bombs" (*q.v.*); if the lava has become granulated it is termed "volcanic sand"; when in a finer state of division it is called ash, or if yet more highly comminuted it is classed as dust; but the latter terms are sometimes used interchangeably. After an eruption the country for miles around the volcano may be covered with a coating of fine ash or dust, sometimes nearly white, like a fall of snow, but often greyish, looking rather like Portland cement; this dust insinuates itself into every crack and cranny, reaching the interior of houses even when windows and doors are closed. A heavy fall of ash or cinders may cause great structural damage, crushing the roofs of buildings by sheer weight, as was markedly the case at Ottajano and San Giuseppe during the eruption of Vesuvius in April 1906. On this occasion the dry ashes slipped down the sides of the volcanic cone like an avalanche, forming great ash-slides with ridges and furrows rather like barrancos, or ravines, caused by rain. The burial of Ottajano and San Giuseppe in 1906 by Vesuvian ejecta, mostly lapilli, has been compared with that of Pompeii in 79.

Lava.—The volcanic cinders, sand, ashes and dust described above are but varied forms of solidified lava, which is the most characteristic product of volcanic activity. It is composed of various silicates, or their constituents, in a state of mutual solution, and heavily charged with certain vapours or gases, principally water-vapour, superheated and under pressure. The lava differs from the magma before eruption, inasmuch as water and various volatile substances may be expelled on extrusion.

The rapidity of a lava flow is determined partly by the slope of the bed over which it moves and partly by the consistency of the lava, this being dependent on its chemical composition and on the conditions of cooling. In an eruption of Mauna Loa, in Hawaii, in 1855, the lava was estimated to flow at a rate of 40 m. an hour; and at an eruption of Vesuvius in 1805 a velocity of more than 50 m. an hour, at the moment of emission, was recorded. The rapidity of flow is, however, rapidly checked as the stream advances, the retardation being very marked in small flows. Where lava travels down a steep incline there is naturally a great tendency to form a rugged surface, whilst a quiet flow over a flat plane favours smoothness. If the lava meet a precipice it may form a cascade of great beauty.

If, after a stream of lava has become crusted over, the underlying magma should flow away, a long cavern or tunnel may be formed. Should the flow be rapid the roof may collapse and the fragments, falling on to the stream, may be carried forward or become absorbed in the fused mass. The walls and roof of a lava-cave are occasionally adorned with stalactites, whilst the floor may be covered with stalagmitic deposits of lava. The volcanic stalactites are slender, tubular bodies, extremely fragile, often knotted and rippled. Beautiful examples of lava stalactites from Hawaii have been described by Prof. E. S. Dana.

Physical Structure of Lavas.—An amorphous vitreous mass may result from the rapid cooling of a lava on its extrusion from the volcanic vent. The common type of volcanic glass is known as obsidian (*q.v.*). In many cases the lava brings up myriads of crystals that have been developed during slow solidification in the heart of the volcano. Showers of crystals of leucite have occurred at Vesuvius, of anorthoclase at Mt. Erebus, of labradorite at Etna and of pyroxene at Vesuvius, Etna and Stromboli. These

"intratelluric crystals" were floating in the molten magma, and had they remained in suspension, this magma would have enveloped them as a ground-mass or base. A rock so formed is generally known as a "porphyry," and the structure as porphyritic. In such a lava the large crystals, or phenocrysts, represent an early phase of consolidation and the minerals of the matrix a later stage. For a discussion of the chemical and mineralogical composition of lavas *see* PETROLOGY.

In the course of the life of a volcano the lava which it emits may vary within moderate limits, being at one time more acid at another more basic. Such changes are sometimes connected with a shifting of the axis of eruption. Thus at Etna the lavas from the old axis of Trifoglietto in the Val del Bove were andesites, with about 55% of silica, but those rising in the present conduit are basaltic, with a silica-content of only about 50%. Other instances could be given.

Capillary Lava.—A filamentous form of lava well known at Kilauea, in Hawaii, is termed *Pele's hair,* after Pele, the goddess of the Hawaiian volcanoes. It resembles the artificial material known as "slag wool"—a material formed by injecting steam into molten slag from a blast-furnace.

Pumiceous Lava.—The copious disengagement of vapour in a glassy lava gives rise to the light cellular or spongy substance, full of microscopic pores, known as pumice (*q.v.*). It is usually, though not invariably, produced from an acid lava, and may be regarded as the solidified foam of an obsidian. During the eruption of Krakatoa in 1883 enormous quantities of pumice were ejected, and were carried by the sea to vast distances, until they ultimately became water-logged and sank. Professor Judd found the pumice to consist of a vitreous lava greatly inflated by imprisoned vapours.

Water in Lavas.—Whether an eruption is of an explosive or a tranquil character must depend largely, though not wholly, on the chemical composition of the magma, especially on the water-content. By relief of pressure on the rise of the column in the volcanic channel, or otherwise, more or less steam will be disengaged, and if in large quantity this must become, with other vapours, a projectile agency of enormous power. The precise physical condition in which water exists in the magma is a matter of speculation.

Volcanic Vapours.—It seems not unlikely that the vapours and gases exist in the volcanic magma in much the same way that they can exist in molten metal. It appears that many igneous rocks contain gases locked up in their pores, not set free by pulverization, yet capable of expulsion by strong heat. The gases in rocks have been the subject of elaborate study by R. T. Chamberlin, whose results appear in publication No. 106 of the Carnegie Institution of Washington.

After the surface of a lava-stream has become crusted over, vapour may still be evolved in the interior of the mass, and in seeking release may elevate or even pierce the crust. Small cones may thus be thrown up on a lava-flow, and when vapour escapes from terminal or lateral orifices they are known as "spiracles." The steam may issue with sufficient force to toss up the lava in little fountains. When the lava is very liquid, as in the Hawaiian volcanoes, it may after projection from the blow-hole fall back in drops and plastic clots, which on consolidation form, by their union, small cones.

Vapour-vents connected with volcanoes are often known as fumaroles (*q.v.*). (*See* also GEYSER and SOLFATARA.)

In some volcanoes much sulphur, formed by a reaction between sulphuretted hydrogen and sulphur dioxide, is deposited. Chlorides also are sometimes formed in considerable quantity, especially ammonium chloride and common salt. The presence of various metallic chlorides and sulphides has often been observed. The pale flames sometimes seen in craters are due to the burning of hydrogen and various hydrocarbons, this being the only true combustion connected with vulcanicity: it is quite unimportant.

The Dust Cloud of Mt. Pelée.—The eruptions in Martinique and St. Vincent in the West Indies in 1902 furnished examples of a type of activity not previously recognized by vulcanologists, though, as Professor A. Lacroix has pointed out, similar phenomena have no doubt occurred elsewhere, especially in the Azores. By Dr. Tempest Anderson and Sir J. S. Flett, who were commissioned by the Royal Society to report on the phenomena, this type of explosive eruption is distinguished as the "Peléan type." Its distinctive character is found in the sudden emission of a dense black cloud of superheated and suffocating gases, heavily charged with incandescent dust, moving with great velocity and accompanied by the discharge of immense volumes of volcanic sand, which are not rained down in the normal manner but descend like a hot avalanche. In its typical form, the cloud at Pelée appeared as a solid bank, opaque and impenetrable, but having the edge in places hanging like folds of a curtain, and apparently of brown or purplish colour. Rolling along like an inky torrent, it produced in its passage intense darkness, relieved by vivid lightning. After leaving the crater, it underwent enormous expansion, and Anderson and Flett were led to suggest that possibly at the moment of emission it might have been partly in the form of liquid drops, which on solidifying evolved large volumes of gas held previously in occlusion. The deadly effect of the blast seems to have been mostly due to the irritation of the mucous membrane of the respiratory passages by the fine hot dust—a serious aggravation of the calamity.

Forms of Volcanoes.—Those volcanic products which are solid when ejected, or which solidify after extrusion, tend to form by their accumulation around the eruptive vent a hill, which, though generally more or less conical, is subject to much variation in shape. It occasionally happens that the hill is composed wholly of ejected blocks, not themselves of volcanic origin. This rather exceptional type is represented in the Eifel by certain monticules which consist of fragments of altered Devonian slate.

In the ordinary paroxysmal type of eruption, however, cinders and ashes are shot upwards by the explosion and then descend in showers, forming around the orifice a mound, in shape rather like the diminutive cone of sand in the lower lobe of an hour-glass, Little cinder-cones of this character may be formed within the crater of a large volcano during a single eruption; whilst large cones are built up by many successive discharges, each sheet of fragmentary material mantling more or less regularly round the preceding layer. The symmetry of the hill is not infrequently affected by disturbing influences—a strong wind, for example, blowing the loose matter towards one side. The sides of a cinder cone have generally a steep slope, varying from 30° to 45°, depending on the angle of repose of the ejectamenta. Excellent examples of small scoria-cones are found among the puys of Auvergne in central France, whilst a magnificent illustration of this type of hill is furnished by Fuji-san, in Japan, which reaches an altitude of 12,000 ft. How such a cone may be rapidly built up was well shown by the formation of Monte Nuovo, near Pozzuoli—a hill 400 ft. high and 1½ m. in circumference, which is known from contemporary evidence to have been formed in the course of a few days in Sept. 1538.

Lava-cones are built up of streams of lava which have consolidated around the funnel of escape. Associated with the lava, however, there is usually more or less fragmentary matter, so that the cones are composite in structure and consequently more acute in shape than if they were composed wholly of lava. As the streams of lava in a volcano run at different times in different directions, they radiate from the centre, or flow from lateral or eccentric orifices, as irregular tongues, and do not generally form continuous sheets covering the mountain. When lava is the sole or chief element in the cone, the shape of the hill is determined to a great extent by the viscosity of the lava, its copiousness and the rapidity of flow. If the lava be highly basic and very mobile, it may spread to a great distance before solidifying, and thus form a hill covering a large area and rising perhaps to a great height, but remarkably flat in profile. Were the lava perfectly liquid, it would indeed form a sheet without any perceptible slope of surface. As a matter of fact, some lavas are so fluent as to run down an incline of 1°, and flat cones of basalt have in some cases a slope of only 10° or even less. The colossal mass of Mauna Loa, in Hawaii, forms a remarkably flat broad cone, spreading over a base of enormous area and rising 13,900 feet.

If the lava be less basic and less fusible, the hill formed by its

accumulation instead of being a low dome will take the shape of a cone with sides of higher gradient; in the case of andesite cones, for instance, the slope may vary from 25° to 35°. Acid rocks, or those rich in silica, such as rhyolites and trachytes, may be emitted as very viscous lavas tending to form dome-shaped or bulbous masses.

The Spine of Pelée.—A peculiar volcanic structure appeared at Mont Pelée in the course of the eruption of 1902, and was the subject of careful study by Professor A. Lacroix, Dr. E. O. Hovey, A. Heilprin and other observers. It appears that from fissures in the floor of the Étang Sec a viscous andesitic lava, partly quartziferous, was poured forth and rapidly solidified superficially, forming a dome-shaped mass invested by a crust or carapace. According to Lacroix, the crust soon became fractured, partly by shrinkage on consolidation and partly by internal tension, and the dome grew rapidly by injection of molten matter. Then there gradually rose from the dome a huge monolith or needle, forming a terminal spine, which in the course of its existence varied in shape and height, having been at its maximum in July 1903, when its absolute height was about 5,276 ft. above sea-level. The walls of the spine, inclined at from 75° to 90° to the horizon, were apparently slickensided, or polished and scratched by friction; masses were occasionally detached and vapours escaped.

The Crater.—The eruptive orifice in a normal volcano—the *bocca* of Italian vulcanologists—is usually situated at the bottom of a depression or cup, known as the crater. This hollow is formed and kept open by the explosive force of the elastic vapours, and when the volcano becomes dormant or extinct it may be closed, partly by rock falling from its crumbling walls and partly by the solidification of the lava which it may contain. If a renewed outburst occurs, the floor of the old crater may reopen or a new outlet may be formed at some weak point on the side of the mountain; hence a crater may, with regard to position, be either terminal or lateral. The position of the crater will evidently be also changed on any shifting of the general axis of eruption. Vesuvius suffered a reduction of several hundred feet during the great eruption of 1906, the east side of the cone having lost, according to V. R. Matteucci, nearly 400 feet.

Whilst in many cases the crater is a comparatively small circular hollow around the orifice of discharge, it forms in others a large bowl-like cavity, such as is termed in some localities a "caldera." In Hawaii the craters are wide pits bounded by nearly vertical walls, showing stratified and terraced lavas and floored by a great plain of black basalt, sometimes with lakes of molten lava. Prof. W. H. Pickering compares the lava-pits of Hawaii to the crater-rings in the moon. Some of the pit-craters here are of great size, but none comparable with the greatest of the lunar craters. Dr. G. K. Gilbert, however, has suggested that the ring-shaped pits on the moon are not of volcanic origin, but are depressions formed by the impact of meteorites. Similarly the "crater" of Coon Butte, near Canyon Diablo, in Arizona, which is 4,000 ft. in diameter and 500 ft. deep, has been regarded as a vast pit due to collision of a meteorite of prodigious size. Probably the largest terrestrial volcanic crater is that of Aso-san, in the isle of Kiushiu (Japan), which is a huge oval depression estimated by some observers to have an area of at least 100 sq.m.

On the floor of the crater ejected matter may accumulate as a conoidal pile; and if such action be repeated in the crater of the new cone, a succession of concentric cones will ultimately be formed. The walls of a perfect crater form a ring, giving the cone a truncated appearance, but the ring may suffer more or less destruction in the course of the history of the mountain. A familiar instance of such change is afforded by Vesuvius. The mountain now so called, using the term in a restricted sense, is a huge composite cone built up within an old crateral hollow, the walls of which still rise as an encircling rampart on the N. and N.E. sides, and are known as Monte Somma; but the S. and S.W. sides of the ancient crater have disappeared, having been blown away during some former outburst, probably the eruption of 79.

Much of the fragmental matter ejected from a volcano rolls down the inside of the crater, forming beds of tuff which incline towards the central axis, or have a centroclinal dip. On the contrary, the sheets of cinder and lava which form the bulk of the cone slope away from the axis, or have a dip that is sometimes described as peri-centric. After the eruption of Krakatoa in 1883 a magnificent natural section of the great cone of Rakata, at the S. end of the island, was exposed—the northern half having been blown away—and it was then evident that this mountain was a solid cone, which was built up of a great succession of irregular beds of tuff and lava, braced together by intersecting dykes.

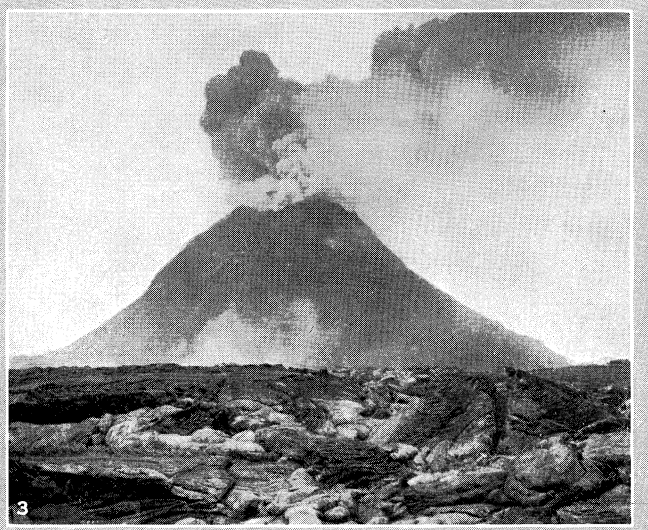
Parasitic Cones.—In the case of a lofty volcano the column of lava may not have sufficient ascensional force to reach the crater at the summit, or at any rate it finds easier means of egress at some weak spot, often along radial cracks, on the flanks of the mountain. Thus at Etna, which rises to a height of more than 10,800 ft., the eruptions usually proceed from lateral fissures, sometimes at least half-way down the mountain-side. When fragmental materials are ejected from a lateral vent a cinder-cone is formed, and by frequent repetition of such ejections the flanks of Etna have become dotted over with hundreds of scoria-cones much like the puys of Auvergne, the largest (Monte Minardo) rising to a height of as much as 750 ft. Hills of this character, seated on the parent mountain, are known as parasitic cones, minor cones, lateral cones, etc. Such subordinate cones often show a tendency to a linear arrangement, rising from vents or *bocche* along the floor of a line of fissure. Thus in 1892 a chain of five cones arose from a rift on the S. side of Etna, running in a N. and S. direction, and the hills became known as the Monti Silvestri, after Professor Orazio Silvestri of Catania. This rift, however, was but a continuation of a fissure from which there arose in 1886 the series of cones called the Monti Gemmellaro, while this in turn was a prolongation of a rent opened in 1883.

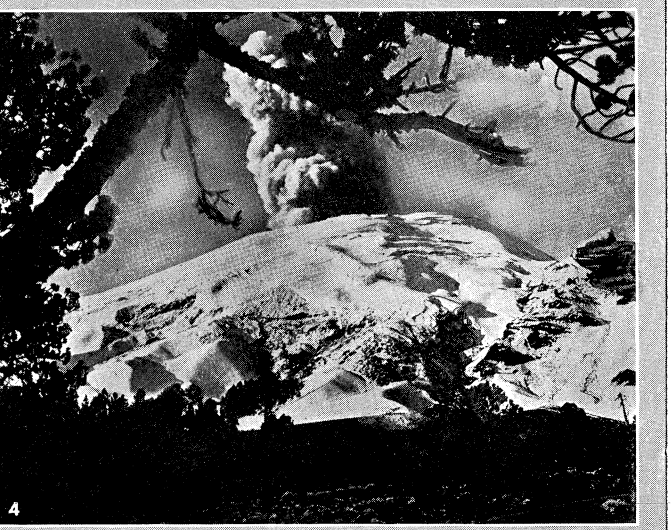
Fissure and Plateau Eruptions.—In certain parts of the world there are vast tracts of basaltic lava with little or no evidence of cones or of pyroclastic accompaniment. To explain their formation von Richthofen suggested that they represent great floods of lava which were poured forth not from ordinary volcanic craters with more or less explosive violence, but from great fissures in the earth's crust, whence they may have quietly welled forth and spread as a deluge over the surface of the country. The eruptions were effusive rather than explosive. At the present day true fissure eruptions seem to be of rather limited occurrence, but excellent examples are furnished by Iceland. Here there are vast fields of black basalt, formed of sheets of lava which have issued from long chasms, studded in most cases with rows of small cones, but these generally so insignificant that they make no scenic features and might be readily obliterated by denudation.

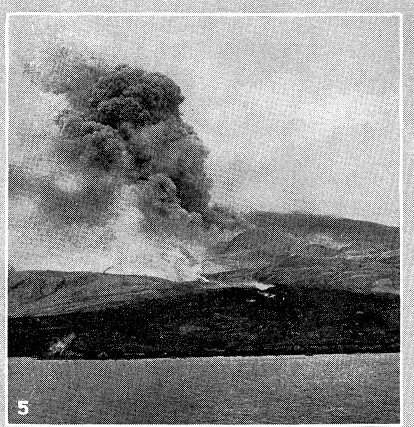
It is believed that fissure eruptions must have played a far more important part in the history of the earth than eruptions of the familiar cone-and-crater type, the latter representing indeed only a declining phase of vulcanism. Sir Archibald Geikie, who specially studied the subject of fissure eruptions, regarded the Tertiary basaltic plateaux of N.E. Ireland and the Inner Hebrides as outflows from fissures, which are represented by the gigantic system of dykes that form so marked a feature in the geological structure of the northern part of Britain and Ireland. These dykes extend over an area of something like 40,000 sq.m., while the outflows form an aggregate of about 3,000 ft. in thickness. In parts of Nevada, Idaho, Oregon and Washington, sheets of late Tertiary basalt from fissure eruptions occupy an area of about 200,000 sq.m., and constitute a pile at least 2,000 ft. thick. In India the "Deccan traps" represent enormous masses of volcanic matter, probably of like origin but of Cretaceous date, whilst South Africa furnishes other examples of similar outflows.

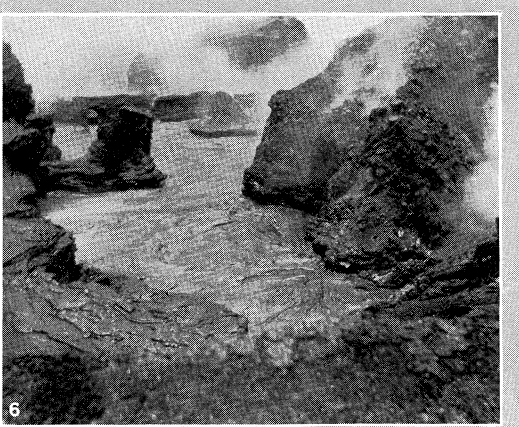
Professor J. W. Gregory recognized in the Kapte plains of East Africa evidence of a type of vulcanism, which he distinguished as that of "plateau eruptions"; according to him a number of vents opened at the points of intersection of lines of weakness in a high plateau, giving rise to many small cones, and the simultaneous flows of lava from these cones united to form a broad sheet.

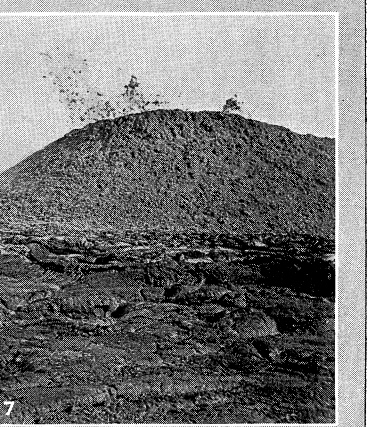
Submarine Volcanoes.—Since much of the face of the earth is covered by the sea, it seems likely that volcanic eruptions must frequently occur on the ocean-floor. When, as occasionally though not often happens, the effects of a submarine eruption











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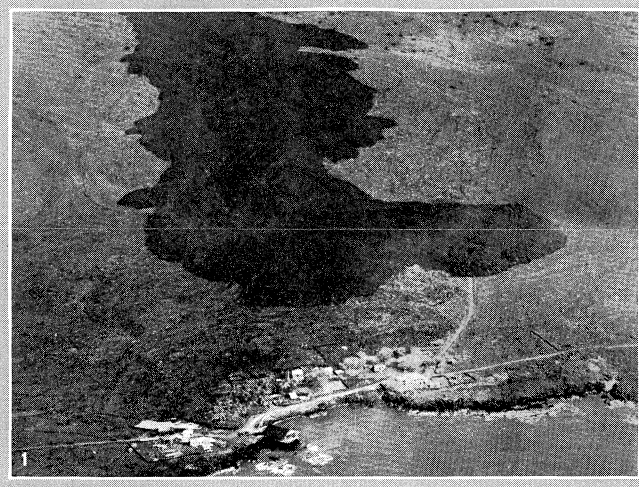
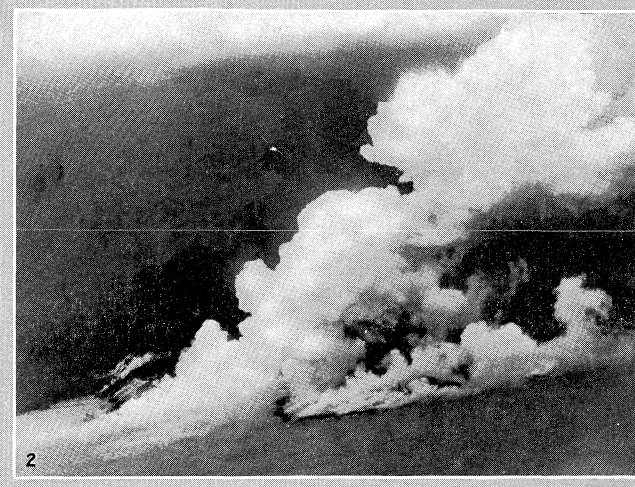
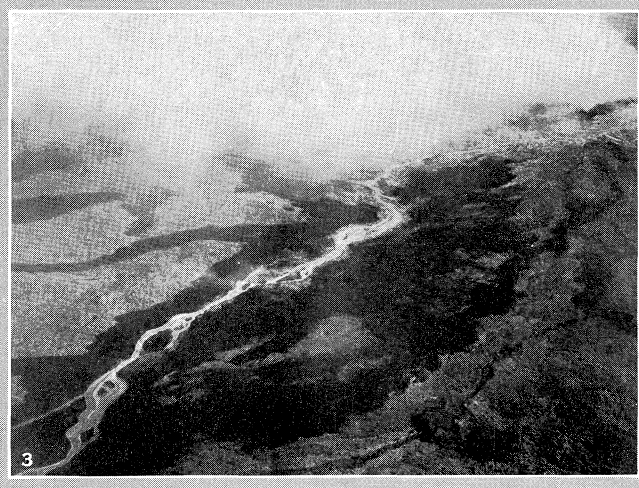
VOLCANOES IN ACTION

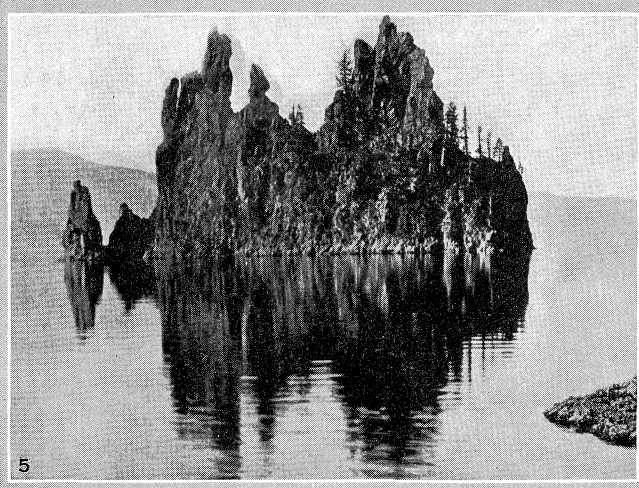
1. Firepit of Kilauea volcano, Hawaii, as it appeared at night during its active period in 1919 and 1920
2. Another view of the Kilauea volcano firepit. This volcano, situated in the Hawaii National Park, was very active in 1920
3. Looking down at the boiling bottom of Mt. Vesuvius' crater 500 ft. below the edge. The central cone of the crater rises to a height of 200 feet
4. Mt. Popocatapetl, near Mexico City, Mexico, in action
5. Eruption of Mt. Pelée near Rivière Blanche, Martinique, W.I.
6. Seething crater of Kilauea volcano
7. Eruption of Mt. Mokuaweoweo in the Hawaiian Islands. Large pieces of lava covered rocks are being thrown high into the air

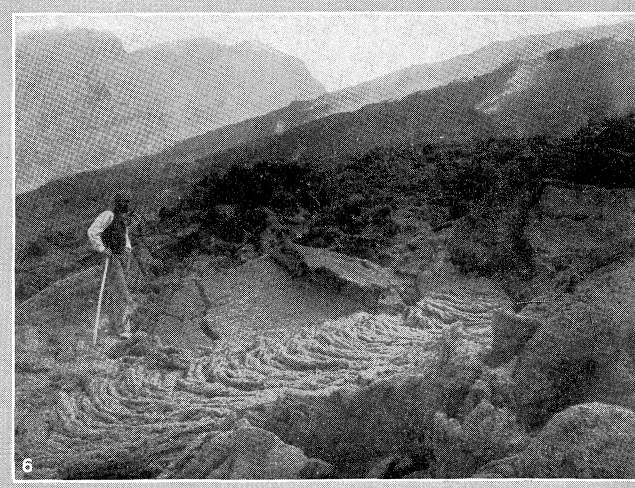
VOLCANO











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ACTIVE AND INACTIVE VOLCANOES

1. Lava stream from erupting Mauna Loa approaching fishing village of Hoopulou, Hawaii. Later the village was destroyed despite prayers and offerings of sacrifices to Pele, goddess of fire
2. Mauna Loa lava flowing into the ocean at Hoopulou Landing. Clouds of steam rise high in the air
3. Stream of molten lava from Mauna Loa flowing down the mountainside in a path of cooled and hardened lava. Spectators were able to approach to the very edge of the molten stream
4. Great mass of corded lava in the crater of Kilauea volcano in Hawaii
5. "Phantom Ship," a small island in Crater Lake, Oregon, supposed to resemble a sailing vessel. Owing to atmospheric changes it frequently seems to disappear from view against the background of Dutton Cliff
6. Corded lava at Mt. Vesuvius following the eruption of 1898. Mt. Somma may be seen in the distance to the left

are observed during the disturbance, it is seen that the surface of the sea is violently agitated, with copious discharge of steam; the water passes into a state of ebullition, perhaps throwing up huge fountains; shoals of dead fishes, with volcanic cinders, bombs and fragments of pumice, float around the centre of eruption, and ultimately a little island may appear above sea-level. This new land is the peak of a volcanic cone which is based on the sea-floor, and if in deep water the submarine mountain must evidently be of great magnitude. Christmas Island in the Indian Ocean, described by Dr. C. W. Andrews, appears to be a volcanic mountain, with Tertiary limestones, standing in water more than 14,000 ft. deep. Many volcanic islands, such as those abundantly scattered over the Pacific, must have started as submarine volcanoes which reached the surface either by continued upward growth or by upheaval of the sea-bottom. Etna began its long geological history by submarine eruptions in a bay of the Mediterranean, and Vesuvius in like manner represents what was originally a volcano on the sea-floor.

One of the best examples of a submarine eruption resulting in the formation of a temporary island occurred in 1831 in the Mediterranean between Sicily and the coast of Africa, where the water was known to have previously had a depth of 100 fathoms. After the usual manifestations of volcanic activity an accumulation of black cinders and ashes formed an island which reached at one point a height of 200 ft., so that the pile of erupted matter had a thickness of about 800 feet. The new island, which was studied by Constant Prévost, became known in England as Graham's Island, in France as Ile Julie and in Italy by various names, among them Isola Ferdinandea. Being merely a loose pile of scoriae, it rapidly suffered erosion by the sea, and in about three months was reduced to a shoal called Graham's Reef. In the year 1891 a submarine eruption occurred in the neighbourhood of the isle of Pantellaria in the same waters, but it gave rise to no island. A well-known instance of a temporary volcanic island was furnished by Sabrina—an islet of cinders thrown up by submarine eruptions in 1811, off the coast of St. Michael's, one of the Azores. The island of Bogosloff, or Castle Island, in Bering Sea, about 40 m. W. of Unalaska Island, is a volcanic mass which was first observed in 1796 after an eruption. In 1883 another eruption in the neighbouring water threw up a new volcanic cone of black sand and ashes, known as New Bogosloff or Fire Island, situated about ½ m. N.W. of Old Bogosloff, with which it was connected by a low beach.

Mud Volcanoes.—Two distinct sets of phenomena are thus described. One type is due to the escape of gas from petroleum-bearing strata and has nothing to do with vulcanicity. Many of the most-quoted examples belong to this group, such as those of the Crimea, the Caspian and Burma. There are, however, true volcanic outbursts which yield mostly mud, that is, mixtures of water and fine volcanic material. They are closely related to geysers (*q.v.*), the chief difference being that the water is more or less muddy, instead of clear. In some cases the material emitted is quite pasty. True mud-volcanoes occur in Iceland, Sicily and in fact in many volcanic areas.

GEOGRAPHICAL DISTRIBUTION

It is a matter of frequent observation that volcanoes are most abundant in regions marked by great seismic activity. Although the volcano and the earthquake are not usually connected in the direct relation of cause and effect, yet in many cases they seem referable to a common origin. Both volcanic extrusion and crustal movement are means of relieving local strains in the earth's crust, and both are found to occur, as might reasonably be expected, in many parts of the earth where folding and fracture of the rocks have frequently happened and where mountain-making appears to be still in progress. Thus, volcanoes may often be traced along zones of crustal deformation, or folded mountain-chains, especially where they run along the oceanic basins.

The most conspicuous example of linear distribution is furnished by the great belt of volcanoes, which engirdles intermittently the huge basin of the Pacific; though here, as elsewhere in studying volcanic topography, regard must be paid to dormant and extinct centres as well as to those that are active at the present time. As volcanoes are in many cases ranged along what are commonly regarded as lines of fracture, it is not surprising that the centres of most intense vulcanicity are in many cases situated at the intersection of two or more fracture-lines. On the eastern side of the Pacific the great volcanic ring may be traced, though with many interruptions, from Cape Horn to Alaska. In South America the chain of the Andes between Corcovado in the south and Tolima in the north is studded at irregular intervals with volcanoes, some recent and many more extinct, including the loftiest volcanic mountains in the world. The grandest group of South American volcanoes, though mostly quiescent, is in Ecuador. Cotopaxi, seen in activity by E. Whymper in 1880, has, according to him, a height of 19,613 ft., whilst Sangay is said to be one of the most active volcanoes in the world. The volcanic rock called andesite was so named by L. von Buch from its characteristic occurrence in the Andes. It is notable that the volcanic rocks throughout the great Pacific belt present much similarity in composition. The volcanoes of Ecuador have been described in detail by A. Stübel and others (*see* ANDES). Central America contains a large number of active volcanoes and solfataras, many of which are located in the mountains parallel to the western coast; Guatemala is peculiarly rich in volcanoes, as described by Dr. Tempest Anderson, who visited the country in 1907; and the plateau of Mexico is the seat of several active volcanoes which occur in a band stretching across the country from Colima in the west to Tuxtla near Vera Cruz. The highest of these is Orizaba (18,200 ft.), which is known to have been active in the 16th century. Popocatepetl ("the smoking mountain") reaches a height of about 17,880 ft., and from its crater sulphur was at one time systematically collected. The famous volcano of Jorullo, near Toluca and about 120 m. from the sea, has been the centre of much scientific discussion since it was regarded by Humboldt, who visited it in 1803, as a striking proof of the elevation theory; it came into existence rapidly during an eruption which began in Sept. 1759, when it was said by unscientific observers that the ground became inflated from below.

In the United States very few volcanoes are active at the present day, though many have become extinct only in times that are geologically recent. An eruption occurred in 1857 at Tres Virgines, in the south of California, and Lassen's Peak (California) renewed its activity in a mild way a few years ago. The Mono Valley craters and Mount Shasta, in California, are extinct. The Cascade range contains numerous volcanic peaks, but only few show signs of activity. Mount Hood, in Oregon, exhales vapour, as also does Mount Rainier in Washington. Mount St. Helens (Washington) was in eruption in 1841 and 1842; and Mount Baker (Washington), the most northern of the volcanoes connected with the Cascade range, was reported active in 1843.

Volcanic activity is prominent in Alaska, along the Coast range and in the neighbouring islands. Mount Fairweather has probably been in recent activity, and the lofty cone of Mount Wrangell, on Copper river, is reported to have been in eruption in 1819. In the neighbourhood of Cook's Inlet there are several volcanoes, including the island of St. Augustine. Unimak Island has two volcanoes, which have supplied the natives with sulphur and obsidian. The Aleutian volcanic belt is a narrow, curved chain of islands, extending from Cook's Inlet westward for nearly 1,600 miles. It is notable that the convexity of the curve faces the ocean.

From the Aleutians the volcanic band of the Pacific changes its direction, and, passing to the peninsula of Kamtchatka, where 14 volcanoes are said to be active, turns southward and forms the festoon of the Kurile Islands. Here again the convexity of the insular arc is directed towards the ocean. This volcanic archipelago leads on to the great islands of Japan. Of the 54 volcanoes recognized as now active or only recently extinct in Japan, the best known is the graceful cone of the sacred mountain Fuji-san, but others less pretentious are far more dangerous. The great eruption of Bandai-san, about 120 m. N. of Tokio, which occurred in 1888, blew off one side of the peak called Kobandai, removing, according to Prof. Sekiya's estimate, about 2,982 million tons of material.

South of the Japanese archipelago the train of volcanoes passes through some small islands in or near the Liu Kiu group and thence onward by Formosa to the Philippines, where subterranean activity finds abundant expression in earthquakes and volcanoes. After leaving this region the linear arrangement of the eruptive centres becomes less distinctly marked, for almost every island in the Moluccas and the Sunda archipelago teems with volcanoes, solfataras and hot springs. Possibly, however, a broken zone may be traced from the Moluccas through New Guinea and thence to New Zealand, perhaps through eastern Australia.

The great volcanic district in New Zealand is situated in the northern part of North Island, memorable for the eruption of Tarawera in 1886. This three-peaked mountain on the south side of Lake Tarawera, not previously known to have been active, suddenly burst into action; a huge rift opened, and Lake Rotomahana subsided, with destruction of the famous sinter terraces.

Far to the south, on Ross Island, off South Victoria Land, in Antarctica, are the volcanoes Erebus and Terror, the former of which is active. These are often regarded as remotely related to the Pacific zone, but Dr. G. T. Prior has shown that the Antarctic volcanic rocks which he examined belonged to the Atlantic and not the Pacific type.

Within the great basin of the Pacific, imperfectly surrounded by its broken girdle of volcanoes, there is a vast number of scattered islands and groups of islands of volcanic origin, rising from deep water, and having in many cases active craters. The most important group is the Hawaiian archipelago, where there is a chain of at least 15 large volcanic mountains—all extinct, however, with the exception of three in Hawaii, namely Mauna Loa, Kilauea and Hualalai; and of these Hualalai has been dormant since 1811. It is noteworthy that the two present gigantic centres of activity, though within 20 m. of each other, appear to be independent in their eruptivity. The volcanic regions of the Pacific are connected with those of the Indian Ocean by a grand train of islands rich in volcanoes, stretching from the west of New Guinea through the Moluccas and the Sunda Islands, where they form a band extending axially through Java and Sumatra. Here is situated the principal theatre of terrestrial vulcanicity, apparently representing an enormous fissure, or system of fissures, in the earth's crust, sweeping in a bold curve, with its convexity towards the Indian Ocean. Numerous volcanic peaks occur in the string of small islands to the east of Java—notably in Flores, Sumbawa, Lombok and Bali; and one of the most terrific eruptions on record in any part of the world occurred in the province of Tomboro, in the island of Sumbawa, in 1815. Java contains within its small area as many as 49 great volcanic mountains—active, dormant and extinct. The most famous is Papandayang, which erupted with great suddenness and violence in 1772.

The little uninhabited island of Krakatoa in the Strait of Sunda appears to be situated at the intersection of two curved fissures, and the island itself represents part of the basal wreck of what was once a volcano of gigantic size. After two centuries of repose, a violent catastrophe occurred in 1883, whereby part of the island was blown away. This eruption and its effects were made the subject of careful study by Verbeek, Bréon and Judd.

Through the great island of Sumatra, a chain of volcanoes runs longitudinally, and may possibly be continued northwards in the Bay of Bengal by Barren Island and Narcondam—the former an active and the latter an extinct volcano. On the western side of the Indian Ocean a small volcanic band may be traced in the islands of the Mascarene group, several craters in Réunion (Bourbon) being still active. Far south in the Indian Ocean are the volcanic islands of New Amsterdam and St. Paul. The Comoro Islands in the channel of Mozambique exhibit volcanic activity, whilst in East and Central Africa there are several centres, mostly extinct but some partially active, associated with the Rift Valleys. The enormous cones of Kenya and Kilimanjaro are extinct, but on one of the summits of the latter, a crater is still preserved. The Mfumbiro volcanoes, S. of Lake Edward, rise to a height of more than 14,700 feet. Kirunga, N. of Lake Kivu, is still partially active. Elgon is an old volcanic peak, but Ruwenzori is not of volcanic origin. On the west side of Africa, the Cameroon Peak is a volcano which was active in 1909, and the island of Fernando Po is also volcanic. Along the Red Sea there are not wanting several examples of volcanoes, such as Jebel Teir, the Twelve Apostles islands, and Aden, which is situated on the wreck of an old volcano.

Passing to the Atlantic, a broken band of volcanoes, recent and extinct, may be traced longitudinally through certain islands, some of which rise from the great submarine ridge that divides the ocean, in part of its length, into an eastern and a western trough. The northern extremity of the series is found in Jan Mayen, an island in the Arctic, where an eruption occurred in 1818. Iceland, however, with its wealth of volcanoes and geysers, is the most important of all the Atlantic centres: according to Dr. T. Thoroddsen there are in Iceland about 130 post-glacial volcanoes, and it is known that from 25 to 30 have been in eruption during the historic period. Many of the Icelandic lava-flows, such as the immense flood from Laki in 1783, are referable to fissure eruptions, which are the characteristic though not the exclusive form of activity in this island. This type was also responsible for the sheets of old lava in the terraced hills of the Faroe Islands, and the Tertiary eruptions of the west of Scotland and the north of Ireland.

An immense gap separates the old volcanic area of Britain from the volcanic archipelagos of the Azores, the Canaries and the Cape Verde Islands. The remaining volcanic islands of the Atlantic chain, all now cold and silent, include Ascension, St. Helena and Tristan da Cunha.

An interesting volcanic region is found in the West Indies, where the Lesser Antilles—the scene of the great catastrophes of 1902—form a string of islands, stretching in a regular arc that sweeps in a N. and S. direction across the E. end of the Caribbean. Subject to frequent seismic disturbance, and rich in volcanoes, solfataras and hot springs, these islands seem to form the summit of a great earth-fold which, rising as a curved ridge from deep water, separates the Caribbean from the Atlantic. The volcanoes are situated on the inner border of the curve.

Vesuvius is the only active volcano on the mainland of Europe but in the Mediterranean there are Etna on the coast of Sicily; the Lipari Islands, with Stromboli and Vulcano in chronic activity; and farther to the east the archipelago of Santorin, which has erupted recently. Submarine eruptions have occurred also between Sicily and the coast of Africa; one in 1831 having—as we have seen above—given rise temporarily to Graham's Island, and another in 1891 appearing near Pantellaria, itself a volcanic isle. Of the extinct European volcanoes, some of the best known are in Auvergne, the Eifel, Bohemia and Catalonia, whilst the volcanic land of Italy includes the Euganean hills, the Alban hills, the Phlegraean Fields, etc.

The number of volcanoes known to be actually active on the earth is generally estimated at between 300 and 400, but there is reason to believe that this estimate is far too low. If account be taken of those volcanic cones which have not been active in historic time, the total will probably rise to several thousands.

THE CAUSES OF VULCANICITY

There is no doubt that the ultimate cause of vulcanicity is the internal heat of the earth; perhaps it would be more correct to say that vulcanicity is merely one of the expressions of the familiar fact that the interior of the earth is hotter than the exterior. The source of this heat is strictly not a geological question, and is fully discussed in the article EARTH, while many of its implications are dealt with under PETROLOGY.

It is self-evident that at great depths the pressure due to the weight of overlying rock must be enormous, and since it is known that magmas are rich in substances that may exist as gases at low pressures, the vapour-tension in depth must also be enormous, quite sufficient to drive material to the surface with explosive violence if a passage is opened for it. In some cases the eruption may actually be brought about by gas-pressure alone, which opens its own passage, and this is doubtless the usual procedure in later eruptions from a vent once established. But in the initiation of a new centre there is probably, as a rule, some other contributing

cause, which, so to speak, pulls the trigger and starts the explosion.

It is now generally held that such a cause is to be looked for in movements and fractures of the outer crust of the earth, however these may be brought about, a matter as yet by no means settled. The common coincidence of mountain-folding and vulcanicity, both in time and place, is highly significant. Folding produces lines of weakness and even actual fracture, and points of special weakness, such as the crossing of two fractures, become the seats of volcanoes, as has been set forth above.

It has long been noted that the majority of volcanoes are more or less near the sea, though in many cases the distances are actually considerable when measured in miles. This association, taken together with the emission of large quantities of steam during eruptions, naturally led to the theory that vulcanicity was due to the access of sea-water to the heated interior of the earth. There can be little doubt that the great explosion at Krakatoa in 1883 was actually due to this cause, but the eruption had begun before the water got in, the explosion being in reality a secondary effect. Access of water through fractures cannot be accepted as a general cause, and most volcanic water is probably of magmatic origin. We can only say that vulcanicity is due to the escape under pressure of heated material through channels of weakness in the earth's crust, and that these channels may be formed in several different ways: by folding and fracture, by compression or by tension; the character and products of the eruptions also varying somewhat in accordance with the different types of crust-movement concerned, as explained earlier in this article.

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VOLCANO ISLANDS, three small islands in the western Pacific Ocean, south of the Bonin Islands, forming part of the Japanese empire (annexed in 1891). They are also known as the Magellan Archipelago, and in Japan as Kwazan-retto (series of volcanic islands). They are situated between 24° and 26° N. and 141° and 142° E. Their names are Kita-iwo-jima (Santo Alessandro), Iwo-jima (Sulphur) and Minami-iwo-jima (Santo Agostino). Kita-iwo-jima—which, as its name (*kita*) implies, is the most northerly of the three—rises 2,520 ft. above the water, and Minami-iwo-jima, the most southerly, to 3,021 ft.

VOLCI: *see* VULCI.

VOLE, a name employed for several genera of rodents allied to the rats and mice and included in the family Muridae. The two common English forms are better known as the water-rat and the short-tailed field-mouse. Voles may be distinguished from rats and mice by their small eyes, blunt snouts, stouter build, inconspicuous ears, short limbs and tail and less brisk movements. They also differ in the structure of the cheek-teeth. The European field-vole (*Microtus agrestis*) is about the size of a mouse and does considerable damage to crops and garden-produce. The water-vole (*M. amphibius*) is larger, diurnal and aquatic. Largely vegetarian, it will also eat insects, mice and young birds. It is absent from Ireland, but extends from England to China. Numerous other species occur in Europe, north Asia and North America, while fossil voles occur in the Pliocene. (*See* RODENTIA.)

See Charles Elton, *Voles, Mice and Lemmings: Problems in Population Dynamics* (Oxford, 1942).

VOLENDAM, a small fishing village of the Netherlands in the province of North Holland, adjoining Edam on the shores of the Zuider Zee. It is remarkable for its quaint buildings and the picturesque costume of the villagers, who are of a singularly dark and robust type. Many artists have been attracted to settle here. Volendam had its origin in the building of the great sea dam for the new waterway to Edam in the middle of the 14th century. On the seaward side of the dike are some houses built on piles in the style of lake dwellings. Pop. (1940) 4,813.

VOLGA (Tatar: Etil, Itil or Atel; Finnish: Rau; in ancient times Rha and Oarus), the longest and most important river of European Russia, and the longest river of Europe. Its length is 2,325 m.; its drainage area covers 563,300 sq.m. and includes middle and eastern Russia, as well as part of south-eastern Russia. The Volga rises on the Valdai plateau at a height of 665 ft., in a small spring in 57° 15′ N., 32° 30′ E., west of Lake Seliger, flows through several small lakes, and after its confluence with the Runa, enters Lake Volga. Below that lake is a dam storing 10,000 million cu.ft. of water, so as to make possible the deepening of the channel as far as the Sheksna, during dry periods. After receiving the Sheksna the Volga flows south-east along a broad valley, consisting of a string of former wide lake beds, with a depth of 150–200 ft., in Permian and Jurassic deposits. It receives numerous tributaries from the north including the Unzha (365 miles). The Oka from the south-west (950 m.) rises in Orel, near the sources of tributaries of the Don and Dnieper, and receives the Upa, Zhizdra, Ugra, Moskva and Klyazma (left), and the Tsna with the Moksha (right).

The Oka and Volga unite at Nizhniy-Novgorod, and the Volga then enters a broad lacustrine depression which must have communicated with the Caspian in post-pliocene times. Its low-water level in this section is only 190 ft. above sea-level, and its width ranges from 350 to 1,750 yards. Islands appear and disappear each year after the spring floods. The Sura, bringing a volume of 2,700 to 22,000 cu.ft. per second enters on the right, as do the Svyaga and many smaller tributaries. The Volga then turns south-eastward and descends into another lacustrine depression, receiving the Kama, volume 52,500 to 144,400 cu.ft. per second, below Kazan, along which come the products of the Ural mining region; remains of molluscs still extant in the Caspian occur in this depression and in the lower Kama. The Volga then flows south-south-west, making a great bend at Samara to avoid the Zheguli extension of the Russian plateau. The Volga at Samara is only 54 ft. above sea-level. Along the whole of the bend, cliffs fringe the right bank, which the river is constantly undercutting, while from the left bank extends a great plain intersected by former channels of the river. At Stalingrad (Tsaritsyn) the river reaches its extreme south-western limit and is only 45 m. from the Don. In 1928 the Soviet government accepted estimates for the construction of a canal with sluices on the Don, to link these two rivers; it is hoped that the canal will be opened in 1935. The river then turns sharply to the south-east, flowing through the low Caspian steppes. A few miles above Stalingrad it sends off a branch, the Akhtuba, which accompanies it to the sea for 330 m. Low hills skirt the right bank, but on the left it anastomoses freely with the Akhtuba and often floods the country for 15 to 35 miles.

Efforts are being made to control the Volga here so as to lessen the annual washing away of fertile alluvial gardens. The delta begins 40 m. above Astrakhan and contains as many as 200 mouths. The Volga is constantly eroding its banks, especially during the spring floods, and towns and loading ports have constantly to be moved back, consequently the volume of suspended matter deposited on the Caspian shores is great; the level of that sea rises during the Volga floods.

Navigation.—There are six sections of the river for navigation. (1) From the Upper Volga Dam, 75 m. from the source, to Tver. Here rapids and shallows are numerous, and this part

is exclusively used for floating rafts. (2) From Tver to Rybinsk, which is the real head of Volga navigation. In this section the main traffic consists of barges for local trade; up to June 20, vessels drawing 2 ft. may use the river, but after that date 1 ft. 9 in. is the maximum possible draft, and the river becomes increasingly shallow, so that navigation may cease altogether. The influence of the Upper Volga Dam may give an extra 9 in. of depth. Above Rybinsk the Volga is joined by the Mologa, and at Rybinsk by the Sheksna, which is navigable and which is linked by the Marii and Württemberg canals with the basins of the Neva and Northern Dwina respectively. Fifteen thousand vessels enter the port per annum. (3) From Rybinsk to Nizhniy-Novgorod, 349 m., the normal draught of vessels is 3 ft. 6 in., but in years of low water, navigation may be completely suspended in July and August. In this section are 30 commercial landing stages and 20 harbours suitable for wintering vessels. (4) From Nizhniy-Novgorod to Kazan, 299 m., the normal draught is 5 feet. There are 40 commercial landing stages and 40 harbours, only ten of the latter being really ice-proof. (5) Kazan to Stalingrad, 938 m., normal draught 7 feet. There are 37 commercial landing stages and 28 harbours, six of which are really safe and ice-proof. (6) Stalingrad to the Caspian is divided into two parts (i.) Stalingrad to Astrakhan, 343 m. where the navigation is still of the river type and (ii.) Astrakhan to the Caspian, 71 m. a stretch of non-tidal estuary, very difficult for navigation, where continuous dredging is necessary to ensure even 8 ft. depth.

The great drawbacks to navigation are (1) the long winter frost, during which the river and its tributaries become sledge routes, the ice lasting from 90 to 160 days; the average date of break-up of ice is April 11 at Tver, the 25th at Kostroma, the 16th at Kazan, the 7th at Stalingrad and March 17 at Astrakhan (2) the shallowness of the river during late summer and the frequent formation of islands and their dissolution during flood time.

Fisheries.—The network of shallow and still *limans* or "cut-offs" in the delta of the Volga and the shallow waters of the northern Caspian, freshened as these are by the water of the Volga, the Ural, the Kura and the Terek, is exceedingly favourable to the breeding of fish, and as a whole constitutes one of the most productive fishing grounds in the world. As soon as the ice breaks up in the delta innumerable shoals of roach (*Leuciscus rutilus*) and trout (*Luciotrutta leucichthys*) rush up the river. They are followed by the great sturgeon (*Acipenser huso*), the pike, the bream and the pike perch (*Leucioperca sandra*). Later on appears the Caspian herring (*Clupea caspia*), which formerly was neglected, but has now become more important than sturgeon; the sturgeon *A. stellatus* and "wels" (*Silurus glanis*) follow, and finally the sturgeon *Acipenser güldenstadtii,* so much valued for its caviare. In search of a gravelly spawning-ground the sturgeon go up the river as far as Sarepta (250 m.). The lamprey, now extensively pickled, the sterlet (*A. ruthenus*), the tench, the gudgeon and other fluvial species also appear in immense numbers. Destructive exploitation at spawning time has much diminished the yield of the Volga fisheries, and the discharge of oil from steamers has also had an adverse effect.

History.—The Volga was probably known to the early Greeks, though it is not mentioned previous to Ptolemy. According to him, the Rha is a tributary of an interior sea, formed from the confluence of two great rivers, the sources of which are separated by 20 degrees of longitude. The Arab geographers throw little light on the condition of the Volga during the great migrations of the 3rd century, or subsequently under the invasion of the Huns, the growth of the Khazar empire in the southern steppes and of that of Bulgaria on the middle Volga. In the 9th century the Volga basin was occupied by Finnish tribes in the north and by Khazars and various Turkish races in the south. The Slavs, driven perhaps to the west, had only the Volkhov and the Dnieper, while the (Mohammedan) Bulgarian empire, at the confluence of the Volga with the Kama, was so powerful that for some time it was an open question whether Islam or Christianity would gain the upper hand, and Islam is strong in Kazan to-day. But, while the Russians were driven from the Black Sea by the Khazars, and later on by a tide of Ugrian migration from the north-east, a stream of Slavs moved slowly towards the north-east, down the upper Oka, into the borderland between the Finnish and Turkish regions. After two centuries of struggle the Russians succeeded in colonizing the fertile valleys of the Oka basin; in the 12th century they built a series of fortified towns on the Oka and Klyazma; and finally they reached the mouth of the Oka, there founding (in 1222) a new Novgorod—the Novgorod of the Lowlands, now Nizhniy-Novgorod. The great lacustrine depression of the middle Volga was thus reached; and when the Mongol invasion of 1239–42 came, it encountered in the Oka basin a dense agricultural population with many fortified and wealthy towns—a population which the Mongols found they could conquer, but were unable to drive before them as they had done so many of the Turkish tribes. This invasion checked, but did not stop, the advance of the Russians down the Volga. Two centuries elapsed before the Russians covered the 300 m. which separate the mouths of the Oka and the Kama and took possession of Kazan.

With the capture of Kazan (1552) the Russians found the lower Volga open to their boats, and eight years afterwards they were masters of the mouth of the river at Astrakhan. Two centuries more elapsed before the Russians secured a free passage to the Black Sea and became masters of the Sea of Azov and the Crimea; the Volga, however, was their route.

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VOLHYNIA, a province of Poland, having on the north the province of Polesie, on the west Lublin, on the south Tarnopol provinces, and on the east Russia. It is only half the old region of Volhynia, which, after belonging in turn to Russia, Poland and Russia again, was divided once more between the two after World War I. Area, 11,693 sq.mi. Pop. (1931) 2,081,501, of whom most are Ruthenians or Ukrainians, 16.5% Poles, about 15% Jews and other nationalities, so that Polish Volhynia, like Russian Volhynia, is almost entirely an Ukrainian country. It is thickly populated in most parts and has always been covered with large estates owned by Polish landowners. It is a plain, washed by the Bug and the tributaries of the Prypet, viz., the Turija, Stochod, Styr, Goryn and Slucz, flowing north from the southern uplands. The north is part of the Polesian forest area, the rest is fertile soil. The chief towns are Luck, Ostróg, Rowno, Dubno, Kowel and Krzemieniec. Volhynia was occupied by the U.S.S.R. in 1939 and by Germany in 1941.

VOLHYNIA, a former Government of Russia, now in the Ukrainian S.S.R. (*see* UKRAINE).

VOLITION, in psychology. *See* CONATION and PSYCHOLOGY.

VOLK, LEONARD WELLS (1828–1895), American sculptor, was born at Wellstown (now Wells), Hamilton county, New York, on Nov. 7, 1828. He first followed the trade of a marble cutter with his father at Pittsfield, Mass. In 1848 he opened a studio at St. Louis, Mo., and in 1855 was sent by his wife's cousin, Stephen A. Douglas, to Rome to study. Returning to America in 1857, he settled in Chicago, where he helped to establish an academy of design and was for eight years its head. Among his principal works are the Douglas monument at Chicago and the Soldiers' and Sailors' monument at Rochester, N.Y.; and statues of President Lincoln and Stephen A. Douglas in the Illinois State capitol at Springfield, Ill. In 1860 he made a life-mask (now in the National Museum, Washington) of Lincoln, of whom only one other, by Clark Mills in 1865, was ever made.

VOLKSRUST, a town of the Transvaal, near the Natal border, situated 5,429 ft. above sea-level, and 320 m. N.N.W. of Durban by rail. It was founded by the Boer Government in 1888 and was of some importance as a customs port of entry. It lost this function at the Union in 1910. It is now a market

centre for a pastoral district. Pop. (1936) 4,810 (3,003 white).

VOLLENHOVEN, CORNELIS VAN (1874–1933), Dutch jurist, was in 1901 appointed professor of colonial law in the University of Leyden. He had a wide reputation as an authority on the common law of the Dutch East Indies and on international law. His chief work is *Hetadatrecht van Nederlandsch-Indië* (The Common Law of the Dutch East Indies, 1906–18).

VOLNEY, CONSTANTIN FRANÇOIS CHASSEBOEUF, Comte de (1757–1820), French *savant,* was born at Craon (Maine-et-Loire) on Feb. 3, 1757, of good family; he was at first surnamed Boisgirais from his father's estate, but afterwards assumed the name of Volney. He spent some four years in Egypt and Syria, and published his *Voyage en Egypte et en Syrie* in 1787, and *Considérations sur la guerre des Turcs et de la Russie* in 1788. He was a member both of the States-General and of the Constituent Assembly. In 1791 appeared *Les Ruines, ou méditations sur les révolutions des empires,* an essay on the philosophy of history. Volney tried to put his politico-economic theories into practice in Corsica, where in 1792 he bought an estate and made an attempt to cultivate colonial produce. He was thrown into prison during the Jacobin triumph, but escaped the guillotine. He was some time professor of history at the newly founded École Normale. In 1795 he undertook a journey to the United States, where he was accused in 1797 of being a French spy sent to prepare for the reoccupation of Louisiana by France. He was obliged to return to France in 1798. The results of his travels took form in his *Tableau du climat et du sol des États-Unis* (1803). He was not a partisan of Napoleon, but, being a moderate man, a *savant* and a Liberal, was impressed into service by the emperor, who made him a count and put him into the senate. At the restoration he was made a peer of France. He became a member of the Institute in 1795. He died in Paris on April 25, 1820.

See G. Chinard, *Volney et l'Amérique* (1923).

VOLO, a seaport of Greece, on the E. coast of Thessaly, at the head of the gulf to which it gives its name. Pop. (1928, last census before World War II) 41,706. It is connected by rail with the main Athens-Salonika railway at Larissa. The anchorage is safe, vessels loading and discharging by lighters.

The *Kastro* (citadel) marks the site of Pagasae, whence the gulf took the name of Sinus Pagasaeus or Pagasicus. Here the Argonautic expedition was said to have sailed. In the fourth century it flourished under the tyrant Jason of Pherae. Two miles S. stand the ruins of Demetrias, one of the "Fetters of Greece," founded 290 B.C. by Demetrius Poliorcetes and a favourite residence of Macedonian kings. Germans occupied Volo in 1941.

VOLOGAESES, the name of five Parthian kings.

(1) Vologaeses I., son of Vonones II. by a Greek concubine (Tac. *Ann.* xii. 44), succeeded his father in A.D. 50 (Tac. *Ann.* xii. 14; *cf.* Joseph. *Ant.* xx. 3, 4). He gave the kingdom of Media Atropatene to his brother Pacorus, and occupied Armenia for another brother, Tiridates (Tac. *Ann.* xii. 50, xv. 2; Joseph, *Ant.* xx. 3, 4). This led to a long war with Rome (54–63), which was ably conducted by the Roman general Corbulo. The power of Vologaeses was weakened by an attack of the Dahan and Sacan nomads, a rebellion of the Hyrcanians, and the usurpation of Vardanes II. (Tac. *Ann.* xiii. 7, 37; xiv. 25; xv. 1; *cf.* Joseph. *Ant.* xx. 4, 2, where he is prevented from attacking the vassal king of Adiabene by an invasion of the eastern nomads). At last a peace was concluded, by which Tiridates was acknowledged as king of Armenia, but had to become a vassal of the Romans; he went to Rome, where Nero gave him back the diadem (Tac. *Ann.* xv. 1 ff.; Dio Cass. lxii. 19 ff., lxiii. 1 ff.); from that time an Arsacid dynasty ruled in Armenia under Roman supremacy. Vologaeses was satisfied with this result, and honoured the memory of Nero (Suet. *Nero,* 57), though he stood in good relations with Vespasian also, to whom he offered an army of 40,000 archers in the war against Vitellius (Tac. *Hist.* iv. 51; Suet. *Vespas.* 6; *cf.* Joseph. *Ant.* vii. 5, 2, 7, 3; Dio Cass. lxvi. 11). Soon afterwards the Alani, a great nomadic tribe beyond the Caucasus, invaded Media and Armenia (Joseph. *Bell.* vii. 7, 4); Vologaeses applied in vain for help to Vespasian (Dio Cass. lxvi. 11; Suet. *Domitian,* 2). It appears that the Persian losses in the east also could not be repaired; Hyrcania remained an independent kingdom (Joseph. *Bell.* vii. 7, 4; Aurel. Vict. *Epit.* 15, 4). Vologaeses I. died about A.D. 77. His reign is marked by a decided reaction against Hellenism; he built Vologesocerta (Balashkert) in the neighbourhood of Ctesiphon with the intention of drawing to this new town the inhabitants of the Greek city Seleucia (Plin. vi. 122).

(2) Vologaeses II., probably the son of Vologaeses I., appears on coins, which bear his proper name, in 77–79, and again 121–47. During this time the Parthian kingdom was torn by civil wars between different pretenders, which reached their height during the war of Trajan, 114–17. Besides Vologaeses II. we find on coins and in the authors Pacorus (78–*c.* 105), Artabanus III. (80–81), Osroes (106–29), Mithradates V. (*c.* 129–47) and some others; thus the Parthian empire seems during this whole time to have been divided into two or three different kingdoms.

(3) Vologaeses III., 147–91. Under him, the unity of the empire was restored. But he was attacked by the Romans under Marcus Aurelius and Verus (162–65). In this war Seleucia was destroyed and the palace of Ctesiphon burnt down by Avidius Cassius (164); the Romans even advanced into Media. In the peace, western Mesopotamia was ceded to the Romans (Dio Cass. lxxi. 1 ff., Capitolin. *Marc. Aur.* 8 f.; Verus 8, etc.). Vologaeses III. is probably the king Volgash of the Parsee tradition, preserved in the *Dinkart,* who gathered the writings of Zoroaster.

(4) Vologaeses IV., 191–209. He was attacked by Septimius Severus in 195, who advanced into Mesopotamia, occupied Nisibis and plundered Ctesiphon (199), but attempted in vain to conquer the Arabic fortress Atra; in 202 peace was restored.

(5) Vologaeses V., 209–*c.* 222, son of Vologaeses IV. Soon after his accession his brother Artabanus IV., the last Arsacid king, rebelled against him, and became master of the greater part of the empire (Dio Cass. lxxvii. 12). But Vologaeses V. maintained himself in a part of Babylonia; his dated coins reach down to A.D. 222. (Ed. M.)

VOLOGDA, a region of the Russian S.F.S.R. Area 57,529 sq.mi. Pop. (1939) 1,662,258. The regions of Archangel, Gorky, Yaroslavl, Kalinin and Leningrad fringe it, as does the Karelian-Finnish S.S.R.

Much of it was under ice during the glacial epoch, and it is a region of boulder clay, marsh, lakes and numerous streams. The largest lakes are Kubensk and Lacha, and the rivers include the Sukhona, flowing northwest from Lake Kubensk, and the upper course of the Onega and of the Vaga, both flowing northward, the former into the Arctic ocean and the latter joining the northern Dvina.

Nearly half of the region is covered with coniferous forest, densest in the north, and there are vast marshes.

The south has been largely cleared of forest and in spite of the poor soil and difficult climatic conditions, crops are raised. The climate is continental and the winter long. Average January temperature at Vologda 10.7° F, July 63.5° F. The climate is variable from year to year, and early autumn frost or unduly prolonged spring frost may ruin the crops.

The rainfall is mainly in July and August and the dry spring and rainy summer are unfavourable to grain crops; it varies from 12 to 20 in. per annum.

The chief crops are winter rye (37.9%) and oats (38.4%). Barley, flax, potatoes, summer wheat, grasses, peas and hemp are also grown in small quantities. The poor soil and need for careful manuring and preparation mean that 50 working days must go for soil preparation as against 15 days in the Kuban—Black Sea district. Cultivation provides 30% of the income of the region, and stock raising and its dependent industries, 40%. Dairy cattle, of the Kholmogory breed in the north and the Yaroslavl breed in the south, are raised and dairying developed rapidly after the railway provided an outlet for butter. There are about 400 dairy artels which co-operate for the purchase of separators and butter coolers and for sales, and refrigerators, new factories and small electric stations were built. Horses, sheep and pigs are also raised, the latter are increasing in dependence on the dairy industry.

Poultry keeping is slowly developing. The timber industry is well developed. The greater part of timber is exported to western Europe. By 1930 the soviet union had become one of the principal lumber exporting countries of the world. In dependence on the industry there are paper manufactures and cellulose and wood pulp factories.

The railway from Moscow to Archangel goes northwards through Vologda and in 1916 the single track was made double, thus much increasing its usefulness, and there are railway links from the town of Vologda to Leningrad and to the Kirov-Molotov railway. The Sukhona is a navigable waterway linking with the northern Dvina, and there is a canal linking Lake Kubensk with the Sheksna, a tributary of the Volga. The population is mainly Russian.

Vologda, the chief town of the above region, situated on the Vologda river above its confluence with the navigable Sukhona river, in 59° 14′ N., 39° 43′ E. Pop. (1939) 95,194. The town is a railway junction, and has railway and steamer repair yards and manufactures agricultural implements, leather, beer, pottery, glass and cement.

There is a municipal electricity and water supply. It grew rapidly after the railway developed, and has numerous trading enterprises, collecting local products for export to Archangel, Leningrad and Moscow.

Its trade is very ancient; it was founded as a colony of Novgorod in 1147, when the fur trade was at its height. The Tatars, in alliance with the Prince of Tver, plundered it in 1273, but it soon recovered. Moscow and Novgorod disputed possession of it until 1447, when it was definitely annexed to the former. The opening of Archangel as a port in 1553 made it the chief depot for goods for the north. It was devastated by the Poles in 1613 and by plague in 1648. With the foundation in 1703 of St. Petersburg (Leningrad) trade went via the Baltic and Vologda declined, but developed again after the building of the railway to Archangel.

VOLPI, COUNT GIUSEPPE (1877–), Italian statesman, was born at Venice on Nov. 19, 1877. In his youth he travelled extensively in the Balkans and the East, taking special note of local economic problems. In 1912 he was employed in the preliminary negotiations for the Peace of Lausanne, which assured for Italy the possession of the Dodekanese, and was one of the Italian delegates at Ouchy. In 1913 he was vice-president of the Balkan financial conferences. Volpi was a great figure in Italian industry and finance; he originated the proposal for the development of the port of Venice, and executed the hydroelectric scheme in the Veneto, and in part of Emilia and Venezia Giulia.

During the World War, Volpi, who was a keen interventionist, served on the Monfalcone front. In 1919 he was a member of the Supreme Economic Council in Paris, in 1921 governor of Tripolitana, where he remained until 1925. He carried out a successful campaign in 1922–23, and then established peace and carried out a bold programme of economic reconstruction. For his services he was created Count Volpi of Misurata. Volpi was chairman of the *Associazione fra la Società Italiana per Azione,* and was the trusted representative of Italian commerce and industry. These considerations and his success in Tripoli led Mussolini to appoint him minister of finance in July 1925, when the dissatisfaction with Stefani's finance administration was acute. Volpi concluded the arrangements for the settlement of the Italian debt to America (Nov. 12, 1925), and to Great Britain (Jan. 27, 1926).

VOLSCI, ancient Italian people who were prominent in the history of the first century of the Roman Republic. They then inhabited the partly hilly, partly marshy district of the S. of Latium, bounded by the Aurunci and Samnites on the S., the Hernici on the E., and stretching roughly from Norba and Cora in the N. to Antium in the S. They were among the most dangerous enemies of Rome, and frequently allied with the Aequi (q.v.). From the little town of Velitrae (Velletri) in the Volscian territory, the birthplace of Augustus, comes a very interesting though brief inscription dating probably from early in the 3rd century B.C. It is cut upon a small bronze plate (now in the Naples Museum), which must have once been fixed to some votive object.

The language of this inscription shows the very marked peculiarities which rank it close beside the language of the Iguvine Tables (*see* UMBRIAN). It shows on the one hand the labialization of the original velar *q* (Volscian *pis*=Latin *quis*), and on the other hand it palatalizes the guttural *c* before a following *i* (Volscian *façia*=Latin *faciat*). Like Umbrian also, it has degraded all the diphthongs into simple vowels.

The name *Volsci* belongs to the -CO- group of tribal names in the centre, and mainly on the west coast, of Italy, all of whom were subdued by the Romani before the end of the 4th century B.C.; and many of whom were conquered by the Samnites about a century or more earlier. They are, from south to north, *Osci, Aurunci, Hernici, Marruci, Falisci;* with these were no doubt associated the original inhabitants of *Aricia* and of *Sidici-num,* of *Vescia* among the *Aurunci,* and of *Labici* close to Hernican territory. The same formative element appears in the adjective *Mons Massicus,* and the names *Glanica* and *Marica* belonging to the Auruncan district, with *Graviscae* in south Etruria, and a few other names in central Italy. With these names must clearly be judged the forms *Tusci* and *Etrusci,* the names given to the Etruscans by the folk among whom they settled. The Samnite and Roman conquerors tended to impose the form of their own group-name, namely the suffix -NO-, upon the tribes they conquered; hence the *Marruci* became the *Marrucini,* the *Arici* became *Aricini.* The conclusion suggested is that these -CO- tribes occupied the centre and west coast of Italy at the time of the Etruscan invasion; whereas the -NO- tribes only reached this part of Italy, or at least only became dominant there, long after the Etruscans had settled in the Peninsula.

It remains, therefore, to ask whether any information can be had about the language of this primitive -CO- folk. If the conclusions suggested under SABINI may be accepted as sound we should expect to find the Volsci speaking a language similar to that of the Ligures, whose fondness for the suffix *-sco-* is marked, and identical with that spoken by the plebeians of Rome, and that this branch of Indo-European preserved the original Indo-European Velars from the labialization which befell them in the speech of the Samnites. The language of the inscription of Velitrae offers at first sight a difficulty from this point of view, in the conversion which it shows of *q* to *p;* but the group-name of Velitrae is *Veliternus,* and the people are called on the inscription itself *Velestrom* (genitive plural); so that there is nothing to prevent our assuming that we have here a settlement of Sabines among the Volscian hills, with their language to some extent (*e.g.,* in the matter of the diphthongs and palatals) corrupted by that of the people round about them.

In the name *Volsci,* the older form *Volusci* clearly contains the word meaning "marsh," since the change of *velos-* to *volus-* is phonetically regular in Latin. The name *Marīca* ("goddess of the salt-marshes") among the Aurunci appears also both on the coast of Picenum and among the Ligurians; Stephanus of Byzantium identified the Osci with the Siculi, who, there is reason to suspect, were kinsmen of the Ligures. In many marshy places this *-co-* or *-ca-* suffix is used. Besides the *Aurunci* and the *dea Marica* and the *intempestaeque Graviscae* (Virg., *Aen.* x. 184), we have the *Ustica cubans* of Horace (*Odes* i. 17, 11), the *Hernici* in the Trerus valley, *Satricum* and *Glanica* in the Pomptine marshes.

BIBLIOGRAPHY.—For the text and fuller account of the Volscian inscription, and for other records of the dialect, *see* R. S. Conway, *Italic Dialects,* pp. 267 sqq. *See* also Camb. Anc. Hist., vol. vii.

VOLSINII, an ancient town of Etruria, Italy. The older Volsinii occupied in all probability the isolated tufa rock, so strongly defended by nature, upon which in Roman times stood the town which Procopius calls Οὐρβιβεντὸς (*Urbs vetus,* the modern Orvieto). It had, and needed, no outer walls, being surrounded on all sides except the south-west by abrupt tufa cliffs; but a massive wall found by excavation on the south-west side of the town may have belonged to the acropolis. An Etruscan temple of the 4th cent. B.C. stood near the north-east extremity of the plateau. It measured 72 by 54 feet and had three *cellae;* and at the foot of the hill on the north a large Etruscan necropolis was found dating from the 5th century B.C. The tombs, con-

structed of blocks of stone and arranged in rows divided by passages, often had the name of the deceased on the façade. Many painted vases, etc., were found; some are in the Museo Civico at Orvieto. Tombs with paintings have also been found at Settecamini to the south-west of the town on the way to Bolsena.

Volsinii was reputed the richest of the twelve cities of Etruria. Wars between Volsinii and Rome are mentioned in 392, 308 and 294 B.C. Zonaras states that the city was destroyed by Fulvius Flaccus in 265–264 B.C. and removed elsewhere, though the old site continued to be inhabited. The new city was certainly situated on the hills on the north-east bank of the Lake of Bolsena (*Lacus Volsiniensis*), 12 m. W.S.W. of Orvieto, where many important antiquities have been found.

See P. Perali, *Orvieto Etrusca* (Rome, 1928), who proposes to identify Orvieto with the ancient *Fanum Voltumnae*.

VOLSTEAD, ANDREW J. (1860–), ex-congressman, born in Goodhue county, Minnesota. He was admitted to the bar in 1884 and then set up his practice at Granite Falls, Minnesota. Mr. Volstead was a member of the 58th to 67th Congresses (1903–23), 7th Minnesota district. He was the author of the Farmers' Co-Operative Act and of the "Volstead Act," the first step in the struggle to enforce the 18th Amendment to the Constitution regarding the prohibition of intoxicating liquors. The Volstead Act was passed Oct. 18, 1919, over the President's veto. Its most drastic feature, and the one most criticized, was the definition of intoxicating liquors as beverages containing "one-half of one per centum or more of alcohol by volume." Volstead was active as a legal adviser in the enforcement of Prohibition until the amendment was repealed in 1933.

VOLTA, ALESSANDRO (1745–1827), Italian physicist, was born at Como on Feb. 18, 1745. He is celebrated as a pioneer of electrical science, after whom the "volt" is named. He was successively appointed professor of physics in the gymnasium of Como (1774) and to the newly founded chair of physics at Pavia in 1779. In 1777 and again in 1782 he journeyed through Switzerland, France, Germany, Holland and England, and became acquainted with many scientific celebrities. In 1791 he received the Copley medal of the Royal Society. In 1801 Napoleon called him to Paris, to show his experiments on contact electricity, and a medal was struck in his honour. He was made a senator of the kingdom of Lombardy. In 1815 the emperor of Austria made him director of the philosophical faculty of Padua. In 1819 he retired and settled in his native town, where he died on March 5, 1827. A statue was erected to his memory at Como. For Volta's electrical work, and his place in the history of discovery, *see* ELECTRICITY; also VOLTMETER.

VOLTA, the largest river of the coast of Upper Guinea, between the Gambia and the Niger, with a length of about 900 m. Its mouth and the greater part of its course are in British territory. Its lower course had been known since the discoveries of the Portuguese, from whom it received (15th century) its name on account of the winding nature of its stream. It was not, however, until the last fifteen years of the 19th century that the extent of its basin—extending far north within the bend of the Niger—was made known.

There are two main upper branches, the Black and the White Volta. Their sources lie on the grassy plateaux north of the forest belt of the Guinea coast, the Black Volta rising (as the Baule) in about 11° N., 4° 50′ W. Its course is at first east and north-east, to 12° 25′ N., at which point, after receiving a tributary from nearly 14° N.—the most northerly point of the basin—it turns sharply south. From the eleventh to the ninth parallel the river forms the boundary between the Northern Territories of the Gold Coast (British) and the French Ivory Coast colony. The southerly course of the stream ceases at 8° 15′ N. where it is deflected east, and even north, by a mountain range composed of sandstone and granite, which it finally breaks through by a narrow pass, in which its width is only some 60 yards. Elsewhere it has a general width of 150 to 200 yards. In 0° 50′ W. it receives the White Volta, which flows generally south from about 13° N. and likewise breaks through a narrow gap in the plateau escarpment. Both rivers shrink greatly in the dry season, reaching their lowest level at the end of January. Below the junction the Volta flows south-east and south, but turns east for 40 m. just north of 6°. In 7° 37′ N. it receives on the left bank a large tributary, the Oti, coming from 12° N. In its lower course, through the forest belt, the river has often a width of over half a mile, with a depth in places of 40 to 50 ft. in the rains, but in 6° 18′ N. it traverses a pass in which its width is narrowed to 30 yards. Its use as a water-way is limited by a number of rapids, the lowest of which occur in 6° 7′ N., above the trading port of Akuse. Its mouth is also obstructed during the greater part of the year by a bar. The river is usually navigable by small vessels from its mouth for about 60 miles.

See H. Hubert, "Sur un important phénomène de capture dans l'Afrique occidentale" (*Annales de Géographie*, 1912).

VOLTAIRE, FRANÇOIS MARIE AROUET DE (1694–1778), (the pen name for François Marie Arouet), was born on Nov. 21, 1694 at Paris, and was baptized the next day. His father was François Arouet, a notary; his mother was Marie Marguerite Daumart or D'Aumard. Both father and mother were of Poitevin extraction, but the Arouets had been for two generations established in Paris, the grandfather being a prosperous tradesman. He was the fifth child of his parents. Not very much is known of the mother, who died when Voltaire was but seven years old. She pretty certainly was the chief cause of his early introduction to good society, the abbé de Châteauneuf (his sponsor in more ways than one) having been her friend.

The abbé instructed him early in belles-lettres and deism, and he showed when a child an unsurpassed faculty for facile versemaking. At the age of ten he was sent to the Collège Louis-le-Grand, which was under the management of the Jesuits, and remained there till 1711. It was his whim, as part of his general liberalism, to depreciate the education he received; but it seems to have been a sound and good education. Nor can there be much doubt that the great attention bestowed on acting—the Jesuits kept up the Renaissance practice of turning schools into theatres for the performance of plays both in Latin and in the vernacular—had much to do with Voltaire's lifelong devotion to the stage. It must have been in his very earliest school years that the celebrated presentation of him by his godfather to Ninon de Lenclos took place, for Ninon died in 1705. She left him two thousand francs "to buy books with."

In August 1711, at the age of seventeen, he came home, and the usual battle followed between a son who desired no profession but literature and a father who refused to consider literature a profession at all. For a time Voltaire submitted, and read law at least nominally. The abbé de Châteauneuf died before his godson left school, but he had already introduced him to the famous and dissipated coterie of the Temple. His father tried to break him off from such society by sending him in the suite of the marquis de Châteauneuf, the abbé's brother, to The Hague. Here he met a certain Olympe Dunoyer ("Pimpette"), a girl apparently of respectable character and not bad connections, but a Protestant, penniless, and daughter of a literary lady whose literary reputation was not spotless. His father stopped any idea of a match by procuring a *lettre de cachet*, which, however, he did not use. Voltaire, who had been sent home, submitted, and for a time pretended to work in a Parisian lawyer's office; but he again manifested a faculty for getting into trouble—this time in the still more dangerous way of writing libellous poems—so that his father was glad to send him to stay for nearly a year (1714–15) with Louis de Caumartin, marquis de Saint-Ange, in the country. When he returned to Paris, Voltaire was forthwith introduced to a less questionable and even more distinguished coterie than Vendôme's, to the famous "court of Sceaux," the circle of the beautiful and ambitious duchesse du Maine. It seems that Voltaire lent himself to the duchess's frantic hatred of the regent Orleans, and helped to compose lampoons on that prince. At any rate, in May 1716 he was exiled, first to Tulle, then to Sully. Allowed to return, he again fell under suspicion of having been concerned in the composition of two violent libels and on May 16, 1717 was sent to the Bastille. He there recast *Oedipe*, began the *Henriade* and determined to alter his name. Ever after his exit

from the Bastille in April 1718 he was known as Arouet de Voltaire, or simply Voltaire, though legally he never abandoned his patronymic. Probably the name is an anagram on "Arouet le jeune," or "Arouet l. j."

A further "exile" at Châtenay and elsewhere succeeded the imprisonment, and though Voltaire was admitted to an audience by the regent and treated graciously he was not trusted. *Oedipe* was acted at the Théâtre Français on Nov. 18 of the year of release. It had a run of forty-five nights, and brought the author not a little profit. With these gains Voltaire seems to have begun his long series of successful financial speculations. But in the spring of next year the production of Lagrange-Chancel's libels, entitled the *Philippiques,* again brought suspicion on him. He was informally exiled, and spent much time with Marshal Villars, again increasing his store of "reminiscences." He returned to Paris in the winter, and his second play, *Artémire,* was produced in February 1720. It was a failure. In December 1721 his father died, leaving him property (rather more than four thousand livres a year), which was soon increased by a pension of half the amount from the regent. In return he offered himself as a secret diplomatist to Dubois.

His visiting espionage, as unkind critics put it—his secret diplomatic mission, as he would have liked to have it put himself—began in the summer of 1722, and he set out for it in company with a certain Madame de Rupelmonde, to whom he as usual made love, taught deism and served as an amusing travelling companion. He stayed at Cambrai for some time, where European diplomatists were still in full session, journeyed to Brussels, went on to The Hague, and then returned. The *Henriade* had got on considerably during the journey. During the late autumn and winter of 1722–23 he abode chiefly in Paris, taking a kind of lodging in the town house of M. de Bernières, a nobleman of Rouen, and endeavouring to procure a "privilege" for his poem. In this he was disappointed, but he had the work printed at Rouen nevertheless, and spent the summer of 1723 revising it. In November he caught smallpox and was very seriously ill. The book was privately printed in the spring of 1724. His third tragedy, *Mariamne* was a failure. The regent had died shortly before, not to Voltaire's advantage; for he had been a generous patron. Voltaire had made, however, a useful friend in another *grand seigneur,* as profligate and nearly as intelligent, the duke of Richelieu, and with him he passed 1724 and the next year chiefly, recasting *Mariamne* (which was now successful), writing the comedy of *L'Indiscret,* and courting the queen, the ministers, the favourites and all who seemed worth while. The end of 1725 brought a disastrous close to this period of his life. He was insulted by the chevalier de Rohan, replied with his usual sharpness of tongue, and shortly afterwards, when dining with the duke of Sully, was called out and bastinadoed by the chevalier's hirelings, Rohan himself looking on. Nobody would take his part, and at last, nearly three months after the outrage, he challenged Rohan, who accepted the challenge, but on the morning appointed for the duel Voltaire was arrested and sent for the second time to the Bastille. He was kept in confinement a fortnight, and was then packed off to England in accordance with his own request. Voltaire revenged himself on the duke of Sully for his conduct towards his guest by cutting Maximilien de Béthune's name out of the *Henriade.*

Voltaire's visit to England lasted about three years, from 1726 to 1729. George II., who succeeded soon after his arrival, was not fond of "boetry," but Queen Caroline was, and international jealousy was pleased at the thought of welcoming a distinguished exile from French illiberality. The Walpoles, Bubb Dodington, Bolingbroke, Congreve, Sarah, duchess of Marlborough, Pope, were among his English friends. He made acquaintance with, and at least tried to appreciate, Shakespeare. He was much struck by English manners, was deeply penetrated by English toleration for personal freethought and eccentricity, and gained some thousands of pounds from an authorized English edition of the *Henriade,* dedicated to the queen. But he visited Paris now and then and gained full licence to return in the spring of 1729.

He was full of literary projects, and immediately after his return he is said to have increased his fortune immensely by a lucky lottery speculation. The *Henriade* was at last licensed in France; *Brutus,* a play which he had printed in England, was accepted for performance, but kept back for a time by the author; and he began the celebrated poem of the *Pucelle,* the amusement and the torment of a great part of his life. At the end of 1730 *Brutus* did actually get acted. Then in the spring of the next year he went to Rouen to get *Charles XII.* surreptitiously printed, which he accomplished. In 1732 another tragedy, *Ériphile,* appeared, with the same kind of halting success which had distinguished the appearance of its elder sisters since *Oedipe.* But at last, on the 13th of August 1732, he produced *Zaïre,* the best (with *Mérope*) of all his plays, and one of the ten or twelve best plays of the whole French classical school. Its motive was borrowed to some extent from *Othello,* but that matters little. In the following winter the death of the comtesse de Fontaine-Martel, whose guest he had been, turned him out of a comfortable abode. He then took lodgings with an agent of his, one Demoulin, in an out-of-the-way part of Paris, and was, for some time at least, as much occupied with contracts, speculation and all sorts of means of gaining money as with literature.

In the middle of this period, however, in 1733, two important books, the *Lettres philosophiques sur les Anglais* and the *Temple du goût* appeared. Both were likely to make bad blood, for the latter was, under the mask of easy verse, a satire on contemporary French literature, especially on J. B. Rousseau, and the former was, in the guise of a criticism or rather panegyric of English ways, an attack on everything established in the church and state of France. The book was condemned (June 10th, 1734, the copies seized and burnt, a warrant issued against the author and his dwelling searched. He himself was safe in the independent duchy of Lorraine with Émilie de Breteuil, marquise du Châtelet, with whom he began to be intimate in 1733. The château of Cirey, a half-dismantled country house on the borders of Champagne and Lorraine, was fitted up with Voltaire's money and became the headquarters of himself, of his hostess, and now and then of her accommodating husband. Many pictures of the life here, some of them not a little malicious, survive. It was not entirely a bed of roses, for the "respectable Emily's" temper was violent, and after a time she sought lovers who were not so much *des cérébraux* as Voltaire. But it provided him with a safe and comfortable retreat, and with every opportunity for literary work. In March 1735 the ban was formally taken off him, and he was at liberty to return to Paris, a liberty of which he availed himself sparingly.

At Cirey he wrote indefatigably and did not neglect business. The principal literary results of his early years here were the *Discours en vers sur l'homme,* the play of *Alzire* and *L'Enfant prodigue* (1736), and a long treatise on the Newtonian system which he and Madame du Châtelet wrote together. In the first days of his sojourn he had written a pamphlet with the title of *Treatise on Metaphysics.* Of metaphysics proper Voltaire neither then nor at any other time understood anything, and the subject, like every other, merely served him as a pretext for laughing at religion with the usual reservation of a tolerably affirmative deism. In March 1736 he received his first letter from Frederick of Prussia, then crown prince only. He was soon again in trouble, this time for the poem of *Le Mondain,* and he at once crossed the frontier and then made for Brussels. He spent about three months in the Low Countries, and in March 1737 returned to Cirey, and continued writing, making experiments in physics (he had at this time a large laboratory), and busying himself with iron-founding, the chief industry of the district. The best-known accounts of Cirey life, those of Madame de Grafigny, date from the winter of 1738–39; they are somewhat spiteful but very amusing, depicting the frequent quarrels between Madame du Châtelet and Voltaire, his intense suffering under criticism, his constant dread of the surreptitious publication of the *Pucelle* (which nevertheless he could not keep his hands from writing or his tongue from reciting to his visitors), and so forth. Frederick, now king of Prussia, made not a few efforts to get Voltaire away from Madame du Châtelet, but unsuccessfully,

and the king earned the lady's cordial hatred by persistently refusing or omitting to invite her. At last, in September 1740, master and pupil met for the first time at Cleves, an interview followed three months later by a longer visit. Brussels was again the headquarters in 1741, by which time Voltaire had finished the best and the second or third best of his plays, *Mérope* and *Mahomet*. *Mahomet* was played first at Lille in that year; it did not appear in Paris till August next year, and *Mérope* not till 1743. This last was, and deserved to be, the most successful of its author's whole theatre. During these years much of the *Essai sur les moeurs* and the *Siècle de Louis XIV.* was composed. He also returned, not too well-advisedly, to the business of courtiership, which he had given up since the death of the regent. He was much employed, owing to Richelieu's influence, in the fêtes of the dauphin's marriage, and was rewarded, through the influence of Madame de Pompadour on New Year's Day 1745 by the appointment to the post of historiographer-royal, once jointly held by Racine and Boileau. In the same year he wrote a poem on Fontenoy, he received medals from the pope and dedicated *Mahomet* to him, and he wrote court *divertissements* and other things to admiration. But Voltaire, who had been for years the first writer in France, had been repeatedly passed over in elections to the Academy. He was at last elected in the spring of 1746, and received on the 9th of May. Then the tide began to turn. His favour at court had naturally exasperated his enemies. He had various proofs of the instability of his hold on the king during 1747 and in 1748. He once lay in hiding for two months with the duchesse du Maine at Sceaux, where were produced the comedietta of *La Prude* and the tragedy of *Rome sauvée*, and afterwards for a time lived chiefly at Lunéville; here Madame du Châtelet had established herself at the court of King Stanislaus, and carried on a liaison with Saint-Lambert, an officer in the king's guard. In 1749 she died after the birth of a child.

After Madame du Châtelet's death Voltaire had some idea of settling in Paris, but mischief was the very breath of his nostrils. He went on writing satiric tales like *Zadig*. He engaged in a foolish and undignified struggle with Crébillon *père* (not *fils*), a rival set up against him by Madame de Pompadour, but a dramatist who, in part of one play, *Rhadamiste et Zénobie*, has struck a note of tragedy in the grand Cornelian strain, which Voltaire could never hope to echo. *Semirame* (1748), *Oreste* (1750) and *Rome sauvée* itself were all products of this rivalry.

All this time Frederick of Prussia had been continuing his invitations. Voltaire left Paris on June 15, 1751, and reached Berlin on July 10. It is certain that at first the king behaved altogether like a king to his guest. He pressed him to remain; he gave him (the words are Voltaire's own) one of his orders, twenty thousand francs a year, and four thousand additional for his niece, Madame Denis, in case she would come and keep house for her uncle. His residence in Prussia lasted nearly three years. It was quite impossible that Voltaire and Frederick should get on together for long. Voltaire was not humble enough to be a mere butt, as many of Frederick's led poets were; he was not enough of a gentleman to hold his own place with dignity and discretion; he was constantly jealous both of his equals in age and reputation, such as Maupertuis, and of his juniors and inferiors, such as Baculard D'Arnaud. He was greedy, restless, and in a way Bohemian. He tried to get D'Arnaud exiled, and succeeded. He got into a quite unnecessary quarrel with Lessing. He had not been in the country six months before he engaged in a discreditable piece of financial gambling with Hirsch, the Dresden Jew. He was accused of something like downright forgery—that is to say, of altering a paper signed by Hirsch after he had signed it. The king's disgust at this affair (which came to an open scandal before the tribunals) was so great that he was on the point of ordering Voltaire out of Prussia, and Darget the secretary had no small trouble in arranging the matter (February 1751). Then it was Voltaire's turn to be disgusted with an occupation he had undertaken himself—the occupation of "buckwashing" the king's French verses. However, he succeeded in finishing and printing the *Siècle de Louis XIV.*, while the *Dictionnaire philosophique* is said to have been devised and begun at Potsdam.

But Voltaire's restless temper was brewing up for another storm. In the early autumn of 1751 La Mettrie, one of the king's parasites, and a man of much more talent than is generally allowed, horrified Voltaire by telling him that Frederick had in conversation applied to him (Voltaire) a proverb about "sucking the orange and flinging away its skin," and about the same time the dispute with Maupertuis, which had more than anything else to do with his exclusion from Prussia, came to a head. Maupertuis got into a dispute with one König. The king took his president's part; Voltaire took König's. But Maupertuis must needs write his *Letters*, and thereupon (1752) appeared one of Voltaire's most famous, though perhaps not one of his most read works, the *Diatribe du Docteur Akakia*. Even Voltaire did not venture to publish this lampoon on a great official of a prince so touchy as the king of Prussia without some permission, and if all tales are true he obtained this by another piece of something like forgery—getting the king to endorse a totally different pamphlet on its last leaf, and affixing that last leaf to *Akakia*. Of this Frederick was not aware; but he did get some wind of the *Diatribe* itself, sent for the author, heard it read to his own great amusement, and either actually burned the ms. or believed that it was burnt. In a few days printed copies appeared. Frederick put Voltaire under arrest for a time. After repeated reconciliations followed by fresh difficulties Voltaire at last left Potsdam on the 26th of March, 1753. It was nearly three months afterwards that the famous, ludicrous and brutal arrest was made at Frankfort, on the persons of himself and his niece, who had met him meanwhile. The whole situation was at last put an end to by the city authorities, who probably felt that they were not playing a very creditable part. Voltaire left Frankfort on July 7, and travelled to Colmar.

Voltaire's second stage was now over in his sixtieth year. He had been, in the first blush of his Frankfort disaster, refused, or at least not granted, permission even to enter France proper. At Colmar he was not safe, especially when in January 1754 a pirated edition of the *Essai sur les moeurs*, written long before, appeared. Permission to establish himself in France was now absolutely refused. Nor did an extremely offensive performance of Voltaire's—the solemn partaking of the Eucharist at Colmar after due confession—at all mollify his enemies. His exclusion from France, however, really meant exclusion from Paris and its neighbourhood. In the summer he went to Plombières, and after returning to Colmar for some time journeyed in the beginning of winter to Lyons, and thence in the middle of December to Geneva. Voltaire had no purpose of remaining in the city, and almost immediately bought a country house just outside the gates, to which he gave the name Les Délices. He was here practically at the meeting-point of four distinct jurisdictions—Geneva, the canton Vaud, Sardinia and France, while other cantons were within easy reach; and he bought other houses dotted about these territories, so as never to be without a refuge close at hand in case of sudden storms. At Les Délices he set up a considerable establishment, which his great wealth made him able easily to afford. He kept open house for visitors; he had printers close at hand in Geneva; he fitted up a private theatre in which he could enjoy what was perhaps the greatest pleasure of his whole life—acting in a play of his own, stage-managed by himself. His residence at Geneva brought him into correspondence (at first quite amicable) with the most famous of her citizens, J. J. Rousseau. His *Orphelin de la Chine*, performed at Paris in 1755, was very well received; the notorious *La Pucelle* appeared in the same year. The earthquake at Lisbon, which appalled other people, gave Voltaire an excellent opportunity for ridiculing the beliefs of the orthodox, first in verse (1756) and later in the (from a literary point of view) unsurpassable tale of *Candide* (1759). All was, however, not yet quite smooth with him. Geneva had a law expressly forbidding theatrical performances in any circumstances whatever. Voltaire had infringed this law already as far as private performances went, and he had thought of building a regular theatre, not indeed at Geneva but at Lausanne. He undoubtedly instigated D'Alembert to include a censure of the prohibition in his *Encyclopédie* article on

"Geneva," a proceeding which provoked Rousseau's celebrated *Lettre à D'Alembert sur les spectacles.* As for himself, he looked about for a place where he could combine the social liberty of France with the political liberty of Geneva, and he found one.

At the end of 1758 he bought the considerable property of Ferney, on the shore of the lake, about four miles from Geneva, and on French soil. Many of the most celebrated men of Europe visited him there. In spite of these interruptions he wrote much and conducted an immense correspondence, which had for a long time once more included Frederick, the two getting on very well when they were not in contact. Above all, he now, being comparatively secure in position, engaged much more strongly in public controversies, and resorted less to his old labyrinthine tricks of disavowal, garbled publication and private libel. The suppression of the *Encyclopédie,* to which he had been a considerable contributor, and whose conductors were his intimate friends, drew from him a shower of lampoons directed now at "l'infâme" (see *infra*) generally, now at literary victims, such as Le Franc de Pompignan, or Palissot or at Fréron, an excellent critic and a dangerous writer, who had attacked Voltaire from the conservative side, and at whom the patriarch of Ferney, as he now began to be called, levelled the farce-lampoon of *L'Écossaise.*

Here, too, he began that series of interferences on behalf of the oppressed and the ill-treated which is an honour to his memory. Volumes and almost libraries have been written on the Calas affair, and we can but refer here to the only less famous cases of Sirven (very similar to that of Calas, though no judicial murder was actually committed), Espinasse (who had been sentenced to the galleys for harbouring a Protestant minister), Lally (the son of the unjustly treated but not blameless Irish-French commander in India), D'Étalonde (the companion of La Barre), Montbailli and others.

In this way Voltaire, who had been an old man when he established himself at Ferney, became a very old one almost without noticing it. The death of Louis XV. and the accession of Louis XVI. excited even in his aged breast the hope of re-entering Paris, but he did not at once receive any encouragement, despite the reforming ministry of Turgot. A much more solid gain to his happiness was the adoption, or practical adoption, in 1776 of Reine Philiberte de Varicourt, a young girl of noble but poor family, whom Voltaire rescued from the convent, installed in his house as an adopted daughter, and married to the marquis de Villette. Her pet name was "Belle et Bonne," and nobody had more to do with the happiness of the last years of the "patriarch" than she had. It is doubtful whether his last and fatal visit to Paris was due to his own wish or to the instigation of his niece, Madame Denis. At the end of 1777 and the beginning of 1778, he had been carefully finishing a new tragedy—*Irène*—for production in the capital. He started on Feb. 5, and five days later arrived at the city which he had not seen for 28 years.

He was received with immense rejoicings, not indeed directly by the court, but by the Academy, by society and by all the more important foreign visitors. About a fortnight after his arrival, age and fatigue made him seriously ill, and a confessor was sent for. But he recovered, scoffed at himself as usual, and prepared more eagerly than ever for the first performance of *Irène,* on March 16. At the end of the month he was able to attend a performance of it, which was a kind of apotheosis. He was crowned with laurel in his box, amid the plaudits of the audience, and did not seem to be the worse for it. He even began or proceeded with another tragedy—*Agathocle*—and attended several Academic meetings. But such proceedings in the case of a man of eighty-four were impossible. To keep himself up, he exceeded even his usual excess in coffee, and about the middle of May he became very ill. On May 30, the priests were once more sent for—to wit, his nephew, the abbé Mignot, the abbé Gaultier, who had officiated on the former occasion, and the parish priest, the curé of St. Sulpice. In a state of half-insensibility he petulantly motioned them away, dying in the course of the night. The result was a difficulty as to burial, which was compromised by hurried interment at the abbey of Scellières in Champagne, anticipating the interdict of the bishop of the diocese by an hour or two. On July 10, 1791 the body was transferred to the Pantheon, but during the Hundred Days it was once more, it is said, disentombed, and stowed away in a piece of waste ground. His heart, taken from the body when it was embalmed, and given to Madame Denis and by her to Madame de Villette, was preserved in a silver case, and when it was proposed (in 1864) to restore it to the other remains, the sarcophagus at Sainte Geneviève (the Pantheon) was opened and found to be empty.

In person Voltaire was not engaging, even as a young man. His extraordinary thinness is commemorated, among other things, by the very poor but well-known epigram attributed to Young, and identifying him at once with "Satan, Death and Sin." In old age he was a mere skeleton, with a long nose and eyes of preternatural brilliancy peering out of his wig. He never seems to have been addicted to any manly sport, and took little exercise. He was sober enough (for his day and society) in eating and drinking generally; but drank coffee, as his contemporary, counterpart and enemy, Johnson, drank tea, in a hardened and inveterate manner. It may be presumed with some certainty that his attentions to women were for the most part platonic; indeed, both on the good and the bad side of him, he was all brain. Conversation and literature were, again as in Johnson's case, gods of his idolatry. He was good-natured when not crossed, generous to dependents who made themselves useful to him, and indefatigable in defending the cause of those who were oppressed by the systems with which he was at war. But he was inordinately vain, and totally unscrupulous in gaining money, in attacking an enemy, or in protecting himself when he was threatened with danger. Voltaire's works, and especially his private letters, constantly contain the word "l'infâme" and the expression (in full or abbreviated) "écrasez l'infâme." This has been misunderstood in many ways—the mistake going so far as in some cases to suppose that Voltaire meant Christ by this opprobrious expression. No careful and competent student of his works has ever failed to correct this gross misapprehension. "L'infâme" is not God; it is not Christ; it is not Christianity; it is not even Catholicism. Its briefest equivalent may be given as "persecuting and privileged orthodoxy" in general, and, more particularly, it is the particular system which Voltaire saw around him, of which he had felt the effects in his own exiles and the confiscations of his books, and of which he saw the still worse effects in the hideous sufferings of Calas and La Barre.

Works.—Vast and various as his work is, its vastness and variety are of the essence of its writer's peculiar quality. The divisions of it have long been recognized, and may be treated regularly.

The first of these divisions in order is the *theatre.* Between fifty and sixty pieces (including a few which exist only in fragments or sketches) are included in his writings, and they cover his literary life. It is at first sight remarkable that Voltaire, whose comic power was undoubtedly far in excess of his tragic, should have written many tragedies of no small excellence in their way, but only one fair second-class comedy, *Nanine.* His tragedies, on the other hand, are works of extraordinary merit in their own way. *Zaïre,* among those where love is admitted as a principal motive, and *Mérope,* among those where this motive is excluded and kept in subordination, yield to no plays of their class.

As regards his *poems* proper, of which there are two long ones, the *Henriade* and the *Pucelle,* besides smaller pieces, of which a bare catalogue fills fourteen royal octavo columns, their value is very unequal. The *Pucelle* is extremely desultory; it is a libel on religion and history. But it is amusing. The minor poems are as much above the *Pucelle* as the *Pucelle* is above the *Henriade.* It is true that there is nothing, or hardly anything, that properly deserves the name of poetry in them—no passion, no sense of the beauty of nature, only a narrow "criticism of life," only a conventional and restricted choice of language, a cramped and monotonous prosody, and none of that indefinite suggestion which has been rightly said to be of the poetic essence. But there is immense wit, a wonderful command of such metre and language as the taste of the time allowed to the poet, a singular if somewhat artificial grace, and great felicity of diction.

The third division of Voltaire's works in a rational order consists of his *prose romances* or *tales*. In these admirable works more than in any others that the peculiar quality of Voltaire—ironic style without exaggeration—appears. That he learned it partly from Saint Evremond, still more from Anthony Hamilton, partly even from his own enemy Le Sage, is perfectly true, but he gave it perfection and completion. If one especial peculiarity can be singled out, it is the extreme restraint and simplicity of the verbal treatment. Voltaire never dwells too long on this point, stays to laugh at what he has said, elucidates or comments on his own jokes, guffaws over them or exaggerates their form. The famous "pour encourager les autres" is an typical example, and indeed the whole of *Candide* shows the style at its perfection.

The fourth division of Voltaire's work, the *historical*, is the bulkiest of all except his correspondence, but it is far from being among the best. The small treatises on Charles XII. and Peter the Great are indeed models of clear narrative and ingenious if somewhat superficial grasp and arrangement. The so-called *Siècle de Louis XIV.* and *Siècle de Louis XV.* (the latter inferior to the former but still valuable) contain a great miscellany of interesting matter, treated by a man of great acuteness and unsurpassed power of writing, who had also had access to much important private information. But even in these books defects are present, which appear much more strongly in the singular olla-podrida entitled *Essai sur les moeurs*, in the *Annales de l'empire* and in the minor historical works. These defects are an almost total absence of any comprehension of what has since been called the philosophy of history, the constant presence of gross prejudice, frequent inaccuracy of detail, and, above all, a complete incapacity to look at anything except from the narrow standpoint of a half-pessimist and half self-satisfied *philosophe*.

To his own age Voltaire was pre-eminently a poet and a philosopher; the unkindness of succeeding ages has sometimes questioned whether he had any title to either name, and especially to the latter. His largest *philosophical* work, at least so called, is the curious medley entitled *Dictionnaire philosophique*, which is compounded of the articles contributed by him to the great *Encyclopédie* and of several minor pieces. No one of Voltaire's works shows his anti-religious or at least anti-ecclesiastical animus more strongly. The various title-words of the several articles are often the merest stalking-horses, under cover of which to shoot at the Bible or the church, the target being now and then shifted to the political institutions of the writer's country, his personal foes, etc., and the whole being largely seasoned with that acute, rather superficial, common-sense, but also commonplace, ethical and social criticism which the 18th century called philosophy. The book ranks perhaps second only to the novels as showing the character, literary and personal, of Voltaire; and despite its form it is nearly as readable.

In general *criticism* and *miscellaneous* writing Voltaire is not inferior to himself in any of his other functions. Almost all his more substantive works, whether in verse or prose, are preceded by prefaces of one sort or another, which are models of his own light pungent *causerie;* and in a vast variety of nondescript pamphlets and writings he shows himself a perfect journalist.

There remains only the huge division of his *correspondence*, which is constantly being augmented by fresh discoveries, and which, according to Georges Bengesco, has never been fully or correctly printed, even in some of the parts longest known. In this great mass Voltaire's personality is of course best shown, and perhaps his literary qualities not worst. His immense energy and versatility, his adroit and unhesitating flattery when he chose to flatter, his ruthless sarcasm when he chose to be sarcastic, his rather unscrupulous business faculty, his more than rather unscrupulous resolve to double and twist in any fashion so as to escape his enemies,—all these things appear throughout the whole mass of letters.

When sympathy and dislike are both discarded or allowed for, he remains one of the most astonishing, if not exactly one of the most admirable, figures of letters. His great fault was an inveterate superficiality. But this superficiality was accompanied by such wonderful acuteness within a certain range, by such an absolutely unsurpassed literary aptitude and sense of style in all the lighter and some of the graver modes of literature, by such untiring energy and versatility in enterprise, that he has no parallel among ready writers anywhere. Not the most elaborate work of Voltaire is of much value for matter; but not the very slightest work of Voltaire is devoid of value in form. In literary craftsmanship, at once versatile and accomplished, he has no superior and scarcely a rival.

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VOLTERRA (anc. *Volaterrae*), a town and episcopal see of Tuscany, Italy, in the province of Pisa, from which it is 51 mi. by rail S.E., and 35 by road W.N.W. from Siena. Pop. (1936) 11,704 (town); 20,638 (commune). It stands on a commanding olive-clad eminence 1,785 ft. above sea-level, with a magnificent view over mountains and sea (the latter some 20 m. distant), and is surrounded by the massive remains of its ancient walls of large, roughly-rectangular blocks of stone, some $4\frac{1}{2}$ m. in circuit, enclosing an area which must have been larger than was actually needed for habitation. Tombs of the later Villanova period (end of the 9th century B.C.) have been found within its circuit, but only at the north-west extremity. Here the clay of which the hill is formed is gradually giving way, causing landslips and the collapse of buildings, notably of the abbey church of S. Salvatore (1030) and SS. Giusto e Clemente. The mediaeval town occupies only the southern portion of this area. The most important relic of its Etruscan period is the Porta dell' Arco, an archway 20 ft. high, the corbels of which are adorned with almost obliterated heads. Volterra contains many picturesque mediaeval towers and houses. The Palazzo dei Priori (1208–57), containing the picture gallery, is especially fine, and the Piazza Maggiore in which it stands most picturesque. The museum contains a valuable collection of Etruscan antiquities, especially cinerary urns from ancient tombs of alabaster, with the figure of the deceased on the lid, and reliefs from Greek myths on the front. They belong to the 3rd and 2nd centuries B.C. The cathedral, enlarged and adorned by Pisan artists in 1254, has a fine pulpit of that period, and on the high altar are sculptures by Mino da Fiesole; it contains several good pictures. The sacristy has fine carvings. The baptistery (1283) has a font by Andrea Sansovino, and a ciborium by Mino da Fiesole. Both these buildings are in black and white marble. S. Francesco has frescoes of 1410, and S. Girolamo terra-cottas by Giovanni della Robbia and pictures. The inhabitants are chiefly employed in the manufacture of vases and other ornaments from alabaster found in the vicinity.

Volaterrae (Etruscan *Velathri*) was one of the most powerful of the 12 confederate cities of Etruria. During the war between Marius and Sulla it withstood the latter's troops for two years in 82–80 B.C. In the 12th and 13th centuries it enjoyed free institutions; in 1361 it fell under the power of Florence. It rebelled, but was retaken and pillaged in 1472.

See C. Ricci, *Volterra* (Bergamo, 1905); R. MacIver, *Villanovans and Early Etruscans* (Oxford, 1924) 63–65. (T. A.)

VOLTMETER, an instrument which indicates the difference of the electric potential between its terminals on a scale graduated in volts. Legally, the (international) volt is the electromotive force which produces a current of one (international) ampere in a resistance of one (international) ohm. This volt is equal to $1{\cdot}00649 \times 10^8$ absolute C.G.S. units. Voltmeters are always connected in parallel across the points whose potential difference is required to be measured, and, since it is essential not to disturb

this potential difference, they must have a high resistance so that they may pass only a very small current. They may be divided into two classes, (a) electrostatic, (b) electrokinetic. Electrostatic voltmeters depend for their action on the fact that when two conductors are at different potentials they attract each other with a force which varies as the square of the potential difference between them. Such voltmeters have the advantage of possessing an infinite resistance, but they are not very suitable for the measurement of small voltages (*e.g.*, 100 volts). Electrokinetic voltmeters are simply high resistance galvanometers, and measure potential differences in terms of the minute currents which pass through them when they are connected to the points whose potential differences are required. (*See* INSTRUMENTS, ELECTRICAL.)

VOLTURNO, a river of central Italy, which rises in the neighbourhood of Alfedena in the central Apennines of Samnium, runs south as far as Venafro, and then south-east. After a course of some 75 m. it receives, about 5 m. E. of Caiazzo, the Calore. The united stream now flows west-south-west past Capua (anc. *Casilinum*), where the Via Appia and Latina joined just to the north of the bridge over it, and so through the Campanian plain, with many windings, into the sea. The direct length of the lower course is about 31 m., so that the whole is slightly longer than that of the Liri, and its basin far larger (1,953 sq.m. with a length of 100 m. in a straight line and a discharge of 40 cubic metres per second at the mouth). The river has always had considerable military importance, and the colony of Volturnum (no doubt preceded by an older port of Capua) was founded in 194 B.C. at its mouth on the south bank by the Romans; it is now about one mile inland. A fort had already been placed there during the Roman siege of Capua, in order, with Puteoli, to serve for the provisioning of the army. The river was navigable as far as Capua.

On Oct. 1, 1860, the Neapolitan forces were defeated on the S. bank of the Volturno, near S. Maria di Capua Vetere, by the Piedmontese and Garibaldi's troops, a defeat which led to the fall of Capua.

VOLUNTEERS, a general term for soldiers who are not professionals nor permanently embodied under arms in peace. The idea of a large organized Volunteer force seems to have originated in England at the time of the Militia bill of 1757, which was amended in 1758 so as to allow the militia captains to accept volunteers instead of the ordinary militiamen who were compulsorily furnished *pro rata* by each parish. In 1778 the volunteers were still voluntary substitutes for militiamen, though formed in separate companies of the militia unit, but volunteer corps soon began to form themselves independently of the militia.

These volunteers, disbanded in 1783, were promptly revived when the French Revolutionary Wars produced a new enemy. When the danger of invasion was at its height the force numbered 380,000 men, or 3½% of a population which already kept up a regular army and a militia. In 1808 the Local Militia was formed, in which enlistment and training were both stricter and better defined and the greater part of the volunteers transferred themselves to this body. By 1812 the Local Militia reached a strength of 215,000 as against the 70,000 of the remaining volunteers. With the general peace of 1814 almost all of these forces disappeared.

After an interval of nearly half a century the warlike attitude of France caused British citizens once more to arm for the protection of their country.

The enrolment of the "Volunteer Force" took place at first under the old statute (44 Geo. III.). The main provisions of that act, however, were found inapplicable to the altered conditions under which invasion was now possible. A new act (Volunteer Act, 1863) was soon passed, the most important provision of which was that apprehended invasion should constitute a sufficient reason for the sovereign to call out the volunteers, in lieu of the old condition which required the actual appearance of the enemy. This was modified in 1900 during the South African War by a further enactment allowing the authorities to call them out at times of "imminent national danger and great emergency." The formation of volunteer corps was so rapid that in the course of a few months in 1859–60 a force of 119,000 was created. The Government, which in the beginning had tolerated rather than encouraged the movement, and had required the volunteer to serve and to equip himself entirely at his own expense, now followed the lead of a public opinion, and decided on maintaining the volunteer force as a part of the regular defensive system.

The turning-point in the history of the volunteers was the South African War. In Jan. 1900, and on several subsequent occasions, the volunteers were invited to supply service companies for South Africa, to be incorporated in the regular battalions to which the volunteer battalions were affiliated. About one-third of the whole force volunteered for service in South Africa besides a great number of volunteers whom the higher pay, easier conditions, and better prospects of active employment in the mounted guerrilla warfare tempted into the ranks of the yeomanry. Various partial reorganizations followed in 1902–5 and at least in 1907–8, the whole force was re-cast, and organized along with the yeomanry into the new Territorial force. (*See* TERRITORIAL ARMY; GREAT BRITAIN: *Army.*)

United States.—The United States has always maintained only a small regular army, and until the World War depended largely upon volunteers in case of national emergency. In the War of 1812 volunteers, rangers and militia numbered 458,460 as against 56,000 regulars. The Mexican war was fought by a larger proportion of regular troops. The President's call for 50,000 volunteers was quickly responded to but food and transportation were not so quickly supplied and thousands of volunteers had to be left behind or sent home again. In the Civil War both sides started with the volunteer system and then came to the draft. The chief difficulties about the volunteer system were the short enlistment terms and the fact that the law gave the governors of states the right to appoint the officers of volunteer regiments. In the Spanish-American War the President was authorized to call out volunteers for a two-year term. Under this act 220,000 volunteers were raised who together with 60,000 regulars formed the United States army during the war. The Volunteer Army Bill of April 25, 1914, did away with the old provisions that the officers of volunteer troops must be appointed by State governors and stipulated that all officers were to be appointed by the President. Also no volunteer was to be appointed to any rank above the grade of colonel.

In the World War the United States definitely abandoned the volunteer system as the basis of its army and resorted at once to a selective draft. Nevertheless the Selective Service Act permitted voluntary enlistment by persons between the ages of 18 and 40, and at the outset enlistment was freely open to persons registered for the draft, provided that such registrants had not yet been called up for examination by their local boards. Regulations issued Dec. 15, 1917, however, prohibited voluntary enlistment for draft registrants. In August, 1918, further volunteering of any kind ceased by order of the War department. Down to that time voluntary enlistments had numbered 390,874 in the regular army, 296,978 in the national guard units, 424,424 in the navy and 51,223 in the marine corps. The crisis of the European War begun in 1939 raised the question of a peace-time draft in Congress, and a selective service bill became law Sept. 16, 1940.

VOLUSENUS, FLORENTIUS [FLORENCE WOLSON, or WOLSEY, in later writers WILSON, though in letters in the vernacular he writes himself VOLUSENE] (*c.* 1504–*c.* 1547), Scottish humanist, was born near Elgin about 1504. He studied philosophy at Aberdeen, went to Paris, and became tutor to Thomas Wynter, reputed son of Cardinal Wolsey. He paid repeated visits to England, where he was well received by the king, and, after Wolsey's fall, he acted as one of Cromwell's agents in Paris. In Paris he knew George Buchanan, and found patrons in the cardinal Jean de Lorraine and Jean du Bellay. He was to have gone with du Bellay on his mission to Italy in 1535, but illness kept him in Paris. As soon as he recovered he set out on his journey, but stopped at Avignon, where Sadolet made him master in the school at Carpentras. Volusenus paid frequent visits to Lyons, probably also to Italy, where he had many friends, perhaps even to Spain. In 1546 he set out to return to Scotland,

but died at Vienne in Dauphiné in 1546 or early in 1547.

Volusenus was a great admirer of Erasmus, but he criticized the purity of his Latin and also his philosophy. His own philosophy is Christian and Biblical rather than classical or scholastic. He takes a fresh and independent view of Christian ethics, and he ultimately reaches a doctrine as to the witness of the Spirit and the assurance of grace which breaks with the traditional Christianity of his time and is based on ethical motives akin to those of the German reformers.

Volusenus's linguistic studies embraced Hebrew as well as Greek and Latin. His reputation, however, rests on the beautiful dialogue, *De Animi Tranquillitate,* first printed by S. Gryphius at Lyons in 1543. From internal evidence it appears to have been composed about that time, but the subject had exercised Volusenus for many years. The dialogue shows Christian humanism at its best, and the verses which occur in it and the poem which concludes it give Volusenus a place among Scottish Latin poets, but it is as a Christian philosopher that he attains distinction.

The dialogue was reissued at Leyden in 1637 by the Scots writer David Echlin, whose poems, with a selection of three poems from the dialogue of Volusenus, appear, with others, in the famous Amsterdam collection *Delitiae Poetarum Scotorum hujus aevi,* printed by Blaev in 2 vols. in 1637. Later editions of the dialogue appeared at Edinburgh in 1707 and 1751 (the latter edited by G. Wishart). All the reissues contain a short life of the author by Thomas Wilson, advocate, son-in-law and biographer of Archbishop Patrick Adamson. Supplementary facts are found in the letters and state papers of the period, and in Sadolet's *Letters.*

VOLUTE, in architecture, a spiral scroll, especially that at each end of an Ionic capital and those under the corners of the abacus of the Corinthian or Composite capital. (*See* ORDER.)

VOLVOX, a well-known genus of organisms claimed by zoologists to belong to the Protozoa, but perhaps more justifiably placed by botanists in the Chlorophyceae, a section of the Algae. *Volvox* consists of spherical colonies of cells, all in protoplasmic connection with their neighbours and each bearing a pair of cilia. These beat in regular co-ordination, imparting a rolling motion to the colony. New colonies are formed from special cells set apart for this purpose and grow within the central cavity of the mother-colony. Sexual reproduction also occurs. (*See* ALGAE; PROTOZOA.)

VONDEL, JOOST VAN DEN (1587–1679), Dutch poet, was born at Cologne on Nov. 17, 1587. His father, a hatter, was an exile from Antwerp on account of his Anabaptist opinions; but he returned to Holland when Joost was about ten years old, and settled in Amsterdam, where he carried on a hosiery business. Joost was the eldest son and was expected to succeed to his father's shop. He was early introduced to the chamber of the Eglantine, however, and devoted most of his time to poetry and study.

When the elder Vondel died he married Maria de Wolff, and seems to have left the management of his affairs in her capable hands. He read the French contemporary poets, and was especially influenced by the *Divine Sepmaine* of Du Bartas; he made some translations from the German; he was soon introduced to the circle gathered in the house of Roemer Visscher, and with these friends began to make a close study of classical writers. His first play, *Het Pascha* (1612) marked the beginning of a long and brilliant literary career. (*See* DUTCH LANGUAGE AND LITERATURE.) After the production of his political drama of *Palamedes, or Murdered Innocence* (1625), which expressed his indignation at the judicial murder of Oldenbarneveldt in 1619, Vondel was forced to go into hiding, but the Amsterdam magistrates eventually satisfied themselves with exacting a small fine.

In the following years he issued a number of stinging satires against the extreme Calvinists, and he entered into close relationship with Hugo Grotius. Vondel had long been attracted by the aesthetic side of the Roman Catholic Church, and this inclination was perhaps strengthened by his friendship with Marie Tesselschade Visscher, for the Visscher household had been Catholic and liberal. Tesselschade's husband died in 1634; Vondel's wife died in 1635; and the ties between the two were strengthened by time. Vondel eventually showed his revolt against the Calvinist tyranny by formally embracing the Roman Catholic faith in 1640. The step was ill-received by many of his friends, and Hooft forbade him the hospitality of his castle at Muiden. In 1657 his only surviving son, who was entrusted with the hosiery business, mismanaged affairs to such an extent that he had to take ship for the East Indies, leaving his father to face the creditors. Vondel had to sacrifice the whole of his small fortune, and became a government clerk.

Vondel was pensioned after ten years' service, and died on Feb. 5, 1679.

The more important of his thirty-two dramas are: *Hierusalem Verwoest* ("Jerusalem Laid Desolate") (1620); *Palamedes, of Vermoorde onnooselheyd* ("Palamedes, or Murdered Innocence") (1625); *Gijsbreght van Aemstel* (1637); *De Gebroeders* (1640), the subject of which is the ruin of the sons of Saul; *Joseph in Egypten* (1640), *Maria Stuart, of gemartelde majesteit* (1646); the pastoral of *De Leeuwendalers* (1648); *Lucifer* (1654); *Salmoneus* (Solomon) (1657); *Jephtha* (1659); *Koning David in ballingschap* ("King David in Banishment"), *Koning David hersteld* ("King David Restored") and *Samson* (1660); *Batavische Gebroeders,* the subject of which is the story of Claudius Civilis (1663); *Adam in ballingschap* ("Adam in Exile") (1664), after the Latin tragedy of Hugo Grotius. He also wrote translations from the tragedies of Seneca, Euripides and Sophocles; didactic poems, and much lyrical poetry beside what is to be found in the choruses of his dramas.

His complete works were edited by van Lennep (12 vols., 1850–69). A bibliography (1888) was published by J. H. W. Unger, who revised van Lennep's edition in 1888–94. *Lucifer* was translated into English verse by L. C. van Noppen (New York, 1898). *See* also E. Gosse, *Studies in Northern Literature* (1879); G. Edmundson, *Milton and Vondel* (1885), where Milton's supposed indebtedness to Vondel is discussed; and critical studies by A. Baumgartner, S. J. (Freiburg, 1882); C. Looten (Lille, 1889), by J. A. Alberdingk Thijm (*Portretten van Joost van den Vondel,* 1876); the chapters on Vondel (pp. 133–325) in W. J. A. Jonckbloet's *Geschiedenis der nederlandsche letterkunde* (vol. iv. 1890); A. J. M. H. Schillings, *Vondel en de regeerders van Amsterdam* (Amsterdam, 1917); J. F. M. Sterck, *Oorkonden over Vondel en zijn kring* (Bussum, 1918); A. J. Barnouw, *Vondel* (N.Y., 1925).

VONDRAK, VACLAV (1859–1925), Czech philologist, was educated at the University of Vienna, where he studied first romance philology and afterwards Slavonic languages. In 1893 he became lecturer on Slavonic languages and literature at the University of Vienna. He wrote works on Church Slavonic and its literature. Later he devoted himself largely to the study of comparative Slavonic philology. His chief works are: *Altslovenische Studien* (Vienna, 1890); *Omluvě Jana Exarcha Bulharského* (Prague, 1896); *Studie Zoborn Církevněslovanského písemnictvi* (Prague, 1903); *Vergleichende Slavische Grammatik* (Göttingen, 1906–08).

VONNOH, ROBERT WILLIAM (1858–1933), U.S. portrait and landscape painter, was born in Hartford, Conn., Sept. 17, 1858. He first studied art at the Massachusetts Normal Art school, and taught there for two years after his graduation (1879–81). In 1881 he went to Paris, where he was a pupil of Boulanger and Lefebvre at the Académie Julian, but when his funds were exhausted in 1883 he was forced to return to the United States. He subsequently taught at the Cowles Art school, Boston (1884–85), at the Boston Museum of Fine Art schools (1885–87), and in the schools of the Pennsylvania Academy of the Fine Arts, Philadelphia (1891–96), to which he returned to teach again later in his life (1918–20).

He received the Proctor portrait prize of the National Academy of Design (1904), as well as a number of other medals and awards for his work. He is represented in the Pennsylvania Academy of Fine Arts, in the Massachusetts Historical society, in the Metropolitan Museum of Art, New York city and in numerous other galleries and institutions. His portrait of Woodrow Wilson's family hangs in the White House. His portraits are generally considered to excel his other paintings, although some of his landscapes are highly regarded. He died at Nice, France, Dec. 28, 1933.

His second wife, BESSIE POTTER VONNOH (1872–), a sculptor, was born in St. Louis, Mo., Aug. 17, 1872, and studied sculpture under Lorado Taft at the Art institute, Chicago. She became a member of the National Sculpture society (1898) and of the National Academy of Design (1921). She is represented in the Art institute, Chicago, the Metropolitan Museum of Art, New York city, the Corcoran Art gallery, Washington, D.C., the Brooklyn museum and elsewhere.

VONONES (on coins ONONES), the name of two Parthian kings. (1) VONONES I, eldest son of Phraates IV. After the assassination of Orodes II (*c.* A.D. 7), the Parthians applied to Augustus for a new king from the house of Arsaces. Augustus sent them Vonones (*Mon. Anc.* 5, 9; Tac. *Ann.* ii, 1 f.; Joseph. *Ant.* xviii, 2, 4), who was living as a hostage in Rome. But Vonones could not maintain himself; he had been educated as a Roman, and was despised as a slave of the Romans. Another member of the Arsacid house, Artabanus II, who was living among the Dahan nomads, was invited to the throne, and defeated and expelled Vonones. The coins of Vonones (who always uses his proper name) date from A.D. 8–12, those of Artabanus II begin in A.D. 10. Vonones fled into Armenia and became king there. But Artabanus demanded his deposition, and as Augustus did not wish to begin a war with the Parthians he removed Vonones into Syria, where he was kept in custody (Tac. *Ann.* ii, 4). When he tried to escape, A.D. 19, he was killed by his guards (Tac. *Ann.* ii, 58, 68).

(2) VONONES II, governor of Media, was raised to the throne after the death of Gotarzes in A.D. 51 (perhaps he was his brother, *cf.* Joseph. *Ant.* xx, 3, 4). But he died after a few months, and was succeeded by his son Vologaeses I (Tac. *Ann.* xii, 14).

(ED. M.)

VOODOO or **VAUDOUX** (Creole Fr. *vaudoux,* a Negro sorcerer, probably originally a dialectic form of Fr. *Vaudois,* a Waldensian), the name given to certain magical practices, superstitions and secret rites prevalent among the Negroes of the West Indies, notably in the republic of Haiti. Serpent-worship and obscene rites involving the use of human blood, preferably that of a white child, were considered features of this religion.

VOORHEES, DANIEL WOLSEY (1827–1897), U.S. lawyer and political leader, was born in Butler county, Ohio, on Sept. 26, 1827, of Dutch and Irish descent. During his infancy his parents removed to Fountain county, Ind., near Veedersburg. He graduated at Indiana Asbury (now De Pauw) university, Greencastle, Ind., in 1849; was admitted to the bar in 1850, and began to practise in Covington, whence in 1857 he removed to Terre Haute. From 1858–60 he was U.S. district attorney for Indiana. In 1861–66 and in 1869–73 he was a Democratic representative in congress; and in 1877–97 he was a member of the U.S. senate.

During the Civil War he seems to have been affiliated with the Knights of the Golden Circle, but he was not so radical as Vallandigham and others. He was a member of the committee on finance throughout his service in the senate, and his first speech in that body was a defense of the free coinage of silver and a plea for the preservation of the full legal tender value of greenback currency, though in 1893 he voted to repeal the silver purchase clause of the Sherman act. He had an active part in bringing about the building of the Congressional library.

He was widely known as an effective lawyer, especially in jury trials. In allusion to his unusual stature he was called "the Tall Sycamore of the Wabash." He died in Washington, D.C., on April 10, 1897.

Some of his speeches were published under the title, *Forty Years of Oratory* (2 vols., 1898), edited by his three sons and his daughter, with a biographical sketch by T. B. Long.

VORARLBERG, the most westerly province of Austria, with an area of 1,005 sq.mi. After Hitler's seizure of Austria in 1938 it was united with Tirol (*q.v.*) to form the German *gau* of Tirol-Vorarlberg, with an area of 5,007 sq.mi. The southern boundary is formed by the limestone range of the Rhätikon Alps (Scesaplana, 9,741 ft.) and part of the crystalline Silvretta massif (Piz Buin, 10,880 ft.). North of the Kloster valley the dolomitic limestone builds the western end of the Lechtal Alps, rising above 8,850 ft., which merge, beyond the Walser valley, into the heights of the Bregenzer Wald. The southern slopes of these are of dolomite and more than 6,500 ft. in height but northward the limestone is replaced by the softer sandstones, marls and conglomerates of the *flysch* zone with a general softening of the landscape.

In this region, near Bregenz, lignite occurs, but elsewhere power is obtained from the mountain streams, rich in falls, and fed by plentiful annual precipitation (80 in.). The climate in the Rhine valley, sheltered and mild, influenced by *föhn* winds, suits vine and fruit cultivation and its influence stretches far up the fertile tributary valley of the Ill.

Of the total area 88% is productive land but of this 30% is occupied by forests and only 3½% is cultivated ground, the remainder being natural or artificial pasture. Cattle-rearing and the production of milk are therefore important and in this respect Swiss influence is more evident than elsewhere in Austria. So, too, the industrial development of Vorarlberg reflects Swiss contacts, for the manufacture of textiles, particularly cotton goods, has grown with the advantage of cheap power in Bludenz, Dornbirn and Feldkirch. The working of embroidery for the warehouses of St. Gallen is a flourishing home industry.

The population—(Tirol-Vorarlberg, 1939) 487,667, German in speech, Catholic in faith—shows a tendency to concentration in small towns along the valleys of the Rhine and the Ill, the principal lines of rail traffic, but no town is large, only two exceeding 10,000 inhabitants, viz., Dornbirn, the chief industrial centre, and Bregenz, the provincial capital.

The name of the district means the "land that is beyond the Arlberg Pass," that is, as it seems to one looking at it from the Tirol. This name is modern and is a collective appellation for the various counties or lordships in the region which the Habsburgs (after they secured Tirol in 1363) succeeded in purchasing or acquiring—Feldkirch (1375, but Hohenems in 1765 only), Bludenz with the Montafon valley (1394), Bregenz (in two parts, 1451 and 1523) and Sonnenberg (1455). After the annexation of Hohenems (its lords having become extinct in 1759), Maria Theresa united all these lordships into an administrative district of Hither Austria, under the name Vorarlberg, the governor residing at Bregenz. In 1782 Joseph II transferred the region to the province of Tirol. The lordship of Blumenegg was added in 1804, but in 1805 all these lands were handed over, by virtue of the peace of Pressburg, to Bavaria, which in 1814 gave them all back, save Hoheneck. In 1815 the administrative arrangements were made which lasted until 1938. The building of the Arlberg railway (1880–1884) effected a considerable strengthening of the economic and political interests of Vorarlberg with the remainder of Austria.

See also under *Austria and Tirol,* relevant sections in C. Brockhausen, *Österreich in Wort und Bild.* (Berlin, 1924), and J. C. Heer, *Vorarlberg und Liechtenstein—Land und Leute* (Feldkirch, 1906).

VORONEZH, a region of the Russian S.F.S.R., having the Ukrainian S.S.R. and the North Caucasian area on the south, Kursk and Orel on the west, Tambov on the north and Stalingrad on the east. Area 26,873 sq.mi. Pop. (1939) 3,551,009 (rural 2,893,333, urban 657,676). It is now included in the recently created Black Earth Area (Central) (*q.v.*). It does not coincide with the pre-1917 province of the same name.

Voronezh occupies the southern slopes of the Central Russian plateau (450–700 ft.), and its surface is hilly and intersected by deep ravines in the west, where two ranges of chalk hills separated by a broad valley run north and south. East of the Don river is a low plain. Glacial clays with erratic boulders, and lacustrine clays and sands cover much of the area, but the Devonian rocks crop out in the north and provide good paving and building stone, while the carboniferous rocks supply millstones and grindstones. There is an abundant supply of chalk and kaolin clay for pottery.

The magnetic anomaly existing in Kursk extends into the southwest of Voronezh and indicates the presence of deep-seated iron ore beds. The soils are mainly black earth formed on loess; they vary in character from the rich black earth with a high humus content of the southern "feather grass" steppe, through the meadow steppe of the centre to the "lyesso steppe" of the north. This latter is black earth on which forest spread with moister conditions; the forest has disappeared, through reckless cutting, and the black earth here is reduced in humus quantity to 4 to 6%. Tree cutting had a disastrous effect in the west and centre for the spring streams, swollen by melting snow, frequently wash away fields and roads. In the first quarter of the 20th century some 135,000 ac. of fertile soil were washed away and replaced by

river sand. Efforts were made to cope with this by prohibition of forest cutting in the upper courses of the rivers, and of cattle driving on ravine slopes; by plowing across the slopes and not down them, and by the construction of canals and ditches. The problem was less acute in the east.

The climate is of the continental type, average January temperature at Voronezh 8·3° F, average July 74·2° F. The rainfall is variable and not very favourable to agriculture. If the spring rains (especially in May) fail, as they often do, famine frequently ensues. June and July are months of thunder-storm and very heavy rainfall, which comes in fierce and often destructive storms. The snow covering also varies; if it is deep, there is a chance of a good harvest, *e.g.*, in 1906–07 it remained 3 ft. deep most of the winter. In some years there is very little snow and the harvest is then poor. Autumn is very brief, but winter often lasts 5½ months, though a duration of two months only has been recorded. The rivers are frozen as a rule from Nov. 20 in the north and from Dec. 10, in the south-west. Snow melts as a rule in April. Winter is dull and cloudy, often with heavy fog. Another cause of disaster is the dry, cold, south-east winds which often blow in May and cause great damage to young crops.

These varied risks of disaster due to climate hamper agriculture seriously and famines have been frequent (1891, 1911, 1921) and severe. Weeds lessen the harvest, and their seeds are frequently not removed from the grain harvest, while rodents, mice, rats, hamsters, susliks and marmots in the south and south-east do great damage. A further drawback is the entirely inadequate system of communications; roads are often impassable through mud or deep in dust, and railways are insufficient, so that in years of abundance there is no outlet for the surplus, and in years of famine it is impossible to help the population. The 1891 famine resulted in some improvements of railway conditions.

The three-field system, probably introduced in the 16th century, gradually ousted the previous system of sowing till the land was exhausted, and then letting it lie fallow, sometimes for 20 or 30 years, till it recovered its fertility, and the hunting, fishing and bee-keeping, formerly wide-spread, has almost disappeared. By the end of the 19th century, a few agricultural specialists had begun to agitate against the wasteful three-field system and about 3% of the land in 1900 was worked on a many-field system, *e.g.*, a fallow year, under manure, rye, oats with clover, two years grass and clover, a clover fallow without manure, rye, potatoes or sugar-beet, oats or sunflower seed. A complicated system such as this, however, demands forethought and a fairly high stage of culture from the farmer, and the peasants in the Black Earth region are illiterate. The region is poverty-stricken and in many villages the peasants live in one-roomed huts infested by lice, fleas, blackbeetles and other vermin. Diet is poor, mainly starchy foods; eggs and butter are reserved for sale and meat is unobtainable in the general poverty-stricken conditions. Sanitation is absent and there is frequently no town or village provision for cleaning or repairing the streets, or for supplying water, or medical and veterinary help. This deplorable social condition is partly due to the difficulties outlined above, but mainly to historic factors. The long subjection of the peasants, first to Tatar oppression and later to serfdom under Russian landlords ended only in 1861, and the so-called "liberation" of the serfs in that year was followed by an almost as oppressive debt slavery. Between 1896 and 1914 thousands of peasants emigrated to Siberia and the south, while others wandered seasonally in search of supplementary occupation. From 1914 onwards, mobilization of the most useful agricultural labour was recklessly enforced and from 1918 to 1920 the region was occupied first by German troops and then by the conflicting armies of the Civil War. Upon this supervened the famine of 1921. Large sums of money were voted by the All Russian Executive at Moscow for the supply of horses, seeds, agricultural implements and agronomic and veterinary help to the region, but it must be many years before conditions are markedly improved.

Of the crops in 1926, rye occupied the first place, followed by hemp, wheat, millet, sunflower seed, potatoes and oats. Sugar-beet, melons and pumpkins and aniseed are also grown. Stock-raising, especially of horses, is carried on in the south-east and with it goes a leather industry. Poultry keeping has an export character, and there is still a little bee-keeping. The Voronezh Agricultural institute was opened in 1913. The University of Voronezh was founded in 1915, when the Germans occupied Yuriev (now in Estonia) and its university was therefore transferred to Voronezh.

Forests, which in the time of Peter the Great supplied timber for ship-building, are now practically all destroyed, especially the oak forests. The Voronezh river carries the pine forest and marsh of the north southwards into the region along its sandy, low left bank, as does the Bityuga. The hedgehog, badger, squirrel, polecat, marsh-otter, otter, weasel, ermine, wolf and fox exist in a few places and marmot fur is worked near Bobrov. The muskrat is found near the Bityuga and the Khoper rivers. Hunting, which even in the early 19th century had some importance and which in the 18th century included the hunting of the wild horse, is dying out. Factory industries mainly depend on local products and include flour-milling, oil-pressing, distilling, the manufacture of makhorka tobacco, brick-making, leather and rope works. The population is mainly Great Russian, with a considerable Tatar intermixture. The region has been inhabited from remote times and the east is thickly strewn with kurgans, or mounds; some contain burial relics, and some are the remains of earlier fortifications. The chief towns are Voronezh and Buturlinovka (*q.v.*).

Voronezh, the chief town of the above region and the administrative centre of the Black Earth Area (Central), situated on the navigable Voronezh river, 5 mi. above its confluence with the Don, in 51° 42′ N., 39° 10′ E. Pop. (1939) 326,836. It has a grain elevator and three railways branching from it and is an important collecting centre for the surrounding agricultural region. Its industrial enterprises include machine-making factories, steam flour mills, oil-pressing mills and the manufacture of bricks, wadding, paint and alcoholic drinks. A university and agricultural institute and museums exist. The site was occupied in the 11th century by a Khazar town, deserted during the 14th and 15th centuries. The Russians built a fort here in 1586, which was burned by the Tatars in 1590, but rebuilt. Peter the Great in 1695 built here a flotilla of boats for the conquest of Azov. The town was destroyed by fire in 1703, 1748 and 1773, but was always rebuilt. During the German offensive in the summer of 1942, Voronezh was fiercely contested by the Russians, who yielded it only to retake it in 1943, after the nazi disaster at Stalingrad.

VORONTSOV or WORONZOFF, the name of a Russian family, various members of which are distinguished in Russian history.

MIKHAIL ILLARIONOVICH VORONTSOV (1714–1767), Russian imperial chancellor, assisted Elizabeth Petrovna during the *coup d'état* of Dec. 6, 1741, when she seized the Russian throne. In 1742 he married Anna Skavronskaya, the empress's cousin; and in 1744 was created a count and vice-chancellor. His jealousy of Alexius Bestuzhev induced him to participate in Lestocq's conspiracy against that statesman, and he lived in retirement during the domination of Bestuzhev (1744–1758). On the disgrace of Bestuzhev, Vorontsov was made imperial chancellor. Vorontsov followed blindly the policy of the court. At first he refused to serve under Catherine II, though she reinstated him as chancellor. When he found that the real control of foreign affairs was in the hands of Nikita Panin, he resigned his office (1763).

ALEXANDER ROMANOVICH VORONTSOV (1741–1805), Russian imperial chancellor, nephew of the preceding and son of Count Roman Vorontsov, represented Peter III for a short time at the court of St. James. Catherine II made him a senator and president of the department of trade; but she never liked him, and ultimately (1791) compelled him to retire from public life. In 1802 Alexander I summoned him back to office and appointed him imperial chancellor. The Vorontsovs had always insisted on the necessity of a close union with Austria and Great Britain, in opposition to Panin and his followers, who had leaned on France or Prussia until the outbreak of the revolution made friendship with France impossible. Vorontsov was also an implacable opponent of Napoleon. The rupture with Napoleon in 1803 is mainly attributable to him. He retired in 1804.

His "Memoirs of my Own Times" (Rus.) is printed in vol. vii of the *Vorontsov Archives*.

SEMEN ROMANOVICH VORONTSOV (1744–1832), Russian diplomatist, brother of Alexander Romanovich, distinguished himself during the first Turkish War of Catherine II at Larga and Kagula in 1770. In 1783 he was appointed Russian minister at Vienna, but in 1785 was transferred to London where he lived for the rest of his life. During Catherine's second Turkish War he contributed to bring about the disarmament of the auxiliary British fleet which had been fitted out to assist the Turks, and in 1793 obtained a renewal of the commercial treaty between Great Britain and Russia. Subsequently, his policies profoundly irritated the empress. On the accession of Paul he was raised to the rank of ambassador extraordinary and minister plenipotentiary, and received immense estates in Finland. Neither Vorontsov's detention of the Russian squadron under Makarov in British ports nor his refusal, after the death of Bezborodko, to accept the dignity of imperial chancellor could alienate the favour of Paul. It was only when the emperor himself began to draw nearer to France that he began to consider Vorontsov as incompetent to serve Russia in England, and in Feb. 1800 all the count's estates were confiscated. Alexander I on his accession at once reinstated him, but ill-health and family affairs induced him to resign his post in 1806.

MIKHAIL SEMENOVICH VORONTSOV (1782–1856) Russian prince and field-marshal, son of the preceding, spent his childhood and youth with his father in London. During 1803–04 he served in the Caucasus under Tsitsianov and Gulyakov. He served in the campaigns of 1805–07 against Napoleon, against the Turks in 1809–11, and with Bagration's army in 1812. In 1814, at Craonne, he brilliantly withstood Napoleon in person. He was the commander of the corps of occupation in France from 1815 to 1818. In 1823 he was appointed governor-general of New Russia, as the southern provinces of the empire were then called. He was the first to start steamboats on the Black sea (1828). The same year he succeeded the wounded Menshikov as commander of the forces besieging Varna, which he captured on Sept. 28. In the campaign of 1829 he took measures to prevent the spread of the plague from Turkey to Russia. In 1844 Vorontsov was appointed commander-in-chief and governor of the Caucasus with plenipotentiary powers. For his brilliant campaign against Shamyl, and especially for his difficult march through the dangerous forests of Ichkerinia, he was raised to the dignity of prince. By 1848 he had captured two-thirds of Daghestan, and the situation of the Russians in the Caucasus, so long almost desperate, was steadily improving. In the beginning of 1853 Vorontsov retired. He was made a field-marshal in 1856, and died the same year at Odessa.

See V. V. Ogarkov, *The Vorontsovs* (Rus.) (St. Petersburg, 1892); *Vorontsov Archives* (Rus. and Fr.) (Moscow, 1870, etc.); M. P. Shelverbinin, *Biography of Prince M. S. Vorontsov* (Rus.) (St. Petersburg, 1858).

VOROSHILOV, KLEMENTIY EFREMOVICH (1881–), Russian soldier and politician, was the son of a workman. He became a revolutionary in 1897; in 1903 he joined the Bolshevik party, and in 1906 was a delegate to the Stockholm congress of the Bolsheviks. In the following year he was sentenced to banishment for organizing strikes and similar activities, and he remained in banishment, except for escapes and rearrests, until 1914. His military career began in the Ukraine, where he organized a detachment of partisans and carried on guerrilla warfare against the German forces of occupation. Later he assumed command of the X Red army. When the Germans left the Ukraine, Voroshilov became a member of the Ukrainian soviet government.

In March 1921, Voroshilov took an active part in the suppression of the revolt at Leningrad. He was elected a member of the central committee of the Communist party, and in May 1921 was appointed to command the Northern Caucasian military district. In 1924 he was appointed commander of the troops in the Moscow district. In 1925 he became president of the revolutionary military council and commissar for military and naval affairs. In 1940, he was made vice-premier. When the Germans invaded the U.S.S.R. in World War II, he was put in command of the northwestern (Leningrad) front.

VOROSHILOVGRAD (formerly known as LUGANSK), a town of the Ukrainian S.S.R., on the small river Lugan, 10 mi. from its confluence with the northern Donets, in 48° 35′ N., 39° 19′ E. It is situated on the railway in the Lugan mining district of the Donets, which consists of the Lisichansk coal mining region and the Gorodishche anthracite mines. Coal was known to exist in the time of Peter the Great, but was not worked until 1795, when an Englishman, Gascoyne, established the town's first ironworks for supplying the Black sea fleet. Its distance from the sea proved a difficulty and the works were closed until the Crimean War, when shot, shell and gun carriages were again produced. After 1923 the town developed rapidly and its population in 1939 was 213,007 as against 34,175 in 1900. It has smelting, engine building and enamel works, manufactures timber saws and ball bearings and has a flour-milling and brewing industry.

VOROSHILOVSK (formerly known as STAVROPOL), a town of Russia, in the North Caucasian Area, in 45° N., 41° 58′ E. situated on a plateau 2,030 ft. above sea level, on the northern slope of the Caucasus. The railway from Rostov-on-Don passes through it. Pop. (1939) 54,794. The town has textile and oil-pressing factories and manufactures agricultural machinery. It is a centre for Armenian, Georgian and Persian trade.

VÖRÖSMARTY, MIHÁLY (1800–1855), Hungarian poet, was born at Puszta-Nyék on Dec. 1, 1800, of a noble Roman Catholic family. Mihály was educated at Székesfejérvár by the Cistercians and at Pest by the Piarists. He had begun a drama entitled *Salamon* when he flung himself recklessly into public life since he was consumed by a hopeless passion for Etelka Perczel, who socially was far above him. To his unrequited love we owe a whole host of exquisite lyrics, while his patriotism found expression in the heroic epos *Zalán futása* (1824), gorgeous in colouring, exquisite in style, one of the gems of Magyar literature. This new epic marked a transition from the classical to the romantic school. Between 1823 and 1831 he composed four dramas and eight smaller epics, partly historical, partly fanciful. Of these epics he always regarded *Cserhalom* (1825) as the best, but modern criticism has given the preference to *Két szomséd vár* (1831), a terrible story of hatred and revenge. When the Hungarian academy was finally established (Nov. 17, 1830) he was elected a member of the philological section, and ultimately succeeded Károly Kisfaludy as director. He was one of the founders of the Kisfaludy society, and in 1837 started the *Athenaeum* and the *Figyelmezö*, the first the chief bellettristic, the second the best critical periodical of Hungary.

From 1830 to 1843 he devoted himself mainly to the drama, the best of his plays, perhaps, being *Vérnász* (1833). He also published several volumes of poetry, containing some of his best work. *Szózat* (1836), which became a national hymn, *Az elhagyott anya* (1837) and *Az úri hölgyhöz* (1841) are all inspired by a burning patriotism. He represented Jankovics at the diet of 1848, and in 1849 was made one of the judges of the high court. The national catastrophe profoundly affected him. For a short time he was an exile, and when he returned to Hungary in 1850 he was already an old man. A profound melancholy crippled him for the rest of his life. In 1854 he wrote his last great poem, the touching *A vén cigány*. He died at Pest in 1855 in the same house where Károly Kisfaludy had died 25 years before. His funeral, on Nov. 21, was a day of national mourning.

The best edition of Vörösmarty's collected works is by Pál Gyulai (Budapest, 1884). Some of them have been translated into German, e.g., *Gedichte* (Pest, 1857); *Ban Marot*, by Mihály Ring (Pest, 1879); *Ausgewählte Dichte*, by Paul Hoffmann (Leipzig, 1895). *See* Pál Gyulai, *The Life of Vörösmarty* (Hung.) (3rd ed., Budapest, 1890), one of the noblest biographies in the language; Brajjer, *Vörösmarty, sein Leben und seine Werke* (Nagy-Becskerek, 1882). (R. N. B.)

VORTICELLA, the bell-animalcule, a Protozoan genus of the large family *Vorticellidae* belonging to the Peritrichous Infusoria (*q.v.*) characterized by the bell-shaped body, with short oral disc and collar, attached by a hollow stalk, inside and around which passes, attached spirally, a contractile bundle of myonemes. By their contraction the stalk is brought into the form of a

corkscrew, and the animal is jerked back near to the base of the stalk. As soon as the contraction of the thread ceases, the elasticity of the stalk extends the animal to its previous position. On fission, one of the two animals swims off by the development of the temporary posterior girdle of membranelles, the disc being retracted and closed over by the collar, so that the cell is ovoid; on its attachment the posterior girdle of cilia disappears and a stalk forms. The other cell remains attached to the old stalk. In the allied genera *Carchesium* and *Zoothamnium* the two produced by fission remain united, so that a branching colony is ultimately produced. The genus is a large one. The gametes in conjugation differ from one another, one being attached, the other free. Each pair fuses together completely and permanently.

VORTIGERN (GUORTHIGIRNUS, WYRTGEORN), king of the Britons at the time of the arrival of the Saxons under Hengest and Horsa in the 5th century. Though many legends have come down to us about him, he may probably be safely regarded as an actual historical figure. Vortigern made use of Hengest and Horsa to protect his kingdom against the Picts and Scots, and rewarded them for their services with a grant of land. Later we find the Britons at war with the newcomers, now established in Kent, and four battles are fought, in the last of which, according to the *Historia Brittonum*, the king's son Vortemir, their leading opponent, is slain. The *Historia Brittonum* is our only authority for the marriage of Vortigern with the daughter of Hengest before the war. It also records the massacre of the British nobles after the death of Vortemir and the subsequent grant of Essex and Sussex to the invaders by Vortigern.

See *Historia Brittonum*, ed. Th. Mommsen in *Mon. Hist. Germ.* xiii; *Anglo-Saxon Chronicle*, ed. Earle and Plummer (Oxford, 1899); Bede, *Hist. Eccl.*, ed. C. Plummer (Oxford, 1896).

VOSGES, an upland department of eastern France, formed in 1790 chiefly by territory previously belonging to Lorraine, together with portions of Franche-Comté and Champagne, and bounded north by Meurthe-et-Moselle, northeast by Bas-Rhin, east by Haut-Rhin, southeast by the territory of Belfort, south by Haute-Saône, west by Haute-Marne and northwest by Meuse. Pop. (1936), 376,926; area 2,279 sq.mi. The Vosges mountains form a natural boundary on the east, their highest French eminence, the Hohneck, attaining 4,482 ft. The Monts Faucilles traverse the south of the department in a broad curve declining on the north into elevated plateaus, on the south encircling the upper basin of the Saône. This chain, dividing the basins of the Rhône and the Rhine, forms part of the European watershed between the basins of the Mediterranean and Atlantic. The Moselle and the Meuse, tributaries of the Rhine, have the largest drainage areas in the department; a small district in the northwest sends its waters to the Seine, the rest belongs to the basin of the Rhône. The Moselle rises in the Col de Bussang in the extreme southeast, and in a north-northwesterly course of about 70 mi. in the department receives the Moselotte and the Vologne on the right; the Mortagne and Meurthe on the right and the Madon on the left bank also belong to this department though they join the Moselle outside its borders.

The elevation and the northward exposure of the valleys make the climate severe, and a constant dampness prevails, owing both to the abundance of the rainfall and to the impermeability of the subsoil. The winter average temperature reduced to sea level is 34° to 35°, the summer average temperature being 66° to 68°. The rainfall varies from 28 in. to 60 in., according to the altitude. Arable farming flourishes in the western districts where wheat, oats, beetroot, tobacco, hops, potatoes and hemp are largely grown. The vine is cultivated on the river banks, to best advantage on those of the Moselle. Pasture is abundant in the mountainous region, where cheese-making is carried on to some extent, but the best grazing is in the central valleys. Forests, which occupy large tracts on the flanks of the Vosges, cover about one-third of the department, and are a principal source of its wealth. Sawmills are numerous in the Vosges and the manufactures of furniture, sabots, brushes and wood-working in general are prominent industries. The department has mines of lignite and stone quarries of various kinds. There are numerous mineral springs, notably those of Contrexéville, Plombières, Vittel, Bains-les-Bains, Martigny-les-Bains and Bussang. Metal goods are made, but the manufacture of textiles is the chief industry, comprising the spinning and weaving of cotton, wool, silk, hemp and flax, and the manufacture of hosiery and of embroidery and lace, Mirecourt (pop. [1936] 5,189), which also makes musical instruments, being an important centre for the two last. The department forms the diocese of St. Dié (province of Besançon), has its court of appeal and educational centre at Nancy, and belongs to the district of the XX army corps. It is divided into three arrondissements of Épinal, the capital, Neufchâteau and St. Dié, with 29 cantons and 532 communes.

VOSGES, a mountain range stretching along the west side of the Rhine valley, from Basel to Mainz, a distance of 150 mi. They are similar to and closely associated with the Black Forest. The ranges are similar in geological formation and are portions of the same structural unit, for the Rhine valley which separates them lies in a rift valley of Tertiary age. In addition both have fine forests on their lower slopes, above which are open pasturages and rounded summits of a uniform altitude; both have a steep fall to the Rhine and a gradual descent on the other side. The Vosges in their southern portion are mainly of granite, with some porphyritic rocks, and a red sandstone (occasionally 1,640 ft. thick) which on the western versant is named "grès Vosgien."

Orographically the range is divided into four sections: the Grandes Vosges (62 mi.), extending from Belfort to the Col de Saales; the Central Vosges (31 mi.), between the latter and the Col de Saverne; the Lower Vosges (30 mi.) from thence to the source of the Lauter; and the Hardt Mts. (*q.v.*). The rounded summits of the Grandes Vosges are called "ballons." The departments of Vosges, Haute Saône, and Haut-Rhin and Belfort territory meet at the Ballon d'Alsace (4,100 ft.). Then northward the average height of the range is 3,000 ft., the highest point, the Ballon de Guebwiller (Gebweiler), or Sultz, rising east of the main chain to 4,668 ft. The Col de Saales is nearly 1,900 ft. high. The central section is both lower and narrower than the Grandes Vosges, Mont Donon (3,307 ft.) being the highest summit. The Rhine and Marne Canal and the Paris-Strasbourg railway traverse the Col de Saverne. There are motor roads over the passes of Bussang (Remiremont to Thann), the Schlucht (3,625 ft.) (Gérardmer to Munster), the Bonhomme (St. Dié to Colmar) and the pass from St. Dié to Ste. Marie-aux-Mines. The Lower Vosges are a sandstone plateau ranging from 1,000 to 1,850 ft. high, and are crossed by the railway from Hagenau to Sarreguemines, defended by the fort of Bitche.

The annual rainfall is much higher and the mean temperature much lower in the western than in the eastern versants while on the latter the vine ripens to a height of 1,300 ft.; but its only rivers here are the Ill and other shorter streams. The Moselle, Meurthe and Saar all rise on the Lorraine side. Moraines, boulders and polished rocks testify to the existence of glaciers which formerly covered the Vosges. The lakes, surrounded by pines, beeches and maples, the green meadows which provide pasture for large herds of cows, and the fine views of the Rhine valley, Black Forest and snow-covered Swiss mountains combine to make the district picturesque.

VOSS, JOHANN HEINRICH (1751–1826), German poet and translator, was born at Sommersdorf in Mecklenburg-Strelitz on Feb. 20, 1751, the son of a farmer. At the invitation of H. C. Boie, whose attention he had attracted by poems contributed to the Göttingen *Musenalmanach*, he went to Göttingen in 1772. Here he studied philology and became one of the leading spirits in the famous *Hain* or *Dichterbund*. In 1775 Boie made over to him the editorship of the *Musenalmanach*, which he continued to issue for several years. He married Boie's sister Ernestine in 1777. Voss was rector of the School at Otterndorf, Hanover (1778–82), and at Eutin (1782–1802). He then became a professor at Heidelberg, where he died on March 28, 1826.

The best of his works is his idyllic poem *Luise* (1795), in which he sought to apply the style and methods of classical poetry to the expression of modern German thought and sentiment. But he is chiefly remembered for his translations of Homer, Hesiod,

Theocritus, Bion and Moschus, Virgil, Horace, Tibullus, Propertius, and of Shakespeare's plays (9 vols.).

J. H. Voss's *Sämtliche poetische Werke* were published by his son Abraham in 1835; new ed. 1850. A good selection is in A. Sauer, *Der Göttinger Dichterbund*, vol. i. (Kürschner's *Deutsche National-literatur*, vol. 49, 1887). His Letters were also published by his son in 4 vols. (1829–33). Voss left a short autobiography, *Abriss meines Lebens* (1818). *See* also W. Herbst, *J. H. Voss* (3 vols., 1872–76); A. Heussner, *J. H. Voss als Schulmann in Eutin* (1882).

VOSS, RICHARD (1851–1918), German dramatist and novelist, was born at Neugrape, in Pomerania, on Sept. 2, 1851, the son of a country squire. Though intended for the life of a country gentleman, he showed no inclination for outdoor life, and on his return from the war of 1870–71, in which he was wounded, he studied philosophy at Jena and Munich, and then settled at Berchtesgaden. In 1884 Voss was appointed by the grand duke of Weimar librarian of the Wartburg, but, in consequence of illness, he resigned the post. He died at Königsee, Thuringia, on July 10, 1918.

Chief among his dramas are *Savonarola* (1878); *Magda* (1879); *Die Patricierin* (1880); *Der Mohr des Zaren* (1883); *Unehrlich Volk* (1885); *Alexandra* (1886); *Eva* (1889); *Wehe dem Besiegten* (1889); *Die neue Zeit* (1891); *Schuldig* (1892). Among his novels may be mentioned *San Sebastian* (1883); *Der Sohn der Volskerin* (1885); *Die Sabinerin* (1888); *Der Mönch von Berchtesgaden* (1891); *Der neue Gott* (1898); *Die Rächerin* (1899); *Allerlei Erlebtes* (1902); *Die Leute von Valdaré* (1902); *Die Erlösung* (1921); *Bergasyl* (1922); *Alpentragödie* (1923); also the war book *Brutus, auch Du* (1917). His recollections (*Erinnerungen*) were published in 1920; *see* also M. Goldmann, *Richard Voss, ein literarisches Charakterbild* (1900).

VOSSEVANGEN or Voss, a village and tourist-centre of Norway, in South Bergenhus *amt* (county), 67 mi. N.W. of Bergen by rail. Vossevangen is situated on the Vangsvand, in fertile upland, and has a stone church of the 13th century, and a *finneloft* or two-storied timber church of the 14th century.

VOSSIUS (Voss), **GERHARD JOHANN** (1577–1649), German classical scholar and theologian, was the son of Johannes Voss, a Dutch Calvinist pastor, and was born in a village near Heidelberg, where his father had found refuge. But Voss was unwelcome among the Lutherans, and returned with his son to Holland. Gerhard was educated at the university of Leyden, where he became the lifelong friend of Hugo Grotius, and studied classics, Hebrew, church history and theology. He was rector (1600–14) of the high school at Dort, and then director of the theological college at Leyden (1614–19). He came under suspicion of heresy, and escaped expulsion from his office only by resignation (1619). In 1618 he had published his history of Pelagian controversies, which his enemies considered favoured the views of the Arminians or Remonstrants. In 1622, however, he was appointed professor of rhetoric and chronology, and subsequently of Greek, in the university. He declined invitations from Cambridge, but accepted from Archbishop Laud a prebend in Canterbury cathedral without residence, and went to England to be installed in 1629, when he was made LL.D. at Oxford. In 1632 he left Leyden to become professor of history in the newly founded Athenaeum at Amsterdam. There he died on March 19, 1649.

Vossius was amongst the first to treat theological dogmas and the heathen religions from the historical point of view. His principal works are *Historia Pelagiana sive Historiae de controversiis quas Pelagius eiusque reliquiae moverunt* (1618); *Aristarchus, sive de arte grammatica* (1635 and 1695; new ed. in two vols., 1833–35); *Etymologicum linguae Latinae* (1662; new ed. in two vols., 1762–63); *Commentariorum Rhetoricorum oratoriarum institutionum Libri VI* (1606 and often); *De Historicis Graecis Libri III* (1624); *De Historicis Latinis Libri III* (1627); *De Theologia Gentili* (1642); *Dissertationes Tres de Tribus Symbolis, Apostolico, Athanasiano et Constantinopolitano* (1642). Collected works published at Amsterdam (6 vols., 1695–1701).

See p. Nicéron, *Mémoires pour servir à l'histoire des hommes illustres*, vol. xiii (Paris, 1730); Herzog's *Realencyklopädie*, art. "Vossius."

VOTING is a procedure whereby group decisions are made on the basis of choices exercised by individual members of the group. The individual voter may be asked to choose between candidates or between measures. The process is used in popular elections and in legislative assemblies. Voting is one of the available means by which a society may organize itself and make formal decisions. Where voting is free it is a system for making decisions regarding the power relations in society, a method for securing political obedience with the minimum of sacrifice of the individual's freedom. The essence of voting is freedom of choice. Under a dictatorship the individual may be asked to ratify choices already made by the dictator, but the procedure is an empty one. It is only under democratic governments that voting has any meaning.

Voting involves formal decisions, arrived at by rules which are accepted in advance. Unanimous consent as a voting rule has been tried and found wanting. If a government cannot act until all members have agreed to a given course of action, stagnation results. Consent under a democracy means partial consent. The convention of majority rule has proved to be useful in ending deadlocks. It has been used by electorates, legislatures, administrative boards, courts and other legally established bodies charged with definite governmental functions. Majority rule means that, more than half of the active electorate is in favour of a regime or a proposition. The winning of a majority is by peaceful means, by persuasion, by electioneering, by trickery sometimes, but not by wholesale threats or acts of violence.

The occasions on which the right to vote is to be exercised must be recurrent ones or the right becomes meaningless, for in the absence of a fixed term of office, the actual use of the vote may be indefinitely postponed.

Not only must the election itself be conducted without coercion, but the results must be accepted peacefully. If an election precipitates a social upheaval or a civil war, it can hardly be said that the democratic process of voting has been accepted. In Spain the election of 1935 was not accepted by the voters of the right, and civil war was the result. The Franco dictatorship followed.

While some groups such as the French *L'Action Française* have boycotted voting, in general, groups have felt that the ballot is a weapon which they could wield to their own advantage. Most groups have felt that they might protect themselves better from hostile sections of the population or even from a majority of the population, that they might satisfy their desires to direct the policies of the state and that they might obtain their share of the material and emotional satisfactions that can result from political action if they go to the polls and vote.

One argument which was always presented prior to the extension of the suffrage was that the groups to be included in the electorate did not desire the vote and would not exercise the right if it were given to them. This was the plea made by conservatives in the United States, Great Britain, Belgium and Prussia, prior to the adoption of important suffrage reforms.

What is the relationship of the size of the vote and the efficient functioning of the democratic process? Voting is a means for obtaining the consent of the governed. Other things being equal, the smaller the vote the more limited becomes the basis of consent. A low poll which is accompanied with wide-spread skepticism regarding the efficacy of the electoral process is a danger signal. It indicates that the masses do not have much faith in the democratic process. Those citizens who will not even go a short distance to the polls to mark their ballots may not be relied upon to put forth the strenuous efforts necessary to defend democratic institutions in troublesome times.

Interest in voting is most accurately and definitely established by the participation of potential electors in the actual voting process. It would seem obvious that the larger the number of eligibles who participate, the healthier the conditions for a working democracy, and to a large extent such a generalization is true.

The plutocratic Athenian democracy had to pay citizens to attend the assembly meeting and vote—an indication of declining popular morale. The groups enfranchised by the French Revolution took slight interest in voting during the years before Napoleon. Participation in elections has not been a confirmed habit in several South American countries, among them Brazil. In the United States, the southern states which are confronted with peculiar and burdensome problems, economic and political, offer in their low participation a good index to the state of deterioration into which democratic institutions have fallen there.

The indifference of the Italians to the fate of parliamentary govern-

ment prior to 1922 was one of the foundations of fascism. The polls in Italy were low during the half century preceding the March on Rome. Nonvoting in Italy was in part the result of the boycott of the Italian state by the Catholic church, but it was also the product of a feeling of hopelessness on the part of the masses. If the Italian Catholics had been rallied to the polls by a strong party such as the Belgian Catholic party, they might have stabilized the parliamentary system. When the ban on political action by Catholics was lifted by the Vatican the Populari party was founded in 1919, but it was not given a chance to prove its worth before Mussolini fell.

Nonvoting is also important because it indicates the presence of inert persons who may be captivated by ruthless demagoguery. If the parties that wish to respect the democratic processes are not successful in winning the confidence of these indifferent citizens, then the anti-democratic parties are in a better position to bid for their support. Persons who feel that the existing regime has little to offer them may be won over by a group which makes wild promises regarding the future.

An examination of the situation in Germany in the 1930s shows that the nonvoters were of importance in Adolph Hitler's rise to power. During the 1920s interest in voting in Germany had been reasonably high, but it tended to decline. One-fourth of the eligible German voters failed to take part in the reichstag election of 1928. The early 1930s brought larger polls and the chief beneficiary of the augmented interest was the nazi party which appealed especially to those who felt frustrated under the Weimar regime. Hitler promised everything to everybody in true demagogic fashion.

While the election of March 5, 1933, was not as free as the preceding elections had been, it was nevertheless more free than the following elections under Hitler. Prior to this election the nazis were in violent clashes chiefly with the communists. In absolute numbers the older parties did not decline greatly in this election. The vote for the Social Democratic party was practically the same as it had been in the two 1932 elections. The 5,000,000 votes gained by the nazi party could be accounted for largely out of the increased poll of about 4,000,000. The glittering promises of Hitler and his aides awakened hopes in many persons who had shunned the electoral process before.

These are circumstances under which a low poll is not particularly alarming as far as the proper functioning of democracy is concerned. In fact, a low poll sometimes indicates that the electoral process is working very efficiently. For example, the U.S. cities under the city manager plan which have councils made up of leading citizens whose control of the city affairs is on the whole very acceptable. The election of the city council in these cities will not bring out the vote that a presidential election does. As long as the council proceeds along the traditional lines and does not raise upsetting issues, as long as there are no powerful interest groups which challenge the rule of the "leading" citizens, as long as the *status quo* is satisfactory, nonvoting may not be a particularly disturbing phenomenon. The efficient city manager government may lull the less alert citizens to sleep and they may be unaware of their voting power, but this situation is certainly not as potentially upsetting as the one in which nonvoting is accompanied with disillusionment. Electoral indifference becomes important in connection with the attitudes held toward the democratic process.

Thus, there is nothing alarming about a high poll or a low poll as long as there is tolerance of opposition, freedom of discussion and agreement on essentials. Voting or nonvoting may register insecurities or satisfactions depending upon the circumstances. The size of the vote under favourable conditions indicates something about the worthwhileness of voting. If there are too many elections and too many choices to exercise at each of them, many voters will ignore what they think are minor offices and minor issues. Long ballots and complicated procedures often mean the difference between voting and nonvoting.

The older English-speaking countries with democratic procedures possessed voting records inferior to the central European democracies of the 1920s and 1930s. Universal suffrage seemed to work remarkably well in Belgium, Czechoslovakia, Switzerland and the Netherlands, as far as interest in voting was concerned. While the U.S. of the 1920s fretted about the "vanishing voter" and the "millions of Americans who failed to vote," the smaller European democracies showed how the voters could be organized—in the case of Switzerland, even through the cataclysmic years of World War II. Contributing to the sustained interest in voting in these countries was the system of proportional representation, the convenient voting arrangements and in the case of Belgium and Czechoslovakia an effective system of compulsory voting. Australia is the only English-speaking country employing compulsory voting, and the device has been just as effective there as it has been in Belgium. Money fines are assessed against qualified voters who fail to show up at the polls without proper justification such as sickness or absence on account of business.

Nonvoting is more prevalent among certain portions of the electorate than it is among others. The available figures on popular participation in elections in various democracies show that nonvoting is more common among women than among men, among the lower-income groups than among the upper, among the young voters than among the middle aged, among the illiterate than among the highly educated, among the newer immigrant groups than among the natives. As far as women are concerned, they have steadily increased their voting efficiency and undoubtedly will soon equal the male record. Where the lower-income groups are well organized into labour unions, their voting records are as good as the upper-income groups. As educational opportunities become more equalized, nonvoting due to illiteracy should decrease. As immigrant groups are assimilated into their new political environment, they improve their voting records.

Democracy on a large scale was made possible by the invention of the printing press and the development of mass education. The ancient Greeks assumed that a community of self-governing citizens could not be larger than one voice could reach, and thus the city-state was the ideal state. With the invention of the telegraph, wireless communications, the camera, the radio and telephotographs, the mass media have become even more indispensable to large-scale democracies.

In democratic jurisdictions where the press and radio are unfair, where the parties are unbalanced or corrupt, where organized pressure groups are unduly powerful, it is still possible for the citizens who have the common interest at heart to organize nonpartisan civic groups to obtain and disseminate the truth about the candidates and their policies. In the United States an outstanding group of this type is the League of Women Voters, which was founded in 1920.

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VOTING MACHINES. The use of the Australian ballot system has been attended with many complications which have seriously handicapped its use. These have resulted in the development of voting machines for registering and counting votes. Every voter under the Australian system uses a separate paper ballot which causes considerable delay in the counting of votes and the announcement of results. It also permits fraud. Void and blank paper ballots are generally 5% of those voting, and sometimes as high as 40%; lost votes sometimes exceed the majorities of successful candidates; close elections cause endless legal disputes; contested elections follow with recount costs that exceed the original cost at the election, and a successful candidate's rights are sometimes abrogated until the term of office expires. There are many ways of marking ballots for those on election boards in collusion with vote buyers outside. Voting machines remedy many of these ills. On the voting machine one mechanical ballot is used by all voters, each setting the ballot as he wishes. The vote is registered on the machine's counters, which shows votes when cast so that each candidate's total is seen at all times.

The first inventors of voting machines were English. The earlier machines of Vassie, Chamberlain, Sydserff (1869) and Davy (1870) all used a ball or equivalent placed in a chosen compartment for casting a vote. A number of American inventors also made machines using balls. All these early machines were only makeshifts because the balls had to be counted. Later, mechanical counters replaced balls; a key and a counter was provided for each candidate, the machine was constructed to prevent voters from giving the keys more than one impulse and from using more keys than those to which they are entitled. The first of these machines used were the Myers ballot machine at Lockport in 1892. About 65 were used in Rochester, N.Y., in 1896. It was not reliable or convenient enough but proved it practical for voters to register votes secretly and pointed to the future developments. The McTammany machine had a separate key for each candidate. Holes punched in a paper web were counted by a pneumatical machine. Bardwell, Abbott and Dean machines registered votes on mechanical counters.

The U.S. Standard, the Empire and the Automatic Registering machines followed, the latter being the last perfected product. All three were made by one company or its successors at Jamestown, N.Y., past owners of Keiper's roller interlock patent. This patent, No. 1,031, issued July 2, 1912, expired in 1929, and opened the voting machine business to competition. This interlock is simple, strong, accurate and flexible, and was installed on all these machines. They constitute about 98% of the 16,000 or more machines in the United States. A separate key is provided for each candidate. The keys, in horizontal party rows and vertical office lines, are pivoted, swinging from the horizontal and pointing to the candidates' names printed on ballot labels below the keys. Combined keys, labels, keyboard, etc., makes a mechanical Australian ballot. At the left of each party row are party levers by moving any one of which all pointers on

its party row are put in voted position. In states not providing for straight tickets, party levers are omitted or locked. A U-shaped rail holding a curtain forms a booth completely enclosing the voter. By a lever at the top the voter closes the curtain and unlocks the machine. As a single stroke of a party lever puts all the keys into position, the voter can turn up the keys of candidates he wants to omit and vote the others. Reversing the curtain lever counts the votes, resets the keys, opens the curtain, and exposes the keyboard. Until the curtain opens the vote is not counted and the voter can take back or change his vote. Repeating is prevented by a knob locking the curtain lever against a second movement by the same voter until it is released by the election officers. The counters are inside of the machine and are concealed by a door in the back. After the election is over the machines must be locked against voting before this door can be opened. Then the total vote for each candidate is read off directly from his counter. These counters are easily reset for another election but they can only be unlocked for that purpose by the custodian's key. This custodian's key is not given to the election board, but is held by the officer charged with the duty of preparing the machine for the election. The keys and counters on a machine provide for voting for those candidates that have been regularly nominated and whose names would be printed on the paper ballot if used. It is the voter's privilege to vote for candidates not nominated and the machine must provide facilities for voting for them. At the top of the machine is a horizontal paper roll that runs the whole length of the machine, on which can be written the names of these candidates. This roll is concealed by slides, one above each line of office keys. One of these slides must be lifted for each office line to expose the paper. The interlocking mechanism must control all the voting keys on the machine so that the voter cannot vote more than he is entitled to vote.

Machines have been built large enough to provide for nine parties of 70 candidates each and for 35 questions or amendments. A machine of such size carries 700 counters besides the total vote and protective counters. The total vote counter shows the number of voters voting at each election and can be reset for each election. Another counter shows the total number of votes cast during the life of the machine. It is made so that it cannot be reset and acts as a seal on the machine. Each state that adopts voting machines enacts a law specifying the requirements that must be met by the machine. The laws of the various states are copied largely from the voting machine law of the state of New York. The laws, in general, require that the machine must give the voter all the facilities for making his choice which the Australian ballot gives him, and further requires that the machine shall prevent those mistakes or frauds which if made on the Australian ballot would invalidate it. Many of the states have special requirements to meet, the solution of which present other problems, but so far the voting machine has been able to meet all of them.

The use of the machines secures accuracy both in casting and counting the vote. It eliminates the interference of the election officer with the counting of the votes. The machine gives the returns promptly and cuts down the cost of holding election. Where straight ticket voting is used the vote for each office usually runs 99% or more of the highest possible vote that could be registered. In the city of Buffalo with more than 218,000 people voting, the complete vote on a large ticket for the whole city has been collected, tabulated and announced within 90 minutes of the closing of the polls. Although voting machines are used but one or two days of each year, election expenses are reduced to such an extent that the machines frequently pay for themselves in five or six elections. Where straight ticket voting is provided more than 1,000 voters have frequently voted on one machine in one election day. Where straight ticket voting is not permitted as many as 600 voters have voted in one day on one machine.

In the election of Nov. 1928, about 80% of the vote of New York state was cast and counted on voting machines. Nearly 3,000 voting machines were used in the city of New York alone and all of the votes of the boroughs of Manhattan, Bronx and Brooklyn were counted on voting machines. Voting machines were also extensively used in Connecticut, Michigan, Indiana, Wisconsin, Iowa, California, Washington, Oregon, Montana and Maryland, and to a lesser extent in some of the other states. About one-sixth of all the votes of the presidential election of 1928 were cast on voting machines. (F. KEI.)

VOTKINSK, a town of the U.S.S.R., in the Udmurtsk A.S.S.R., on a tributary of the Kama river in 57° 5′ N., 53° 55′ E. Population 19,479. It manufactures agricultural machinery, and has railway and shipbuilding yards; it is the terminus of a branch railway.

VOTYAK REPUBLIC: *see* UDMURTSK.

VOUET, SIMON (1590–1649), French painter, was born at Paris on Jan. 9, 1590. He passed many years in Italy, where he married, and established himself at Rome, enjoying there a high reputation as a portrait painter. Louis XIII recalled him to France and lodged him in the Louvre with the title of First Painter to the Crown. All royal work for the palaces of the Louvre and the Luxembourg was placed in his hands. The king became his pupil and he formed a large school, renewing the traditions of that of Fontainebleau. Among his scholars was the famous Le Brun. Vouet was an exceedingly skilful painter, especially in decoration, and executed important works of this class for Cardinal Richelieu (Rueil and Palais Royal) and other great nobles. His better easel pictures bear a curious resemblance to those of Sassoferrato. Almost everything he did was engraved by his sons-in-law.

VOUSSOIR, in architecture and building, one of the wedge-shaped stones, tiles, bricks or blocks of other material of which an arch (*q.v.*) is composed. The lowest voussoir on each side of an arch is known as a springer (*q.v.*); the highest, or central voussoir, as a keystone (*q.v.*).

VOW, a transaction between a man and a god, whereby the former undertakes in the future to render some service or gift to the god or devotes something valuable now and here to his use. The god on his part is reckoned to be going to grant or to have granted already some special favour to his votary in return for the promise made or service declared. Different formalities and ceremonies may in different religions attend the taking of a vow, but in all the wrath of heaven or of hell is visited upon one who breaks it. A vow has to be distinguished, first, from other and lower ways of persuading or constraining supernatural powers to give what man desires and to help him in time of need; and second, from the ordered ritual and regularly recurring ceremonies of religion. These two distinctions must be examined a little more at length.

It would be an abuse of language to apply the term vow to the uses of imitative magic, *e.g.*, to the action of a barren woman among the Battas of Sumatra, who in order to become a mother makes a wooden image of a child and holds it in her lap. For in such rites no prominence is given to the idea—even if it exists—of a personal relation between the petitioner and the supernatural power. The latter is, so to speak, mechanically constrained to act by the spell or magical rite; the forces liberated in fulfilment, not of a petition, but of *a wish* are not those of a conscious will, and therefore no thanks are due from the wisher in case he is successful.

The deities, however, to whom vows are made or discharged are already personal beings, capable of entering into contracts or covenants with man, of understanding the claims which his vow establishes on their benevolence, and of valuing his gratitude; conversely, in the taking of a vow the petitioner's piety and spiritual attitude have begun to outweigh those merely ritual details of the ceremony which in magical rites are all-important.

Sometimes the old magical usage survives side by side with the more developed idea of a personal power to be approached in prayer. For example, in the Maghrib (in North Africa), in time of drought the maidens of Mazouna carry every evening in procession through the streets a doll called *ghonja*, really a dressed-up wooden spoon, symbolizing a pre-Islamic rain-spirit. Often one of the girls carries on her shoulder a sheep, and her companions sing the following words:—

"Rain, fall, and I will give you my kid.
He has a black head; he neither bleats
Nor complains; he says not, 'I am cold.'
Rain, who fillest the skins,
Wet our raiment.
Rain, who feedest the rivers,
Overturn the doors of our houses."

Here we have a sympathetic rain charm, combined with a prayer to the rain viewed as a personal goddess and with a promise or vow to give her the animal. The point of the promise lies, of course, in the fact that water is in that country stored and carried in sheepskins.

Second, the vow is quite apart from established cults and is not provided for in the religious calendar. The Roman vow (*votum*), as W. W. Fowler observes in his work *The Roman Festivals* (London, 1899), p. 346, "was the exception not the rule; it was a promise made by an individual at some critical moment, not the ordered and recurring ritual of the family or the state." The vow, however, contained so large an element of ordinary prayer that in the Greek language one and the same word (εὐχή) expressed both. The characteristic mark of the vow, as Suidas in his lexicon and the Greek church fathers remark, was that it was a promise either of things to be offered to God in the future and at once consecrated to Him in view of their being so offered, or of austerities to be undergone. For offering and austerity, sacrifice and suffering, are equally calculated to appease an offended deity's wrath or win his goodwill.

The Bible affords many examples of vows. Thus in Judges xi Jephthah "vowed a vow unto the Lord, and said, If thou wilt indeed deliver the children of Ammon into my hand, then it shall be that whosoever cometh forth out of the doors of my house to meet me, when I return in peace from the children of Ammon, it shall be the Lord's, and I will offer it up for a burnt-offering." In the sequel it is his own daughter who so meets him, and he sacrifices her after a respite of two months granted her in order to "bewail her virginity upon the mountains." A thing or person thus vowed to the deity became holy or tabu; and for it, as the above story indicates, nothing could be substituted. It belonged to the sanctuary or to the priests who represented the god. In the Jewish religion, the latter, under certain conditions, defined in Leviticus xxvii, could permit it to be redeemed. But to substitute an unclean for a clean beast which had been vowed, or an imperfect victim for a flawless one, was to court with certainty the divine displeasure.

It is often difficult to distinguish a vow from an oath. Thus in Acts xxiii, 21, more than 40 Jews, enemies of Paul, bound themselves under a curse, neither to eat nor to drink until they had slain him. In the Christian Fathers we hear of vows to abstain from flesh diet and wine. But of the abstentions observed by votaries, those which had relation to the barber's art were the commonest. Wherever individuals were concerned to create or confirm a tie connecting them with a god, a shrine or a particular religious circle, a hair-offering was in some form or other imperative. They began by polling their locks at the shrine and left them as a soul-token in charge of the god, and never polled them afresh until the vow was fulfilled. So Achilles consecrated his hair to the river Spercheus and vowed not to cut it till he should return safe from Troy; and the Hebrew Nazarite, whose strength resided in his flowing locks, only cut them off and burned them on the altar when the days of his vow were ended, and he could return to ordinary life, having achieved his mission. So in Acts xviii, 18, Paul "had shorn his head in Cenchreae, for he had a vow." In Acts xxi, 23, we hear of four Jews who, having a vow on them, had their heads shaved at Paul's expense. Among the ancient Chatti, as Tacitus relates (*Germania*, 31), young men allowed their hair and beards to grow, and vowed to court danger in this guise until they each had slain an enemy. Robertson Smith (*Religion of the Semites*, ed. 1901, p. 483) with much probability explains such usages from the widespread primitive belief that a man's life lurks in his hair, so that the devotee being consecrated or tabu to a god, his hair must be retained during the period of tabu or purification (as it is called in Acts xxi, 26) lest it be dissipated and profaned. The hair being part and parcel of the votary, its profanation would profane him and break the tabu. The same author remarks that this is why, when the hair of a Maori chief was cut, it was, being like the rest of his person sacred or tabu, collected and buried in a sacred place or hung on a tree. And we meet with the same scruple in the initiation rite, called σχήμα of Eastern monks. First the novice is carefully denuded of the clothes, shoes and headgear which he wore in the world, and which, being profane or unclean, would violate the tabu about to be set on him. His hair is then polled cross-wise by way of consecrating it; and in some forms of the rite the presiding monk, called the "father of the hair," collects the shorn locks and deposits them under the altar or in some other safe and sacred place. Greek nuns used to keep the hair thus shorn off, weave it into girdles, and wear it for the rest of their lives round their waists, where close to their holy persons there was no risk of its being defiled by alien contact.

The prohibition, to one under a vow, of flesh diet and fermented drinks is due to the belief that by partaking of these a man might introduce into his body the unclean spirits which inhabited them. The brute soul which infested meat (especially when the animal was strangled), and the cardiac demon, as the rabbis called it, which was harboured in wine, were abhorred. Similar considerations help to explain the custom of votive offerings. Any popular shrine in Latin countries is hung with wax models of limbs that have been healed, of ships saved from wreck, or with pictures representing the votary's escape from perils by land and sea, which may have had originally another significance than that of merely recording the votary's salvation and of marking his gratitude. The model ship may be a substitute for the entire ship which is become sacred to the god, but cannot be deposited in the shrine; the miniature limbs of wax are substitutes for the real limbs which now belong to the god. In other cases the very objects which are tabu are given to the god as when a sailor deposits his salt-stained suit before the idol.

The general idea, then, involved in vows, whether ancient or modern, is to express that which the anthropologist borrows from the Polynesian word tabu. The votary desirous to "antedate his future act of service and make its efficacy begin at once," formally dedicates through spoken formula and ritual act a lifeless object such as a ring, an animal, his hair or his entire person to the god. He so either makes sure of future blessings, or shows gratitude for those already conferred. Most of the ritual prescriptions that accompany vows are intended to guard inviolate the sanctity or tabu, the atmosphere of holiness or ritual purity, which envelops the persons or objects vowed or reserved to the god, and thereby separated from ordinary secular use.

VOZNESENSK, a river port in the Ukrainian S.S.R., on the left bank of the Bug river, at the head of navigation, and on the Odessa-Cherkassy railway, in 47° 32′ N., 31° 20′ E. Population 20,813.

VRANJE (VRANJA), capital of the Vranje department of Serbia, Yugoslavia. Pop. (1931) 9,817, a large part being Albanians. The town is picturesquely situated on hilly ground with a stream running through it spanned by six stone and two wooden bridges. The inhabitants are employed chiefly in the cultivation of flax and hemp and in the making of ropes, but there are also cloth, glass, porcelain, iron ware, paper, boot, lamp and oven factories and leather tanneries in the town, while the fertile land around it produces wheat, maize, fruit and vegetables, as well as cattle. Vranje was captured by the Montenegrins in the Russo-Turkish war of 1877–78, and assigned to Serbia by the treaty of Berlin (1878). The gold washing station in the district was abandoned during World War I. Vranyska Banya, 4½ mi. E., is a summer resort. In 1941 Vranje was occupied by German troops.

VRATSA, the capital of the department of Vratsa, Bulgaria, on the northern slope of the Stara Planina and on a small subtributary of the Danube. Pop. (1934) 16,177. Vratsa is an archiepiscopal see. Wine, leather and gold and silver filigree are manufactured, and there is a school of sericulture.

VRSAC, a town of the Banat, in the province of the Voivodina, Yugoslavia (Magyar *Versecz*). Pop. (1931) 29,411, com-

prising Serbs, Germans and Magyars. It is famous for its red wines and brandy. Large quantities of maize are grown in the district and some wheat and oats. There are flour mills and distilleries in the town, which also manufactures distilling and general mill machinery. It has a handsome church and is the seat of a Greek Orthodox bishop. During the revolution of 1848–49 the Hungarians defeated the Serbs here in 1848 and were themselves defeated and the town occupied by the Austrians in 1849. In 1941 the town came, after the German invasion of Yugoslavia, again under Hungarian control.

VRYHEID, a town in South Africa, 291 mi. N. by W. of Durban; 27° 49′ S. lat., 30° 44′ E. long.; altitude 3,921 ft. Pop. (1936) 6,436 (3,127 white). In the vicinity a considerable number of important collieries are being worked. The Hlobane coalfields are southeast of the town. Vryheid is the chief centre of a district of the same name, which contains indications of gold, iron, galena, etc. Valuable deposits of manganese exist.

VULCAN, the Roman god of fire (*Volcanus*), and more especially of devouring flame (Virg., *Aen.* 5, 662). Whether he was also, like Hephaestus, the deity of smiths, is very doubtful; his surname *Mulciber* may rather be referred to his power to allay conflagrations. In the Comitium was an "area Volcani," also called "Volcanal"; and there on Aug. 23 (Volcanalia) the Flamen Volcanalis sacrificed, and the heads of Roman families threw into the fire small fish, which the Tiber fishermen sold on the spot.

It is not easy to explain these survivals of an old cult. But in historical times the association of this god with conflagrations becomes very apparent; when Augustus organized the city in *regiones* and *vici* to check the constant danger from fires, the *magistri vicorum* (officers of administrative districts) worshipped him as *Volcanus quietus augustus* (C. I. L. vi, 801 and 802), and on Aug. 23 there was a sacrifice to him, together with Ops Opifera and the Nymphae, which suggests the need of water in quenching the flames. At Ostia, where much of the corn was stored which fed the Roman population, the cult of this god became famous.

VULCANITE, a useful insulating material, manufactured by over-vulcanizing rubber, whence its name. Rubber rolled with a considerable proportion of sulphur and heated to a temperature of about 150°, becomes hard and capable of taking a high polish. It can be either moulded in manufacture to any required form or cut or carved when hard. It is very useful to the electrician, and, under the name of ebonite, is much used for combs, etc.

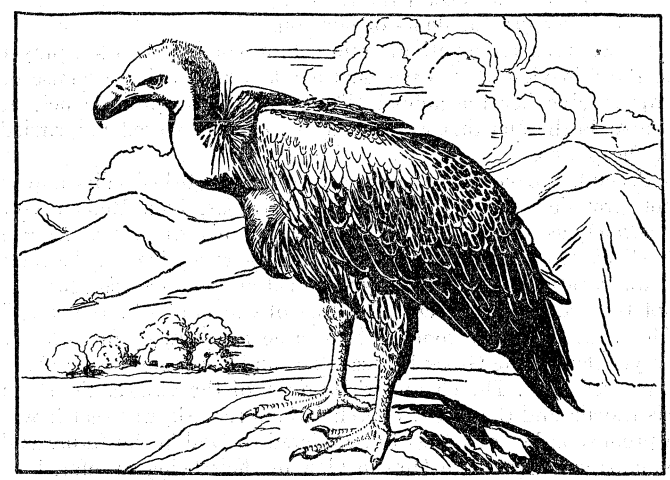
VULCANIZATION: *see* RUBBER: PRODUCTION AND MANUFACTURE; TYRE.

VULCI, an ancient town of Etruria, some 10 mi. N.W. of Tarquinii. The circuit of the walls measures about 4 mi., and scanty traces of them and of Roman buildings within them still exist. The Ponte della Badia over the Fiora, a bridge with a main arch of 66 ft. span, 98 ft. above the stream, is also Roman. An aqueduct passes over it. About 1½ mi. above a dam has been built for a hydro-electric plant to provide at least 6,000 h.p. The former wealth of the town is mainly proved by the discoveries made in its extensive necropolis—Greek vases, bronzes, etc.—many of which are now in the Vatican. In 1828–56 over 15,000 tombs were opened. These were entirely subterranean, but some of the chamber tombs are being re-examined and cleared. There is one great tumulus, the Cuccumella, and a few smaller ones. The frescoes from the François tomb, illustrating Greek and Etruscan myths, are now in the Museo Torlonia at Rome. Vulci was one of the 12 cities of Etruria. Coruncanius triumphed over the people of Vulsinii and Vulci in 280 B.C.

See S. Gsell, *Fouilles dans la nécropole de Vulci* (Paris, 1891), for the excavations of 1889 (with copious references to earlier publications); Bendinelli in *Notizie degli Scavi* 1921, 342 *sqq.*

VULGATE, a Latin version of the Bible prepared in the 4th century by St. Jerome, and so called from its common use in the Roman Catholic Church (*see* BIBLE: *Old Testament: Texts and Versions*).

VULTURE, the name applied to a group of birds whose best-known characteristic is that of feeding on carrion. The American forms belong to the family Cathartidae and include the condor (*q.v.*), the California condor (*Gymnogyps californianus*), the king vulture (*Sarcoramphus papa*) with a gaudily coloured head, the turkey buzzard or turkey vulture (*Cathartes aura*) and the black buzzard, black vulture or carrion crow (*Coragyps atratus*), the last two being familiar birds in southern U.S.A. They resemble the European vultures in habits.



BY COURTESY OF THE CANADIAN PACIFIC STEAMSHIPS

THE CINEREOUS VULTURE, (AEGYPIUS MONACHUS), FOUND IN PARTS OF EUROPE, NORTH AFRICA AND ASIA

Old world vultures belong to the hawk family (Accipitridae). The cinereous vulture (*Aegypius monachus*) inhabits the tropical and subtropical zones from the Straits of Gibraltar to China. The Egyptian vulture or Pharaoh's hen (*Neophron percnopterus*), which ranges over most of Africa and thence to India, is a remarkably foul feeder. Numerous other species are known from Africa and southern parts of Europe and Asia.

Vultures have the head and neck bare of feathers. They locate food by sight rather than scent. When one circling bird descends to a corpse, others see and quickly follow. Vultures, gorged with food, are often unable to take flight. (G. F. Ss.)

VYATKA, R.S.F.S.R.: *see* KIROV.

VYAZMA, a town of Russia in the Smolensk province in 55° 11′ N., 34° 19′ E., at the confluence of the Berba and Vyazma rivers. Population 17,217. It is a railway junction and has leather, oil-pressing and match factories. In the 11th century it was a trade centre linked with Narva on the Gulf of Finland. It was captured by Lithuania in the 15th century, but later became Russian. From 1611–34 it was under Polish rule.

VYCPÁLEK, LADISLAV (1882–), Czech composer, was born at Vrsovice near Prague in 1882. He is one of the most serious and intellectual of modern composers, leaning strongly towards mysticism and sacrificing both colour and euphony, where necessary to polyphonic requirements. His most interesting work is the cantata, *Of the Last Things of Man* (1920), which may be described as a spiritual protest against the materialism which prevailed after World War I. It is based on Moravian folk-music and consists of choruses and soprano and bass solos. Other works are: a string quartet op. 3; four sets of songs *Visionen, Lebensfeste, In Gottes Hut* and *Erwachen;* Moravian folk-songs and ballads and pianoforte pieces. Vycpálek holds the post of librarian to Prague university.

VYERNYI: *see* ALMA ATA.

VYRNWY (*Fyrnwy*), an artificial lake or reservoir in the northwest of Montgomeryshire, North Wales, constructed for the Liverpool water supply. It was formed by damming the river Vyrnwy, which joins the Severn above Shrewsbury.

VYSHNI VOLOCHEK, a town of the U.S.S.R. in the Kalinin region, in 57° 38′ N., 34° 33′ E., on the Moscow-Leningrad railway, and on the Vyshne-Volotsk navigation system, constructed by Peter the Great in 1703–09, to connect the upper Volga with the Neva. The Mariinsk system has now largely superseded it. Saw-milling is the chief industry in this forested district, but there are also textile, glass and brewing industries. Pop. (1939) 63,642.

WTHIS letter, as its name implies, was the letter *u* or *v*, which were identical till comparatively recent times, doubled and used by the Norman scribes to represent the English bilabial spirant (modern *w*), which had previously been represented in the Saxon hands by a Runic letter. The sound did not occur in the Romance languages. Latin had possessed it, but it had passed in imperial times into the voiced labial spirant (modern *v*). A separate symbol was thus required to represent the English sound, and the French preferred the doubling of one of their own letters to the use of the rune. (B. F. C. A.)

WA, a tribe inhabiting northeast Burma, between the Salwin river and the state of Kēng Tūng. They claim to be autochthonous and may represent the aborigines of northern Siam and of Indo-China; old records and travellers (*e.g.,* McLeod in 1837) speak of them as the original inhabitants. Their village sites are still found covered with jungle. The people are short and dark, and may have Negrito blood in them, though speaking a Mon-Khmer language. They are popularly divided into wild and tame. The wild Wa are head hunters. Outside every village is an avenue of huge oaks. Along one side is a line of posts facing toward the path with skulls fitted into niches, cut sometimes in front sometimes behind the post, when there is a hole in front, through which the skull is visible. Skulls must be added annually if the crops are to be good; those of distinguished and pious men are the most efficacious, and head hunting (*q.v.*) takes place during the sowing season. Villages are high on the slopes of hills, usually on a knoll or spur. The only entrance is through a tunnel 30 to 100 yd. long, of which there are usually two at opposite sides of the village, about 5 ft. high, and so narrow that two persons cannot pass freely, sometimes winding slightly to prevent gunfire; the path is studded with pegs to prevent a rush. Tattooing is occasional only; divination is performed with chicken bones; dogs are eaten; polygamy is permitted, monogamy prevails and the tame Wa have five clans presumably exogamous.

See Scott & Hardiman, *Gazetteer of Upper Burma, etc.* (1900).

WAALS, JOHANNES DIDERIK VAN DER (1837–1923), Dutch physicist, was born at Leyden, Netherlands, Nov. 23, 1837. He was a self-taught man who took advantage of the opportunities offered by the university of Leyden. He first attracted notice in 1873 with his treatise *Over de continuiteit van den gas-en vloeistoftoestand* (On the continuity of the gaseous and liquid state), by which he gained his doctor's degree. He taught physics at various high schools, and in 1877 he was appointed professor of physics in the university of Amsterdam, a post which he retained until 1907. Van der Waals built up a kinetic theory of the fluid state, he combined the determination of cohesion in Laplace's theory of capillarity with the kinetic theory of gases, and this led to the conception of the continuity of the liquid and gaseous states. Using this as a starting point he arrived at an equation of state which gave an explanation of critical phenomena and fitted in very well with the experimental observations of Andrews on carbon dioxide. Continuing this work he tried to arrive at an equation which would be the same for all substances. He eventually did this by using the values of the volume, temperature and pressure divided by their critical values. This led van der Waals to his statement of the "law of corresponding states" which enabled Dewar and Onnes to determine the necessary data in the liquefaction of the permanent gases. He also discovered the law of binary mixtures. In 1910 van der Waals was awarded the Nobel prize for physics. He died on March 9, 1923.

WABASH, a city of Indiana, U.S.A., on the Wabash river and federal highway 24. Pop. 1930, 8,840 and in 1940, 9,653. It is a manufacturing city and the trade centre for a rich agricultural region. Wabash was settled about 1834 and chartered as a city in 1866. It was one of the first cities in the world to be lighted by electricity, a lighting plant being established in Feb. 1880.

WABASH RAILWAY COMPANY is the oldest transportation system in the Mississippi valley, U.S.A. The first train was run on Nov. 8, 1838. At that time the railway was known as the "Northern Cross," and ran from Meredosia to Morgan City, Illinois, a distance of 12 miles. It was almost 20 years later before "Wabash" appeared in the corporate name. The construction of the railroad across Indiana was commenced in 1855. From this small beginning the Wabash Railway company has grown to one of the most important units in the transportation systems of America. It serves the richest section of the central portion of the United States. The company had (1939) 2,409 mi. of track; and operated, besides passenger trains, a fleet of fast freight trains serving both the industrial and agricultural market. The par value of capital stock issued to Dec. 31, 1939, was $138,492,967.17.

WACE (?) ROBERT (1100?–1175?), Anglo-Norman chronicler, was born in Jersey. He studied at Caen; he became personally known to Henry I, Henry II, and the latter's eldest son, Prince Henry; from Henry II he received a prebend at Bayeux and other gifts. Except for these facts he is known to us only as the author of two metrical chronicles in the Norman-French language. Of these the earlier in date is the *Roman de Brut,* completed in 1155, which is said to have been dedicated to Eleanor of Aquitaine (ed. A. J. V. Le Roux de Lincy, 2 vols., Rouen, 1836–38). This is a free version of the Latin *Historia Britonum* by Geoffrey of Monmouth, in rhyming octosyllables; it was rendered into English, shortly after 1200, by Layamon, a Mass priest of Worcestershire, and is also largely used in the rhymed English chronicle of Robert Mannyng. Wace's second work, the *Roman de Rou,* written between 1160 and 1174, has a less fabulous character than the *Brut,* being a chronicle of the Norman dukes from Rollo to Robert Curthose. It has been ably dissected by Gustav Körting (*Über die Quellen des Roman de Rou,* Leipzig, 1867), who shows that it is mainly based upon Dudo and William of Jumièges. There is also reason for thinking that Wace used the *Gesta regum* of William of Malmesbury. Where Wace follows no ascertainable source for the material in his chronicles he must be used with caution. Undoubtedly he used oral tradition; but he also seems in various instances to have given free play to his imagination.

The *Roman de Rou* is written in rhyming octosyllables, varied by assonanced alexandrines. It has been edited by F. Pluquet (2 vols. and supplement, Rouen 1827–29) and more completely by H. Andresen (2 vols., Heilbronn, 1877–79). (H. W. C. D.)

WACHSMUTH, CHARLES (1829–1896), American palaeontologist, born in Hanover, Germany, Sept. 13, 1829. In 1852 he emigrated to America and after two years in New York city he settled in Burlington, Iowa. Ill health forced him into the open and he began to collect fossils, especially the crinoids, or sea lilies, of the Burlington Limestone, and in a few years he possessed a fine collection. In 1864 he became acquainted with Agassiz, and in the following year paid a visit to Europe, where he studied the crinoids in the British museum and other famous collections. He decided to devote all his energies to the elucidation of the crinoidea, and did so with signal success. He made further extensive collections, and supplied specimens to the Harvard museum at Cambridge, Mass., and to the British museum. Together with Frank Springer (1848–1927) of Burlington, he published a series of important papers on their studies of crinoids, also an extensive monograph on the *Revision of the paleocrinoida* (1879–86). After Wachsmuth's death at Burlington, on Feb. 7, 1896, appeared *The North American Crinoidea Camerata* (2 vol. and atlas, 1897).

A complete bibliography of his work is given in the *Bulletin of the Geol. Soc. of America,* vol. 8, p. 376.

WACKENRODER, WILHELM HEINRICH (1773–1798), German writer, the fellow student of Ludwig Tieck (*q.v.*) at Erlangen and Göttingen. Wackenroder inspired his friend with his own enthusiasm for the art of the middle ages. They went to Berlin in 1794, and after the breach with Nicolai there in 1796, to Dresden. The relation between mediaeval art and religion is the theme of Wackenroder's *Herzensergiessungen eines Kunstliebenden Klosterbruders* (1797). His early death, in 1798, was a great blow to his friend, who completed Wackenroder's fragmentary works.

See Wackenroder's *Werke und Briefe*, ed., in 2 vols., by F. von der Leyen (Jena, 1910); P. Koldewey, *Wackenroder und sein Einfluss auf Tieck* (1904).

WACO, a city of Texas, U.S.A. Population (1930) 52,848; in 1940, 55,982 (77% native white and 20% Negroes) by federal census. It is an important agricultural and manufacturing centre. The city is the seat of Baylor university, founded at Independence in 1845 by the Texas Union Baptist association and chartered by the Republic of Texas; and of Paul Quinn College for Negroes. The city has a commission-manager form of government, adopted in 1909. Waco was settled in 1849 and incorporated as a town in 1856. It was named after the Hueco Indians, who had a large village here until 1830, when they were nearly exterminated by the Cherokees.

WAD, a black, earthy mineral consisting mainly of hydrated manganese dioxide; of importance as an ore of manganese. Being an amorphous substance, it varies considerably in chemical composition, and contains different impurities often in large amount. A variety containing much cobalt oxide is called "asbolite," while "lampadite" is a cupriferous variety. It is very soft, readily soiling the fingers, and may be considered as an earthy form of psilomelane (*q.v.*). It results from the decomposition of other manganese minerals, and is often deposited in marshes ("bog manganese") or by springs. The name wad is of uncertain origin, and has been applied also to graphite.

WADAI, a region of north central Africa, bounded north by the Sahara and east by Darfur province of the Anglo-Egyptian Sudan. West and southwest it extended to Kanem and Bagirmi and southeast to Dar Runga. Formerly an independent Mohammedan sultanate, it was conquered by the French in 1909–10 and now forms part of the Chad colony of French Equatorial Africa. By the French it was divided into the departments of Wadai and Batha. Total area about 170,000 sq.mi. Approximate population (1936): Wadai, 230,000; Batha, 190,000.

Physical Features.—Wadai is for the most part a flat, dreary plain, about 1,500 ft. in altitude, part of the clay zone which covers much of the basin of Lake Chad. It is, however, traversed by ranges of hills which rise another 1,000 ft., and east and north is encircled by mountains—part of the ranges which stretch in a rough semicircle from Tibesti to Darfur. In the northeast Dar Tama rises to a plateau of 2,500 to 3,000 ft., with the peak of Niéré reaching 4,700 ft. The plains are mostly bush covered, but in places this gives way to long grass, with parklike regions in the west. The surface is often sandy, but there are considerable areas of black-cotton soil. To the south and east the land rises, and there are large forests, which, northward along the Darfur frontier, thin down to scrub. The northern region, bordering the Sahara is semi-arid, though much of it, watered by intermittent streams, affords good pasturage. Here, on the northwest confines of Wadai, are remarkable sand ridges of fantastic shape—hollow mounds, pyramids, crosses, etc., which are characteristic of the Libyan desert. There are also sandstone rocks of varying colours —red, blue, pink, white, black—presenting the aspect of ruined castles, ramparts and churches. In the extreme northeast are some intermittent streams, with an easterly flow. Here the Wadi Homr, in 16° N., marks the limit of vegetation—beyond, northward, is absolute desert. South of it are many similar wadis, their banks covered with thick thorn bush. And 75 mi. S. of Wadi Homr is a lake, 2 mi. long by 500 yd. wide, called Undur. This desert lake dries up for half the year. Apart from this northeast region, the country forms part of the Chad drainage area. The supposition that the Bahr-el-Ghazal (of the Chad system) might afford a connection with the Nile, owing to the remarkably even level of the country for a great distance, was disproved by the investigations of Col. Jean Tilho in 1914–15. The streams which rise on the western side of the divide in the northeastern districts, of which the Batha (more than 300 mi. long) is the largest, flow west, the Batha ending in a depression, about 200 mi. east of Lake Chad, called Fittri. Another stream, the Wadi Rime, with a more northerly course than the Batha, goes in the direction of Chad, but ends in swamps in the clayey soil. These rivers are intermittent, and after seasons of drought Fittri is completely dry. In the dry season, water is obtained from wells 250 to 300 ft. deep. The rivers of Dar Runga—a forested district south of Wadai proper—flow westward towards the Shari, but, save the Bahr Salamat, none reaches it. They only contain water in the rainy season. About 100 mi. above the Salamat-Shari confluence is Lake Iro, joined to the Salamat by a short channel.

The flora includes timber trees, numerous dum palms, mimosa, acacia, the tamarind, and many kinds of grasses. The cotton plant grows wild, and a species of wild coffee tree reaches 50 to 60 ft. and yields excellent berries. Among animals are large herds of gazelle; baboons are common, and elephants are found in the forest. Ostriches are found in the north, where the lion is also occasionally seen. Of birds, the most conspicuous are cranes (white, black and crested); storks are also common in some regions. Of domestic animals, the camel is common in the northern district, elsewhere the bull is used for transport. Horses, cattle, sheep and goats are numerous. Caterpillars are sometimes a plague, and there are visitations of locusts.

Inhabitants and Trade.—The inhabitants consist of Negroid and Negro tribes, Arabs, Fula, Tibbu and half-castes. The Maba, the dominant race, are said to be of Nubian origin; they live chiefly in the northeastern district, and in the days of the sultanate were allied with the Arab tribes, known in Wadai as Zoruk (dark) and Homr (red). The Maba had a reputation for pride, valour, cruelty, drunkenness, and barbaric splendour. The usual dress of the people is, for men, a long white jibba or shirt and very baggy trousers of homespun, coarse but strong cotton; for women, the tobe, usually blue, thrown over head and shoulders, with another piece of cotton wrapped round the body to form a tight skirt. Heavy silver bangles round the ankles and silver and copper rings are worn.

The capital, Abeshr, is in the northeast in about 21° E., 13° 50′ N. Abeshr, which is set on a plain surrounded by hills, is a town of two-storied mud brick buildings with flat, battlemented roofs and a fine market square. The military post, which includes a governor's home, barracks, prison, treasury and a wireless station, is surrounded by a solid wall. The population of the town, reputed to be more than 30,000 in 1873, had in 1922 dwindled to about 5,000. From Abeshr a caravan route crosses the Sahara via the Kufra oases to Bengasi in Cyrenaica. Another route, on the pilgrim way from West Africa to Mecca, goes east through Darfur to Khartoum. Maize, millet, cotton and indigo are cultivated, and cloth is woven. There is also an industry in leather goods. Ivory and ostrich feathers used to be taken to Tripoli by the desert route, together with small quantities of coffee and other produce. This trade has greatly decreased. There is a trade in cattle, horses and coffee with the Anglo-Egyptian Sudan, with the regions to the south and with Nigeria. Development is much hindered by the lack of easy transport, but good roads have been made by the French, rest houses provided, and security for travellers is assured. Until the French conquest, Wadai was a great centre of the slave trade. Slaves were obtained by raiding and in the form of tribute from Bagirmi, Kanem and other countries once dependent on Wadai. The slaves were sent north to Bengasi, or eastward to Darfur. Wadai was also notorious for traffic in eunuchs.

History.—Wadai early became a meeting ground of Negro and Arab culture. Eastern influences and the Mohammedan religion ultimately obtained predominance, though the sovereignty of the country reverted to the Negro race. It was sometimes tributary to and sometimes the overlord of the neighbouring countries, such as Bagirmi and Kanem. It was made known to Europe by

the writings of the Arab geographers, but it was not until Nachtigal's visit in 1873 that accurate knowledge of the land and people was obtained. About 1640 a Maba chieftain named Abd-el-Kerim conquered the country, driving out the Tunjur, a dynasty of Arabian origin. Thereafter Wadai suffered from many civil and foreign wars. The Senussi brotherhood, introduced by Mohammed Sherif, sultan from 1838 to 1858, gained a dominant position in Wadai.

In the last decade of the 19th century the French advancing from the Congo made their influence felt in Wadai, and by the Anglo-French declaration of March 21, 1899 Wadai was recognized as within the French sphere. That state was then torn by civil wars. The Sultan Ibrahim was murdered in 1900, and Ahmed Ghazili became sultan. He ordered one of his rivals, the Emir Acyl, to be blinded, whereupon Acyl fled westward and entered into friendly relations with the French. A few months later (Dec. 1901) Ahmed was dethroned. With Doud Murra, who then became sultan, the French endeavoured to come to an understanding, and in Nov. 1903 the Wadaians agreed to recognize the possession of Bagirmi, Kanem, etc., by France. However, in the spring of 1904, acting, it is believed, at the instigation of the Senussi, the Wadaians attacked French posts in the Shari region and carried off many slaves. Intermittent fighting continued for years. It resulted in strengthening the position of the French and of their ally Acyl, and in 1908 Doud Murra, again, it is stated, at the instigation of the Senussi, proclaimed the *jihad*. His army was split up under *aguids* (feudal lords), and was beaten in detail.

By 1912 Wadai had been completely pacified by the French and the once powerful sultanate was abolished, though the sultans of the petty states, such as Dar Tama, between Wadai and Darfur retained their authority under French protection. In the years 1913 and 1914 a terrible famine caused immense loss of life. Col. Jean Tilho says "the population of Wadai, put by Nachtigal at more than 2,000,000 in 1872, had fallen to 300,000 when I went that way [in 1917]." Abeshr then "retained few traces of its ancient splendour," though it was later gradually rebuilt by the French. Wadai was but little affected by Senussi activity during World War I. The occupation of Darfur by the Sudan government in 1916 led to better order in the borderlands, and to the demarcation of the frontier in 1923. The French had rigorously suppressed slave trading, but other trade gradually increased, especially with the Sudan.

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WADDINGTON, WILLIAM HENRY (1826–1894), French statesman, was born at St. Remi-sur-l'Avre (Eure-et-Loir) on Dec. 11, 1826. He was the son of a wealthy Englishman who had established a large spinning factory in France and had been naturalized as a French subject. After receiving his early education in Paris, he was sent to Rugby, and thence to Trinity College, Cambridge. He undertook travels in Asia Minor, Greece and Syria, the fruits of which were published in two *Mémoires*, crowned by the Institute, and in his *Mélanges de numismatique et de philologie* (1861). His other archaeological works include the *Fastes de l'empire romain*, and editions of Diocletian's edict and of Philippe Lebas's *Voyage archéologique* (1868–1877). He was elected in 1865 a member of the Académie des Inscriptions et Belles-Lettres.

After standing unsuccessfully for the department of the Aisne in 1865 and 1869, Waddington was returned by that constituency at the election of 1871. He was minister of public instruction in the short-lived cabinet of May 19, 1873, and in 1876, having been elected senator for the Aisne, he was again entrusted by Dufaure with the ministry of public instruction. His most important project, a bill transferring the conferment of degrees to the state, passed the Chamber, but was thrown out by the Senate. He continued to hold his office under Jules Simon, with whom he was overthrown on the famous *seize mai* 1877. (*See* SIMON, JULES.)

Waddington was minister of foreign affairs under Dufaure and a French plenipotentiary at the Berlin Congress. He obtained, from Lord Salisbury, a promise that Great Britain in return for Cyprus would allow France a free hand in Tunis. Early in 1879 Waddington succeeded Dufaure as prime minister but held office only by sufferance of Gambetta, and had to retire in December. In 1883 he accepted the London embassy, which he continued to hold till 1893, showing an exceptional tenacity in defence of his country's interests. He died on Jan. 13, 1894. His wife, an American lady, whose maiden name was Mary A. King, wrote some interesting recollections of their diplomatic experiences—*Letters of a Diplomatist's Wife, 1883–1900* (New York, 1903), and *Italian Letters* (London, 1905).

WADE, BENJAMIN FRANKLIN (1800–1878), American statesman, was born near Springfield, Mass., on Oct. 27, 1800, of Puritan ancestry. He was reared on a farm, receiving little systematic education, and in 1821 he removed with his family to Andover, in the Western Reserve of Ohio. In 1825 he began the study of law at Canfield, was admitted to the bar in 1827, and began practice at Jefferson, Ashtabula county, where from 1831 to 1837 he was a law partner of Joshua R. Giddings, the anti-slavery leader. From 1851 until 1869 he was a member of the U.S. Senate, first as an anti-slavery Whig and later as a Republican. In the Senate Wade was from the first an uncompromising opponent of slavery, his bitter denunciations of that institution and of the slaveholders receiving added force from his rugged honesty and sincerity. His blunt, direct style of oratory and his somewhat rough manners were characteristic. After the outbreak of the Civil War he was one of the most vigorous critics of the Lincoln administration. He advocated the immediate emancipation and arming of the slaves, the execution of prominent southern leaders, and the wholesale confiscation of Confederate property. In 1864, with H. W. Davis (*q. v.*), he secured the passage of the Wade-Davis Bill (for the reconstruction of the southern States), the fundamental principle of which was that reconstruction was a legislative, not an executive, problem. This bill was passed by both houses of Congress, just before their adjournment, but President Lincoln withheld his signature. Soon afterward (Aug. 5) Wade and Davis published in the New York *Tribune* the famous "Wade-Davis Manifesto," a vituperative document impugning the President's honesty of purpose and attacking his leadership.

As long as President Johnson promised severe treatment of the conquered South, Wade supported him, but when the President definitively adopted the more lenient policy of his predecessor, Wade became one of his most bitter and uncompromising opponents. In 1867 he was elected president *pro tem* of the Senate, thus becoming acting vice president. He voted for Johnson's conviction on his trial for impeachment, and for this was severely criticized, since, in the event of conviction, he would have become president; but Wade's whole course before and after the trial would seem to belie the charge that he was actuated by any such motive. After leaving the Senate he resumed his law practice. He died at Jefferson, O., on March 2, 1878.

See A. G. Riddle, *Life of Benjamin F. Wade* (Cleveland, O., 1886).

WADE, GEORGE (1673–1748), British field-marshal, was the son of Jerome Wade of Kilavally, Westmeath, and entered the British army in 1690. He was present at Steinkirk in 1692, and in 1695 he became captain. In 1702 he served in Marlborough's army, earning particular distinction at the assault on the citadel of Liége. After service in Portugal, Minorca, and Spain, Wade, as major-general, was military governor at home during the Jacobite rebellion of 1715. He twice detected important Jacobite conspiracies, and on the second occasion procured the arrest of the Swedish ambassador in London, Count Gyllenborg. In 1719 he was second in command of the land forces in the "conjunct" military and naval expedition to Vigo. In 1724 he was sent to the Highlands where he began the system of metalled roads which is commemorated in the lines—

> Had you seen these roads before they were made,
> You would lift up your hands and bless General Wade.

Wade superintended the construction of 40 stone bridges and with great tact, disarmed the clans. In 1742 he was made a privy coun-

cillor and lieutenant-general of the ordnance, and in 1743 field-marshal. In this year he commanded the British contingent in Flanders, and was associated in the supreme command with the duke d'Aremberg, the leader of the Austrian contingent. The campaign, as was to be expected when the enemy was of one nation, superior in numbers and led by Saxe, was a failure, and Wade, who was seventy years of age and in bad health, resigned the command in March 1744. George II. promptly made him commander-in-chief in England, and in that capacity Field-Marshal Wade had to deal with the Jacobite insurrection of 1745, in which he was utterly baffled by the perplexing rapidity of Prince Charles Edward's marches. On the appointment of the duke of Cumberland as commander-in-chief of the forces, Wade retired. He died on March 14, 1748.

WADELAI, a village in the British protectorate of Uganda on the west bank of the Nile, one mile north of the mouth of the Ora river. It was first visited by Lieut. H. Chippindall, an assistant of C. G. Gordon, in March 1875. Now largely abandoned, it was a much disputed place during the Mahdi rebellion. In 1885 Emin Pasha made it his fortified headquarters (the old perimeter trench may still be seen in an air photograph). For three years Wadelai was the headquarters of the Egyptian Equatorial province. After Emin Pasha's withdrawal with Sir Henry Stanley in 1889, Wadelai remained under the control of the mutinous troops commanded by Fadi el Mula Bey, who eventually enlisted in Belgian service. Following the Anglo-Belgian agreement of May 12, 1894, Wadelai became a station of the Congo Free State; in 1910, a year after the death of King Leopold II, ruler of the Congo Free State, it was incorporated into the Anglo-Egyptian Sudan, and in 1914 it was finally transferred to Uganda. (H. A. WF.)

WADHWAN, a town of India, in Western India States Agency, Bombay, the capital of a petty state of the same name, and the junction of the Kathiawar railway system with the Bombay and Baroda line, 389 m. N. of Bombay. Pop. (1931), 18,269. It has considerable trade and manufactures; cotton is imported and cotton stuffs and grain exported. There is a school for *girasias* or subordinate chiefs. The civil station, which is the headquarters of the agent for the Eastern Kathiawar states, had a population in 1931 of 13,344. The state of Wadhwan has an area of 242 sq.m.; pop. (1941) 50,915. Soap is manufactured, stone quarried, and cotton weaving, pressing, ginning and dyeing carried on.

WADI HALFA or HALFA, a town of the Anglo-Egyptian Sudan on the right bank of the Nile. About 6 mi. above the town is the second cataract, and on the west bank of the Nile opposite Halfa are the ruins of the ancient Egyptian city of Buhen (Bohon). Halfa is the northern terminus of the Sudan railway and the southern terminus of a steamboat service on the Nile, which, running to Shellal (Aswan), connects there with the Egyptian railways.

WAFER. A thin flat cake or biscuit. As articles of stationery, wafers consist of thin, brittle, adhesive discs, used for securing papers together, and for forming a basis for impressed official seals. They are made of a thin paste of very fine flour, baked between "wafer irons" over a charcoal fire till the thin stratum of paste becomes dry and brittle and the flour starch is partly transformed into glutinous adhesive dextrin. The cake is cut into round disks with suitable steel punches.

WAFERASH (*Ptelea trifoliata*), a small North American tree of the rue family (Rutaceae, *q.v.*), called also shrubby trefoil and hoptree, found from New York and southern Ontario to Nebraska and south to Florida, Arizona and Mexico, and often planted for ornament. While often shrubby, it sometimes grows to a height of 25 ft. and bears strong-smelling, long-stalked trifoliate leaves and greenish-white flowers in dense clusters. The somewhat hop-like fruit is a nearly orbicular samara with a membranous, netted-veined wing, about $\frac{3}{4}$ in. broad.

WAGER: *see* GAMING AND WAGERING.

WAGES. Wages, said Charles Gide, is the price of labour hired and employed by an *entrepreneur*. Labour is the commodity offered for sale, the worker is the seller and the employer is the purchaser. One correction should be made to this and most other definitions of wages. Entrepreneurs are employers who hire labour with a view to making a profit. But there are many employers, such as housewives, and commonly governments, who hire labour and pay wages but not with a purpose or possibility of making a profit through the employment of such labour. The payment made to the worker is nevertheless wages. A distinction is properly drawn between the wages of labour (wage-earners) and the wages of management (executives).

The question of the relation between the size of a country's population, hence the size of its labour supply, and the level of wages in it has long been of interest. The notable rise of wages which followed the depletion of the population of England by the Black Death in the middle of the 14th century, and the relatively high wages which have obtained in the United States and other "new countries," have both tended to foster the idea that sparsity of population and high wages go hand in hand. The low wages in the densely populated Orient have tended to give additional colour to the notion.

But wages were high after the Black Death and have been high in the new world because labour was scarce relative to the supply of land, capital, and resources. A unit of labour is more productive when it is combined with a large dose of capital, land, resources, and managerial oversight than when the supply of these complementary factors is deficient. That has been the trouble in the Orient. There has not been enough capital, land, resources, and modern executive capacity available to utilize the labour supply efficiently.

Wages can be high only in an economy where labour is highly productive. In such an economy some individuals may be paid higher wages than their individual productivity justifies; others lower. But the general level of wages will be adjusted roughly to the average productivity. The decreased rate of population growth in the Occident during recent years will result in higher wage levels only if a rising standard of living with increased per capita consumption and concurrent increases in productive efficiency increase per capita output.

The Wages-Fund Doctrine.—Some of the ablest British political economists of the 19th century thought, however, that in one particular way the general level of wages might be looked upon as the outcome of the play of the forces of supply and demand. Emphasis was put upon the circumstance that in modern industry wages are advances, in the sense that they are paid before, and often long before, the final product to which the labourer contributes in direct or indirect ways, passes into the hands of the consumer. Wages are paid out of capital, and the demand for labour depends upon the amount of capital which is or can be devoted to that purpose. The amount of capital which is, or can be, so used was dubbed the wages fund, and was held to be pre-determined, in the sense that it depended upon how much and what had been produced in the past. The present demand of consumers for commodities, it was insisted, is not a demand for labour, but merely a demand for the products of past labour. The wages-fund doctrine was not altogether untrue, but it involved misplaced emphasis, so that it led to untrue or misleading inferences. What is, at most, an important aspect of the way in which goods are produced and apportioned, was made to serve as a fundamental determinant of wages. The doctrine implies a static conception of what, as its proponents recognized in other connections, is essentially a dynamic problem. Wages are paid, not out of a fixed fund, but out of a continuing flow of wealth. Changes in the aggregate volume of that flow—changes, that is, in the magnitude of the total product of industry—have a more important bearing in the long run upon the amount which labour receives than can be attributed to variations in the relative demand for present labour and for finished goods. Through the modern mechanism of credit, moreover, the future value of part of the product of present labour is discounted, and the proceeds are used in paying present wages. A sudden increase in the total amount of money paid to labourers, such as comes sometimes after a period of industrial depression, may have the effect at first, however, of increasing the labourers' own purchases of finished products more rapidly than the supply can be replenished,

so that prices will rise, and the increase in the amount of real wages received will not be proportionate to the increased amount of money wages paid. An adherent of the wages-fund doctrine might maintain, and not without point, that this temporary effect shows how an increase of real wages is dependent upon an increase of the "fund" (the supply of goods of the kinds for which money wages are expended) from which real wages are drawn.

Wages and the Standard of Living.—Another theorem respecting wages, closely allied historically to the wages-fund doctrine, was that wages must conform very closely, in the long run, to the amount needed to enable the labouring population to maintain its customary standard of living. An early and more rigid form of this theorem had made a bare minimum of subsistence the norm to which wages were held to be constrained to approximate. In this rigid form the doctrine was taken over by some of the Socialists, named the "Iron Law of Wages," and made much of as showing the hopeless position of the labouring classes under the existing economic régime. In developing the doctrine, however, the Socialists rested it upon the power which they imputed to the owners of capital to assign to labour no larger share of the aggregate product of industry than they conceived to be in their own interest. The grounds upon which the economists supposed their standard-of-living theory to rest were quite different, and, if they were valid, would have retained both their validity and their significance under a socialistic or any other régime. These grounds were, first, the Malthusian theory of population, serving as a basis for the affirmation that the labouring population would increase as fast as the increase of the means of maintaining its customary standard of living would permit; and second, the assumption that the level of wages must vary inversely with the supply of labour, falling off with an increase in the number of labourers, and rising with a decrease. Granting the premises the conclusions followed logically. Deviations from the normal level would be self-correcting, for an advance beyond that level would enable labourers to marry earlier and to rear larger families, so that the supply of labour would be increased and wages would be forced down again, while a fall below the supposed normal level would have the opposite series of effects. This doctrine naturally led to the pessimistic conclusion that there could be no permanent improvement of the economic status of the labouring classes except as the result of their own voluntary restriction of the growth of their numbers. On all this, it is enough to say that during the last century and a half there has been a notable increase in the level of real wages, a corresponding advance of the standard of living of wage earners and at the same time an unprecedented growth in the populations of the European nations, which were the economic world that was being considered by these economists.

Wage Levels and Economic Activity.—The discussion of wages, 1920–39, has revolved principally around the problem of the effect of wages upon cycles of economic prosperity and depression. Four particular questions have been much discussed by economists during the decade of the '30s: The effects of "wage rigidities" upon costs of production, prices, and the volume of business; whether the maintenance of high wage levels will stabilize business by providing large wage earner purchasing power or whether, on the contrary, wages should rise and fall in accordance with business trends; what steps can be taken to provide wage earners with dependable, annual incomes either by guaranteeing them annual wages or through insurance benefits which will supplement their inadequate annual earnings; and, after 1935, the effect of relief-work wages upon the general wage level.

The wage rigidity problem was emphasized by British and European economists as a causal factor of the prolonged period of unemployment which began with the depression of 1921 and by many American economists during the depression of the '30s. They have argued that wage earners increase unemployment by refusing to allow wage levels to be lowered when price levels fall, thus causing labour costs to become excessive in relation to selling prices. They contend that recovery from depression-unemployment is practically impossible without readjustments in labour costs.

Critics of their views, while not denying that cost-rigidities frequently impair business activity, point out that wage rigidities are only one of several types of rigidities that have characterized the modern business structure—that there has been a trend toward price rigidities because of manufacturers fixing the retail prices of their products, that interest rates, taxes, rents, and even profit expectations involve rigidities due to the unwillingness of the recipients of such incomes to reduce their "prices." Lescohier pointed out that: "Interest rates, rents, and artificially maintained prices exercise their full potential effects upon an economic situation, but when wage rates are maintained it does not mean necessarily an equivalent maintenance of labour costs" since improved technology and management can cut labour costs even when wage rates are rigid (*History of Labor*, Vol. III, p. 154).

The second contention, that high wage levels tend to stabilize prosperity through the maintenance of purchasing power, approaches the question of wage levels from an exactly opposite point than the rigidity theories. Its proponents contend that prosperity depends upon buying, that wage earners constitute a large part of the buying public, and that the way to insure prosperity is to see to it that wage earners are able to buy freely and continuously. They emphasize the expenditure aspect of wages and tend to give less attention to wages as a production cost. Their interest is in consumer demand. If industry has the demand for its goods they believe it will be able to meet the production costs. During the prosperous '20s this theory was widely accepted and during 1930–31 the Government and American industry endeavoured to apply the theory during a business recession. It is unfortunate that factors entirely disassociated from American production costs threw the whole world deeper into depression in 1931 and obscured the workings of this experiment so that its results cannot be precisely determined. Under the National Industrial Recovery Act the theory was again applied but once more, because of the invalidation of the act, the results of the test are far from clear. The suggestion that wage earners' incomes ought to be on an annual rather than an hourly, weekly, or piece basis is receiving increased attention, partly because of experiments with annual wages now (1939) in process in a number of American companies (*e.g.*, Nunn-Bush, Hormel Packing Co.) and partly because of the nation-wide enactments of unemployment insurance laws, which are causing employers to face an obligation to supplement regular wages by what may be called out-of-work wages if they do not arrange employment so that their employees will earn annual incomes in employment.

The Works Progress Administration, created in 1935 to provide work for the unemployed, was required by Congress (until the law was amended in 1939) to pay the hourly rate prevailing in the community where the relief worker was employed for the type of work that he was doing for WPA. Each worker's monthly earnings were limited to a monthly "security wage." The result was that the WPA gave each person a number of hours' work per month determined by dividing his "prevailing rate" into his security wage. The higher his hourly rate the fewer his hours per month.

A bitter controversy raged from 1935 to 1939 over the "prevailing rate" policy in work relief. Employers contended that the Government was competing with private employers and that, since the Government did not require as hard work as private employers, and enabled people to earn a living without working a full month, they were making many wage earners unwilling to accept private jobs. They contended, and a large number of the public agreed, that a relief job should be less desirable than a "regular job" and that the prevailing wage policy was a demoralizing influence. Labour contended, and for four years Congress acceded to their point of view, that if the Government paid lower hourly rates on relief work than prevailed in private industry, the private employers would reduce their rates to the Government wage level. Opponents of the prevailing wage policy maintained that there is little direct relationship between private wages and work-relief wages because there is so little direct competition for labour between private work and work-relief projects.

Far-reaching, but gradual, effects upon wages may result from the technological changes in process in the more highly industrialized nations. The mass production industries tend to decrease the relative proportion of the total labour force who are skilled mechanics, also the proportion who are unskilled labourers, and to increase the proportion who are semi-skilled operatives. Since the per capita productivity of the semi-skilled and unskilled workers is being increased progressively by the new methods, it looks as if wage earners, on the whole, will earn higher, rather than lower, real wages in the future.

Differences in Wages.—Wage data seems to indicate that differences in wages are more than proportionate to native differences in capacities, physical and mental. Proceeding from the lower wage levels to the higher, earning power appears to increase more rapidly than capacity, as measured by some non-economic standard of attainment. A variety of causes, probably, rather than any single cause, are responsible. Wages are paid for efficiency, not for capacity. Efficiency is a matter of education and training as well as of native capacity, and education and training are partly matters of opportunity. The higher wages paid to the more efficient workers are in some measure a return to investments in "personal capital," whether by means of education, in the ordinary sense, or by means of a period of service in some employment in which wages are small but from which paths lead upward, in preference to some better-paid employment with no larger future ahead of it. Every factor which deflects men from the paths which lead to the better paid employments, or which impedes their entry into such employments, helps to swell the numbers of the "hewers of wood and drawers of water" who compete for the poorer places, and thus operates to increase the difference between high wages and low. Moreover, in modern economic life the individual worker is a sharer in a co-operative effort. The results which he achieves cannot be measured separately, on a fixed scale of reference, as the results of a test of his physical or mental capacity might be measured. The product of industry is not got by merely adding the results of one man's work to the results of the work of others. The productivity of the individual worker is in some measure multiplied into, not merely added to, the productivity of the complex of productive agents with which he works. One man's efficiency directly affects the results which others get. More is gained by equipping a good workman with good tools or a good farmer with good land than by assigning good tools or good land to a poorer workman or a poorer farmer. The man best equipped to manage a large industrial undertaking may really earn twice as large a salary, measured by the results he gets, as a man only slightly inferior in capacity. A good foreman, by getting a maximum product from the workers under his charge, will increase the earnings of his men and earn a larger wage for himself. In short, it is probable that in many employments the differences between the increments of product which are dependent upon the labour of a superior workman and of an inferior one are disproportionate to such differences in their skill or ability as would be revealed by a test which would deal with them as isolated individuals. It is these larger differences which are reflected in differences in the wages which they can command. (*See* also ECONOMICS.)

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WAGES BOARDS: *see* INDUSTRIAL RELATIONS.

WAGE STATISTICS: INTERNATIONAL COMPARISONS. "How do wages in Germany, France, etc., compare with wages in one's own country?" It was to answer such enquiries that the British Ministry of Labour, in 1923, and, in the next year, the International Labour Office at Geneva undertook a monthly collection of comparative data. The first difficulty was the lack of information. Up-to-date particulars of the national level of wages in any trade or occupation are for most countries either lacking or imperfect, while even where excellent information exists it relates in some countries to the time rates of wages agreed upon by employers and workpeople and in other countries to the actual earnings taken home by the workpeople.

The various countries collect wage data by different methods and with widely different adequacy of coverage of their industries. The figures in some cases are merely men's wages; in others both men's and women's, and in some cases include minors. Some countries cover few industries; others a wide range of industries. The details are shown in the *International Labour Review*. Six different methods of presentation are used. Hourly wage rates are given by Australia, Canada, France, and Germany; daily wage rates by Yugoslavia; and weekly rates by Great Britain, New Zealand, and South Africa. In the other countries, earnings rather than time-rates are furnished. Average hourly earnings are published by Belgium, Bulgaria, Denmark, Sweden, Switzerland, and Italy; daily earnings by Norway and Japan; weekly earnings by the United States in the series used here; and monthly earnings by Rumania.

If it be calculated that the average London rate for 48 hours' work would be say, 60/–, the average Berlin rate, say, 40 marks, the average Paris rate, say, 200 francs, and so on for each country, the question would straightway arise: how do 40 marks compare, in value to the Berlin workman, with 60 shillings to the London workman? The question is an extremely difficult one. It can be answered in a sort of a way by looking up the rate of foreign exchange and converting marks and francs into shillings at that rate; but that solution merely tells how many shillings the Berlin workman could get in exchange for the marks he earns, and it is obvious that the real issue is not how many shillings, but how much food and other articles of daily requirement his marks will buy.

The tastes and habits of wage-earners differ greatly as between country and country. The English worker drinks much tea and little coffee, the French worker much coffee and little tea; the English worker is fond of bacon but seldom touches veal, the French is fond of veal and seldom touches bacon. And so from country to country. For these reasons the list of commodities on which the purchasing power of the various wages is to be estimated must be as far as practicable confined to articles which are consumed, in some quantity at any rate, in all the countries under comparison. The International Labour Office list comprises bread, flour and butter; margarine; eight kinds of butchers' meat, bacon, potatoes, sugar, coffee, tea, cheese, rice, eggs and milk. Even in this simple list there is hardly an item that does not present difficulties as to kind and quality.

The difficulties of obtaining comparable statistics of rent are almost insuperable. What is the value, according to some common standard of value, of the dwelling accommodation the worker of each country gets in exchange for the money he pays in rent? The information does not exist; but in view of the wide disparities due to rent legislation, the International Labour Office offers a column in which an allowance is made, dubious but perhaps better than none at all, for differences in the level of rents.

Family Budgets.—In all cost of living comparisons the different items of which account is taken must be "weighted" in accordance with their importance in the normal expenditure. In other words, a "family budget" is required. Imagine a shopping basket containing a week's provisions of a typical working-class family. Take such a basket from capital to capital and ascertain in each place what the contents cost, and you have a picture of the operation necessary for establishing the prices part of the real wage comparisons. The final question is: what articles shall be put in the basket? Shall one put into it the assortment a London workman buys, or that a Milan workman buys, or that a Philadelphia workman buys? The International Labour Office has found a way out of this dilemma by making up six baskets of commodities according to the habits and tastes of workers in six widespread parts of the world and pricing the contents of each of the six baskets in each industrial centre. The computations of comparative

TABLE I.—*Index Numbers of Money Wages (Base: 1929=100)*

Country	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Australia	100	98	89	84	81	82	83	85	89	96
Belgium	100	108	101	92	90	86	82	88	99	105
Bulgaria	100	94	91	79	84	78	78	77	85	90
Canada	100	100	98	91	87	89	91	93	101	104
Denmark	100	102	102	102	102	103	104	103	105	..
France	100	109	108	104	104	104	102	116	165	172
Germany	100	102	96	82	79	79	79	79	79	80
Great Britain	100	100	98	96	95	96	97	100	104	107
Italy	100	99	93	91	89	86	85	90	101	108
Japan	100	96	92	95	96	94	92	91	94	94
New Zealand	100	100	93	85	82	82	84	93	102	106
Norway	100	100	96	98	96	97	97	100	107	118
Rumania	100	96	85	69	63	62	61	62	66	67
South Africa	100	100	97	93	94	94	98	100	100	101*
Sweden	100	104	103	101	98	98	99	100	103	..
Switzerland	100	101	102	98	97	94	92	90	89	93
United States	100	93	83	68	66	72	78	84	93	86
Yugoslavia	100	101	100	93	88	84	82	82	86	90

Compiled from *International Labour Review*, July 1939.
*Provisional.

real wages are then made for every country on the basis of each of the six baskets and on the average of the contents of the six baskets. The enquirer is thereby enabled to select a figure corresponding to the budget-basis he thinks most appropriate for his purpose.

Table I shows by index numbers the trend of money wages in 18 countries from 1929 to 1938. As indicated above, the series for the different countries are in some cases wage rates and in other cases actual earnings, and the time periods covered by these rates or earnings vary from country to country. *But within itself each series is consistent.* If the index number for 1929 is for hourly earnings, the index number given for that country for subsequent years is also for hourly earnings. The greatest weakness of the series, from the point of view of international comparisons, is their unequal representativeness of the wage structures of the respective countries. Some series are built from inadequate data on relatively few industries; others cover their national labour market far more completely.

Recognizing the limitations of the figures, one should be conservative about deriving conclusions from them. Nevertheless, they probably indicate the general trend of wage earners' money incomes in the respective countries. In some cases, such as France, the indexes were distorted by more than ordinary changes in the value of the monetary unit.

Table II presents index numbers of the trend of real wages, *i.e.*, of the purchasing power of wages, in the 18 countries. It uses the same money wages data as Table I and the standard cost of living figures of each country. Striking increases in real wages are indicated for Bulgaria and France in 1937–38. The general upward trend of real wages during the decade resulted, of course, from the greater drop in prices than in wages. The actual buying power of wage earners did not increase as much as the table suggests, since unemployment was bad in most of the countries during most of the period 1929–38. A large number of workers, also, suffered from part time employment. Hence, real earnings, in terms of actual family income of goods and satisfactions, was not, over the whole body of wage earners, as favourable as the table indicates.

TABLE II.—*Index Numbers of Real Wages (Base: 1929=100)*

Country	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Australia	100	103	105	104	104	103	102	103	105	110
Belgium	100	104	109	111	109	108	103	104	108	112
Bulgaria	100	103	114	108	123	122	131	135	146	149
Canada	100	101	109	112	112	113	115	115	121	124
Denmark	100	107	114	114	111	107	105	103	102	..
France	100	104	106	110	111	112	117	127	148	137
Germany	100	106	109	104	104	101	99	98	98	98
Great Britain	100	104	109	110	112	111	111	111	110	113
Italy	100	102	107	110	112	114	111	109	111	110
Japan	..	..	..	100	99	93	98	86	84	79
New Zealand	100	102	103	102	103	102	101	108	111	112
Norway	100	104	104	109	109	108	106	107	107	114
Rumania	100	107	116	111	111	116	110	108	100	90
South Africa	100	102	103	104	108	106	111	112	110	107*
Sweden	100	106	109	110	108	107	107	107	108	..
Switzerland	100	103	109	114	119	117	116	111	105	109
United States	100	95	94	84	80	92	96	102	109	103
Yugoslavia	100	110	114	115	111	112	111	111	110	104

Compiled from *International Labour Review*, July 1939.
*Provisional.

Active improvements in the computation are continually going forward. Three conferences under the auspices of the International Labour Office have discussed comparable data of clothing prices and rents. The ideal would be a dual series of computations, one based on time rates of wages and the other on national earnings, but the data for earnings is at present greatly lacking. Suggestions have been made for yet another series in which *family* earnings would be used as the basis, but reliable statistics of family earnings are most difficult of all to obtain.

BIBLIOGRAPHY.—The basis of the Ministry of Labour series is described in the Ministry of Labour *Gazette* for July, 1923. *See* also *International Labour Review* for October, 1924, for an account of how the range of the statistics was amplified and subsequent issues for accounts of various improvements introduced. International wage comparisons appear in the *International Labour Review* periodically. Commentary upon the composition and characteristics of the different series appears in various issues which present the data. (D. D. L.)

WAGES: STATISTICS OF UNITED KINGDOM.

This account of wages since 1795 should be read in conjunction with the articles on COST OF LIVING, INDEX-NUMBERS, PRICE, UNEMPLOYMENT and HOURS OF LABOUR.

The account is restricted to estimates of wages obtainable by persons in full employment—either time-wages or average earnings on piece-rates; it deals principally with general movements, the resultant of all changes in rates, time and piece, the shifting of the numbers engaged in different occupations and all other circumstances which affect earnings.

A slow reduction of weekly hours of work took place in the half-century before World War I, and in 1919–20 hours were generally reduced to 47 or 48 per week and much greater uniformity was reached than before. It will be seen from a study of the statistics that follow that progress has been nearly continuous, when viewed broadly, through the past century, sometimes by advances of money wages, sometimes by reduction of prices, and especially in the most recent period by reduction of hours of work.

The Period 1795–1850.—The earliest general investigation into wages in the United Kingdom was made in 1886, and the study of movements before that date depends on scattered accounts, which can only be pieced together with great difficulty and some uncertainty, at least till 1850 after which date records are more numerous. Table I. exhibits the wages in some of the occupations for which records can be traced back to an early date. With the great rise of prices during the Napoleonic wars wage-rates increased by more than 50%, reaching a maximum in 1815; during the next 15 or 20 years there was an irregular fall, and then wages were nearly stationary till about 1850, at a height about one-third above that of 1790–95. If the movements of money wages are compared with those of prices, it becomes evident that a considerable advance was made in real wages between 1815 and 1850. One account gives average weekly wages of men (artisans and labourers, town and country) as 13s. 6d. in 1795, 17s. in 1807, 18s. in 1824, 16s. in 1833 and 17s. in 1850; if these are transformed into the money values of 1850 they become about 8s. 6d. in 1795, 8s. 3d. in 1807, 13s. in 1824, 13s. 6d. in 1833 and 17s. in 1850, that is to say that the average workman could buy nearly twice as much in 1850 as in 1795. To take a particular case, the Sussex agricultural labourer's wage was equivalent to $4\frac{1}{2}$ pecks of wheat a week in 1795 and to 9 pecks in 1850. This is a very general statement and it may be that real wages rose somewhat less than is indicated in the 55 years.

The Period 1850–1914.—Soon after 1850 prices began to rise, and after some fluctuations culminated in 1873 and then fell rapidly, till in 1880 they were near the 1850 level again. During these 30 years it is computed that wage-rates in specific occupations rose about 30%, but owing to the relative increase of numbers in the better paid occupations average wages of all men rose

TABLE I. *Illustrative Movements in Weekly Wages*

Year	Bricklayer (London summer-time rates)		Bricklayer's labourer (London summer-time rates)		Compositor, London time rate	Fitter, London time rate	Cotton mill-spinner, Lancashire. Average earnings		Agricultural labourer, Eng. and Wales. Average earnings	
	s.	d.	s.	d.	s.	s.	s.	d.	s.	d.
1795	18	0	12	0	30	..	..		10	6
1800	19	6	14	3	30	..	..		12	6
1805	25	0	18	0	33	..	25	10	15	6
1810	30	0	20	0	36	..	30	1	16	0
1815	30	0	20	0	36	..	26	0	15	6
1820	28	6	19	0	33	..	26	0	14	0
1825	33	0	21	0	33	..	25	8	11	6
1830	30	0	20	0	33	..	24	9	11	6
1835	27	0	18	0	33	..	24	4	11	6
1840	30	0	20	0	33	..	22	6	12	6
1845	30	0	20	0	33	..	23	5	11	6
1850	30	0	20	0	33	..	21	10	11	0
1855	33	0	20	0	33	34	22	0	14	6
1860	33	0	20	0	33	34	24	4	13	6
1865	35	4	20	0	33	35	28	6	14	0
1870	37	8	22	4	36	36	28	6	15	0
1875	39	4	25	2	36	36	33	6	18	0
1880	39	4	25	2	36	36	30	11	16	0
1885	39	4	26	3	36	38	31	1	14	0
1890	39	4	26	3	36	38	36	0	15	0
1895	39	7	27	1	38	38	36	0	15	6
1900	43	9	29	2	38	38	36	0	16	6
1905	43	9	29	2	39	39	41	5	17	0
1910	43	9	29	2	39	40	41	5	17	6
1914	47	11	33	4	39	40	41	5	19	0
1920	102	8	91	8	95	60*	..		49	0
1925	78	10	60	6	89	61	..		32	6
1928	77	0	58	8	89	61	..		32	6

*Plus 12½% on week's earnings.

The first four columns are the trade-union or other agreed rates. The cotton mill-spinners' earnings are as estimated by G. H. Wood in the *Statistical Journal*, p. 135 (1910) with some adjustment of dates. The agricultural earnings are obtained by adding to the year's money receipts for weekly wages and occasional earnings the value of payments in kind, and dividing by 52. (See *Statistical Journal* p. 562; 1899.)

more than 40% and reached about 24s. weekly. The index-numbers in Table II. show the movement year by year. It is probable that prices more than kept pace with money wages till 1860, and that wages gained on prices till 1870, and in the next decade real wages made rapid progress (at the expense of some unemployment) as prices fell. Prices continued to fall irregularly till about 1895, and then rose with some interruptions, till, at the outbreak of war, the level of 1880 and of 1850 was again approximately reached.

Money wages rose from 1886 to 1890 and again from 1896 to 1900 and, after a slight fall, from 1911 to 1914. Throughout the period of falling prices real wages rose considerably, but from 1900 to 1914, or even from 1895 to 1914, it is doubtful whether money wages were as fast as prices, and some statisticians have computed that real wages fell perceptibly in the 15 or 20 years before the war.

The Period 1914–1928.—This is dealt with in detail below. By 1928 average money earnings were more than 90% above those of 1914 while prices had risen about 70%. The account now given may be thus summarized:—

Average Weekly Wages of Fully-employed Men in Great Britain

	Actual wage	Corrected to value of money in:	
		1914	1928
1795	13s. 6d.	8s. 6d.	14s. 6d.
1850	17s.	17s.	29s.
1880	24s.	24s.	41s.
1902	29s.	32s.	54s.
1914	32s.	32s.	54s.
1928	60s.	35s.	60s.

It must be emphasized that the element of approximation in these figures is very considerable; in no year can the average be certainly computed within a margin of, say, 2s., and the adjustment for the change of purchasing power of money is hazardous, even when the dates 1850, 1880 and 1914 are selected, at which prices were nearly the same; but the statement is consistent with such evidence as is available. In considering the possibility of a family living in 1795 on a weekly wage equivalent to only 14s. 6d. in our present currency, it is to be remembered that little was spent except on food, that all members of the family except the very young and very old worked, and that in the country where wages were lowest, rent was very little and garden produce and perquisites were relatively more important than now. Sufficient detail is available from 1850 onwards to allow at least an approximate account of the general movement of wages year by year. The convenient method of making the calculation and exhibiting the results is by index numbers, by which average wages in each occupation are expressed as percentages of their amount in a particular year—1914 is selected as giving the best perspective both for pre-war and post-war years—and combining the results, with due attention to the relative importance of the industries. In Table II. the figures in the column headed "A" are intended to represent the movement of the average weekly earnings (at full time) of all manual workers (male and female, adults and children) in the United Kingdom, and are based on all available information. Under "B" an alternative reckoning is given in which the gradual shifting of population to the better paid industries is ignored, so that it indicates the movement of wages for persons who remain in the same occupation. Column "C" gives the Ministry of Labour's statement from 1880 to 1914 of "the General Course of Rates of Wages," and from 1914 to 1928 of the "estimated average percentage increase in weekly full-time rates of wages generally" (100 being added to convert the percentage increase into percentages); the earlier series depends only on wages of building and engineering artisans, piece-rate changes in coal-mining and textiles and cash rates of wages of ordinary agricultural labourers; the latter series has a wider basis; but in neither is any weight given to change of relative numbers, and in both it is assumed that earnings move proportionately with piece-rates. The wage-

TABLE II. *Average Earnings of Manual Workers for a Normal Week in the United Kingdom Expressed as Percentages of the Level in 1914 (Index Numbers of Wages)*

Year	G. H. Wood's numbers		Year	G. H. Wood's numbers		Ministry of Labour	Year	Ministry of Labour	
	A	B		A	B	C		A	C
1850	50	62	1880	73	81	77	1910	94	94
1851	50	62	1881	73	81	78	1911	94	94
1852	50	62	1882	75	81	79	1912	96	96
1853	55	68	1883	75	82	80	1913	99	99
1854	57	69	1884	75	82	79	1914	100	100
1855	58	71	1885	74	81	78	1915	..	101 to 102*
1856	58	71	1886	73	81	77	1916	..	110 „ 115
1857	56	68	1887	75	81	77	1917	..	120 „ 125
1858	55	66	1888	76	81	79	1918	..	155 „ 160
1859	56	66	1889	80	84	81	1919	..	195 „ 200
1860	57	68	1890	84	87	84	1920	..	215 „ 220
1861	57	68	1891	84	87	85	1921	..	270 „ 280
1862	58	68	1892	84	87	84	1922	..	210 „ 215
1863	58	69	1893	84	86	84	1923	..	170 „ 175
1864	62	73	1894	84	86	83	1924	195	165 „ 170
1865	63	74	1895	84	85	83	1925	196	170 „ 175
1866	66	76	1896	84	86	83	1926	196	175
1867	65	76	1897	85	87	84	1927	196	175
1868	65	74	1898	87	89	86	1928	194	170 to 175
1869	65	74	1899	90	90	89			
1870	66	76	1900	95	94	93			
1871	69	79	1901	94	93	92			
1872	73	84	1902	92	91	91			
1873	77	88	1903	91	91	90			
1874	78	89	1904	90	91	90			
1875	77	87	1905	90	90	90			
1876	76	86	1906	91	93	91			
1877	75	85	1907	95	94	94			
1878	74	83	1908	94	94	94			
1879	73	81	1909	93	93	93			

*Beginning of year from 1915 onwards.

censuses of 1886, 1906 and 1924 discussed below show conclusively that the Ministry of Labour's method fails to register the whole movement of average earnings.

Table III. shows the movement of average earnings in some of the industries which are included in the account of Table II. The figures are taken from G. H. Wood's paper "Real Wages and the Standard of Comfort since 1850" in the *Statistical Journal*, p. 93 (1909), the numbers in 1906 being equated to 91 in accordance with Table II.

TABLE III. *The Course of Average Wages in Certain Industries, 1850–1906*

	1850	1855	1860	1866	1871	1874	1877	1880	1883	1886	1891	1896	1900	1906
Agriculture, England and Wales	58	68	68	72	76	85	86	83	83	82	84	84	90	91
Scotland	44	57	53	53	63	75	82	75	73	77	80	84	88	91
Ireland	50	50	55	59	64	66	69	71	72	74	77	80	83	91
	53	57	62	68	70	76	82	79	79	79	83	86	91	91
Building	72	72	72	73	76	81	84	84	84	84	87	88	89	91
Printing	59	65	63	71	72	78	77	75	84	75	87	86	92	91
Shipbuilding	60	66	65	69	71	78	78	73	78	74	83	86	89	91
Engineering	63	88	72	94	75	101	72	68	73	68	94	82	101	91
Coal	77	104	77	98	91	120	90	94	82	75	84	76	117	91
Puddling	46	51	58	63	69	72	75	70	74	74	78	82	86	91
Cotton														
Wool and worsted, Huddersfield	56	63	68	73	75	83	92	86	82	77	78	80	83	91
Worsted, Bradford	62	63	70	74	89	109	93	83	82	82	82	84	86	91
Gas	60	61	62	65	71	77	79	78	78	78	86	87	89	91
Furniture	60	62	65	71	74	83	85	84	84	83	86	86	91	91

In the column headed "A" full allowance is made for the relative changes in numbers in different occupations. Under "B" some allowance is made for changes within industries, but the relative importance of industries is assumed not to change. Under "C" are averaged the changes in time-rates in specific occupations or of piece-rates, with no allowance for relative changes in numbers or for the varying relation between piece-rates and earnings. In all cases the wages are for the normal working week at each date, and the increase in hourly rates is considerably greater than that here shown. G. H. Wood's numbers are converted from his account (*Statistical Journal* [1909], pp. 102–23 and 1912–13 p. 220) by taking the level in 1910 as 94.

It is noticeable in Tables I. and III. that the movement of wages has differed greatly in different occupations; in some there has been a steady increase, in others long periods of stationary wages, in others marked fluctuations.

Official Investigations of 1886, 1906 and 1924.—In 1886 the Board of Trade instituted an enquiry into the actual wages paid by employers in all the principal industries, and in 1906 the Labour Department of the Board of Trade made a similar investigation. The returns were voluntary at both dates, and while in those industries where the factory system had been long established a considerable proportion of employers filled in the schedules, in others, such as clothing industries and the minor metal trade, returns were sporadic and insufficient. Table IV. exhibits the results for all cases where the reports in 1886 appear to be adequate, together with estimates for coal-miners and railways in 1906 and for agriculture of both dates, which were not included in the general enquiry. Except in the principal textile and some of the metal industries, we have no assurance that the classification was the same at the two dates and detailed comparison can only be made with considerable reservations. The general averages for all industries massed together are, however, more dependable.

In 1886 the detailed enquiry was not as to actual earnings, but as to the wages or earnings obtainable by different classes for a full week. In 1906 there was a double tabulation, one for the earnings of those who worked for the normal week, without short time or overtime, the other of the earnings of all persons receiving

TABLE IV. *United Kingdom*

Men and Boys. Average Weekly Earnings

Industry (a)	Men Normal hr. 1886 (b)	Men Normal hr. 1906 (c)	Boys Normal hr. 1886 (d)	Boys Normal hr. 1906 (e)	All males Actual hr. 1906 (f)	All males Actual hr. 1924 (g)	Col. (g) as % of Col. (f) (h)
Textile Industries	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	
Cotton	25 3	29 6	9 4	11 6	24 2	47 0	194
Wool and worsted	23 3	26 10	7 5	8 10	21 2	53 10	254
Linen, hemp, jute	21 0	22 7	6 4	8 7	18 2	41 2	226
Silk	22 3	25 8	7 2	8 2	20 10	59 10	287
Lace	27 3	39 6	9 4	12 8	30 4	52 1	172
Hosiery	24 5	31 5	9 6	9 5	26 3	54 8	208
Bleaching, finishing	..	..	..	..	23 8	56 9	240
Others	22 0	26 4	7 10	10 4	22 3	50 6	227
Average	..	..	..	..	23 0	50 7	220
Clothing Industries							
Dressmaking, tailoring, etc.	..	..	..	..	25 4	57 2	226
Boots	24 3	28 8	8 4	10 4	22 6	53 7	238
Hats	..	..	..	..	28 7	57 11	203
Others	..	..	..	..	24 0	53 7	223
Average	..	..	..	..	24 2	55 11	231
Food, Drink and Tobacco							
Milling	..	..	..	..	23 0	56 9	247
Bread, biscuits, etc.	..	..	..	..	23 3	53 10	232
Other food	..	..	..	..	22 11	58 7	256
Brewing and distilling	23 11	26 0	9 9	10 6	24 3	59 1	244
Tobacco	..	..	..	..	24 9	69 5	280
Average	..	..	..	..	23 2	57 1	246
Earthenware, Chemicals, etc.							
Earthenware	..	..	..	..	26 7	55 6	209
Bricks	22 10	26 7	9 0	11 6	23 1	51 10	225
Glass	..	..	..	..	26 2	56 1	214
Chemicals	..	..	..	..	26 10	59 7	222
Explosives	..	..	..	..	28 5	54 10	193
Cement	..	..	..	..	26 10	59 0	219
Others	..	..	..	..	24 6	58 9	240
Average	..	..	..	..	25 5	56 10	224
Metal Industries							
Iron and steel manufacture	24 6*	34 4	10 8*	13 0	32 10	60 5	184
Tin plate	33 5	42 0	11 3	12 4	33 8	73 7	218
Brasswork	29 7	31 9	8 5	10 3	24 11	50 7	203
General engineeringmachinery, cars, etc.	25 9	32 5	9 1	9 7	27 4	52 9	193
Cutlery	..	..	..	..	26 5	48 9	185
Wire	..	..	..	..	26 1	56 4	216
Screws, etc.	..	..	..	..	25 3	45 5	180
Railway carriages	25 2	30 9	10 6	11 3	27 2	55 0	202
Watches, jewelery	..	..	..	..	28 10	55 11	194
Shipbuilding	29 3	35 11	12 2	11 10	30 8	51 11	169
Other metal industries	..	..	..	..	25 3	54 9	216
Average	..	..	..	..	29 0	54 2	187
Paper, Printing, etc.							
Paper manufacture	..	..	..	..	26 1	56 10	218
Stationery	..	..	..	..	23 9	54 7	230
Printing and binding	..	..	..	..	27 6	75 3	274
Cardboard boxes	..	..	..	..	22 8	54 7	241
Average	..	..	..	..	27 9	69 8	251

*Pig-iron only.

TABLE IV. *United Kingdom—Continued*

Men and Boys. Average weekly earnings (*continued*)

Industry	Men Normal hr. 1886 (b)	Men Normal hr. 1906 (c)	Boys Normal hr. 1886 (d)	Boys Normal hr. 1906 (e)	All males Actual hours 1906 (f)	All males Actual hours 1924 (g)	Col. (g) as % of Col. (f) (h)
(a)							
Building Woodwork	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	
Building and construction	29 0	33 0	8 2	9 7	27 11	58 2	208
Wood . .	. . .	. . .	. . .	. . .	23 1	52 2	226
Furniture. .	. . .	. . .	. . .	. . .	26 11	57 1	212
Average .	. . .	. . .	. . .	. . .	27 3	57 3	210
Public Utility							
Gas, water, electricity .	. . .	. . .	. . .	. . .	29 9	61 6	207
Coal Mines .	22 11	30 2	10 9	12 4	30 2	58 7	194
Railways . .	22 5	24 6	10 3	11 11	25 0	67 4	269
Docks . .	. . .	. . .	. . .	. . .	33 8	67 4	200
Agriculture (Eng. and Wales) . .	14 0	16 2	. . .	. . .	16 2†	28 0†	173
General average	23 6	28 9	8 11	10 7	24 10	52 10	213

†Men only.

Women and Girls. Average weekly earnings

Industry	Women Normal hr. 1886 (b)	Women Normal hr. 1906 (c)	Girls Normal hr. 1886 (d)	Girls Normal hr. 1906 (e)	All females Actual hours 1906 (f)	All females Actual hours 1924 (g)	Col. (g) as % of Col. (f) (h)
(a)							
Textile Industries	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	
Cotton . .	15 3	18 8	6 10	10 1	16 2	28 3	175
Wool and worsted . .	12 7	13 10	6 8	8 4	12 1	30 7	253
Linen, hemp, jute . .	9 2	11 4	4 11	7 3	10 5	24 11	239
Silk . . .	10 1	11 2	5 8	6 4	9 9	28 0	287
Lace . . .	12 8	13 5	6 2	7 1	11 7	24 5	211
Hosiery . .	11 6	14 3	8 3	7 9	12 4	28 8	232
Bleaching, finishing, etc. .	. . .	12 4	. . .	8 2	11 0	24 9	225
Others . .	10 9	13 3	5 11	7 3	10 11	27 3	250
Average .	. . .	. . .	. . .	. . .	13 9	27 11	203
Clothing Industries							
Dressmaking, tailoring, etc.	. . .	13 7	. . .	5 3	11 3	27 0	240
Boots . .	12 6	13 1	5 6	6 10	10 6	26 5	252
Hats. . .	. . .	17 8	. . .	8 9	15 6	25 8	166
Others . .	. . .	13 0	. . .	6 7	11 2	27 3	244
Average .	. . .	. . .	. . .	. . .	11 4	27 5	242
Food, Drink and Tobacco							
Bread, biscuits, etc. . .	. . .	12 8	. . .	7 0	9 10	27 4	278
Cocoa, etc. .	. . .	11 9	. . .	6 7	10 5	25 9	247
Other food .	. . .	10 5	. . .	7 2	9 6	26 6	279
Brewing and distillery .	. . .	9 5	. . .	7 5	9 1	27 7	304
Tobacco . .	. . .	12 0	. . .	6 2	9 4	33 2	355
Average .	. . .	. . .	. . .	. . .	9 8	27 6	284
Earthenware, Chemicals, etc.							
Pottery . .	. . .	11 11	. . .	6 2	10 1	22 3	221
Chemicals .	. . .	10 8	. . .	7 4	9 11	24 5	246
Explosives .	. . .	13 1	. . .	8 1	11 7	28 1	242
Others . .	. . .	11 6	. . .	7 9	9 11	25 5	256
Average .	. . .	. .	. . .	. . .	10 2	24 8	243

TABLE IV. *United Kingdom—Continued*

Women and Girls. Average weekly earnings (*continued*)

Industry	Women Normal hr. 1886 (b)	Women Normal hr. 1906 (c)	Girls Normal hr. 1886 (d)	Girls Normal hr. 1906 (e)	All females Actual hours 1906 (f)	All females Actual hours 1924 (g)	Col. (g) as % of Col. (f) (h)
(a)							
Metal Industries							
General engineering machinery, cars, etc.	. . .	13 9	. . .	8 7	11 4	26 11	237
Cutlery . .	. . .	11 7	. . .	6 10	10 0	21 8	217
Wire. . .	. . .	13 2	. . .	7 3	10 5	24 2	232
Screws, etc. .	. . .	11 2	. . .	7 6	9 7	21 11	229
Brass work .	. . .	12 0	. . .	7 0	10 3	25 0	244
Jewellery, etc .	. . .	13 2	. . .	6 1	10 7	23 5	221
Others . .	. . .	12 2	. . .	7 0	10 7	26 8	252
Average .	. . .	. . .	. . .	. . .	10 8	26 0	244
Paper, Printing, etc.							
Paper manufacture . .	. . .	11 11	. . .	7 6	11 0	25 6	232
Stationery .	. . .	11 11	. . .	6 6	9 9	25 11	266
Printing and binding. .	. . .	12 6	. . .	6 3	9 10	28 8	292
Cardboard boxes . .	. . .	12 3	. . .	6 1	9 9	25 8	263
Average .	. . .	. . .	. . .	. . .	10 0	27 7	276
Furniture, etc.	. . .	13 1	. . .	6 2	11 0	27 3	248
General average	12 8	13 6	6 4	7 3	13 0	27 3	210

Full Time Weekly Earnings of Adult Male Manual Workers
Industries in general, excluding Mining and Agriculture, showing percentage of whole

Year	Under 20s.	20s. and under 25s.	25s. and under 30s.	30s. and under 35s.	35s. and under 40s.	40s. and under 50s.	50s. and over
1886	25	30	23	14	5	2	..
1906	10	21½	19½	16½	16½	11	5

payment in the selected weeks. The first method is used for columns (*c*) and (*e*) in Table IV., since it agrees more closely with the method of 1886. In fact in most industries, taken as a whole, the averages are nearly the same by the two methods, since overtime nearly balanced short time. The 1924 enquiry, of which a summary is given in the *Ministry of Labour Gazette*, July 1927, was less detailed. No distinction was made by age and consequently comparison with 1906 is only possible for all males and all females as in columns (*f*) and (*g*). The returns relate to actual earnings, not to estimated earnings in a normal week, and the second tabulation of the 1906 figures is therefore used for column (*f*). Information is, however, given in 1924 about the number of hours normal in each industry and the hours actually worked in the weeks for which returns were made. Normal hours in all industries (excluding railways, mining, docks and agriculture) average 47·0 weekly, and except for building and construction where the average was 45·3 there is singular uniformity in the hours. The hours actually worked (excluding, of course, persons totally unemployed) averaged 45·6, so that if full time (without overtime) had been universal, earnings would have risen about 3%.

The averages in Table IV. have all been computed by applying to the wages the numbers recorded in the different industries in the Census of Production of 1907 and 1924 or in the Population Census, or in the reports of numbers of insured persons, and are thus independent of the numbers that happened to be included in the employers' voluntary wage-returns. In comparing the wages of boys in 1886 and 1906 and of girls at the same dates it is to be remembered that there were more half-timers at the earlier date, and in comparison between 1906 and 1924, that half-timers hardly existed at the second date, and the age of commencing work had generally risen from 13 to 14. These changes, however, have very little influence on the general averages. In the 1906 account not only are averages given but also, for each industry, the num-

TABLE V. *Rates of Wages in Typical Occupations, 1914 to 1928. Men*

For each occupation the first line gives the number of shillings for a normal week's work, and the second line expresses these amounts as percentage of the wage in July 1914.

	1914 July	1915 Dec.	1916 Dec.	1917 Dec.	1918 Dec.	1919 Dec.	1920 Dec.	1921 Dec.	1922 Dec.	1923 Dec.	1924 Dec.	1925 Dec.	1926 Dec.	1927 Dec.	1928 Dec.
Time-rates															
Skilled															
Carpenters	40	41	44	52	69	81	101	88	71	69	73	74	74	74	72
	100	103	111	131	173	202	252	220	178	172	183	183	183	183	179
Engineers' fitters	39	43	47	67	77	83	90	77	56	55	56·5	56·5	56·5	56·5	56·5
	100	111	119	172	195	212	230	196	143	141	145	145	145	145	145
Compositors	36	36	39	47	65	76	93	88	77	74	74	74	74	74	74
	100	102	110	133	184	213	262	248	216	207	207	207	207	207	207
Engine-drivers, railway	40·5	45·5	50·6	61·5	73·5	83	97	89	81	81	81	81	81	81	81
	100	112	125	152	182	205	240	220	200	200	200	200	200	200	200
Semi-skilled															
Painters (building)	36	37	40	47	65	78	100	88	71	68	72·5	73	73	73	71
	100	102	109	129	175	215	275	243	196	188	200	201	201	201	196
Tram-drivers	31	33	37	44	61	65	74	69	60	59	60	60	..	..	..
	100	106	116	142	197	209	238	222	194	190	193	193	..	..	..
Labourers															
Building	27	29	32	40	56	67	88	70	53	52	55·5	55·5	55·5	55·5	53·5
	100	109	119	148	206	271	325	260	198	191	206	206	206	206	198
Engineering	23	27	30	49	58	64	71	59	40	40	40	40	40	40	40
	100	116	132	214	255	280	310	260	176	176	176	176	176	176	176
Local authorities	27	29	32	40	52·5	62·5	75	68	55	51·5	53	53	..	..	..
	100	109	119	150	197	234	279	254	204	192	199	200	..	..	..
Carters (one-horse)	25·5	29	32	44	56	60	68·5	62	54	51·5	53	53	..	..	..
	100	113	126	172	219	235	267	241	211	201	208	208	..	..	..
Dockers (5½ days)	33·5	39·5	46	54	69	73	89	79	64	57	67·5	67·5	67·5	67·5	67·5
	100	118	138	162	207	219	266	236	190	171	201	201	201	201	201
Agriculture (Eng. and Wales)	18	..	..	25	30·5	38	47	37	28	28	28	31·5	31·5	31·5	31·5
	100	..	..	139	169	210	260	205	154	156	156	173	173	173	173
Piece-rates															
Cotton	100	100	105	133	205	202	259	202	161	161	161	161	161	161	161
Coal mines (5½ shifts)	36	42·5	48	52	68	79	102	70	52	56·5	58	57·5	..	53	..
	100	119	135	145	191	222	285	195	145	168	163	161	..	148	..
General average of %s	100	110 to 115	120 to 125	155 to 160	195 to 200	215 to 220	270 to 280	210 to 215	170 to 175	165 to 170	170 to 175	175	175	170 to 175	..
Index Number of average earnings, all persons	100	..	..	..	..	..	..	..	..	..	..	195	196	197	196	194
Cost of living Index No.	100	135	165	185 to 190	220	225	265	192	178	177	180	175	175	168	164

bers at each rate of wages, and less detailed information is shown for 1886. These detailed figures lead to the following very rough comparison.

Thus in 1906 the average was 30s. 6d.; the central half earned between 23s. and 27s.; four-fifths between 19s. 6d. and 46s., one-tenth of all more than 46s. The increase in relative numbers in the higher grades of wages is very noticeable.

Changes from 1914 to 1928.—Wage-rates rose slowly in the first few months of the World War, and, when the general rise of prices became evident, were increased at frequent intervals by such amounts as were considered necessary to balance the increased cost of living. In many cases equal money increases were given to all men in an industry, skilled or unskilled, with the result that unskilled wages rose relatively to skilled. Thus in the building trade labourers' wages had been two-thirds of artisans', but at the end of the War they were more than four-fifths. A study of Table V. will show that part, but not all, of this relative gain has been preserved. Women's wages have similarly gained on men's and there has been a general levelling up of the lowest wages. Wage-rates in many cases failed to keep exact pace with prices in the years 1915–19, but piece-rates and overtime were prevalent, while unemployment practically disappeared, so that in fact the standard of living was preserved as far as was possible under the restrictions of the food-supply. In the boom of 1919 wages rose rapidly and continued to rise in 1920 after wholesale prices had begun to fall in 1920; industry entered suddenly on a period of depression at the beginning of 1921, and the wages fell rapidly from March 1921 to Dec. 1922. From the beginning of 1923 till the middle of 1928 wage-rates remained nearly stationary, but wholesale prices fell appreciably during the year 1925, 1926 and the first half of 1927 and in consequence the Cost of Living index number was 13 points (7%) lower in Jan. 1928, than in Jan. 1925.

For reasons already indicated average earnings for all workers rose more than wage-rates for individual occupations. When we compare 1928 with 1914 we find that average rates had risen by 70 to 75%, average earnings 90 to 95%, and rates for unskilled workers and for many women's occupations 100%, while the cost of living had risen only 64% and the length of the working week had fallen by some 13%. On the other hand, unemployment was prevalent, especially in mining, shipbuilding and some other important industries, and wages in mining and shipbuilding have risen less than 50%. Though engineering artisans' time-rates have only risen 45% (*see* Table V.), actual earnings of all employed in engineering and machinery and motor-car construction have increased more than 80%, and it is only those wage-earners who are on pure time-rates without bonus who have realized only the minimum increase.

Table V., most of which is compiled from the 18th *Abstract of Labour Statistics* pp. 116–19, illustrates the changes in rates that have taken place. The rates are in general the averages of those in several districts, stated to the nearest shilling or sixpence. It is to be noticed that when the reduction of hours took place in 1919 or 1920 time-rates were generally unchanged, the same sum being payable for the shortened week, but piece-rates were generally increased about 15%. It is probable that piece-workers gained by this arrangement, and that for example the percentages shown in the table for cotton, which are the arranged piece-rates without this 15% increase, underestimate the increase in earnings for those at full work; certainly in the period 1906 to 1924 during which piece-rates (apart from this 15%) rose 61%, earnings of males in the cotton trade rose over 90% and of females about 75%.

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WAGES: STATISTICS OF UNITED STATES. The rise in real wages of American wage earners between 1915 and 1929 attracted world-wide attention. The ensuing collapse in wage earners' welfare between 1930 and 1934 was no less spectacular. From 1899 to 1915 net gains in real wages were slight. During the first two years of the World War living costs rose faster than wages in most industries, but from 1917 to 1929 average wage increases exceeded the rise in the cost of living, and during the nineteen-twenties real wages were substantially better than before the war. A census report stated in 1929 that "It seems quite certain that the manufacturing wage earner has achieved permanently higher levels of real wages . . . his real earnings in 1925 were 37 per cent higher than . . . 1899 and 43 per cent higher than in 1914." The general trend in railroads, mines, and construction was closely similar. These gains were largely due to the low cost of living after 1921. Wages in general were stable. They fell slightly in many of the manufacturing industries between 1921 and 1927.

It is easy to overestimate the gains made by labour in years when real wages increase. The high earnings of a good year are partly consumed in paying the debts left over from preceding years. There were only seven years between 1899 and 1929 when average real annual earnings in manufactures fell below those of 1899 but there were thirteen years in which they were lower than the year before. On four occasions two successive years yielded lower purchasing power to labour than the year which preceded them. It was only in the period 1923 to 1929 that real wages were both enough higher and sufficiently continuous at the higher levels to permit wage earners to shift to a higher standard of living and maintain that standard long enough to establish it.

The first impact of the depression of the thirties did not affect the wage structure. It cut the earnings of millions through unemployment and part time work before it affected wage rates. It was not until the last quarter of 1930 that appreciable downward changes in manufacturing wages occurred and the reduction was but a cent an hour from the 1929 average of 59 cents.

The next year, 1931, saw a slow but progressive decline in hourly earnings, which dropped about three cents before the end of the year. Weekly earnings, on account of unemployment, dropped much faster. Average weekly earnings in the industries reporting to the National Industrial Conference Board were $28.69 in 1929, $25.74 in 1930, $22.64 in 1931, and $17.05 per week in 1932—a decline of over 40% from 1929 levels. In addition, nearly one-half of the employees in these industries were entirely idle in 1932. A slow increase in weekly earnings began with a rise to $17.71 in 1933. They were $20.12 in 1934, $22.28 in 1935, $24.64 in 1936, and $26.80 in 1937.

The year 1938 saw a drop to $24.43, due to the business recession of that year. Fewer hours per week rather than lower hourly earnings accounted for the drop in 1938.

Curiously enough, average weekly earnings in manufactures during the first 11 months of 1939 were the same as for the year 1938—$24.43. Employment improved during 1939 but its effects were registered in the re-absorption of workers who had been laid off rather than in increases in weekly earnings. The employment index for 1938 was 86·8 and for the first 11 months of 1939 was 96·2.

The average wage of an industry is often quoted as if it was the average wage of men in the industry. It is, instead, the average wage of all persons employed; men, women, and children, skilled and unskilled. The average wages of married men exceed the industry averages. Men's average wages in manufactures have exceeded women's about 87 per cent and the differential has not changed materially since the beginning of the century.

American wage earners' families, in a large percentage of cases, have more than one source of income. Typically husbands earn about 90 per cent of family incomes. Some families have but one wage earner; others 2, 3, or 4. The proportion of married women gainfully employed has increased sharply. In 1930, 24·8 per cent of the married women of the United States were in employment, and they constituted 28·9 per cent of all employed women. There has been a marked decrease in child labour.

Table I was compiled from data published by the United States Bureau of Labor Statistics, Sept. 22, 1939. The table shows the annual money earnings of workers in manufactures to have been substantially higher in 1920 than in any year since that date up to 1938.

More workers were employed than in any year except 1937 and their weekly earnings were higher in 1920 than in any other year. The decline in weekly earnings was particularly sharp after 1929 and the gradual recovery of 1934–37 still left them 9·2% lower in 1937 than in 1929.

In 1933, weekly earnings in manufactures were 34·4% below 1929. Weekly payrolls in 1934 were 55% below 1929.

TABLE I. *Average Number of Wage Earners Employed, Average Total Weekly Payrolls, and Average Weekly Earnings in Manufacturing Industries, 1919–38*

Year	Number of persons employed	Average Weekly Payrolls	Average per capita weekly earnings of persons employed	Average annual earnings (weekly×52)
1919	8,418,400	$185,863,000	$22·10	$1,149
1920	8,452,600	222,329,000	26·30	1,368
1921	6,468,900	143,507,000	22·20	1,154
1922	7,157,900	153,985,000	21·50	1,118
1923	8,194,700	195,238,000	23·80	1,238
1924	7,669,100	182,074,000	23·90	1,243
1925	7,875,000	191,915,000	24·40	1,269
1926	8,024,300	191,791,000	24·60	1,279
1927	7,851,500	194,225,000	24·70	1,284
1928	7,865,200	196,385,000	25·00	1,300
1929	8,368,800	209,495,000	25·00	1,300
1930	7,292,700	169,586,000	23·30	1,212
1931	6,162,300	128,632,000	20·90	1,087
1932	5,235,500	88,632,000	16·90	879
1933	5,790,500	95,087,000	16·40	853
1934	6,763,900	122,454,000	18·10	941
1935	7,202,600	140,590,000	19·50	1,014
1936	7,810,800	162,751,000	20·80	1,082
1937	8,569,300	194,381,000	22·70	1,180
1938	7,079,700	147,887,000	20·90	1,087

Source: Department of Labor Release No. 8166, Sept. 22, 1939.

Table II compares the trend of union hourly wage rates with the actual hourly earnings in the non-agricultural industries, *i.e.* manufactures, transportation, public utilities, mining, construction, wholesale and retail trade, hotels, and laundries and dry cleaning. It will be noted that the index numbers for union rates and actual earnings are closely similar from 1913 through 1915. In 1916 the index for average earnings begins to rise more rapidly than the union rates. This was due, of course, to the upward trend of both hour and piece rates in the war industries followed by similar, although not as large, increases in wages in other lines. Union as well as non-union workers participated in the wage increases of the war years, thousands of them being paid more than the rates specified in their trade agreements. Hourly earnings were higher in 1920 than in any subsequent year down to 1934. But union rates continued to rise down to 1931. During 1921 and 1931–34 substantial decreases in hourly earnings resulted from wage cuts and decreased piece work earnings.

The last column of the table shows that average hourly *real* earnings did not increase materially from 1913 through 1919, then increased almost steadily until 1931. It must be remembered, however, that these index numbers are not corrected for employment and unemployment, and that in 1914, 1921, 1924, 1927 and 1930–34, weekly real earnings were much below those suggested by these

index numbers, since there was widespread part time employment.

Table II gives in index numbers the trend of union wage rates and "all industries" rates in the years 1913–34. It was not possible to get data for a comprehensive index of union rates per hour for the years 1935–39. Figures on union building trades and printing wage rates showed increases in hourly rates of 21% in building; 10% in printing (*Monthly Labor Review*, Nov.-Dec. 1939).

TABLE II. *Index Numbers of Union Wage Rates, Hourly Earnings in all Industries, Retail Prices of Food, Cost of Living of Wage Earners, and Real Wages* (1913 = 100)

Year	Index of union rates per hour	Index of hourly earnings in all industries except agriculture	Index of retail food costs in large cities (Annual weighted averages)	Index of cost of goods purchased by wage earners and low salaried workers in large cities	Index of purchasing power of hourly wages in terms of cost of goods index	
					Union rates	Average hourly earnings, all industries
1913	100·0	100·0	100·0	100·0	100·0	100·0
1920	199·0	234·	211·0	202·6	98·3	114·1
1921	205·3	218·	161·0	180·6	113·5	120·5
1922	193·1	208·	150·6	169·4	114·0	122·6
1923	210·6	217·	154·9	172·4	122·0	125·8
1924	228·1	223·	154·0	173·0	132·0	129·0
1925	237·9	226·	166·8	177·5	134.0	127·3
1926	250·3	229·	173·0	179·1	140·0	127·8
1927	259·5	231·	170·2	177·0	146·5	130·5
1928	260·6	232·	163·5	173·4	160·0	133·8
1929	262·1	233·	165·1	173·1	173·5	134·5
1930	272·1	229·	157·7	169·1	164·0	140·0
1931	273·0	217·	129·5	154·3	177·0	140·5
1932	241·8	186·	108·7	139·3	175·0	133·5
1933	231·2	178·	104·9	132·0	175·0	135·0
1934	..	200·	116·0	136·6	..	142·5

Sources: *Bulletin* 600, United States Bureau of Labor Statistics; *Monthly Labor Review*, June, 1935.

The enactment of the National Industrial Recovery Act (Public Act No. 67, 73d Congress, June 16, 1933) provided for the organization of industries under codes and required that one feature of the code should be the regulation of labour conditions. This regulation was intended to improve the standards of working conditions to prevent employers from taking competitive advantage by undercutting wages or other working conditions and to establish maximum hours of labour and minimum rates of pay. The effect of the codes upon wages would have been, apparently, to have established minimum rates of pay higher than had obtained for the industry as a whole but ordinarily no higher than obtained in the better plants in the industry; and second, a decrease in the differentials between the wages of unskilled labour and skilled labour. The application of the minimum wage standards raised the wages of common labour more than the wages of skilled labour. When the Supreme Court held that the National Industrial Recovery Act was unconstitutional it made it impossible to determine what the long time effect of the code method of wage-fixing would have been. The National Wages and Hours Act, which went into effect in 1939, raised wages in some occupations before the end of the year. Its long time effect upon the wages structure remains to be seen.

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WAGE-SYSTEMS IN INDUSTRY. The normal methods of payment for the work of persons employed in industry under the capitalist system are wage-payment and salary-payment. It is not easy to draw an absolute line of distinction between these two forms of payment. Wages are usually paid weekly and salaries over a longer period—monthly, or quarterly, for example. There are, however, cases of weekly salaries and of wages paid monthly. Moreover, a good many of the supervisory grades in various industries are paid what is called an "upstanding wage," which in many of its conditions approximates rather to the salary basis of payment than to the wage as ordinarily understood. Usually the salary-earner possesses a higher status and a slightly greater measure of security than the wage-earner. Wages are, as a rule, paid only for hours actually worked, subject to the conditions mentioned below, and any period of illness or suspension of work for any cause, whether under the worker's control or not, involves the cessation of the payment of wages. Salary-earners, on the other hand, are in many cases paid during periods of sickness, and are usually paid for a full week, or month, even if some spells of enforced absence from work or failure of work due to some other cause are included. There are, however, very many intermediate varieties between the continuous salary paid throughout the whole year and the wage paid only for hours actually worked.

The salary-earner, it should be remarked, is usually entitled to a longer period of notice, from a month upward, than the wage-earner, who can usually be dismissed or suspended on a week's notice or less. The period adopted as a basis for the calculation of wages differs from trade to trade and even from district to district or factory to factory within the same trade. In some cases the basis is hourly, in others weekly. In either case, there may be, but in the majority of cases is not, what is termed the "guaranteed week," that is, a guaranteed minimum weekly payment. In certain other cases, notably that of the dockers, there is the "guaranteed day," but not the "guaranteed week." The demand for a greater measure of security than is afforded by hourly payment, without any guarantee by the week or the day, has increased, and a number of trades have secured concessions giving them guarantees of some sort. There has also been a rapid spread since 1937 of the system of "holidays with pay"; and it seems likely that these will soon be made compulsory, as they have been already in France.

Broadly speaking, the methods of remunerating the wage-earner under the wage-system can be divided into two main groups: (1) time-payments, and (2) systems of "payment by results," although there are many intermediate varieties, and disputes often arise on the question whether a particular system is or is not to be regarded as "payment by results."

(1) Under the time-work (or "day-work") system, the worker's remuneration varies with the time which he actually spends on the employer's business. Thus, carpenters and joiners in certain districts in the building industry in Great Britain have a time-rate of 1/8d. an hour, and the majority of grades on the railways have time-rates varying from 46/- per week upward. These time-rates are practically always fixed in relation to a definite number of hours in the week, and if a larger number of hours has to be worked, the hours in excess of the standard week are termed overtime, and are usually remunerated on a slightly higher hourly rate—"time and a quarter," "time and a third," "time and a half" or "double time," for example. Extra payment is also frequently made for work done during the week-end or at night ("night-shift"). The time-work system operates throughout a large number of trades, including the greater part of the building industry and the railway and road transport services, and almost the whole range of non-manual employment. In many other industries it is found side by side with various systems of "payment by results." In almost every time-work industry there are some piece-workers; and in almost every piece-work industry some time-workers. A particularly obnoxious form of time-work is that known as "task-work," under which the worker is required to perform a definite amount of labour in return for a time wage, but receives no additional remuneration

for higher output. This is strongly opposed by trade unions and does not prevail at all in organized industries in Great Britain.

(2) Under the term "payment by results" are comprehended many different methods of wage payment, the common factor among them being that, to a greater or less extent, the worker's earnings under them vary with the amount of output which he, either individually, or in conjunction with a group of his fellow-workers, is able to produce. The amount of work produced may not be the sole factor determining his remuneration under a system of "payment by results"; for such systems are very frequently, and in the organized trades usually, accompanied by guaranteed minimum or standard time-rates, which the worker is entitled to receive irrespective of the actual output which he produces. Strongly organized trade unions in many British industries have consented to accept "payment by results" only on the condition that the standard time-rates of wages shall be guaranteed irrespective of output (*e.g.*, engineering).

The simplest form of "payment by results" is that known as "piece-work." Under this system, a price is fixed for each unit of the commodity upon the production of which the worker is engaged, *e.g.*, if the worker is turning out screws, a price will be fixed per hundred, or per gross of screws, this price being calculated, in theory at least, according to the time which is estimated to be necessary for the performance of the operation in question. Sometimes, as in the "time logs" in the tailoring trade, the piece-work price is expressed not in terms of money, but in terms of hours, and the worker is paid for so many hours at the standard rate, irrespective of the time actually occupied on the job. "Straight" piece-work systems vary very much in complexity. Where the operations are simple, and the character of the goods produced uniform, piece-work prices can be laid down with almost mathematical accuracy; but as soon as provision has to be made for a wide range of different products complications almost inevitably arise. These complications are of two kinds. The cotton industry in Great Britain is almost entirely a piece-work industry; but, despite the immense variety in the types of cotton goods produced and the variation in the times required for the spinning and weaving of different types of goods, piece-work rates can be devised to correspond with practically mathematical accuracy to the time required for the job because of the high degree of standardization at which the industry has arrived. The piece-work lists agreed to by the weaving trade unions and the cotton manufacturers are immensely complicated, and only skilled technicians are able to understand them. But problems arise over faulty material, or when machines are adapted to new uses, or the number of machines operated by a single worker is altered. The universal acceptance of piece-work in the cotton industry is mainly accounted for by the fact that, under the system which has been adopted, a given amount of effort can be approximately relied upon under normal conditions to produce equivalent earnings. Measurement is much more difficult in such an industry as engineering, where the products are far less uniform and where also the machinery which the worker is called upon to manipulate is far less standardized, so that it may take very different times to do the same job on two different machines. The fixing of piece-work prices in the engineering industry in Great Britain is therefore a constant source of friction, and it has been found impossible to express, in any tables corresponding to the cotton piece-work lists, the fair remuneration for most forms of work on engineering products. Piece-work prices in the engineering industry are a constant subject of workshop and trade-union bargaining, and there has been resistance in many sections. In spite of this, the system spread rapidly with the advance of standardization and mass-production; but it produces constant allegations of "speeding up" and "price-cutting" on the one side, and of "speeding down" and "restriction of output" on the other. Where, owing to special circumstances, it is regarded as impossible to fix in advance a piece-work price for a particular job, the worker, especially in the engineering and shipbuilding industries, is sometimes paid what is called a "lieu rate," *e.g.*, "time and a third" or "time and a half" for the hours actually occupied on the job in lieu of a fixed piece-work price.

Bonus Systems.—The other main system of payment by results is the system of "bonus on output." Under this system the worker is normally paid a time-rate irrespective of output; but, if the output exceeds a given minimum, an additional bonus, calculated upon this excess output, is paid. There are literally hundreds of different methods of calculating this bonus. The system to which the greatest attention has been attracted in recent years, both in Great Britain and in America, is the "premium bonus system" in its various forms, of which the two best-known are the "Halsey" and the "Rowan" premium bonus systems. Under both these systems, a "basis time" is fixed for the accomplishment of the piece of work in question. If the work is done in less than the basis time, the workman is paid, over and above his time-rate of wages, which is guaranteed, a bonus, proportionate in one way or another to the time saved. The effect of this method of payment is that, under both the Halsey and the Rowan system, the labour cost of the job to the employer falls with every increase in output, while at the same time the earnings of the workman increase, but not in proportion to the increase in output. The simpler of the two best-known premium bonus systems is the "Halsey" system, so called after its inventor, F. A. Halsey, an American efficiency engineer. Under this system, the workman is paid a fraction, usually either a third or a half, of his time-rate for time saved. Thus supposing the time allowed for an operation is 12 hours, and a worker, whose time-rate is a shilling an hour, does it in 9 hours, he will be paid at his time-rate for the 9 hours and in addition will receive payment for a further hour or for an hour and a half, according to the particular variety of the system adopted.

The Rowan system is more complicated. The simplest way of explaining it is to say that for every 10% that is saved on the time allowed, the workman receives a 10% increase in earnings. The more complicated way is to quote the quite unnecessarily abstruse formula which is usually adopted by those who desire to explain the system. This formula is as follows:—

$$\text{Bonus} = \frac{\text{Time saved}}{\text{Time allowed}} \times \text{Time taken.}$$

There are all manner of modifications of these two systems, both in the direction of greater simplicity and in that of greater complexity. The advocates of "scientific management" have been especially active in devising fresh variations in the method of payment, intended to stimulate the workers' productive efficiency in the fullest degree. Efficiency engineers often contend that it is necessary to work out a different formula for each type of operation in order to apply in each case precisely the right stimulus to increased output. Most of these systems are based in one way or another on the premium bonus system in one or other of its two forms, or on the so-called "differential piece-rate" system advocated by F. W. Taylor, the founder of "scientific management." Under this system, two different piece-rates are fixed for the same job, and at the same time a standard output per hour is laid down. When the worker reaches or exceeds the standard output he is paid on the higher piece-rate; when he falls below the standard of output he is paid on the lower piece-rate. Day-work rates are not guaranteed. The object of this system is stated to be the elimination from the job of the less efficient worker by discouraging him with the offer of a lower piece-work price. It is impossible to attempt to chronicle the many different bonus and piece-work systems which have been put forward in Great Britain and America. The Ministry of Munitions in England, during the World War, accumulated a list of many hundreds of different systems which were actually in operation in the British engineering shops alone. It is particularly in the engineering and kindred industries that this wide diversity of forms of wage-payment exists.

It should be noted that both the piece-work system and the various bonus systems and adaptations of them can be operated on either an individual or a collective basis. Under the individual system a single worker is remunerated in accordance with his individual output. Under the collective system a group of workers is treated as a unit, and the piece-work price or bonus

is paid in respect of the output of the whole group. Collective systems are most often found where the work itself necessarily involves collaboration, and where it is therefore difficult or impossible to separate the individual contribution of the workers engaged upon it (*e.g.*, "squad" or "gang" work). It has, however, been applied also in a large number of cases over a considerably wider area in the form of an output bonus paid on the work of a whole shop or factory. In these cases, bonus is sometimes paid only to workers directly engaged on production; but in other cases auxiliary workers, such as foremen, millwrights, maintenance workers, and even workers on the staff, may share in the pool. Many such systems were adopted in shell factories in various countries during the war. There are, moreover, signs that collective systems are finding increased favour with progressive employers, as the mechanization of industrial processes takes the control of the pace of production largely out of the control of the individual worker, while leaving it largely within the control of the workshop group as a whole.

A variety of collective "payment by results" is that which is known as the "fellowship" system. Under this system, the workers themselves form groups on a voluntary basis, and share out among themselves, either through the office of the firm, or by a subsequent re-division of the sums paid through the office, their collective earnings. This system usually operates among "fellowships" of skilled workers in a particular craft.

There are many different ways of sharing out the payment made under collective systems of "payment by results." The most usual method is that each worker included in the group shares in the payment in proportion to his time-rate and to the hours worked on the job. Sometimes, however, the pool, or any surplus over the time-rates of the workers concerned, is equally shared, and sometimes regard is paid only to one or other of the two factors mentioned above. In a few cases a specially large share in the pool is offered as an inducement to a leading worker, or to a few leading workers; but the system in this form approaches the system of "sub-contracting," which is universally objected to by the trade-union movement.

"Sub-contracting" is usually understood to mean a system under which one worker undertakes a piece of work which requires the co-ordinated labour of a group of workers. The sub-contractor receives the whole sum paid for the execution of the job, making, subject to any limitations that may be laid down in his contract, his own wage contract with the workers under him, and retaining any surplus for himself. Often a sub-contractor, himself paid "by results," remunerates the workers under him on a time-work basis. It is generally recognized that the sub-contracting system is open to grave abuse, and with the advance of trade-union organization it has been gradually eliminated from industry, surviving only in a comparatively small number of cases. The outstanding instances of it in the past have been the "butty" system in the mining industry, which still exists in one or two British coalfields, and the methods of payment which used to be common in the iron and steel industry.

Commission Payments.—Distinct from both the piece-work system and the various bonus systems is the system of "commission," which is applied in a certain number of occupations. Under this system the worker receives a commission on "takings" or on profits either as his sole mode of remuneration, or as an addition to a minimum wage or salary. This is the position of most workers in the insurance business, of many commercial travellers and of a number of managerial and semi-managerial workers in the distributive trades. It is also found occasionally in other occupations.

Recently, attention has been concentrated on the endeavours of employers to introduce systems of "payment by results" into industries in which time-work systems are at present largely in operation, *e.g.*, building, engineering, shipbuilding. Usually these attempts have met with strong trade-union opposition. It must not, however, be concluded that employers are universally favourable or trade unions universally opposed to "payment by results." The position differs from industry to industry. In the textile industries, and in a number of the less-organized occupations, "payment by results" has been introduced and maintained not merely with the acquiescence, but often at the instance of the workers, who have seen in it an opportunity of securing higher earnings. At the other extreme, the worst forms of "sweating" in industry are very frequently found in conjunction with the time-work system of payment. In the past, trade unions have usually favoured, or at least not opposed, "payment by results" in those industries in which a standard of measurement can be found of such a character as to insure that, under normal conditions, a given amount of effort expended will result in a given amount of output, and therefore of earnings under the system.

On the other hand, the unions have generally been opposed to the introduction of "payment by results" in those industries in which no such standard can be laid down, as well as in other cases where it has been contended that "speeding up," consequent upon the inducements offered for higher output, would have the effect of impairing the quality of the work done (*e.g.*, building). Where "payment by results" has been accepted in industries of this latter type, a struggle has often followed over the question whether the right of the organized workers to bargain collectively over the fixing of piece-work prices or "basis times" shall or shall not be recognized. This struggle is still in progress over a wide range of industries; but the fixing of piece-work prices and "basis times" is still normally done by the employer or his representative, subject only to protests by the workers.

It should be noted that the growth of "scientific management" gave a great impetus to the introduction of "payment by results," and also considerably affected the methods adopted by employers in fixing piece-work prices or "basis times." In the great majority of factories, other than textile factories, in which systems of payment by results are in operation piece-work prices are still fixed in a very haphazard fashion, and modified from time to time in accordance with actual experience of their working. But, as one feature or another of "scientific management" has been introduced, experiments have been made with the object of introducing greater scientific accuracy into the fixing of prices and times—mainly "time study" and "motion study." "Time study" means an attempt, by actual observation of the doing of a particular job, to fix the time which ought to be taken by a normal worker. "Motion study" means observation with a view to eliminating all surplus motions, and to laying down in detail the method by which it can be done in the least possible time. The former method has been adopted by a number of firms in Great Britain, the latter in comparatively few cases. Both are largely in operation in America. "Time study" and "motion study" are usually resented by the workers employed, and are regarded as devices adopted by the employer with a view of "speeding up." It is also contended that both, and especially "motion study," result in making work more monotonous, in taking such variety of initiative as remains to the worker under modern factory conditions out of his hands, and in concentrating control in the hands of a small body of expert rate-fixers.

Of late years, attention has been centred upon the "Bedaux" system. The "Bedaux" engineers often propose changes in the machinery and methods of work, designed to raise output. But chiefly they devise and introduce methods of wage-payment, based largely on the premium bonus system—*i.e.*, on fixing a standard time to be taken over each job, and on offering wage-inducements to complete it in a shorter time. There have been many struggles in particular establishments into which the "Bedaux" system has been introduced. The workers affected by it have alleged that it leads to remorseless speeding-up, whereas employers maintain that the work is often made less irksome by the new methods. The Trades Union Congress published in 1933 the results of an enquiry into the system. The conclusion was, broadly, that everything depended upon the spirit in which it was administered, but that it was capable of being highly unfavourable to the workers unless adequate safeguards were provided for the observance of Trade Union conditions, and for collective bargaining over difficulties as they arose.

Where piece-work or bonus systems are in operation, friction is very likely to arise because there is a constant suspicion on the part of the workers that the employer is endeavouring to "cut" piece-work prices and to "speed up" the slower workers to the pace of the more rapid. Employers, on the other hand, allege that workers deliberately slow down with a view to forcing up piece-work prices. It is difficult to estimate the relative productivity of workers under time-work systems and under systems of "payment by results"; but it may be taken as certain that no system of "payment by results" which has yet been devised has succeeded in eliminating friction or the possibility of "price-cutting" on the one hand and "restriction of output" with a view to securing higher prices on the other. Perhaps the nearest approach to the elimination of these two factors is in the British cotton industry; but the comparatively smooth working of the piece-

work system in this case is mainly due to the highly standardized character both of the product and of the machinery. The cotton "price-list" system cannot readily be adapted for use in the majority of industries.

BIBLIOGRAPHY.—There are only two books giving a general survey of the various wage systems. These are (1) *Methods of Industrial Remuneration* by D. F. Schoss (Williams and Norgate), which was written a good many years ago, and is now in many respects out of date, and (2) *The Payment of Wages* by G. D. H. Cole (new edition, 1928) which is the most recent study. *See* also, for conditions in England, *Industrial Democracy* by Sidney and Beatrice Webb, and *The Works Manager To-day* by Sidney Webb. There is an immense literature dealing with scientific management in relation to "payment by results." Reference may be made especially to *Scientific Management and Labour* by R. F. Hoxie; *Scientific Management* by C. B. Thomson; *Scientific Management* by F. W. Taylor; *Scientific Management* by H. B. Drury; *Efficiency* and other works by Harrington Emerson; *Work, Wages and Profit* by H. L. Gantt and *Cooperative Production* by H. Atkinson. For premium bonus systems, see *The Premium System of Paying Wages,* published by *The Engineer; The Rowan Premium Bonus System* by W. Rowan Thompson; *The Premium Bonus System, Report of an Enquiry,* and *Bedaux: The T.U.C. Examines the Bedaux System,* both published by the British Trades Union Congress. A great deal of information will also be found in the following reports issued by the Board of Trade, "Report on Collective Agreements" (1910) and "Report on Standard Piece-Rates." Unfortunately, however, no new or revised editions of these have been issued. *See* also the *Final Report of the Commission on Industrial Relations,* published by the U.S. Government in 1915, and the *Survey of Industrial Relations,* published by the British Committee on Industry and Trade in 1926. (G. D. H. C.)

WAGGA WAGGA: *see* RIVERINA.

WAGNER, RUDOLPH (1805–1864), German anatomist and physiologist, was born on June 30, 1805, at Bayreuth, where his father was a professor in the gymnasium. He began the study of medicine at Erlangen in 1822, and finished his curriculum in 1826 at Würzburg, where he had attached himself mostly to J. L. Schönlein in medicine and to K. F. Heusinger in comparative anatomy. Aided by a public *stipendium,* he spent a year or more studying in the Jardin des Plantes, under the friendly eye of Cuvier, and in zoological research at Cagliari and other places on the Mediterranean. He became prosector at Erlangen and was (1832–40) professor of zoology and comparative anatomy there. In 1840 he succeeded J. F. Blumenbach at Göttingen, where he remained till his death (May 13, 1864).

Wagner's activity was enormous, his hard work being done at Erlangen while his health was good. In 1835 he communicated to the Munich academy of sciences his researches on the physiology of generation and development, including the famous discovery of the germinal vesicle of the human ovum. These were republished under the title *Prodromus historiae generationis hominis atque animalium* (Leipzig, 1836). In 1843, after his removal to Göttingen, he began his great *Handwörterbuch der Physiologie, mit Rücksicht auf physiologische Pathologie,* and brought out the fifth (supplementary) volume in 1852; the only contributions of his own in it were on the sympathetic nerve, nerve-ganglia and nerve-endings, and he modestly disclaimed all merit except as being the organizer. While resident in Italy for his health from 1845 to 1847, he occupied himself with researches on the electrical organ of the torpedo and on nervous organization generally; these he published in 1853–1854 (*Neurologische Untersuchungen,* Göttingen). Controversy arose.

He entered the lists boldly against the materialism of "Stoff und Kraft," and avowed himself a Christian believer, whereupon he lost the countenance of a number of his old friends and pupils, and was unfeelingly told that he was suffering from an "atrophy of the brain." In his later years, Wagner became anthropologist and archaeologist. His last writings were memoirs on the convolutions of the human brain, on the weight of brains, and on the brains of idiots (1860–1862).

See memoir by his eldest son in the *Göttinger gelehrte Anzeigen,* "Nachrichten" for 1864. Wagner's works include *Beiträge zur vergleichenden Physiologie des Blutes* (Leipzig, 1832–33); *Lehrbuch der vergleichenden Anatomie* (Leipzig, 1834–35); *Grundriss der Encyklopädie und Methodologie der medicinischen Wissenschaften* (Erlangen, 1838).

WAGNER, WILHELM RICHARD (1813–1883), German dramatic composer, poet and essay-writer, was born at Leipzig on May 22, 1813. In 1822 he was sent to the Kreuzschule at Dresden, and in 1828 he was removed to the Nicolaischule at Leipzig. His first music master was Gottlieb Müller, who thought him self-willed and eccentric; and his first production as a composer was an overture, performed at the Leipzig theatre in 1830. In that year he matriculated at the university, and took lessons in composition from Theodor Weinlig, cantor at the Thomasschule. A symphony was produced at the Gewandhaus concerts in 1833, and in the following year he was appointed conductor of the opera at Magdeburg. He had composed an opera called *Die Feen* adapted by himself from Gozzi's *La Donna Serpente,* and another, *Das Liebesverbot,* founded on Shakespeare's *Measure for Measure,* but only *Das Liebesverbot* obtained a single performance in 1836.

In that year Wagner married Wilhelmina Planer, an actress at the theatre at Königsberg. He had accepted an engagement there as conductor; but, the lessee becoming bankrupt, the scheme was abandoned in favour of a better appointment at Riga. Accepting this, he remained actively employed until 1839, when he made his first visit to Paris, taking with him an unfinished opera based on Bulwer Lytton's *Rienzi,* and, like his earlier attempts, on his own libretto. The venture proved most unfortunate. Wagner failed to gain a footing, and *Rienzi,* destined for the Grand Opera, was rejected. He completed it, however, and in 1842 it was produced at Dresden, where, with Madame Schroeder Devrient and Herr Tichatschek in the principal parts, it achieved a success which went far to make him famous.

Der fliegende Holländer, for which he designed a libretto quite independent of any other treatment of the legend was warmly received at Dresden on Jan. 2, 1843; but its success was by no means equal to that of *Rienzi.* Spohr, however, promptly discovered its merits, and produced it at Cassel some months later.

On Feb. 2, 1843, Wagner was formally installed as Hofkapellmeister at the Dresden theatre, and he soon set to work on a new opera. He chose the legend of Tannhäuser, collecting his materials from the ancient *Tannhäuser-Lied,* the *Volksbuch,* Tieck's poetical *Erzählung,* Hoffmann's story of *Der Sängerkrieg,* and the mediaeval poem on *Der Wartburgkrieg.* This last-named legend introduces the incidental poem of "Loherangrin," and so led Wagner to the study of Wolfram von Eschenbach's *Parzival* and *Titurel,* with great results later on. On Oct. 19, 1845, he produced his *Tannhäuser,* with Schroeder Devrient, Johanna Wagner, his niece, Tichatschek and Mitterwurzer in the principal parts. Notwithstanding this powerful cast, the success of the new work was not brilliant, for it carried still further the principles embodied in *Der fliegende Holländer,* and the time was not ripe for them. On the flight of the king, Wagner fled to Paris and thence to Zürich, where he lived in almost unbroken retirement until the autumn of 1859. During this period most of his prose works—including *Oper und Drama, Über das Dirigieren, Das Judentum in der Musik*—were given to the world.

The mediaeval studies which Wagner had begun for his work at the libretto of *Tannhäuser* bore rich fruit in his next opera *Lohengrin,* in which he also developed his principles on a larger scale and with a riper technique than hitherto.

Lohengrin was, in fact, produced at Weimar under Liszt's direction on Aug. 28, 1850. It was a severe trial to Wagner not to hear his own work, but he knew that it was in good hands, and he responded to Liszt's appeal for a new creation by studying the *Nibelungenlied* and gradually shaping it into a gigantic tetralogy. At this time also he first began to lay out the plan of *Tristan und Isolde,* and to think over the possibilities of *Parsifal.*

During his exile Wagner matured his plans and perfected his musical style; but it was not until some considerable time after his return that any of the works he then meditated were placed upon the stage. In 1855 he accepted an invitation to London, where he conducted the concerts of the Philharmonic Society with great success. In 1857 he completed the libretto of *Tristan und Isolde* at Venice, adopting the Celtic legend modified by Gottfried of Strassburg's mediaeval version. In 1859, *Tannhäuser* was accepted at the Grand Opera, Paris. Great preparations were made; it was rehearsed 164 times, 14 times with the full orchestra; and the scenery and dresses were placed entirely under the com-

poser's direction. More than £8,000 was expended upon the venture; and the work was performed for the first time in the French language and with the new Venusberg music on March 13, 1861. But, for political reasons, a powerful clique was determined to suppress Wagner. A scandalous riot was inaugurated by the members of the Parisian Jockey Club, who interrupted the performance with howls and dog-whistles; and after the third representation the opera was withdrawn. Wagner was broken-hearted, but the Princess Metternich continued to befriend him, and by 1861 she had obtained a pardon for his political offences, with permission to settle in any part of Germany except Saxony. Even this restriction was removed in 1862.

Wagner now settled for a time in Vienna, where *Tristan und Isolde* was accepted, but abandoned after fifty-seven rehearsals, through the incompetence of the tenor. *Lohengrin* was, however, produced on May 15, 1861, when Wagner heard it for the first time. His circumstances were now extremely straitened; it was the darkness before dawn. In 1863 he published the libretto of *Der Ring des Nibelungen.* King Ludwig of Bavaria was much struck with it, and in 1864 invited Wagner, who was then at Stuttgart, to come to Munich and finish his work there. Wagner accepted with rapture. The king gave him an annual grant of 1,200 gulden (£120), considerably enlarging it before the end of the year, and placing a comfortable house in the outskirts of the city at his disposal. The master expressed his gratitude in a "Huldigungsmarsch."

On June 10, 1865, at Munich, *Tristan und Isolde* was produced for the first time, with Herr and Frau Schnorr in the principal parts. *Die Meistersinger von Nürnberg,* first sketched in 1845, was completed in 1867 and first performed at Munich under the direction of Hans von Bülow on June 21, 1868. *Das Rheingold* and *Die Walküre* were performed, the one on Sept. 22, 1869, and the other on June 26, 1870. The scheme for building a new theatre at Munich having been abandoned, there was no opera-house in Germany fit for so colossal a work. A project was therefore started for the erection of a suitable building at Bayreuth (*q.v.*). Wagner laid the first stone of this in 1872, and the edifice was completed, after almost insuperable difficulties, in 1876.

After this Wagner resided permanently at Bayreuth, in a house named Wahnfried, in the garden of which he built his tomb. His first wife, from whom he had parted since 1861, died in 1866; and in 1870 he was united to Liszt's daughter Cosima, who had previously been the wife of von Bülow. Meantime *Der Ring des Nibelungen* was rapidly approaching completion, and on Aug. 13, 1876, the introductory portion, *Das Rheingold,* was performed at Bayreuth for the first time as part of the great whole, followed on the 14th by *Die Walküre,* on the 16th by *Siegfried* and on the 17th by *Götterdämmerung.*

Wagner's next and last work was *Parsifal,* based upon the legend of the Holy Grail, as set forth, not in the legend of the *Morte d'Arthur,* but in the versions of Chrestien de Troyes and Wolfram von Eschenbach and other less-known works. The libretto was complete before his visit to London in 1877. The music was begun in the following year, and completed at Palermo on Jan. 13, 1882. The first sixteen performances took place at Bayreuth, in July and August 1882, under Wagner's own directing, and fully realized all expectations.

Unhappily the exertion of directing so many consecutive performances seems to have been too much for the veteran master's strength, for towards the close of 1882 his health began to decline rapidly. He spent the autumn at Venice, and was well enough on Christmas Eve to conduct his early symphony (composed in 1833) at a private performance given at the Liceo Marcello. But late in the afternoon of Feb. 13, 1883, his friends were shocked by his sudden death from heart-failure.

Wagner was buried at Wahnfried in the tomb he had himself prepared, on Feb. 18; and a few days afterwards King Ludwig rode to Bayreuth alone, and at dead of night, to pay his last tribute to the master of his world of dreams.

In the articles on MUSIC and OPERA, Wagner's task in music-drama is described, and it remains here to discuss his progress in the operas themselves. This progress has perhaps no parallel in any art, and certainly none in music, for even Beethoven's progress was purely an increase in range and power. Wagner's earlier works have too long been treated as if they represented the pure and healthy childhood of his later ideal; as if *Lohengrin* stood to *Parsifal* as Haydn, Mozart and early Beethoven stand to Beethoven's last quartets. But Wagner never thus represented the childhood of an ideal, though he attained the manhood of the most comprehensive ideal yet known in art. To change the metaphor—the ideal was always in sight, and Wagner never swerved from his path towards it; but that path began in a blaze of garish false lights, and it had become very tortuous before the light of day prevailed. Beethoven was trained in the greatest and most advanced musical tradition of his time. In spite of all his impatience, his progress was no struggle from out of a squalid environment; on the contrary, one of his latest discoveries was the greatness of his master Haydn. Now Wagner's excellent teacher Weinlig did certainly, as Wagner himself testifies, teach him more of good music than Beethoven, Haydn and Mozart could have seen in their youth; for he showed him Beethoven. But this would not help Wagner to feel that contemporary music was really a great art; indeed it could only show him that he was growing up in a pseudo-classical time, in which the approval of persons of "good taste" was seldom directed to things of vital promise. Again, he began with far greater facility in literature than in music, if only because a play can be copied ten times faster than a full score. Wagner was always an omnivorous reader, and books were then, as now, both cheaper than music and easier to read. Moreover, the higher problems of rhythmic movement in the classical sonata forms are far beyond the scope of academic teaching, which is compelled to be contented with a practical plausibility of musical design; and the instrumental music which was considered the highest style of art in 1830 was as far beyond Wagner's early command of such plausibility as it was obviously already becoming a mere academic game. Lastly, the rules of that game were useless on the stage, and Wagner soon found in Meyerbeer a master of grand opera who was dazzling the world by means which merely disgusted the more serious academic musicians of the day.

In *Rienzi* Wagner would already have been Meyerbeer's rival, but that his sincerity, and his initial lack of that musical *savoir faire* which is prior to the individual handling of ideas, put him at a disadvantage. The step from *Rienzi* to *Der fliegende Holländer* is without parallel in the history of music, and would be inexplicable if *Rienzi* contained nothing good and if *Der fliegende Holländer* did not contain many reminiscences of the decline of Italian opera; but it is noticeable that in this case the lapses into vulgar music have a distinct dramatic value.

Spohr's appreciation of *Der fliegende Holländer* is a remarkable point in musical history; and his criticism that Wagner's style (in *Tannhäuser*) "lacked rounded periods" shows the best effect of that style on a well-disposed contemporary mind. Of course, from Wagner's mature point of view his early style is far too much cut up by periods and full closes; and its prophetic traits are so incomparably more striking than its resemblance to any earlier art that we often feel that only the full closes stand between it and the true Wagner. With all its defects, *Der fliegende Holländer* is the most masterly and the least unequal of Wagner's early works. As drama it stood immeasurably above any opera since Cherubini's *Medée.* As a complete fusion between dramatic and musical movement, its very crudities point to its immense advance towards the solution of the problem, propounded chaotically at the beginning of the 17th century by Monteverde, and solved in a simple form by Gluck. And as the twofold musical and dramatic achievement of one mind, it already places Wagner beyond parallel in the history of art.

Tannhäuser is on a grander scale, but its musical execution is disappointing. The weakest passages in *Der fliegende Holländer* are not so helpless as the original recitatives of Venus in the first act; or Tannhäuser's song, which was too far involved in the whole scheme to be ousted by the mature "New Venusberg music" with which Wagner fifteen years later got rid both of the end of the overture and what he called his "Palais-Royal" Venus.

It is really very difficult to understand Schumann's impression that the musical technique of *Tannhäuser* shows a remarkable improvement. Not until the third act does the great Wagner arbitrate in the struggle between amateurishness and theatricality in the music, though at all points his epoch-making stagecraft asserts itself with a force that tempts us to treat the whole work as if it were on the Wagnerian plane of Tannhäuser's account of his pilgrimage in the third act.

After even the finest things in *Tannhäuser,* the *Vorspiel* to *Lohengrin* comes as a revelation, with its quiet solemnity and breadth of design, its ethereal purity of tone-colour, and its complete emancipation from earlier operatic forms. The suspense and climax in the first act is so intense, and the whole drama is so well designed, that we must have a very vivid idea of the later Wagner before we can see how far the quality of musical thought still falls short of his ideals. The elaborate choral writing sometimes rises to almost Hellenic regions of dramatic art; and there is no crudeness in the passages that carry on the story quietly in reaction from the climaxes—a test far too severe for *Tannhäuser* and rather severe for even the mature works of Gluck and Weber.

The crowning complication in the effect of *Der fliegende Holländer, Tannhäuser* and *Lohengrin* on the musical thought of the 19th century was that the unprecedented fusion of their musical with their dramatic contents revealed some of the meaning of serious music to ears that had been deaf to the classics. Wagnerism was henceforth proclaimed out of the mouths of babes and sucklings; learned musicians felt that it had an unfair advantage; and by the time Wagner's popularity began to thrive as a persecuted heresy he had left it in the lurch.

Wagner had hardly finished the score of *Lohengrin* before he was at work upon the poem of *Der Ring des Nibelungen.* And with this he suddenly became a mature artist. Wagner's choice of subjects had from the outset shown an imagination far above that of any earlier librettist; yet he had begun with stories which could attract ordinary minds, as he dismally realized when the libretto of *Der fliegende Holländer* so pleased the Parisian wire-pullers that it was promptly set to music by one of their friends. But with *Der Ring des Nibelungen* Wagner devoted himself to a story which any ordinary dramatist would find as unwieldy as, for instance, most of Shakespeare's subjects; a story in which ordinary canons of taste and probability were violated as they are in real life and in great art. Wagner's first inspiration was for an opera (*Siegfrieds Tod,* projected in 1848) on the death of Germany's mythical hero; but he found that the story needed a preliminary drama to convey its antecedents. This preliminary drama soon proved to need another to explain it, which again finally needed a short introductory drama. Thus the plan of the *Ring* was sketched in reverse order; and it has been remarked that *Götterdämmerung* shows traces of the fact that Wagner had begun his scheme in the days when French grand opera, with its ballets and pageantry, still influenced him. There is little doubt that some redundant narratives in the *Ring* were of earlier conception than the four complete dramas, and that their survival is due partly to Wagner's natural affection for work on which he had spent pains, and partly to a dim notion that (like Browning's method in *The Ring and the Book*) they might serve to reveal the story afresh in the light of each character. Be this as it may, we may confidently date the purification of Wagner's music at the moment when he set to work on a story which carried him finally away from that world of stereotyped operatic passions into which he had already breathed so much disturbing life.

In *Lohengrin* we take leave of the early music that obscured Wagner's ideals, and in the *Ring* we come to the music which transcends all other aspects of Wagnerism. Had Wagner been a man of more urbane literary intellect he might have been less ambitious of expressing a world-philosophy in music-drama; and it is just conceivable that the result might have been a less intermittent dramatic movement in his later works, and a balance of ethical ideas at once more subtle and more orthodox.

If we wish to know what Wagner means, we must fight our way through his drama to his music; and we must not expect to find that each phrase in the mouth of the actor corresponds word for note with the music. That sort of correspondence Wagner leaves to his imitators; and his views on "Leit-motif-hunting," as expressed in his prose writings and conversation, are contemptuously tolerant. We shall indeed find that his orchestra interprets the dramatic situations which his poetry roughly outlines. But we shall also find that, even if we could conceive the poetry to be a perfect expression of all that can be given in words and actions, the orchestra will express something greater; it will not run parallel with the poetry; the *Leitmotif* system will not be a collection of labels; the musical expression of singer and orchestra will not be a mere heightened resource of dramatic declamation. All that kind of pre-established harmony Wagner left behind him the moment he deserted the heroes and villains of romantic opera for the visionary and true tragedy of gods and demi-gods, giants and gnomes, with beauty, nobility and love in the wrong, and the forces of destruction and hate set free by blind justice.

In Wagner's harmonic style we encounter the entire problem of modern musical texture. Wagner effected vast changes in almost every branch of his all-embracing art, from theatre-building and stage-lighting to the musical declamation of words. Most of his reforms have since been intelligently carried out as normal principles in more arts than one; but, shocking as the statement may seem to 20th-century orthodoxy, Wagnerian harmony is a universe as yet unexplored, except by the few composers who are so independent of its bewildering effect on the generation that grew up with it, that they can use Wagner's resources as discreetly as he used them himself. The last two examples at the end of the article on HARMONY show almost all that is new in Wagner's harmonic principles. The peculiar art therein is that while the discords owe their intelligibility and softness to the smooth melodic lines by which in "resolving" they prove themselves but transient rainbow-hues on or below the surface, they owe their strangeness to the intense vividness with which at the moment of impact they suggest a mysteriously remote foreign key. Wagner's orthodox contemporaries regarded such mixtures of key as sheer nonsense; and it would seem that the rank and file of his imitators agree with that view, since they either plagiarize Wagner's actual progressions or else produce such mixtures with no vividness of key-colour and little attempt to follow those melodic trains of thought by which Wagner makes sense of them. There is far more of truly Wagnerian harmony to be found before his time than since. It was so early recognized as characteristic of Chopin that a magnificent example may be seen at the end of Schumann's little tone-portrait of him in the *Carnaval:* a very advanced Wagnerian passage on another principle constitutes the bulk of the development in the first movement of Beethoven's sonata *Les Adieux;* while even in the "Golden Age" of music, and within the limits of pure diatonic concord, the unexpectedness of many of Palestrina's chords is hardly less Wagnerian than the perfect smoothness of the melodic lines which combine to produce them.

Wagnerian harmony is, then, neither a side-issue nor a progress *per saltum,* but a leading current in the stream of musical evolution. That stream is sure sooner or later to carry with it every reality that has been reached by side-issues and leaps; and of such things we have important cases in the works of Strauss and Debussy. Strauss makes a steadily increasing use of avowedly irrational discords, in order to produce an emotionally apt physical sensation. Debussy has this in common with Strauss, that he too regards harmonies as pure physical sensations; but he differs from Strauss firstly in systematically refusing to regard them as anything else, and secondly in his extreme sensibility to harshness. We have seen (in the articles on HARMONY and MUSIC) how harmonic music originated in just this habit of regarding combinations of sound as mere sensations, and how for centuries the habit opposed itself to the intellectual principles of contrapuntal harmony. These intellectual principles are, of course, not without their own ground in physical sensation; but it is evident that Debussy appeals beyond them to a more

primitive instinct; and on it he bases an almost perfectly coherent system of which the laws are, like those of 12th-century music, precisely the opposite of those of classical harmony. The only illogical point in his system is that the beauty of his dreamlike chords depends not only on his artful choice of a timbre that minimizes their harshness, but also on the fact that they enter the ear with the meaning they have acquired through centuries of harmonic evolution on classical lines. There is a special pleasure in the subsidence of that meaning beneath a soothing sensation; but a system based thereon cannot be universal. Its phenomena are, however, perfectly real, and can be observed wherever artistic conditions make the tone of a mass of harmony more important than the interior threads of its texture. This is of constant occurrence in classical pianoforte music, in which thick chords are subjected to polyphonic laws only in their top and bottom notes, while the inner notes make a solid mass of sound in which numerous consecutive fifths and octaves are not only harmless but essential to the balance of tone. In Debussy's art the top and bottom are also involved in the antipolyphonic laws of such masses of sound, thus making these laws paramount.

LIST OF WAGNER'S WORKS

The following are Wagner's operas and music-dramas, apart from the unpublished *Die Hochzeit* (three numbers only), *Die Feen*, and *Das Liebesverbot* (*Das Liebesverbot* was disinterred in 1910).

1. *Rienzi, der letzte der Tribunen: grosse tragische Oper;* 5 acts (1838–40).
2. *Der fliegende Holländer: romantische Oper;* 1 act, afterwards cut into 3 (1841).
3. *Tannhäuser und der Sängerkrieg auf Wartburg: romantische Oper;* 3 acts (libretto, 1843; music, 1844–45; new Venusberg music, 1860–61).
4. *Lohengrin: romantische Oper;* 3 acts (libretto, 1845; music, 1846–48). This is the last work Wagner calls by the title of Opera.
5. *Das Rheingold,* prologue in 4 scenes to *Der Ring des Nibelungen; ein Bühnenfestspiel* (poem written last of the series, which was begun in 1848 and finished in 1851–52; music, 1853–54).
6. *Die Walküre: der Ring des Nibelungen, erster Tag;* 3 acts (score finished, 1856).
7. *Tristan und Isolde;* 3 acts (poem written in 1857; music, 1857–1859).
8. *Siegfried: der Ring des Nibelungen, zweiter Tag;* 3 acts, the first two nearly finished before *Tristan,* the rest between 1865 and 1869.
9. *Die Meistersinger von Nürnberg;* 3 acts (sketch of play, 1845; poem, 1861–62; music, 1862–67).
10. *Götterdämmerung: der Ring des Nibelungen, dritter Tag;* introduction and 3 acts (*Siegfried's Tod* already sketched dramatically in 1848; music, 1870–74).
11. *Parsifal: ein Bühnenweihfestspiel* (a solemn stage festival play), 3 acts (poem, 1876–77; music, 1877–82, *Charfreitagszauber* already sketched in 1857).

As regards other compositions, the early unpublished works include a symphony, a cantata, some incidental music to a pantomime, and several overtures, four of which have recently been discovered and produced. The important small published works are *Eine Faust Overture* (1839–40; rewritten, 1855); the *Siegfried Idylle* (an exquisite serenade for small orchestra on themes from the finale of *Siegfried,* written as a surprise for Frau Wagner in 1870); the *Kaisermarsch* (1871), the *Huldigungsmarsch* (1864) for military band (the scoring of the concert-version finished by Raff); *Fünf Gedichte* (1862), a set of songs containing two studies for *Tristan;* and the early quasi-oratorio scene for male-voice chorus and full orchestra, *Das Liebesmahl der Apostel* (1843). Wagner's retouching of Gluck's *Iphigenie en Aulide* and his edition of Palestrina's *Stabat Mater* demand mention as important services to music, by no means to be classified (as in some catalogues) with the hack-work with which he kept off starvation in Paris.

The collected literary works of Wagner in German fill ten volumes, and include political speeches, sketches for dramas that did not become operas, autobiographical chapters, aesthetic musical treatises and polemics of vitriolic violence. Their importance will never be comparable to that of his music; but, just as the reaction against Ruskin's ascendancy as an art-critic has coincided with an increased respect for his ethical and sociological thought, so the rebellious forces that are compelling Wagnerism to grant music a constitution coincide with a growing admiration of his general mental powers. The prose works have been translated into English by W. A. Ellis (8 vols., 1892–99). The translation by F. Jameson (1897) of the text of the *Ring* (first published in the pocket edition of the full scores) is the most wonderful *tour de force* yet achieved in its line. A careful reading of the score to this English text reveals not a single false emphasis or loss of rhetorical point in the fitting of words to notes, nor a single extra note or halt in the music; and wherever the language seems stilted or absurd the original will be found to be at least equally so, while the spirit of Wagner's poetry is faithfully reflected. Such work deserves more recognition than it is ever likely to get. Rapidly as the standard of musical translations was improving before this work appeared, no one could have foreseen what has now been abundantly verified, that the *Ring* can be performed in English without any appreciable loss to Wagner's art. The same translator has also published a close, purely literary version.

BIBLIOGRAPHY.—The Wagner literature is too enormous to be dealt with here. The standard biography is that of Glasenapp (6 vols., of which five appeared between 1894 and 1909). Of readable English books we may cite Ernest Newman, *A Study of Wagner* (1899); H. E. Krehbiel, *Studies in the Wagnerian Drama* (1891); Jessie L. Weston, *Legends of the Wagner Dramas* (1906). *The Perfect Wagnerite,* by G. Bernard Shaw, though concerned mainly with the social philosophy of the *Ring,* gives a luminous account of Wagner's mastery of musical movement. The highest English authority on Wagner is his friend Dannreuther, whose article in *Grove's Dictionary* is classical. A new study of Wagner's participation in the Dresden affair is set forth by Woldemar Lippert, *Richard Wagner's Verbannung und Ruckkehr, 1849–1862* (1929).

See also ARIA, HARMONY, INSTRUMENTATION, MUSIC, OPERA, and OVERTURE. (D. F. T.; X.)

WAGON or **WAGGON,** a large four-wheeled vehicle for the carriage of heavy loads, and drawn by two or more horses. This is the general English use of the term, where it is more particularly confined to the large vehicles employed in the carrying of agricultural produce. It is also used of the uncovered heavy rolling stock for goods on railways. (*See* RAILWAYS.) In America the term is applied also to lighter vehicles, such as are used for express delivery, police work, etc., and to various forms of four-wheeled vehicles used for driving, to which the English term "cart" would be given.

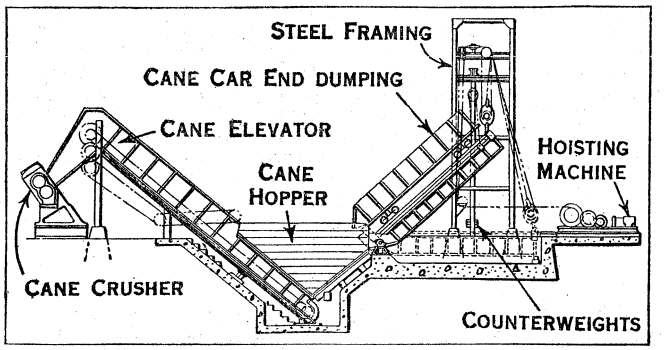
WAGONS-LITS, COMPAGNIE INTERNATIONALE DES. The International Sleeping Car company was started in 1876 by M. Georges Nagelmackers who purchased the patent of the "Mann Railway Sleeping Car Carriage" from America to provide sleeping car accommodation in Europe. It was only between 1883 and 1896 that contracts with the main railways in France were definitely concluded and the company put on a firm basis. This period saw the inauguration of the Orient express, the Sud express, the Mediterranean express, and, in 1885, the extension of the Orient and Ostend-Vienna expresses to Constantinople. In 1896, the inception of the Nord express services took place, linking Paris and St. Petersburg, and in 1897, the Nord-Brenner express, uniting Berlin, Milan and Naples. In 1898, complete sleeping car trains, together with restaurant wagons, were run throughout Europe, and the Trans-Siberian service from Moscow to Irkutsk, and finally the service from Vladivostock to the Pacific first functioned. In 1906, the Simplon Pass being opened, the company at once started the Simplon express, uniting Paris, Milan and Venice. The World War in 1914 disorganised the services, and it was not until 1920 that all these were running again in full and the famous train, Calais-Mediterranean, known as the "Blue Train," was first commissioned. From 1923 onwards, great strides were made, especially in the Oberland and Engadine expresses, also the Pyrénées Côte-d'Argent. In 1926 the company included Pullman trains similar to those run by the Pullman company in England, on such trains as the Sud express between Paris and Madrid, the "Golden Arrow" between Paris and London, the Edelweiss express, Antwerp-Basle, and the "North Star," Paris-Amsterdam. The two last mentioned trains have both first and second class Pullmans.

In 1928, the company acquired the capital of Messrs. Thomas Cook and Son, thereby extending their amenities to all classes of travellers and tourists. The Sleeping Car company, as it now exists, can safely be said to be the most extensive travel bureau in the world, having numerous agencies in all corners of the globe. (H. M. S.)

WAGON TIPPLERS. The unloading of mineral wagons by manual labour is a tedious and expensive operation which has an adverse economic effect on all industrial undertakings which employ coal as fuel, and minerals generally as raw product. Ordinary standard rolling stock for the conveyance of minerals is provided with side doors through which a relatively small proportion of the material falls out by gravity, when they are opened,

while the remainder has to be raked and shovelled out. In this way a man can unload at the rate of four to five tons per hour, and the actual cost of unloading one ton might be taken as 20% to 25% of his hourly wage.

A better method is to use hopper wagons, or, as they are sometimes called, "self-unloaders." As their name implies, they are wagons hoppered at the base in four directions, the inverted cone



BY COURTESY OF THE LINK BELT CO.

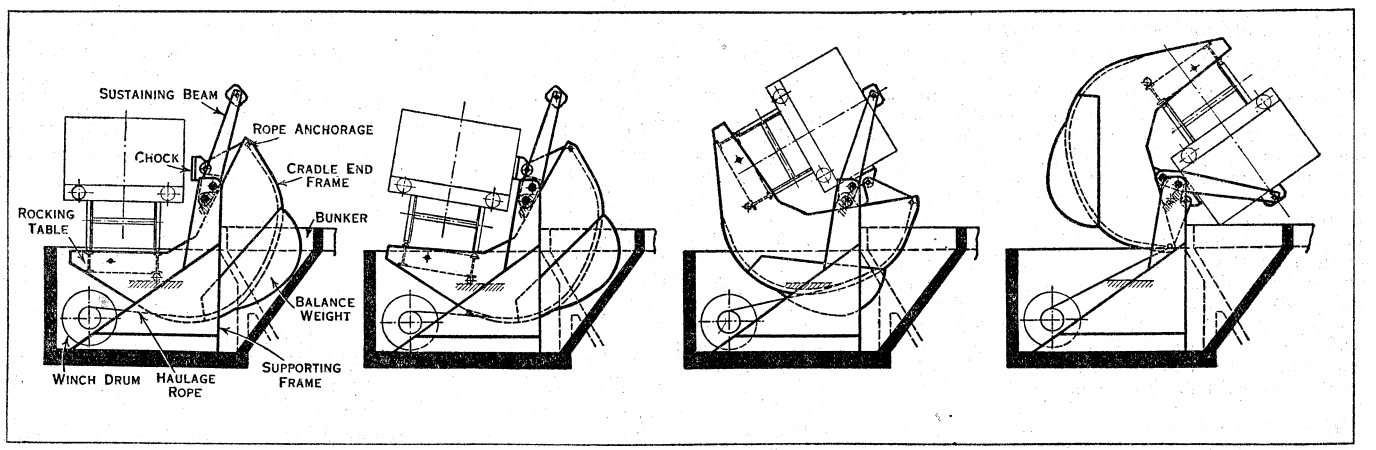
FIG. 1.—END TIPPLER BY WHICH THE WAGONS ARE LIFTED FROM THE REAR BY HOISTING MACHINERY

outlet being closed by a sliding gate, on the opening of which the whole of the contents runs out by gravity. The drawback to this otherwise excellent device is that such wagons are useless for other freight and have therefore to be returned idle, so that it would not pay railway companies to provide them.

Private owners, however, find these wagons very successful, particularly in cases where the haulage distance is not great and where they can be in continuous use between, say, a quarry or mine and a factory. Such users are, however, few and far between.

End Tipplers.—By the combined efforts of railway companies and industrials the unloading of railway wagons was mechanized just before the end of the last century. The railway companies provided thousands of mineral wagons with hinged end doors in place of side doors, and the industrials provided pits beneath the rails, at the points where they wished to unload, for receiving the coal and accommodating the mechanical lifting devices which engage, by means of "crutches," with the rear axles of the trucks, lifting the rear ends sufficiently high for the material to flow out through the end doors, while the other pair of wheels remains on the rails. The lifting device consists either of a hydraulic ram, a screw-operated ram or one with a tooth-rack and pinion. An alternative lifting method is a hoisting gear in an overhead position, which, with the aid of a wire rope, raises the rear end of the wagon. In fig. 1 such an arrangement is shown for unloading sugar-cane. End tipplers with rams, as described, though in many ways satisfactory, have one inherent drawback, viz., that the wagons cannot be raised beyond an angle of 40° to 45°, since the buffers foul the rails at a steeper incline and small, particularly washed, coal will not slide out without manual assistance. In order to get a clean discharge for all materials an angle of 45° to 55° is necessary, and this may be obtained by cutting out a section of the rail track a few feet longer than the largest wagon and developing this into a hinged platform, to the end of which the lifting ram is swivelled. The wagon to be unloaded is secured to this platform in such a position that an increase of tilt is possible without the buffers touching the rails. As an alternative the rails are kept intact and an independent hinged lifting frame is used. With all end tipplers it is imperative that the trucks be delivered on the siding with their end doors foremost, otherwise some shunting or the use of a turntable becomes necessary. In some cases it may be undesirable, on account of the ground water, to make deep excavations for the accommodation of the lifting ram, its motor and speed reduction gear. This difficulty also has been overcome by tipplers which can be tipped either way, of which there is quite a number of types. Generally speaking, end trucks require from four to five minutes to tip.

Rotary Side Tipplers.—These are recommended for larger capacities. They are all similar in external appearance but quite a number of types have been built. In order to reduce manual labour to a minimum it is essential that the wagons should be held by automatic means during the tippling process, and that these should be capable of adaptation to the widely different types of mineral wagons. For instance, 20-ton capacity, high-sided wagons, and those of eight tons, low-sided, have to be handled by the same means. Moreover, the device must accomplish this without causing any damage to the wagons. A great variety of such sustaining devices form integral parts of the standard tipplers. When several trucks have to be discharged quickly these devices act automatically, but for smaller capacities they can be adjusted by hand. These, like most side tipplers, are of squirrel-cage type and built in two varieties: one in which the wagon is clamped in position on the cradle by hand and the other where the operation is carried out mechanically. The former is slower and therefore handles fewer wagons per hour than the latter. The great advantage of such tipplers is that any type of wagon can be handled by them, whether with side doors, end doors or no doors at all. The operation is as follows. The wagon is simply run into the tippler, the driving gear is started up and the tippler commences to revolve. As soon as the framing begins to rotate the wagon is lowered at one side, by means of a pivoted rocking table, against the side chock. The continued rotation of the tippler framing causes the cradle in which the wagon is contained to slide in the outer tippler rings until the top of the wagon comes in contact with the longitudinal sustaining beam at the top of the tippler framing, and the tippler then continues to revolve until the wagon is inverted sufficiently to discharge its contents. The process is now reversed, the cradle containing the wagon gradually sinking down to the initial position, the empty wagon being pushed out by a full one. The action of the sliding cradle with the wagon in it is controlled by means of a dashpot, in order to prevent shock.



BY COURTESY OF THE MITCHELL CONVEYOR & TRANSPORTER CO.

FIGS. 2, 3, 4 & 5.—DIAGRAMS SHOWING OPEN-CRADLE TYPE OF SIDE TIPPLER

Hand labour is almost entirely dispensed with.

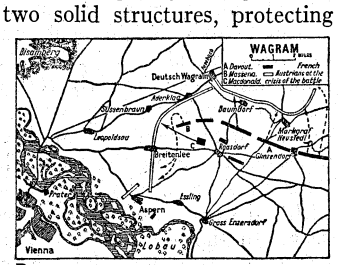
In another type an open cradle has been substituted for the squirrel-cage. The wagon is shown in the initial position in fig. 2. When rotation begins it is tilted gently till it leans against the longitudinally supporting chock (fig. 3); then it further rotates through an angle of 90°, at which point the top of the wagon encounters a longitudinal sustaining beam. As the wagon continues to turn slowly over, an increasing proportion of its weight is borne by the beam until, when fully turned, it rests, as it were, in a V formed by the supporting chock and the sustaining beam, both of which are covered with hemp, fender-like, where they touch the wagons (fig. 4). In fig. 5 the wagon is shown in the unloading position. After emptying, the wagons are returned to their initial position, when they are absolutely free to be shunted off the cradle. The advantage of the open cradle over the squirrel cage is that a shunting engine can pass over the tippler. An objection to side tipplers is that the oil may run out of the axle boxes. But the operation is too quick for this to happen, and the latest arrangement is an "inkwell" type of oil reservoir.

Where wagons of large capacities are in use, as in America, the end-tipping method is impracticable. In that country rotary side tipplers only are employed, which, in the majority of instances, are raised to a higher level before reaching the unloading position. (*See* LOCOMOTIVE COALING.)

In Germany end tipplers only are employed, since side tipplers are debarred by the railway authorities. (G. F. Z.)

WAGRAM or **DEUTSCH WAGRAM,** a village of Austria in the plain of the Marchfeld, 11½mi. N.E. of Vienna. It gives its name to the battle of July 5 and 6, 1809, in which the French army under Napoleon defeated the Austrians under the archduke Charles. On the failure of his previous attempt to pass his whole army across the Danube at Aspern (*see* NAPOLEONIC CAMPAIGNS and ASPERN-ESSLING, BATTLE OF), Napoleon set himself to concentrate around Vienna and the island of Lobau, not only his own field forces, but also every man, horse and gun available from Italy and South Germany for a final effort. Every detachment was drawn in within 48 hours' call, his rearward communications being practically denuded of their covering troops. The island of Lobau itself was converted practically into a fortress, and over 100 guns were mounted on its banks to command the Austrian side of the stream. Giving up, in face of this artillery, the direct defence of the river-side, the Austrians formed in a great arc of about 6 mi. radius extending from the Bisamberg, overlooking the Danube, in the west, to Markgrafneusiedl on the east. From this point to the Danube below Lobau a gap was left for the deployment of the archduke Johann's army from Pressburg 35 mi. distant. This army, however, arrived too late. Their total front, therefore, was about 12 mi. for 120,000 men, which could be reduced to about 6 mi. by a forward march of a couple of hours.

Meanwhile Napoleon replaced the temporary bridges over the main stream by means of two solid structures, protecting them by palisades of piles and floating booms, and organized an armed flotilla to command the waterway. On the island itself preparations were made to throw three bridges across the Lobau arm of the stream opposite Aspern and Essling, and seven more on the right, facing east between Gross Enzersdorf and the main river. For several days previous to the great battle the French had sent across small detachments, and hence when, on the afternoon of July 4, an advanced guard was put over near Gross Enzersdorf, the attention of the Austrians was not particularly attracted and they did not interfere. Under cover of this detachment Napoleon's pontoniers made the seven bridges. Long before daylight on the 5th the troops began to stream across, and about 9 A.M. the three corps destined for the first line (Davout, Oudinot and Masséna) had completed their deployment on a front of some 6,000yd. and were moving forward to make way for the second line (Eugene and Bernadotte) and the third line (Marmont, Bessières's cavalry and the guard). About noon the general advance began, the French opening outwards like a fan to obtain space for manoeuvre.



PLAN OF THE BATTLE OF WAGRAM, JULY 5–6, 1809

The Austrians held a strong position along the line of the Russbach from Deutsch Wagram to Markgrafneusiedl with their left, whilst their right was held ready for a counter-attack intended to roll up the French attack from left to right when the proper moment should come. The movements of the great French masses in the confined space were slow, and although the French left under Masséna pushed the Austrians back beyond Leopoldsau and Süssenbrunn, the main attack on the line of the Russbach did not declare itself till 8 P.M.; the corps did not attack simultaneously, and failed altogether to make any serious impression on the Austrian position. But, hearing of the success of his left wing on the Russbach, the archduke determined to anticipate the French next morning on that side, and four corps were directed upon Masséna, who had bivouacked his troops overnight on the line Leopoldsau-Süssenbrunn-Aderklaa, the latter, a strongly built village, forming, as it were, a bridge-head to the passages of the Russbach at Deutsch Wagram. Another corps with a strong cavalry force was also directed to pivot round Markgrafneusiedl and to attack Davout on his right; on this flank also the arrival of the archduke Johann was expected later in the day.

The Austrian movements were somewhat ill-connected; nevertheless, by 11 A.M. Masséna's detached left division had been driven back almost to Aspern, and his right, though aided by Bernadotte, had failed to recapture Aderklaa, from which the Austrians had driven his advanced posts early in the morning. The situation for the French looked serious, for their troops were not fighting with the dash and spirit of former years. But Napoleon was a master in the psychology of the battlefield, and knew that on the other side things were much the same. He therefore sent orders for a great counter-stroke. Davout on the right was to press his attack on Markgrafneusiedl and roll up the Austrian left flank; Oudinot, next him, was simply to engage the enemy on the heights with artillery fire for the time being. The capture of Markgrafneusiedl was to be the signal for the main blow against the Austrian centre by Eugene's two corps (under Macdonald and Grenier), which were then moving up. Meanwhile Masséna was to move laterally across the front to aid his isolated division in guarding the threatened left flank. The gap thus left was covered by a line of guns, soon raised to a total of 104, which prepared the advance of the V. Corps (Macdonald) through the gap on Süssenbrunn, followed by the guard and reserve cavalry.

Macdonald formed his 30,000 men in a gigantic hollow square —two lines, each of four deployed battalions, closed up so that the whole was six ranks deep, whilst the remainder of the infantry marched behind in column on either flank, and cavalry closed the rear. The Austrian round-shot cut swaths through this dense square—whose trail appeared one mass of dead and dying, creating a terrible impression on all who saw it. It had shrunk so much from losses, and still more from stragglers, that it came to a halt in a sandpit a mile short of Süssenbrunn. When reinforced, both directly and by divisions launched to attack Aderklaa and Breitenlee on its flanks, Macdonald resumed his advance and reached his objective. At the same time Napoleon had ordered forward Oudinot to cross the Russbach between Baumdorf and Wagram and to strike the joint of the Austrian line at Wagram. The Austrian left centre had been weakened by reinforcements sent to the left, hard pressed by Davout, and by stretching to cover the gap on the other side. This weakening enabled Oudinot to gain Wagram, while Davout had also made headway. With the penetration near Wagram, the Austrian army was split, and learning that the archduke Johann could not arrive until evening the archduke Charles at about 2.30 P.M. ordered a general retreat, the main part westward and the left wing northward.

The French had seen more of the slaughter than their adversaries, and except the emperor and Davout all seem to have been completely shaken. Even in Davout's command, always the steadiest in danger, the limit of endurance had been passed, for when about 5 P.M. the advanced patrols of the archduke Johann's force appeared on their flank, panic on a scale hitherto unknown in the

Grande Armée seized the right wing, and Napoleon had to confess that no further advance was possible for several days.

Berndt (*Zahl im Kriege*) gives the following figures: French 181,700 (including 29,000 cavalry) and 450 guns engaged, of whom 23,000 men were killed and wounded, 7,000 missing; Austrians, 128,600 (including 4,600 cavalry) and 410 guns engaged; losses, 19,110 killed and wounded, and 6,740 missing.

WAGTAIL, the popular name for birds of the subfamily *Motacillinae,* which, together with the *Anthinae* (*see* PIPIT), form the passerine family *Motacillidae.*

The pied wagtail is almost confined as a breeding species to the British Isles. It constitutes a good example of a species owing its origin to isolation. It is represented on the Continent by the white wagtail (*M. alba*), of which it is a sub-species. Three other species occur in England, but the subfamily with several genera and many species ranges over the Old World, except Australia and Polynesia, whilst Asiatic species reach North-west America.

Wagtails are long-tailed, generally parti-coloured birds, frequenting streams and stagnant water, and feeding on seeds, insects, worms, small molluscs, and crustaceans. The nests are made of moss, grass, and roots, with a lining of hair and feathers; four to six eggs are laid, bluish-white or brown, with yellow marks.

WAHHABI, the name of a Puritan movement within Islam. Wahhabis or *Ikhwan* (brothers), purport to follow in detail the practice of the Prophet, and regard as infidels all who do otherwise. Their enemies are the enemies of the true faith and their every campaign is therefore a *Jihad* (holy war), death in which is a sure passport to Paradise. Another feature of these communities is the complete elimination of all tribal distinctions. The old pastime of tribal raid and counter-raid is discountenanced. The blood-feud is no more. In the matter of doctrine the Wahhabis (*Ikhwan*) differ from their fellow Muslims in rejecting a large mass of tradition which they regard as un-authentic. Like all Muslims they regard the Koran (Quran) as the Word of God and therefore the foundation of their social code, but there is admittedly much in the Koran and much not in it which from the earliest days of Islam required explanation or consideration. Such matters were freely dealt with by the Prophet in conversation or in his practice, the records of which were subsequently collected in the form of "Traditions of the Prophet" which, being generally handed down by word of mouth, grew in volume as time progressed. (*See* ARABIA: *History.*)

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WAHOO (*Evonymus atropurpureus*), a small North American tree of the staff-tree family (Celastraceae), known also as burning-bush, found from New York to Montana and southward and sometimes planted for ornament. The handsome fruit, ripening in October and persisting until midwinter, is a deeply lobed capsule with smooth purple valves which split apart at maturity, disclosing large seeds covered with a scarlet aril. (*See* CLIMBING BITTERSWEET; SPINDLE-TREE.)

WAIBLINGEN, a town of Germany, in the *Land* of Württemberg. Pop. (1939) 10,927. Waiblingen is mentioned in the 9th century, when it had a palace of the Carolingian sovereigns. Subsequently it belonged to the dukes of Franconia, and gave a surname to the emperor Conrad II. It was in this way that the Hohenstaufen family, which was descended in the female line from Conrad, received the name of Waiblingen, corrupted by the Italians into Ghibelline.

WAINEWRIGHT, THOMAS GRIFFITHS (1794–1852), English journalist and subject-painter, was born at Chiswick in October 1794. He contributed to various magazines and painted pictures some of which were exhibited at the Academy. Owing to his extravagant habits, Wainewright's affairs became deeply involved. In 1830 he insured the life of his sister-in-law in various offices for a sum of £18,000, and when she died, in the December of the same year, payment was refused by the companies on the ground of misrepresentation. Wainewright retired to France, was seized by the authorities as a suspected person, and imprisoned for six months. He had in his possession a quantity of strychnine, and it was afterwards found that he had destroyed, not only his sister-in-law, but also his uncle, his mother-in-law and a Norfolkshire friend, by this poison. He returned to London in 1837, but was at once arrested on a charge of forging, thirteen years before, a transfer of stock, and was sentenced to transportation for life. He died of apoplexy in Hobart Town hospital in 1852.

The *Essays and Criticisms* of Wainewright were published in 1880, with an account of his life, by W. Carew Hazlitt; and the history of his crimes suggested to Dickens his story of *Hunted Down* and to Bulwer Lytton his novel of *Lucretia.* His personality, as artist and poisoner, has interested latter-day writers, notably Oscar Wilde in "Pen, Pencil and Poison" (*Fortnightly Review,* Jan. 1889), and A. G. Allen, in T. Seccombe's *Twelve Bad Men* (1894).

WAITE, MORRISON REMICK (1816–1888), American jurist, was born at Lyme, Conn., on Nov. 29, 1816. He graduated at Yale in 1837, and soon afterwards removed to Maumee City, practised at Maumee City and at Toledo. In 1850 he removed to Toledo. In politics he was a Whig and later a Republican. In 1871, with William M. Evarts and Caleb Cushing, he represented the United States as counsel before the "Alabama" Tribunal at Geneva. In 1874 he was appointed chief-justice of the U.S. Supreme Court, and he held this position until his death. In the cases which grew out of the Civil War and reconstruction, and especially in those which involved the interpretation of the 13th, 14th and 15th amendments, he sympathized with the general tendency of the court to restrict the further extension of the powers of the Federal Government. He concurred with the majority in the Head Money Cases (1884), the Ku-Klux Case (*United States* v. *Harris,* 1882), the Civil Rights Cases (1883) and the *Juillard* v. *Greenman* (legal tender) Case (1883). He died in Washington, D.C., March 23, 1888.

WAITHMAN, ROBERT (1764–1833), lord mayor of London, born at Wrexham, was returned to parliament, as a Liberal, for the city of London in 1818. He lost his seat at the election of 1820, but regained it in 1826, and retained it till his death, taking part vigorously in the parliamentary debates, and strenuously supporting reform. In 1823 he was lord mayor of London. Waithman died in London on Feb. 6, 1833.

WAITS, the itinerant musicians who parade the streets at night at Christmas time (A.S. *wacan,* to "wake" or "watch"). The waits of the 14th and 15th centuries were watchmen who sounded horns or even played a tune to mark the hours. The book of household expenses of Edward IV. (1478) provides for "a wayte, that nyghtely from Mychelmas to Shreve Thorsdaye pipe the watch within this courte fowere tymes; in the somere nightes three tymes." Elaborate orders as to his housing occur. During his actual attendance at court he was to receive 4½d. a day or less in the discretion of the steward of the household. He had a livery given him and during illness an extra allowance of food. Besides "piping the watch" and guarding the palace against thieves and fire, this wait had to attend at the installation of knights of the Bath. London and all the chief boroughs had their corporation waits from the early 16th century. In 1582 Dudley, earl of Leicester, writes to the corporation of London asking that a servant of his should be admitted to the city waits. The London waits played before the mayor during his annual progress through the streets and at city dinners, and had a uniform of blue gowns with red sleeves and caps with silver collars or chains round the neck. In the 18th and early 19th century the ordinary street watchman serenaded householders at Christmas time, calling round on Boxing Day to receive a gratuity for their tunefulness. When in 1829 their place as guardians of the city's safety was taken by police, private individuals kept up the custom.

WAKATSUKI, REIJIRO (1866–), Japanese statesman, graduated in law at the Imperial university of Tokyo in 1892, when he also entered the civil service. He was nominated crown member of the house of peers in 1911, and was minister of finance in 1912 and in 1914–1915, and also minister of home affairs in 1924–1926. He succeeded Viscount Kato as prime minister and leader of the Kensei-kwai party in 1926. He desired to broaden the basis of his cabinet by including members of the Seiyuhonto

party, but failed, and was compelled to reconstitute his ministry (June 1926), exclusively with members of the Kensei-kwai party. Later on, he succeeded in obtaining the support of the Seiyuhonto party, thus securing a majority in the Chamber. During the autumn of 1926 proceedings against students accused of communism caused considerable unrest. Some of them had been arrested in December 1925, but no information on the subject had appeared in the press until September. But the real cause of his fall on April 16, 1927, was the failure of the Suzuki firm. Later, the Kensei-kwai and Seiyuhonto united to establish a new party, Minseito, on June 1, 1927. Wakatsuki transferred the leadership to Hamaguchi, co-operating with Tokonami, the leader of Seiyuhonto.

WAKE, "waking" or watching round a corpse before burial (A.S. *wacan,* to "wake" or "watch"); in the wider sense a vigil kept in commemoration of the dedication of the parish church. This religious wake consisted in an all-night service of prayer and meditation in the church. These services, officially termed *Vigiliae* by the church, appear to have existed from the earliest days of Anglo-Saxon Christianity. Each parish kept the morrow of its vigil as a holiday. Wakes soon degenerated into fairs; people from neighbouring parishes journeyed over to join in the merry-making, and the revelry and drunkenness became a scandal. The days usually chosen for church dedications being Sundays and Saints' days the abuse was the more scandalous. In 1445 Henry VI. attempted to suppress markets and fairs on Sundays and holy days. Wakes are specially mentioned in the *Book of Sports* of James I. and Charles I.

Side by side with these church wakes there existed the custom of "waking" a corpse. The custom, as far as England was concerned, seems to have been older than Christianity, and to have been at first essentially Celtic. Doubtless it had a superstitious origin, the fear of evil spirits hurting or even removing the body. The Anglo-Saxons called the custom lich-wake or like-wake (A.S. *lic,* a corpse). With the introduction of Christianity the offering of prayer was added to the vigil. As a rule the corpse, with a plate of salt on its breast, was placed under the table, on which was liquor for the watchers. These private wakes soon tended to become drinking orgies. With the Reformation and the consequent disuse of prayers for the dead the custom of "waking" became obsolete in England, but survived in Ireland. Many countries and peoples have a custom equivalent to "waking," which, however, is distinct from the funeral feasts pure and simple.

For detailed accounts of Irish wakes *see* Brand's *Antiquities of Great Britain* (W. C. Hazlitt's edition, 1905) under "Irish Wakes."

WAKEFIELD, EDWARD GIBBON (1796–1862), British colonial statesman, was born in London on March 20, 1796, of an originally Quaker family. His father, Edward Wakefield (1774–1854), author of *Ireland, Statistical and Political* (1812), was a surveyor and land agent in extensive practice; his grandmother, Priscilla Wakefield (1751–1832), was a popular author for the young, and one of the introducers of savings banks. Wakefield was for a short time at Westminster school, and was brought up to his father's profession, but he eloped at 20 with Miss Pattle, the orphan daughter of an Indian civil servant. Her relatives became reconciled to the match, and procured him an appointment as attaché to the British legation at Turin. He resigned this post in 1820, upon the death of his wife, and then spent some years in Paris. In 1826 he decoyed Ellen Turner from school by means of a forged letter, by which she was induced to believe that she could only save her father from ruin by marrying Wakefield, whom she accordingly accompanied to Gretna Green. He was tried with his confederates at Lancaster assizes, March 1827, convicted, and sentenced to three years' imprisonment in Newgate. The marriage, which had not been consummated, was dissolved by a special act of parliament.

Wakefield turned his attention while in prison to colonial subjects, and acutely detected the main causes of the slow progress of the Australian colonies in the enormous size of the landed estates, and the reckless methods of allocation of land. He proposed the sale of land in small quantities at a sufficient price, and the employment of the proceeds as a fund for promoting immigration. These views were expressed with extraordinary vigour in his *Letter from Sydney* (1829), published while he was still in prison, but composed with such graphic power that it has been continually quoted as if written on the spot. After his release Wakefield produced a tract on the *Punishment of Death,* with a terribly graphic picture of the condemned felons in Newgate, and another on incendiarism in the rural districts, with an equally powerful exhibition of the degraded condition of the agricultural labourer.

He soon, however, became entirely engrossed with colonial affairs, and, having impressed John Stuart Mill, Colonel Torrens (*q.v.*) and other leading economists with the value of his ideas, became a manager of the South Australian Company, by which the colony of South Australia was ultimately founded. In 1833 he published anonymously *England and America,* a work primarily intended to develop his own colonial theory, which is done in the appendix entitled "The Art of Colonization." The body of the work, however, is fruitful in seminal ideas, though some statements may be rash and some conclusions extravagant. It contains the proposal that the transport of letters should be wholly gratuitous—the precursor of subsequent reform—and the prophecy that, under given circumstances, "the Americans would raise cheaper corn than has ever been raised." In 1836 Wakefield published a volume of an uncompleted edition of Adam Smith.

Colonization of New Zealand.—In 1837 the New Zealand Association was established, and he became its managing director. Scarcely, however, was this great undertaking fairly commenced when he accepted the post of private secretary to Lord Durham on the latter's appointment as special commissioner to Canada. The Durham Report, the charter of constitutional government in the colonies, though drawn up by Charles Buller, embodied the ideas of Wakefield, and the latter was the means of its being given prematurely to the public through *The Times,* to prevent its being tampered with by the Government. He acted in the same spirit a few months later, when (about July 1839), understanding that the authorities intended to prevent the despatch of emigrants to New Zealand, he hurried them off on his own responsibility, thus compelling the Government to annex the country just in time to anticipate a similar step on the part of France. (*See* NEW ZEALAND: *History.*) In 1846 Wakefield, exhausted with labour, was struck down by apoplexy, and spent more than a year in complete retirement, writing during his gradual recovery his *Art of Colonization.*

The management of the company had meanwhile passed into the hands of others, whose sole object was to settle accounts with the Government, and wind up the undertaking. Wakefield seceded, and joined Lord Lyttelton and John Robert Godley in establishing the Canterbury settlement as a Church of England colony. A portion of his correspondence on this subject was published by his son as *The Founders of Canterbury* (Christchurch, 1868). In 1854 he appeared in the first New Zealand parliament as extra-official adviser of the acting governor, a position which excited great jealousy, and as the mover of a resolution demanding the appointment of a responsible ministry. In that year Wakefield's health broke down. He spent the rest of his life in retirement, dying at Wellington on May 16, 1862.

Wakefield was a man of large views and lofty aims, and in private life displayed the warmth of heart which commonly accompanies these qualities. But he hesitated at nothing necessary to accomplish an object, and the conviction of his untrustworthiness gradually alienated his associates, and left him politically powerless. Excluded from parliament by the fatal error of his youth, he was compelled to resort to indirect means of working out his plans by influencing public men. But for a tendency to paradox, his intellectual powers were of the highest order, and as a master of nervous English he rivals Cobbett.

For an impartial examination of the Wakefield system, *see* Leroy-Beaulieu, *De la colonisation chez les peuples modernes* (3rd ed. pp. 562–575 and 696–700). *See* also R. Garnett's *Life of Wakefield* (1898); and R. C. Mills, *The Colonisation of Australia; 1829–42; the Wakefield Experiment in empire building* (1915).

WAKEFIELD, a city, and county and parliamentary borough in the West Riding of Yorkshire, England. Pop. (est. 1938)

59,000. Area, 8.3 sq.mi. It lies on the river Calder at the eastern edge of the Pennines and developed as a market at the meeting place of the lowlanders with the people of the dales. It was also at the first easy crossing place in flood time. It is now a focus of rail and road routes from all parts of Yorkshire and is the headquarters of the county council of the West Riding.

Wakefield (Wachefeld) was the chief place in a large estate belonging to King Edward the Confessor and was still a royal manor in 1086. Shortly afterwards it became an extensive baronial liberty extending into the confines of Lancashire and Cheshire. In 1203–04, the lord of the manor received a grant of a three-days' fair at Wakefield, and as early as 1231 the town seems to have had some form of burghal organization. An ancient church existed on the site of the present cathedral church, but only slight traces remain of buildings previous to the 14th century. In the early part of that century the church was almost rebuilt and it was consecrated in 1329. A new stone bridge was erected over the river in 1343. The river is also crossed by a fine bridge of eight arches on which stands the chapel of St. Mary, built in the richest Decorated style. Its endowment is attributed to Edward IV, in memory of his father Richard, duke of York, who fell in the battle of Wakefield, in 1460, but both bridge and chapel existed before the middle of the 14th century, a license for the chapel being obtained in 1357. It was completely restored in 1847. An additional bridge over the Calder was opened in 1933. The town was attacked and taken by Fairfax in 1643, but Sandal castle, an extensive stronghold to the south of the river remained in the hands of the Royalists for another 12 months, when it was besieged and taken; it was dismantled in 1648.

About 1470, foreign cloth weavers, chiefly Flemings, began to settle, and by 1500, Wakefield was the centre of the district. During the 18th century it became noted for the manufacture of woollen stuffs. It possesses mills for spinning worsted and carpet yarns, coco-nut fibre and China grass. It has also rag-crushing mills for the manufacture of "shoddy," chemical works, soap-works and iron industries of various kinds. Wakefield is also the chief agricultural town in the West Riding. Down to 1832, Wakefield was under the superintendence of a constable appointed by the steward of the lord of the manor, but in that year the town was enfranchised and now the borough returns one member. In 1848 a charter of incorporation was granted, in 1888 the town was created a city and in 1915 became a county borough. In 1888 the Bishopric of Wakefield was formed, almost entirely from that of Ripon. The diocese includes about one-seventh of the parishes of Yorkshire and covers a small portion of Lancashire. The parish church of All Saints became the cathedral. The Elizabethan grammar school was founded in 1592. The corporation owns three public parks, a library, museum and art gallery.

WAKEFIELD, a town of Middlesex county, Mass., U.S.A., 10 mi. N. of Boston. Pop. (1920) 13,025 (25% foreign-born white); 1940 federal census 16,223. The town park, shaded by fine old elms, extends to Lake Quannapowitt, and opposite are Crystal lake and Hart's hill, another park. Rattan and willow furniture are made. The first settlement was made in 1639. In 1812 the southern parish of Reading was set off and incorporated as the town of South Reading, and in 1868 the present name was adopted in honour of Cyrus Wakefield (1811–73), who established the rattan works and gave the town its town hall.

WAKEFIELD ESTATE, the birthplace of George Washington, in Westmoreland county, Va., was settled in 1656 by Col. John Washington, great-grandfather of George Washington. It was held continuously by the Washington family until 1812. George Washington lived there for four years and then moved with his parents to their estate at Mt. Vernon. The house in which he was born was burned in 1780, but the Wakefield National Memorial association completed an approximate reproduction of it in 1931. The estate, at the entrance to which is a granite shaft 50 ft. high, became the George Washington Birthplace National Monument in 1930.

WAKE ISLAND, in the mid-Pacific ocean, consists of three islets, Wake, Peale and Wilkes, lying within an area four miles in length in a northwest, southeast direction; lat. 19° 15′ N., long. 166° 38′ E. By executive order dated Dec. 29, 1934, Wake was placed under jurisdiction of the U.S. navy department. The islets in places reach a height of 21 ft.; they enclose a lagoon with a depth of 1 to 1½ fathoms. The higher parts are covered with a fairly heavy growth of umbrella hardwood. The shores consist of sandy beaches, interspersed with coral rocks. There is a boat landing at the southeastern end of Wilkes; but Wake had few visitors, except occasional Japanese fishermen, until the Pan American Airways selected it as a port of call on the clipper service to the Philippines. A hotel and an aviation radio station were constructed on Peale islet. Wake became famous as the scene of one of the most heroic episodes of the first days of the U.S. war with Japan in Dec. 1941. Its garrison consisted of 377 marines, under command of Major James P. S. Devereux. There were also about 1,000 workers who had been brought from the United States to strengthen the defenses of the island. The first Japanese attack was from the air and took place on Dec. 8, immediately after the raid on Pearl Harbor, Hawaii (Wake lies west of the international date line). Seven grounded U.S. planes were destroyed and another was damaged. An attempt to land on Dec. 10 was beaten off with considerable losses for the Japanese, a cruiser and a destroyer being sunk. For two weeks the little garrison was under intermittent air and sea attack. Workers, of whom a number were killed, co-operated with the marines and helped to patch together damaged planes so that they could take to the air again. A Japanese landing was effected on Dec. 22. The garrison had been keeping in touch with Washington, D.C. by radio, and the message which announced the landing contained the first suggestion that the end was near when it used the phrase: "The issue is in doubt." The capture of Wake took place on Dec. 24. The exact casualties among the garrison personnel were not known; the marines fought until their last plane had been shot down. Japanese losses are believed to include a cruiser, three destroyers and a submarine, while several other warships were damaged, and about a dozen planes were shot down. (W. H. CH.)

WAKE-ROBIN: *see* CUCKOO-PINT; TRILLIUM.

WAKLEY, THOMAS (1795–1862), English medical and social reformer, was born at Membury in Devonshire on July 11, 1795. After qualifying as a surgeon he set up in practice in London, and in 1823 started the well-known medical weekly paper, the *Lancet,* in which he exposed the jobbery and other malpractices among the practitioners of the day. This attack he carried still further against the whole constitution of the Royal College of Surgeons. In 1835 he was returned to parliament as Radical member for Finsbury, retaining his seat till 1852. He died on May 16, 1862, the *Lancet* remaining in the family.

See S. S. Sprigge, *Life and Times of Thomas Wakley* (1897).

WALACHIA or **WALLACHIA,** a former principality of southeastern Europe, constituting after its union with Moldavia on Nov. 9, 1859, a part of Rumania (*q.v.*).

WALAFRID STRABO (or Strabus, *i.e.,* "squint-eyed") (d. 849), German monk and theological writer, was born about 808 in Swabia. He was educated at the monastery of Reichenau, near Constance, where he had for his teachers Tatto and Wettin. Then he went on to Fulda, where he studied under Hrabanus Maurus before returning to Reichenau, of which monastery he was made abbot in 838. There is a story—based, however, on no good evidence—that Walafrid devoted himself so closely to letters as to neglect the duties of his office, owing to which he was expelled from his house; but, from his own verses, it seems that the real cause of his flight to Spires was that he espoused the side of Lothair (*q.v.*) on the death of Louis the Pious in 840. He was, however, restored to his monastery in 842, and died on Aug. 18, 849, on an embassy to his former pupil, Charles the Bald.

Works.—Of his theological works the most famous is the exegetical compilation which, under the name of *Glosa ordinaria* or the *Glosa,* remained for some 500 years the most widespread and important quarry of mediaeval biblical science, and even survived the Reformation, passing into numerous editions as late as the 17th century. The oldest known copy, in four folio volumes, is almost entirely Walafrid's work and gives us his method.

In the middle of the pages is the Latin text of the Bible; in the margins are the "glosses," consisting of a very full collection of patristic excerpts in illustration and explanation of the text. An *Expositio quatuor Evangeliorum* is also ascribed to Walafrid.

Of interest also is his *De exordiis et incrementis rerum ecclesiasticarum*, written between 840 and 842. It deals with ecclesiastical usages, churches, altars, prayers, bells, pictures, baptism and the Holy Communion. Walafrid shows no trace of belief in transubstantiation as taught by his famous contemporary Radbertus.

Walafrid's chief historical works are the rhymed *Vita sancti Galli* and a much shorter life of St. Othmar, abbot of St. Gall (d. 759). A critical edition of them by E. Dummler is in the *Monumenta Germaniae hist. Poëtae Latini*, ii. (1884), p. 259 ff. Walafrid's poetical works also include a short life of St. Blaithmaic, a high-born monk of Iona, murdered by the Danes in the first half of the 9th century; a life of St. Mammas; and a *Liber de visionibus Wettini*. Many of Walafrid's other poems are, or include, short addresses to kings and queens (Lothair, Charles, Louis, Pippin, Judith, etc.) and to friends.

His most famous poem is the *Hortulus*, dedicated to Grimald. It is an account of a little garden that he used to tend with his own hands, and is largely made up of descriptions of the various herbs he grew there and their medicinal and other uses. Sage holds the place of honour; then comes rue, the antidote of poisons; and so on, to wind up with the rose. The poem *De Imagine Tetrici* was inspired by an equestrian statue of Theodoric the Great at Aix-la-Chapelle.

For a bibliography of Walafrid's historical works, and of writings dealing with them, *see* Potthast, *Bibliotheca hist. med. aevi* (Berlin, 1894) p. 1102 ff. Walafrid's works are published in Migne's *Patrologia Latina*, vols. cxiii. and cxiv. For further references *see* the article by Eduard Reuss and A. Hauck in Herzog-Hauck, *Realencyklopädie* (Leipzig, 1908), xx. 790.

WALCOTT, CHARLES DOOLITTLE (1850–1927), American palaeontologist, born in New York Mills, N.Y., Mar. 31, 1850. He was educated at Utica academy, and in 1876 became an assistant to James Hall, New York state geologist and eminent palaeontologist. Three years later he joined the newly organized U.S. geological survey as assistant geologist. He became director of the U.S. geological survey in 1894. During the 13 years of his control the reclamation service, the forestry service and the bureau of mines were all founded as branches of the geological survey. He was appointed secretary of the Smithsonian institution in 1907, in which capacity he served 20 years (1907–27). He was one of the founders of the Carnegie institute, its first secretary and administrative officer, 1902–05, and a member of the executive committee until his death. He was also active in the organization of the Federal Research council, serving afterwards as a member of the executive committee. He was responsible for the establishment of the National Advisory Committee for Aeronautics and was its chairman until his death.

His chief contribution to science lies in his full description and interpretation of the early Cambrian and Algonkian fauna. With Arnold Hague he surveyed and worked out the great Paleozoic region of central Nevada. He examined the Cambrian formation of the Appalachian belt and eastward, and began a determination of the Cambrian and pre-Cambrian rocks of the western states. Almost every summer after 1907 he devoted to unearthing the Cambrian succession in the Rocky mountains of Canada, where it is unusually complete.

In 1910 he discovered the remarkable Burgess deposit of Cambrian fossils in British Columbia, the finest invertebrate fossil field yet known.

He published a series of 38 octavo volumes on Cambrian geology and palaeontology and two volumes on *Cambrian Brachiopoda* (1912), besides about 300 scientific papers See *Smithsonian Miscellaneous Collections*, vol. 80 (1928) for complete bibliography and memoir.

WALD, LILLIAN D. (1867–1940), American sociologist, was born at Cincinnati, O. on March 10, 1867. She graduated from the New York Hospital training school for nurses. In 1893 she founded the internationally known Henry Street settlement, and organized the district nursing work in connection with it. The first municipalization of school nursing anywhere was due to her when she originated the work of the school nurse in New York in 1902. The idea of the Federal Children's Bureau which passed commissions of both houses of Congress, 1908, was also hers, as well as the foundation of what is known as "public health nursing" in the United States following Florence Nightingale's conception of "health nursing." She served the cause of public welfare on several national and international commissions and conferences, notably in the 1919 series at Cannes, Zürich and Washington; was chairman of the American Union against Militarism; one of the organizers of the National Women's Trade Union League; represented the public from 1910 on the joint board of sanitary control of certain trades, and was author of *The House on Henry Street*, *Windows on Henry Street*, etc.

WALDECK, a portion of Prussia, divided between Westphalia and Hesse-Nassau. Formerly a principality and from November, 1918, to March, 1929, a Republic and constituent State of the German Republic, it was, on April 1, 1929, amalgamated with Prussia at the request of its people. It has an area of 433 sq.m., covered with hills, which culminate in the Hegekopf (2,775 ft.). The centre is the plateau of Corbach. The chief rivers are the Eder and the Diemel, flowing into the Weser. The population was 58,641, an average of about 135 persons to the square mile. It is almost wholly Protestant. The lowest area is 540 ft. above the sea-level—the climate is inclement. The soil is nowhere fertile. Oats is the principal crop, but rye, potatoes and flax are also grown, and fruit cultivated. There are mines, slate and stone quarries. Manufactures are retarded by isolation from railways. Old capital was Arolsen (pop. 2,564 in 1933). Wildungen is a spa of repute. The provisional Constitution of the Republic of Waldeck dated from April 15, 1919, and the Diet consisted of 17 members. Until its amalgamation with Prussia, the Republic was governed by that state in accordance with a treaty of 1867.

For former political conditions *see* Curtze, *Geschichte und Beschreibung des Fürstentums Waldeck* (Arolsen, 1850); Löwe, *Heimatskunde von Waldeck* (Arolsen, 1887); J. C. C. Hoffmeister, *Historisch-genealogisches Handbuch über alle Grafen und Fürsten von Waldeck seit 1228* (Cassel, 1883); Böttcher, *Das Staatsrecht des Fürstentums Waldeck* (Freiburg, 1884); A. Wagner, *Die Geschichte Waldecks und Pyrmonts* (Wildungen, 1888), and the *Geschichtsblätter für Waldeck und Pyrmont* (Mengeringhausen, 1901, fol.).

WALDECK-ROUSSEAU, PIERRE MARIE RENÉ ERNEST (1846–1904), French statesman, was born at Nantes on Dec. 2, 1846. He studied law at Poitiers and in Paris and joined the bar of St. Nazaire. In 1873 he removed to Rennes, and six years later was returned to the Chamber of Deputies, where he supported the policy of Gambetta. He made his reputation in the Chamber by a report which he drew up in 1880 for the committee appointed to inquire into the French judicial system. He had a large share in 1884 in securing the recognition of trade unions.

In 1881 he became minister of the interior in Gambetta's *grand ministère*, and he held the same portfolio in the Jules Ferry cabinet of 1883–1885, when he sought to put down the system by which civil posts were obtained through the local deputy, and he made it clear that the central authority could not be defied by local officials. He had begun to practise at the Paris bar in 1886, and in 1889 he did not seek re-election to the Chamber, but devoted himself to his legal work. The most famous of the many noteworthy cases in which his cold and penetrating intellect and his power of clear exposition were retained was the defence of M. de Lesseps in 1893. In 1894 he returned to political life as senator for the department of the Loire, and next year stood for the presidency of the republic against Félix Faure and Henri Brisson, being supported by the Conservatives, who were soon to be his bitter enemies. He received 184 votes, but retired before the second ballot to allow Faure to receive an absolute majority.

During the political anarchy of the next few years he was recognized by the moderate republicans as the successor of Jules Ferry and Gambetta, and at the crisis of 1899 on the fall of the Dupuy cabinet he was asked by President Loubet to form a government. He formed a coalition cabinet which included M. Millerand and General de Galliffet. He himself took the ministry of the interior, and set to work to quell the discontent with which the country was seething, to put an end to the various agitations against republican institutions, and to restore independence to the

judicial authority. His efforts enabled the government to leave the second court-martial of Captain Dreyfus at Rennes an absolutely free hand, and then to compromise the affair by granting a pardon to Dreyfus. Waldeck-Rousseau won a great personal success in October by his successful intervention in the strikes at Le Creusot. With the condemnation in January 1900 of Paul Déroulède and his monarchist and nationalist followers by the High Court the worst of the danger was past, and Waldeck-Rousseau kept order in Paris without having recourse to irritating displays of force. The Senate was staunch in support of M. Waldeck-Rousseau, and in the Chamber he displayed remarkable astuteness in winning support from various groups. The Amnesty Bill, passed on Dec. 19, chiefly through his unwearied advocacy, alleviated bitterness.

But the most important measure of his later administration was the Associations Bill of 1901. The royalist bias given to the pupils in the religious seminaries was undoubtedly a principal cause of the passing of this bill. His speeches on the religious question were published in 1901 under the title of *Associations et congrégations,* following a volume of speeches on *Questions sociales* (1900). With the defeat, at the general election of 1902, of the machinations against the republic M. Waldeck-Rousseau considered his task ended, and on June 3, 1902, he resigned office, having proved himself the "strongest personality in French politics since the death of Gambetta." He emerged from his retirement to protest in the Senate against the construction put on his Associations Bill by M. Combes, who refused in mass the applications of the teaching and preaching congregations for official recognition. He died on Aug. 10, 1904.

His speeches were published as *Discours parlementaires* (1889); *Pour la république, 1883–1903* (1904), edited by H. Leyret; *L'État et la liberté* (1906); and his *Plaidoyers* (1906, etc.) were edited by H. Barboux. *See* also H. Leyret, *Waldeck-Rousseau et la troisième république* (1908), and the article FRANCE: *History.*

WALDEN, PAUL (1863–), Russian chemist, was born at Livland on July 14 (O.S.), 1863; he studied at Riga, Leipzig and Munich. In 1885 he was appointed assistant in the physics department of the Riga polytechnic, and he successively held the posts of assistant in chemistry (1888), *dozent* (1892), professor of analytical and physical chemistry (1894) and ordinary professor of inorganic and physical chemistry (1896); in addition in 1902 he was made director of the polytechnic. In 1910 he was appointed director of the chemistry department of the science academy at St. Petersburg (Leningrad), then in 1918 was made professor at the new German *Hochschüle* in Riga, and finally in 1919 he became professor and director of the chemistry institute of the University of Rostock.

Walden is probably best known for the curious reaction known as the "Walden inversion" which he discovered in 1895. (*See* ELECTROLYSIS.) An optically active compound generally yields a compound of the same sign as a result of a chemical change, but Paul Walden discovered exceptions to this rule; further instances have since been brought to light. His other important work is on the electrical conductivity of aqueous solutions of organic acids and a comprehensive study of the conductance of non-aqueous solutions, with particular reference to viscosity. His more recent work deals with dielectric constants and other electrical properties of solutions. He has written *Das Leitvermögen der Lösungen* and *Elektrochemie nichtwässeriger Lösungen.*

WALDENBURG, a town in Silesia, Germany. Pop. (1939) 64,131. Waldenburg, which became a town in 1426, lies in the centre of the productive coal district of the Waldenburger Gebirge, a branch of the Sudetic chain. Among other industrial establishments are machine, brick, wire, furniture, porcelain and earthenware factories and a china-painting establishment; there are also numerous flax-spinneries and linen-factories in the neighbourhood. To the south is the village of Oberwaldenburg, pop. (1933) 4,692, with a château and some coal mines.

WALDENSES. The Waldensian valleys lie to the south-west of Turin, in the direction of Monte Viso, being fertile and well wooded. The principal town near the valleys is Pinerolo (Pignerol). Just to its south-west there opens the chief Waldensian valley, the Val Pellice, watered by the stream of that name, with the capital, Torre Pellice.

SECTS OF THE MIDDLE AGES

The name Waldenses was given to the members of an heretical Christian sect which arose in the south of France about 1170. The history of the sects of the middle ages is obscure, because the earliest accounts of them come from those who were concerned in their suppression. Later apologists of each sect reversed the process. In early times these sectaries produced little literature of their own; when they produced a literature at the beginning of the 15th century they attempted to claim for it a much earlier origin. Hence there is confusion on every side. The polemical conception which has done much to perpetuate this confusion is that of the historical continuity of Protestantism from the earliest times. According to this view the church was pure and uncorrupt till the time of Constantine, when Pope Sylvester gained the first temporal possession for the papacy, and so began the system of a rich, powerful and worldly church, with Rome for its capital. Against this secularized church a body of witnesses silently protested; they were always persecuted but always survived, till in the 13th century a desperate attempt was made by Innocent III. to root them out from their stronghold in southern France. Persecution gave new vitality to their doctrines, which passed on to Wycliffe and Huss, and through these leaders produced the Reformation in Germany and England.

But, so far as can now be discovered the heretical sects of the middle ages rested upon a system resembling Manichaeism which was imported into Europe from the East. (*See* MANICHAEISM.) The Manichaean system of dualism, with its severe asceticism, and its individualism, which early passed into antinomianism, was attractive to many minds in the awakening of the 11th century. Its presence in Europe can be traced in Bulgaria soon after its conversion in 862, where the struggle between the Eastern and Western churches for the new converts opened a way for the more hardy speculations of a system which had never entirely disappeared, and found a home amongst the Paulicians (*q.v.*) in Armenia. The name of Cathari (*see* CATHARS), taken by the adherents of this new teaching, sufficiently shows the Oriental origin of their opinions, which spread from Bulgaria amongst the Slavs, and followed the routes of commerce into central Europe. The earliest record of their presence there is the condemnation of ten canons of Orleans as Manichees in 1022, and soon after this we find complaints of the prevalence of heresy in northern Italy and in Germany. The strongholds of these heretical opinions were the great towns, the centres of civilization, because there the growing sentiment of municipal independence, and the rise of a burgher class through commerce, created a spirit of criticism directed against the worldly lives of the clergy.

The system of Catharism recognized two classes of adherents, *credentes* and *perfecti.* The *perfecti* only were admitted to its esoteric doctrines and to its superstitious practices. To the ordinary men it seemed to be a reforming agency, insisting on a high moral standard, and upholding the words of Scripture against the traditions of an overgrown and worldly church. It may be said generally that Catharism formed the abiding background of mediaeval heresy. Prevailing discontent, in conflict with authority generally ended by borrowing something from Catharism. The result was that in the beginning of the 13th century there was a tendency to class all bodies of heretics together.

WALDENSIAN SECT

Most of these sects were stamped out before the period of the middle ages came to a close. The Waldenses, under their more modern name of the Vaudois, survived into the 19th century in the valleys of Piedmont, and have been regarded as at once the most ancient and the most evangelical of the mediaeval sects. It is, however, by no means easy to determine their original tenets, as in the 13th and 14th centuries they were a body of obscure and unlettered peasants, hiding themselves in a corner, while in the 16th century they were merged in the Reformation.

Already in the 9th century there were many protests against the rigidity and want of spirituality of a purely sacerdotal church. Thus Berengar of Tours (999–1088) upheld the symbolic character of the Eucharist and the superiority of the Bible over

tradition. The Paterines in Milan (1045) raised a protest against simony and other abuses of the clergy, and Pope Gregory VII. did not hesitate to enlist their Puritanism on the side of the papacy and make them his allies in imposing clerical celibacy. In France, at Embrun, Peter de Bruys founded a sect known as Petrobrusians, who denied infant baptism, the need of consecrated churches, transubstantiation, and masses for the dead. A follower of his, a monk, Henry, gave the name to another body known as Henricians, who centred in Tours. The teachers of these new opinions were men of high character and holy lives, who in spite of persecution wandered from place to place, and made many converts from those who were dissatisfied at the want of clerical discipline which followed upon the struggle for temporal supremacy into which the reforming projects of Gregory VII. had carried the church.

It was at this time (1170) that a rich merchant of Lyons, Peter Waldo, sold his goods and gave them to the poor; then he went forth as a preacher of voluntary poverty. His followers, the Waldenses, or poor men of Lyons, were moved by a religious feeling which could find no satisfaction within the actual system of the church, as they saw it before them. Like St. Francis, Waldo adopted a life of poverty that he might be free to preach. He had a translation of the New Testament made into Provençal, and his preachers explained the Scriptures. Pope Alexander III., who had approved of the poverty of the Waldensians, prohibited them from preaching without the permission of the bishops (1179). Waldo answered that he must obey God rather than man. He was excommunicated by Lucius III. in 1184.

DIVISIONS OF WALDENSIAN BELIEF

The earliest definite account given of Waldensian beliefs is that of the inquisitor Sacconi about 1250. (D'Argentré, *Collectio judiciorum de novis erroribus,* i. 50, etc.) He divides them into two classes; those north of the Alps and those of Lombardy. The first class hold (1) that oaths are forbidden by the gospel, (2) that capital punishment is not allowed to the civil power, (3) that any layman may consecrate the sacrament of the altar, and (4) that the Roman Church is not the Church of Christ. The Lombard sect went farther in (3) and (4), holding that no one in mortal sin could consecrate the sacrament, and that the Roman Church was the scarlet woman of the Apocalypse, whose precepts ought not to be obeyed, especially those appointing fast-days. This account sufficiently shows the difference of the Waldenses from the Cathari: they were opposed to asceticism and had no official priesthood; at the same time their objection to oaths and to capital punishment are closely related to the principles of the Cathari.

These opinions were subversive of the system of the mediaeval church, and were viewed with disfavour by its officials. The earliest known document proceeding from the Waldensians is an account of a conference held at Bergamo in 1218 between the ultramontane and the Lombard divisions, in which the Lombards showed a greater opposition to the recognized priesthood than did their northern brethren. (Preger, *Beiträge zur Geschichte der Waldensier.*)

ATTEMPTS AT SUPPRESSION

The spread of these heretical sects led to resolute attempts at their suppression. The crusade against the Albigensians could destroy prosperous cities and hand over lands from a heedless lord to one who was obedient to the church; but it could not get rid of heresy. The revival of preaching, which was the work of the order of St. Dominic, did more to combat heresy, especially where its persuasions were enforced by law. The work of inquisition into cases of heresy proceeded slowly in the hands of the bishops, who were too busy with other matters to find much time for sitting in judgment on theological points about which they were imperfectly informed. The greatest blow struck against heresy was the transference of the duty of inquiry into heresy from the bishops to Dominican inquisitors. The secular power, which shared in the proceeds of the confiscation of those who were found guilty of heresy, was ready to help in carrying out the judgments of the spiritual courts. Everywhere, and especially in the district round Toulouse, heretics were keenly prosecuted, and before the continued zeal of persecution the Waldenses slowly disappeared from the chief centres of population and took refuge in the retired valleys of the Alps. There, in the recesses of Piedmont, where the streams of the Pellice, the Angrogne, the Clusone and others cleave the sides of the Alps into valleys which converge at Susa, a settlement of the Waldensians was made who gave their name to these valleys of the Vaudois. In the more accessible regions north and south heresy was exposed to a steady process of persecution, and tended to assume shifting forms. Among the valleys it was less easily reached, and retained its old organization and its old contents. Little settlements of heretics dispersed throughout Italy and Provence looked to the valleys as a place of refuge, and tacitly regarded them as the centre of their faith. At times attempts were made to suppress the sect of the Vaudois, but the nature of the country which they inhabited, their obscurity and their isolation made the difficulties of their suppression greater than the advantages to be gained from it. However, in 1487 Innocent VIII. issued a bull for their extermination, and Alberto de' Capitanei, archdeacon of Cremona, put himself at the head of a crusade against them. Attacked in Dauphiné and Piedmont at the same time, the Vaudois were hard pressed; but luckily their enemies were encircled by a fog when marching upon their chief refuge in the valley of the Angrogne, and were repulsed with great loss. After this Charles II., duke of Piedmont, interfered to save his territories from further confusion, and promised the Vaudois peace. They were, however, sorely reduced by the onslaught. Scattered bodies of Waldenses in Germany influenced, and afterwards joined, the Hussites and the Bohemian Brethren.

The last step in the development of the Waldensian body was taken in 1530, when two deputies of the Vaudois in Dauphiné and Provence, Georges Morel and Pierre Masson, were sent to confer with the German and Swiss Reformers. A letter addressed to Oecolampadius gives an account of their practices and beliefs at that time, and shows us a simple and unlettered community, which was the survival of an attempt to form an esoteric religious society within the mediaeval church. It would appear that its members received the sacraments of baptism and the holy communion from the regular priesthood, at all events sometimes, but maintained a discipline of their own and held services for their own edification, largely dependent on the work of itinerant preachers. After giving an account of themselves they asked for information about several points in a way which showed the exigencies of a rude and isolated society, and finally they said that they had been much disturbed by the Lutheran teaching about freewill and predestination, for they had held that men did good works through natural virtue stimulated by God's grace, and they thought of predestination in no other way than as a part of God's foreknowledge. Oecolampadius gave them further instruction, especially emphasizing the wrongfulness of their outward submission to the ordinances of the church: "God," he said, "is a jealous God, and does not permit His elect to put themselves under the yoke of Antichrist." The result of this intercourse was an alliance between the Vaudois and the Swiss and German Reformers. A synod was held in 1532 at Chanforans in the valley of the Angrogne, where a new confession of faith was adopted, which recognized the doctrine of election, assimilated the practices of the Vaudois to those of the Swiss congregations, renounced for the future all recognition of the Roman communion, and established their own worship no longer as secret meetings of a faithful few but as public assemblies for the glory of God.

THE VAUDOIS AND PROTESTANTISM

Thus the Vaudois ceased to be relics of the past, and became absorbed in the general movement of Protestantism. This was not, however, a source of quiet or security. In France and Italy alike they were marked out as special objects of persecution, and the Vaudois church has many records of martyrdom. The most severe trial to which the Vaudois of Piedmont were subjected occurred in 1655. The Congregation *de Propaganda Fide*

established, in 1650, a local council in Turin, which exercised a powerful influence on Duke Charles Emmanuel II., who ordered that the Vaudois should be reduced within the limits of their ancient territory. Fanaticism took advantage of this order; and an army, composed partly of French troops of Louis XIV., partly of Irish soldiers who had fled before Cromwell, entered the Vaudois valleys and spread destruction on every side. They treated the people with horrible barbarity, so that the conscience of Europe was aroused, and England under Cromwell called on the Protestant powers to join in remonstrance to the duke of Savoy and the French king. The pen of Milton was employed for this purpose, and his famous sonnet is but the condensation of his state papers. Sir Samuel Morland was sent on a special mission to Turin, and to him were confided by the Vaudois leaders copies of their religious books, which he brought back to England, and ultimately gave to the university library at Cambridge. Large sums of money were contributed in England and elsewhere, and were sent to the suffering Vaudois.

By this demonstration of opinion peace was made for a time between the Vaudois and their persecutors; but it was a treacherous peace, and left the Vaudois with a hostile garrison established among them. Their worship was prohibited, and their chief pastor, Leger, was obliged to flee, and in his exile at Leyden wrote his *Histoire générale des églises vaudoises* (1684). The revocation of the edict of Nantes in 1685 began a new period of persecution, which aimed at entire extermination. This was found so difficult that the remnant of the Vaudois, to the number of 2,600, were at last allowed to withdraw to Geneva. But the love of their native valleys was strong among the exiles, and in 1689 one of their pastors, Henri Arnaud, led a band of 800 men to the reconquest of their country. His first attempts against the French were successful; and the rupture between Victor Amadeus, duke of Savoy, and Louis XIV. brought a sudden change of fortune to the Vaudois. They were recognized once more as citizens of Savoy, and in the war against France which broke out in 1696 the Vaudois regiment did good service for its duke. The peace of Utrecht saw the greater part of the French territory occupied by the Vaudois annexed to Savoy, and, though there were frequent threatenings of persecution, the idea of toleration slowly prevailed in the policy of the house of Savoy. The Vaudois, who had undergone all these vicissitudes, were naturally reduced to poverty, and their ministers were partially maintained by a subsidy from England, which was granted by Queen Anne. The 18th century, however, was a time of religious decadence even among the Alpine valleys, and the outbreak of the French revolution saw the Vaudois made subjects of France. This led to a loss of the English subsidy, and they applied to Napoleon for an equivalent. It was granted, and their church was organized by the state. On the restoration of the house of Savoy in 1816 English influence was used on behalf of the Vaudois, who received a limited toleration. From that time onwards the Vaudois became the objects of much interest in Protestant countries. Large sums of money were collected to build hospitals and churches among their valleys, and they were looked upon as the possible centre of a Protestant church in Italy. Especially from England did they receive sympathy and help. An English clergyman, Dr. Gilly, visited the valleys in 1823, and by his writings on the Vaudois church attracted considerable attention, so that he was enabled to build a college at La Torre. Moreover, Dr. Gilly's book (*A Visit to the Valleys of Piedmont*), chancing to fall into the hands of an officer who had lost his leg at Waterloo, Colonel Beckwith, suggested an object for the energies of one who was loth at the age of twenty-six to sink into enforced idleness. Beckwith visited the valleys, and was painfully struck by the squalor and ignorance of a people who had so glorious a past. He settled among them, and for thirty-five years devoted himself to promoting their welfare. During this period he established no fewer than 120 schools; moreover he brought back the Italian language which had been displaced by the French in the services of the Vaudois church, and in 1849 built a church for them in Turin. He lived in La Torre till his death in 1862, and the name of the English benefactor is still revered by the simple folk of the valleys.

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WALDERSEE, ALFRED, COUNT (1832–1904), Prussian field marshal, made his first campaign (that of 1866) as aide-de-camp to General of Artillery Prince Charles of Prussia, with whom he was present at Königgrätz. In the Franco-German War he was present at Metz and joined the staff of the grand duke of Mecklenburg-Schwerin, who was operating against Chanzy's army on the Loir. In 1881 Waldersee became Moltke's principal assistant at Berlin. He succeeded Moltke as chief of the general staff in 1888, and during the Boxer insurrection in China in 1900, he was placed in command of the joint forces. He arrived, however, too late for the fighting before Peking. He died on March 5, 1904.

WALDO, SAMUEL LOVETT (1783–1861), American artist, born in Windham, Connecticut, April 6, 1783. He began with a studio in Charleston, South Carolina. In 1806 he went to London, where he painted portraits for some years with success. In 1809 he returned to New York, and was a conspicuous figure in the city's art life until his death there on the 16th of February 1861. He became an associate of the National Academy in 1847. Among his works are a series of portraits of the early mayors of New York, now in the New York City Hall, a portrait of Peter Remsen, in possession of the New York Historical Society, and two portraits of John Trumbull.

WALDSTEIN, FERDINAND, COUNT (1762–1823), the youngest son of Graf Waldstein und Wartemburg von Lux, was born on March 24, 1762. At Bonn, Beethoven received encouragement from this young nobleman, whom he immortalized by dedicating to him his opus 53, afterwards known as the "Waldstein" sonata. A theme of Count Waldstein's also served for a set of 12 variations for piano duet, written by Beethoven in 1791 or 1792. Waldstein died on Aug. 29, 1823.

WALENSEE, also called the Lake of WALLENSTADT, a Swiss lake. It is formed by the Seez river, which now enters the lake at its eastern end. Near its western end the Linth has been diverted through the Escher canal (completed in 1811) into the lake, from which it soon again issues in order, by means of the Linth canal (completed in 1816), to flow into Lake Zürich. The Walensee has an area of 9 sq.m. It is 495 ft. deep, and its surface is 1,388 ft. above sea-level. On the northern shore rises the seven-peaked range of the Kurfursten (7,576 ft.). On the south side are the crags of Murtschenstock (8,012 ft.).

WALES. The principality of Wales (*Cymru, Gwalia, Cambria*) in Great Britain has an area of 7,469.7 sq.mi. and had in 1931 a population of 2,158,374. The resident population (including Monmouthshire) was estimated to be 2,465,800 in the middle of 1938; on account of war conditions no census was taken in 1941.

Its maximum length from north to south is 136 mi., while its breadth varies between 92 mi. from St. David's head to the English border near Crickhowell, and 37 mi. in central Wales between Aberystwyth and the Shropshire boundary.

Structure and Physical Features.—Wales is a hill country composed almost entirely of Palaeozoic rocks much dissected by deep valleys. The portion of the central highland mass above 2,000 ft. is sharply worn by deep cut cirques and is in marked contrast to the more rounded hills below that elevation. Anglesey is a remnant of a very ancient land mass that formed the nucleus against which the mountains of Caernarvonshire were thrown up as Palaeozoic Wales in its turn became the old block against which the newer geological deposits of England were built up. The worn-down ribs of the ancient land in Anglesey (Môn) still run as moorland between slightly lower lines of marsh. One of these lower north-east to south-west lines forms the picturesque Menai strait. The north-east to south-west mountain line of Caernarvonshire (*q.v.*) culminates in Snowdon (3,560 ft.), highest mountain in England and Wales. Carnedd Dafydd (3,426 ft.) and Carnedd Llewel-

lyn (3,484 ft.) are especially marked. The mountain line tapers out south-westward to the peninsula of Lleyn, which has some hills of crystalline rock, and ends in the Island of Bardsey (Ynys Enlli)—the isle of the saints. A low line running north-east to south-west cuts off the main range from another lofty group culminating in Moel Siabod (2,860 ft.). The Snowdon country is interspersed with lakes: those in the valley bottoms—long and deep—show evidences of glacial as well as structural factors and contrast markedly with the smaller, rounder, darker lakes of the cirques. To the south in Merionethshire is the so-called Harlech dome. The southern section of this volcanic tract is marked off by a region of faults. The major fault runs from Corwen to Bala and thence to the sea. It is best known as the Bala Cleft. Cader Idris (2,927 ft.). Aran Mawddwy (2,970) and Arenig (2,800) are conspicuous peaks.

To the east and south, there stretches a vast plateau of crumpled grits and shales in an endless succession of rounded hills from Denbighshire around to north Pembrokeshire. Plynlymon (2,468 ft.) is among the higher points of this central moorland. The region is covered to a great extent by boulder clay giving a cold, wet subsoil with many bogs and consequently able to support only a small population.

To the south and east of this crescent plateau of pre-carboniferous rocks lies the country of the Old Red Sandstone and the coal measures. This region is more varied in relief with outstanding hills of sandstone like Radnor forest (2,163 ft.) or the steep scarp of the Brecknock Beacons (2,907 ft.), the Black mountains or the volcanic rocks of the Breidden. The coal measure country has become very distinct from the rest of Wales in many respects, whether we consider the belt on the English border in Flint and Denbigh or the great coalfield of South Wales. The latter is oval in form, becoming narrower at its western end in Pembrokeshire. Geologically it is a syncline within which the hard bands of Pennant grit stand out above the deeply incised valley-ways. Numerous streams flow right across the coalfields in long, narrow, steep-sided valleys that limit possibilities of settlement and communication. Many of the resulting problems, both industrial and social, have been very difficult. (*See* RHONDDA.) The south side of the coalfield known for the most part as the Vale of Glamorgan has Triassic and Liassic rocks with much fertile soil.

The south coastal plain of Wales is broken by the sea giving Carmarthen and Swansea bays. The north Wales coastline is low westwards from the Dee estuary, but Great Orme's head, a peninsula of Carboniferous limestone, stands out, as does the igneous rock of Penmaenmawr farther west. The coasts of Lleyn are rocky, as many of the mountain lines die away to the sea. The former low ridges between the valleys run out to sea as partly submerged causeys. They are known locally as *Sarnau*.

South-west Wales sends out hard, resistant bands of old rock to form numerous headlands, the softer rock between being worn away to form small bays in the coast of north Pembrokeshire. In south Pembrokeshire we have a coast with the great submerged valley or ria of Milford Haven. There are evidences of subsidence along the south Wales coast in the west; submerged forests are recovered from Amroth. The rivers may be said to fan out to sea from the interior highland mass. In the north we have the Clwyd and the Conway. On the west the Dwyryd, Mawddach, Dyfi, Rheidol, Ystwyth, Teifi, and on the south the eastern and western Cleddau, the Tâf, Towy, Loughor, Nedd (Neath), Taff and Wysg (Usk). It is these radiating valleys, or rather those of them which are more shut off from the English influences working along the coastal plains, that are the special homes of the Welsh heritages. The interior highland mass is drained also by rivers which fall to the lowlands of the English border—the Dee, Severn and Wye, and these valleys have offered opportunities for contacts between English and Welsh.

Peoples and Settlement.—The earliest traces of man in Wales are known from Paviland cave in the Gower which seems to have been inhabited in the later Palaeolithic age. As pine forests spread with the return of a somewhat milder climate after the Glacial period, Wales was inhospitable to early man, especially as the only flint available in it was that derived from boulder clay belonging to an ice sheet that worked its way south from Scotland down into Cardigan bay. People appear to have drifted to Wales finding forest free spots on the windswept tops of the lower moorland and along the shore where in several places occur flint chipping floors with implements of early type but unknown date. Among the early drifts there came to Wales survivals of what appeared to be Aurignacian types of men still to be found in remote moorland areas such as Plynlymon and the Black mountain region of Carmarthenshire. These people have dark hair and eyes with long, high-ridged heads, big eyebrows and rather prominent mouths. A very much larger element in the Welsh population are the little dark people with dark hair and eyes and rather long heads and slender build. These represent early drifts from south-west Europe by land and sea. Wales, with its volcanic rocks in the north-west and the south-west, was more attractive to people who had learnt the art of polishing stone and the principality has yielded many beautiful examples of polished stone axes. A proportion of the population on coastal patches in south Glamorganshire, north-west Pembrokeshire, Ardudwy and elsewhere, belongs to a type with broad head, strong jaws, with very dark hair and often strong, tall build. Similar people occur on many of the coastal patches of south-west and western Europe and represent emigrants or traders of the early ages of metal. In several, though not in all cases, this type occurs in regions with megalithic monuments, and these are important in the projecting peninsulas of north-west and south-west Wales.

The stone circle seems to have been of special significance in west Wales, since modern evidence shows that the stones of the inner circle at Stonehenge were originally derived from north-west Pembrokeshire. (*See* H. H. Thomas, "The Source of the Stones of Stonehenge" *Antiquaries Jour.* vol. III p. 239, 1923.) The arrival of large numbers of Beaker folk at the dawn of the age of metal in Yorkshire and East Anglia does not seem to have influenced Wales to any great extent, although there are evidences of their culture along the south Wales coastal plain and in the north. The Bala Cleft has yielded many examples of the broad-headed, fair tall type with arched skull and deep-set eyes that is associated with Beaker burials in England and the Continent. The movement of Bronze swordsmen through western Europe to Britain and Ireland in the later Bronze age is thought by some to be responsible for the spread of the Gaelic languages now surviving in Ireland, the Hebrides and north-west Scotland; it apparently had relatively little influence in Wales. The movement of the La Tène culture from the Continent to Britain in the last centuries B.C. are usually associated with the spread of Brythonic Celtic speech, the foundation of the Welsh language. This movement entered Wales very likely just before or during Roman times along valleys stretching up from the English plain and probably along the coastal plains as well. The newcomers appear to have strengthened the Nordic, or tall, fair, long-headed elements in the population, and it is to this period that we can ascribe many hill-top fortresses that guard the lower slopes of the Welsh moorlands. It is thought that the builders of these hill-top camps were native peoples in some fairly peaceful relation with the Romans, and in Cardiganshire their influence was strong where the traces of Roman work are weak.

In post-Roman centuries Wales, in common with most of western Europe, entered difficult times. There were several invasions of Brythonic tribes many of which have become known as the sons of Cunedda. Welsh folk tale illustrates culture-clashes between iron-armed people of the valleys and older populations on the moorlands and one suspects that these are the clashes of pre-Roman times coloured by those of post-Roman centuries. The influence of the sea again became important. Raiders of mixed ancestry, but mainly Irish, landed not infrequently on the northern and western shores, while it is claimed that an invasion of the Irish Deisi entered south-west Wales in the 3rd century A.D. This influence was at work in peace as well as in war as is shown by the Celtic saint movements of the 5th and 6th centuries. Old links with the west—with Ireland, Cornwall, Brittany and north-west Spain—became again important, resulting among other things in

focusing the country's ecclesiastical traditions at St. David's (*q.v.*). The subsequent centuries saw similar raids from Scandinavian peoples who had settled in Ireland and the Western isles. Many Scandinavian place names are still found on the coastal patches especially in south Pembrokeshire and south Glamorganshire. New peoples entered Wales, not only from the western seas, but also along her landward frontier. The ways that led into the country through the gaps that were guarded by Chester in the north, Ludlow and Shrewsbury in the centre and Gloucester in the south, became henceforth the main entries of new cultures. The Norman conquest provided Wales with new elements in its population. Districts in south Pembrokeshire and the Gower peninsula seem to have been systematically colonized with Flemings by Henry I and Henry II.

In subsequent centuries Wales received immigrants from the continent to those areas where weaving was important.

Population.—In 1931 the total population of the principality was 2,158,374. The sparseness of inhabitants on the hill pastures and the crowding of the coal field has made the distribution of population very uneven. The density per square mile (1931) was 1,546.5 in Glamorganshire, while in the hill-pastures it falls to 50, in Radnorshire.

County	Area in sq. miles	Population 1871	Population 1901	Population 1931	Estimated Mid-1938*
Anglesey (Ynys Môn)	276.1	51,040	50,606	49,029	46,530
Breconshire (Brycheiniog)	733.3	59,901	54,213	57,775	53,060
Cardiganshire (Aberteifi)	692.5	73,441	61,078	55,184	52,120
Carmarthenshire (Caerfyrddin)	919.5	116,710	135,328	179,100	172,700
Caernarvonshire (Arfon)	568.9	106,121	125,649	120,829	118,590
Denbighshire (Dinbych)	668.7	105,102	131,582	157,648	156,840
Flint (Fflint)	255.8	76,312	81,485	112,889	121,020
Glamorganshire (Morgannwg)	813.2	397,859	859,931	1,225,717	1,154,960
Merionethshire (Meirionydd)	660.0	46,598	48,852	43,201	39,970
Montgomeryshire (Drefaldwyn)	797.0	67,623	54,901	48,473	44,890
Pembrokeshire (Benfro)	614.1	91,998	87,894	87,206	83,200
Radnorshire (Faesyfed)	470.6	25,430	23,281	21,323	19,540
Total	7,469.7	1,217,135	1,714,800	2,158,374	2,063,420

*These are the figures for the counties, giving the estimates of *resident* populations derived from the 1931 census returns after allowances for (*a*) the difference between resident and enumerated populations and (*b*) the changes due to births, deaths and migration which occurred between the date of the census and the middle of 1938. Including Monmouthshire (402,380), the estimated resident population of Wales in mid-1938 was 2,465,800. On account of war conditions, no decennial census was taken in 1941.

Cardiff (223,110); Swansea (161,110) and Rhondda (121,940) had in 1938 over 100,000 inhabitants; Merthyr Tydfil (62,250) exceeded 50,000; and Llanelly, Aberdare, Barry, Caerphilly, Gelligaer, Llwehwr, Maesteg, Mountain Ash, Neath, Ogmore and Garw, Pontypridd and Port Talbot exceeded 25,000. All these centres are on the South Wales coal field.

Monmouthshire, geographically belonging to Wales, came to be regarded as an English county considerably later than 1536, when the marches were abolished. It remains largely peopled by Celts, however, and the county is ecclesiastically within the bishopric of Llandaff, while for legislative and other purposes it is frequently treated as part of Wales.

Religion.—Classical references to religious cults in pre-Roman Britain have been the pretext for much conjecture as to the nature of the pre-Christian religions of Wales. All that can be said is that the island of Anglesey seems to have had a tradition of special sanctity. The post-Roman centuries were characterized by a revival of prehistoric conditions in the west and although Christianity reached here very early the salient feature is its close associations with the previously existing traditions. The church of Yspytty Cynfyn in north Cardiganshire is built within what was once a stone circle and observers have recorded many circular churchyards in Wales. The spread of the Celtic saints or preachers of Christianity from Ireland to Wales, Cornwall, Brittany and many parts of the continent helped to make St. David's important. It stands at the convergence of a number of routes from little landing places on a storm-washed peninsula. The itinerant Celtic saints established many small cells or churches in Wales, many of which still bear the founder's name in their dedication. From the 7th century onwards the power of the Roman Church grew and the older Welsh traditions were brought nominally under its sway. The attempts of Giraldus Cambrensis in the 12th century to gain ecclesiastical independence for Wales are an echo of the marked individuality of the Celtic traditions.

Among pilgrim routes to Santiago de Compostela (*q.v.*) the maritime one from Ireland via Wales, Cornwall and Brittany was important, and it seems to have been also a survival or revival of a prehistoric route of trade. By the Renaissance the Roman Church had gathered into itself and assimilated all the earlier ritual, and the Anglican Church did not replace it completely in rural Wales. The strongholds of Anglicanism were in the small castle-towns of the coastal plains. The mass of the population of moorland Wales long retained its mediaeval ideas. Early Puritanism appeared in those regions that had the closest associations with the English plains and particularly in those regions that had specialized in weaving. Such districts attracted refugees from the continent.

Radnorshire became an early centre of the Quakers and Baptists, Montgomeryshire of the Independents, while in the weaving centres of the south Wales coastal plains early Puritanism was developed especially by the Independents and the Baptists, who seem to have been specially selected for persecution and whose early chapels are in several cases in remote spots. They seem to have entered regions in southwest Wales (*e.g.*, northwest Pembrokeshire) that were sparsely populated in the middle ages, a movement that seems to have been associated with the introduction of root crops. The Methodist revival of the 18th century, mainly through the influence of the Welsh language, affected chiefly the moorland regions of Wales. Henceforth the country was predominantly Nonconformist.

An honourable exception to the absentee or indifferent English prelates of this period is to be found in Thomas Burgess, bishop of St. David's, to whose exertions was mainly due the foundation in 1822 of St. David's college at Lampeter, an institution erected to provide a better and cheaper education for intending young Welsh clergymen. It was not until 1870 that, by Gladstone's appointment of Dr. Joshua Hughes to the see of St. Asaph, the special needs and claims of the Welsh Church were officially recognized.

Thus, between 1811 (the year of the Methodist secession) and 1832 (the date of the Reform bill), the number of dissenting chapels had risen from 945 to 1,428. In 1870, the dissenting bodies were supporting two quarterly, six monthly and ten weekly papers, all published in the vernacular. A result was the Sunday Closing act of 1881 and the Welsh Intermediate Education act of 1889. In 1893 Lord Rosebery's cabinet appointed the Welsh Land Tenure commission, whose report, published in 1896, did much to exonerate the squirearchy from charges of extortion and sectarian oppression.

In 1914 the Bill for the Disestablishment and Disendowment of the Church of England in Wales was passed. It provided that the secularized portion of the endowment of the Church should be applied to specified national purposes, mainly educational, and a financial amendment in the direction of compensation to the Church was passed in 1919.

Under a new constitution (1922) the supreme authority of the "Church in Wales" was vested in a governing body, representative of the clergy and laity. The area that came under the jurisdiction of this body became known as the province of Wales, with an archbishopric, established for the time being at St. Asaph. The province is practically coterminous with Wales and Monmouthshire, with the exception of a few border parishes which under the Welsh Church act voted themselves out of the Church in Wales. Six dioceses are comprised within the ecclesiastical

province of Wales: Bangor in the north-west, St. Asaph in the north-east, St. David's in the south-west, while the populous area of the south-east is shared between Llandaff, Monmouth and Swansea and Brecon (including the almost entirely rural counties of Brecon and Radnor).

Roman Catholicism is still strong here and there in the border counties, especially Flintshire. In most cases it survives in conjunction with mediaeval landed families. After the last half of the 19th century it flourished exceedingly in the south Wales industrial regions, especially among the immigrants of Irish descent.

In 1898 a bishop with the title of Menevia (Latin form of St. David's) was appointed for the Roman Catholic community in all Wales except the counties of Glamorgan and Monmouth; these latter (and Herefordshire) were included in the archbishopric of Cardiff, which was founded in 1916. After the expulsion of the religious orders from France in 1903, several communities of French monks and nuns took up their abode in the principality.

The majority of the followers of the Methodist revival movement of the 18th century in Wales form the Calvinistic Methodist Church of Wales, known also as the Presbyterian Church of Wales by virtue of an act of parliament passed in 1927. While its churches are strongholds of the Welsh language, many use English in the services. It is organized under the *Cymanfa Gyfredinol* (general assembly), which meets annually and elects a moderator. There are two *Cymdeithasfa* (synods), representing respectively the north and south of the country. The individual churches are grouped into a *Cwrdd Dosbarth* (district meeting), and the latter into a large unit, the *Cwrdd Misol* (presbytery). In addition to the presbyteries in Wales, there are three of the Welsh body in England: in London, Manchester and Liverpool.

Other followers of the Methodist revival are members of the Methodist Church in Wales (formerly the Wesleyan Methodist Church), an integral part of the Methodist Church in England; Welsh candidates for the ministry are trained in English Methodist theological colleges.

The Independents and Baptists have each an *Undeb* (union) for Wales; the former is part of the Congregational Union of England and Wales, and the latter is within the Baptist Union of Great Britain. (E. G. Bow.; X.)

University.—The University College of Wales was founded at Aberystwyth in 1872; that of South Wales and Monmouthshire at Cardiff in 1883; and that of North Wales at Bangor in 1884. In Nov. 1893 the constituent colleges were incorporated by royal charter as the University of Wales, with Lord Aberdare (d. 1895) for its first chancellor. The university was reorganized with a supplemental charter in 1920, and the college at Swansea added.

The majority of the members of the governing body are elected by county and county-borough councils in Wales and Monmouthshire, which councils support the university by the levy of rates for the purpose. All the main branches of cultural education are provided for, and some special attention is given to Celtic studies and to music. The National school of medicine is at Cardiff. Extramural studies have been strongly developed throughout Wales. In addition to the regular financial support mentioned above, after 1910 there were liberal benefactions. The total number of students in 1943 was about 3,000. (A. L. Wi.; X.)

ECONOMIC AND INDUSTRIAL CONDITIONS

Wales and Monmouthshire form an area approximately one-seventh of England and Wales. One-half of the land reaches an altitude of 600 ft. above sea level, while one-half of this exceeds 1,000 ft. This nature of the country enabled its inhabitants to maintain a distinct political existence for centuries after the English lowlands had become subject to one authority. It was not until the 19th century that the traditional isolation of Wales began to be profoundly affected by the development of railways. World competition became operative, to the embarrassment of local industries previously protected by the isolation of the local market.

The Industrial Revolution in Wales.—In 1801 Wales and Monmouthshire had a population of 587,245, fairly evenly distributed over the land, since the vast majority of the people were engaged in agriculture or in related occupations. As the industrial revolution developed, and particularly after 1841, the rural exodus, accompanied by the decay of many industries which had supplemented the earnings of agriculture, led to an enormous concentration of population in the iron- and coal-producing valleys of south-east Wales.

According to the 1931 census the population of Wales and Monmouthshire was 2,593,332, of which well over 50% (1,660,671) was concentrated in the two counties of Glamorgan (1,225,713) and Monmouth (434,958).

Trade unionism has long been a potent force in South Wales. The first important organization of miners and iron workers was the Union club, and after its suppression in 1831 there came into existence a secret society, the Scotch Cattle, whose symbol was a bull's head and horns.

In the 1860s the Amalgamated Association of Miners, a rival to the National Miners' union, gained much support in Wales, where, from 1875, there was constant agitation against the sliding scale payment of wages. Following a strike in 1898 the sliding scale was abolished and the South Wales Miners' federation was organized. This body, later affiliated with the Miners' Federation of Great Britain, has continued to be prominent in the trade union movement. (*See* Ness Edwards' *History of the South Wales Miners' Federation,* 1938).

Coal Mining.—Because of the high quality of the coal and its proximity to tidal waters, from 1881 the South Wales coal field was the chief coal-exporting region of the world. However, the narrow mining valleys present unusual difficulties, for the level ground is occupied by surface works and the hillsides are used as waste tips. The same causes which gave Welsh coals their superiority also made mining in this area more costly and dangerous than in any other part of Britain. Welsh coal is dry and fiery, and the fine coal dust is a constant source of danger. Loose-jointed coal and loose or rotten roof, more frequent in South Wales mines than elsewhere, are responsible for numerous accidents accompanied by loss of life. For these reasons, the output per man is less than the average for the rest of Britain.

After World War I the demand for Welsh coal decreased greatly, both at home and abroad. Although the population and the industrial power equipment increased substantially, economies in the utilization of coal lessened consumption in the United Kingdom. The Welsh coal export trade fell off because of the development of coal resources abroad and the increased use of fuel oils, coupled with heavy import duties, drastic quotas and the subsidizing of industries. In 1938 there were 136,000 miners employed in the coal field, as compared with 168,000 in 1928 and nearly 250,000 in 1913. The output of coal in 1928 was 43,300,000 tons, but by 1938 the figure had fallen to 35,300,000 tons. South Wales continued, however, to be the premier coal exporting area in the United Kingdom.

Metal Industries.—Prior to 1870 the leading place in the economic development of South Wales was held by the iron industry. Along the northern edge of the coal field plentiful and readily accessible supplies of coal, iron ore and limestone occurred in close proximity. Consequently, in the first half of the 19th century a narrow upland tract, extending for about 20 mi. from Pontypool and Blaenavon to Hirwain, with its chief centre at Merthyr-Dowlais, became the greatest iron-producing region in the world. The invention of processes for the large-scale manufacture of steel, and the resulting demand for richer and purer iron ores than those found in the coal field, caused many of those works to be closed or to be transferred to the seaboard, where imported iron ore could be treated.

Within a radius of 15 mi. from Swansea there were 13 works, in 1943, engaged in the production of tin plate and sheet bar, although the virtual world monopoly enjoyed by Welsh tin plate manufacturers had disappeared.

In 1935, 706,234 tons of steel plates were produced, and rather more than half this quantity was exported. The manu-

facture of heavy steel products (such as rails, sleepers [ties], ship plates and girders) is carried on at Port Talbot, Cardiff and Ebbw Vale. The works at Cardiff, completed in 1936, were the most modern of their type in Great Britain, and those at Ebbw Vale replaced the old steel works, which had been closed after World War I. The smelting and rolling of iron and steel products was valued at £14,332,000 in 1930, and five years later this figure had risen to £18,834,000, with 19,560 men employed, as compared with 18,152 in 1930.

Copper ores were shipped from all parts of the world to Swansea for smelting and refining, in the 19th century, but because of the lessened copper content of ores and the increasing cost of freights, smelting came to be conducted in close proximity to the copper mines, and the industry disappeared in Wales. However, a copper manufacturing industry still remained. In the years following World War I many works were closed down, but though export trade was affected by economic, financial and political conditions in foreign countries, the industry was continued at Landore, Llanelly and Port Talbot.

Copper sulphate, a by-product of copper manufacturing, was exported mainly to France and Italy for the purpose of spraying in vineyards.

Copper-nickel sulphide ores smelted in Canada to a kind of bessemer matte are shipped to Swansea for refining. The principal by-products of the nickel manufacturing process, copper sulphate, nickel sulphate and nickel ammonium sulphate, are put to a variety of uses.

Spelter (zinc) is produced in Swansea from sulphide ores imported mainly from Australia and used chiefly in the making of alloys, brass and bronze, and in the manufacture of galvanized iron. General engineering industries in Wales include iron and brass founding, the manufacture of railway material, and pattern making; wire, wire netting and wire rope are also made. In 1922 an oil refinery was built at Llandarcy, between Neath and Swansea, for treating crude petroleum imported through Swansea by the Anglo-Iranian Oil company.

North Wales.—North Wales is more closely related in its economic life to Lancashire and the Midlands than to South Wales, for east-to-west routes are far more practicable than north-to-south in Wales. The North Wales coal field lies in the counties of Flint and Denbigh and extends for about 40 mi. from south to north along the Dee valley. Although extensive, it is far less rich and varied in its output than the South Wales field. The coal obtained is used chiefly for domestic purposes and for gas manufacture, the cannel coal of Flintshire (around Leeswood, Hope and Mold) being specially reputed for its gas-producing qualities. Fire clay, which is mined along with the coal, is used in the brick and tile industries at Ruabon, Cefn, Rhosllanerchrugog and near Mold.

The first iron works in Wales was established at Bersham, near Wrexham, in 1701, but the ore mined from the coal measures of North Wales became almost exhausted before the close of the 19th century. However, as in South Wales, the manufacture of steel from imported ores became a considerable industry, and galvanized iron and tin plates are made at several places. The chief centre of the fine chemical industry in Wales is at Ruabon, and around Holywell and Flint are important paper and artificial silk industries. Although the mining of lead and zinc declined, it was still being carried on at Halkyn during World War II. Holywell is the centre of the woollen industry of North Wales, fine imported wools being employed in preference to the coarser local product. Wales produces the best slates in the world. The chief centres of the slate-quarrying industry are Bethesda, Llanberis, Nantlle and Festiniog, in the counties of Caernarvon and Merioneth.

Agriculture.—About 90,000 persons are engaged in agriculture. Owing to the mountainous character of the land and the heavy rainfall, which in some districts reaches 120 in., agricultural Wales is mainly devoted to the production of meat and milk. In 1939 Wales (including Monmouthshire) had 1,812,000 ac. of rough grazing land, 2,159,000 ac. of permanent pasture and 538,000 ac. of arable land. The rough grazing is devoted mainly to extensive sheep walks.

About 4,000,000 sheep are maintained, including the hardy native mountain breed, and these are sold for the English market. English graziers also purchase the cattle reared on the upland pastures of Wales and fatten them rapidly on their richer lowland pastures. Due largely to improved road transport facilities, there was a striking increase in milk production on the lowland farms of Wales after World War I.

The cultivation of wheat, which is particularly risky owing to the heavy rainfall, is confined entirely to the deeper river valleys and accounts for only 5% of the arable land. The greatest production is in the Vale of Glamorgan, in the valleys of the Wye and the Usk in Monmouthshire. Barley and oats are grown fairly generally, the latter cereal being sufficiently hardy to return a good yield at a height of 1,000 to 1,500 ft. above sea level. Root crops for the feeding of store cattle occupy the remainder of the arable land. Even of the more common products of arable cultivation, only a small proportion is sold off Welsh farms, the bulk of the crops being consumed by the farm population.

Many of the large farms in the Welsh lowlands employ paid labourers, but in the uplands the manual work is done for the most part by family labour. Agriculture in Wales made marked progress after the application of scientific methods to all branches of farming, in which the University colleges at Bangor and Aberystwyth, with the support of the board of agriculture, have rendered invaluable service. Agricultural co-operative societies, first established in Wales in 1901, multiplied rapidly after World War I, and in 1922 a Welsh agricultural organization society was founded. Small mixed holdings of the average size of 47 ac. are characteristic of Wales, and the small farmers were quick to grasp the advantages provided by the co-operative purchasing of foodstuffs, etc. The independent Welsh Farmers' union, founded in 1918, was later merged in the National Farmers' union.

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HISTORY: I. 1 TO 1485

Wales was won for the Roman Empire by Frontinus and Agricola. The former was legate in Britain from A.D. 74 to 78 and in the course of his term of office crushed the Silures, the warlike tribesmen of south-eastern Wales. Farther to the west were the Demetae, of the country round Carmarthen; they were probably subdued at the same time. Agricola's first act, upon his arrival in 78, was to conquer the Ordovices of mid-Wales; in the same campaign, he attacked the tribes of the north-west, crossed the Menai Straits and completed the conquest of Anglesey, from which Suetonius had been recalled eighteen years earlier. The island had been the stronghold of the Druids and throughout its history has held an exceptional position as an area of great fertility (hence known as "Mon mam Cymru," *i.e.*, Mona, the mother of Wales), defended from attack by a rampart of mountains. Wales was effectively held throughout the period of the Roman occupation of Britain, but always as a part of the imperial frontier, and by purely military measures. Two of the three legions quartered in the island after 120 held the portals. The Twentieth was stationed at Deva, the modern Chester, known to the Welsh ever since as Caerlleon, the Second Augustan at Isca, also known to later times as Caerllion and Caerleon. From the two legionary stations roads ran west to smaller forts such as Segontium (Caernarvon), Conovium (Caerhun), Cardiff and Gelligaer; roads and forts of the same type were built in the interior. Some of these forts, perhaps, served only a temporary purpose, but it is clear from the absence in Wales (save around Cardiff and Newport) of Roman towns and country houses that the region had no settled civil life of the type found in Eastern Britain. Recent excavations, notably at Dinorben, near Abergele, show that the natives, while not uninfluenced by Roman culture, lived for

the most part an independent and semi-barbarous life and still occupied the rude stone and earthen hill-forts of their ancestors. The survival of Welsh, a Celtic language akin to Gaulish, supports this conclusion and that it should contain a large number of Latin loan-words is natural. (*See* BRITAIN: *Roman Britain.*)

Irish and Saxon in Wales.—In the age following the abandonment of Britain by the Empire, the two outstanding features are the conflict between the Brythonic and the Goidelic elements and the rapid conversion of the country to the Christian faith. It is beyond doubt that, in the fifth century, western Wales was occupied by an Irish-speaking people; the traditions on the subject have been confirmed by the discovery of Ogham inscriptions, especially in Pembrokeshire and Carmarthenshire. Whether these Goidels were aboriginal or invaders from Ireland is still an open question; in either case, they were overborne by Brythonic conquerors from the east and their language became extinct. Tradition ascribed the Brythonic triumph in Gwynedd (northwest Wales) to a leader from North Britain named Cunedda, whose posterity became kings of various districts from Cardigan to Denbigh. As to the coming of Christianity, there is nothing to associate it with Roman rule in Wales. Yet, in the middle of the sixth century, it is to be gathered from the *De Excidio* of Gildas (the one British work of this epoch which has survived) that the British princes who had risen to power on the ruins of the old order were Christians, and, if lawless and licentious, yet amenable to the influence of the Church. He mentions especially Maglocunus, the Maelgwn Gwynedd of Welsh tradition, lord of Anglesey and Snowdonia, and great grandson of Cunedda, as having at one time forsworn his realm and become a monk. Monasticism, in fact, was the movement which wrought the transformation; Wales was converted by the monks, the "sancti" of Gildas, to which company belonged Dewi, who became in Norman times the patron saint of Wales.

While these events were taking place, the eastern side of Britain was being occupied by English settlers. Wales was not, at first, greatly affected, for the flight of the defeated Britons into the mountains of the west is legend, and not history. But at the beginning of the 7th century a new problem arose, which was directly due to the Saxon conquests. When Augustine, after the conversion of Kent, strove to establish relations with the British clergy, he met with unexpected opposition and failed in his purpose. The differences were merely the result of the long separation between the Celtic and the Continental churches; they did not affect doctrine, but concerned such practical questions as the true date of Easter. Nevertheless, they were sufficient to bring about a schism, which was still violent in the time of Bede; the Welsh Church did not accept the Roman Easter until 768, when it finally gave way at the instance of Elfodd, who was bishop in North Wales. By this time, secular life in Wales had also come to feel the full force of the English impact. The victories of Wessex, notably that of Deorham in 577, had parted the Welsh of Gwent and Glamorgan from their brethren in Somerset, Devon and Cornwall; in the north, the efforts of Cadwallon of Gwynedd, who fell in 634 in battle with Oswald of Northumbria, did not avail to maintain British ascendancy in that region, with the result that, in the eighth century, having lost Chester, Shrewsbury and Hereford to the Mercians, the Welsh were confined to the mountainous tract in the west which has ever since been their home. It was Offa (757–796) who definitely marked the boundary by the dyke which bears his name, a "travelling" earthwork connecting the mouth of the Clwyd with the Wye above Hereford and shown by place names to have been for centuries the actual frontier between the two races.

Wales bore the full brunt of the attacks of the Northmen. Her monasteries, distributed along the coast and often set, as was the manner of the Celts, on lonely islands, suffered grievously. St. David's was often in peril, but contrived to keep up a tradition of learning, of which the leading representative in the ninth century was Asser, the friend and biographer of Alfred of Wessex. It does not appear, however, that the pirates made any substantial settlement on Welsh soil; they were held at bay by the gallant Rhodri the Great (844–877), founder of the princely houses of Gwynedd and Deheubarth (South Wales) and ruler of all Wales save Dyfed (the land of the Demetae), Brecknock, Gwent and Glamorgan. Through all the confusion of the next hundred and fifty years, a time of conflict with the Northmen and with the Mercians, as well as of internal strife, the line of Rhodri maintained itself in its two branches in North and in South Wales. It produced one remarkable man in Howel the Good (910–950), a scion of the southern line, who married the heiress of Dyfed, journeyed to Rome in 928 and is styled "King of all the Welsh." His position enabled him to undertake a reform of Welsh law, for which posterity gratefully remembered him; the representative gathering which met at Whitland (Y Ty Gwyn ar Daf) to receive the new code is without a parallel in the early annals of Wales, and "the law of Howel," amplified and re-edited by generation after generation of Welsh legists, became the standard of tribal and personal relations throughout the country. In its precision and subtlety, it has been held (by Loth) to be the greatest intellectual achievement of mediaeval Wales.

The Norman Conquest.—On the eve of the Norman conquest, there was a striking outburst of activity under one of the ablest of Welsh princes. Gruffydd ap Llywelyn (1039–1063) was not of the ruling dynasty, yet he succeeded in making himself master of the whole of Wales—a position never reached by any Welsh chieftain in later times. He owed his power to his success against the Mercians, whom he drove out of their villages in the neighbourhood of Prestatyn, Mold, Wrexham, Oswestry, Montgomery, Knighton and Radnor. Later, he formed an alliance with Aelfgar and Mercia against the Normans whom Edward the Confessor had posted at Hereford (1055); on Aelfgar's death, he was exposed to the hostility of Harold Godwinson and by him was overthrown. His meteoric career made a great impression in England and led to the question of Wales being envisaged there as one of national defence. When William I. had completed the subjugation of the English, he attacked this problem with his usual insight and, as a first measure, set up the three earldoms of Chester, Shrewsbury and Hereford to protect the realm from the ravages of the Welsh. Further, he encouraged his followers to win land for themselves in North Wales, and to such good purpose that in 1098 the earls of Chester and Shrewsbury had almost conquered Anglesey. In that year, however, the Normans discovered their weakness in sea power, without which the island could not be held; the attempt to subjugate Gwynedd was abandoned. Progress in South Wales had been slower; the Conqueror had here recognized the claims of Rhys ap Tewdwr (1078–1093), who had stepped into the dominant position in the south through the signal victory of Mynydd Carn (1081), won in comradeship with Gruffydd ap Cynan of Gwynedd. On the death of Rhys, however, the floodgates were opened and Norman adventurers swept irresistibly over the southern area.

During the reign of Henry I., the Welsh problem appeared to have been settled. The Norman hold upon South Wales was complete, extending even to the bishopric of St. David's, and the line of Rhys ap Tewdwr was almost forgotten. Powys, the region between Chester and Machynlleth, kept its independence under the posterity of Bleddyn ap Cynfyn (d. 1075), but it was much enfeebled by the quarrels of the reigning house. The weak spot in the Norman system was Gwynedd; here, behind the shelter of the Snowdonian range, Gruffydd ap Cynan (1081–1137) was able to rebuild from humble beginnings the edifice overthrown by Henry's father and brother. No sooner was the King's hand removed by death than a revolt broke out against the foreign power, in which the leaders were Gruffydd's sons, Owain and Cadwaladr, backed by the renewed strength of Gwynedd. The reign of Stephen marks a general revival of energy among the Welsh, who profited to the full by the English civil war; Gwynedd, Powys and Deheubarth became strong principalities under the respective leadership of Owain Gwynedd (1137–1170), Madog ap Maredudd (1132–1160) and Rhys ap Gruffydd (1155–1197). It was thus a hard task which Henry II. had before him when he strove in Wales, as elsewhere, to re-establish the conditions of his grandfather's rule; temporary success against Owain in 1157 and against Rhys in 1163 was followed by virtual defeat in 1165,

when storms drove him back from the Berwyn moorlands before he had encountered the united forces of the Welsh. The Becket quarrel and his Irish schemes induced him to reconsider his policy; he now resolved upon an alliance with Rhys ap Gruffydd, whom events had made not only master of most of South Wales, but also beyond question the leading Welsh prince. The pact between Henry and Rhys, concluded in September, 1171, was observed until the King's death and bore fruit in the assistance given by the Welsh to the crown in the rebellion of 1173–74. Bard and chronicler alike sound the praises of "the Lord Rhys," who is also well known from the writings of his relative, Gerald of Barry (Giraldus Cambrensis). The authentic history of the Eisteddfod begins with the festival he held in Cardigan in 1176; he was also the liberal patron of the Cistercian movement, and supported Archbishop Baldwin, when in 1188 he made a tour of Wales to preach the crusade.

The Power of Gwynedd.—After Rhys's death, the primacy of Wales reverted to Gwynedd. A grandson of Owain, Llywelyn ab Iorwerth (1194–1240), ousted his rivals in that district and proved his quality by the capture of Mold from the English (1199). He had two external opponents to fear, the ruler of Southern Powys and the English king. From Gwenwynwyn (1195–1216) he wrested his dominions and, with Northern Powys in vassalage, he remained arbiter of North Wales until his death. John was, at first, friendly, but the inevitable struggle came in 1211, and, having survived this ordeal, Llywelyn was able to co-operate, first with the pope and then with the insurgent barons, in the humiliation of the King. His services were recognized in the Great Charter and he profited by the situation to carry his arms into South Wales, where he became overlord of the descendants of the Lord Rhys and aided them in the destruction of Norman castles. Under Henry III., he was one of the magnates of the English realm, wedded to a half-sister of the King, an ally of the feudal party, attacked in vain by Hubert de Burgh in 1228.

Llywelyn's son, David (1240–46), struggled to retain his father's position, but died before the issue was finally determined. He left no heir, and Gwynedd passed to his young nephews, against whom Henry III. had no difficulty in asserting the royal power. In 1255, however, Llywelyn ap Gruffydd defeated his brothers at Bryn Derwin and prepared to repeat the triumphs of his grandfather. Seizing the opportunity afforded by the baronial revolt, he found himself lord in a few years of as wide a territory as his great namesake; even the fall of his ally, Earl Simon, did not check his progress, and by the Treaty of Montgomery (1267) he was recognized as Prince of Wales (the first official appearance of the title) and suzerain of the other Welsh chieftains. When Edward I. succeeded, he was at the height of his power, but, misjudging the situation, he soon lost all; resistance in 1277 led to the forfeiture of everything save Western Gwynedd and his title; a second rebellion in 1282 resulted in total overthrow and death in a chance encounter not far from Builth (December 11th).

The English Conquest.—In both his wars with Llywelyn the Last, Edward had won his victory by the use of sea power against Gwynedd. He had realized that it was only thus that Wales could be crippled, namely by a final blow at the vulnerable danger-spot. The dynasty was disposed of by the execution of David, Llywelyn's brother, in 1283. But it was in a quite limited sense that Wales was conquered at this time. Llywelyn's dominions were brought by the Statute of Rhuddlan (1284) under the direct rule of the crown; they were divided into counties, furnished with crown officials and protected by new castles and boroughs at Caernarvon, Conway, Beaumaris, Criccieth, and Harlech. But the old marcher lordships, baronial preserves where the lords ruled as little kings and royal writs did not run, were not interfered with; indeed, their number was increased and new franchises arose around Denbigh, Ruthin, Wrexham and Chirk. Even the loyalist princes of Powys and the Vale of Towy were left undisturbed and among the smaller Welsh landowners the changes were far fewer than might have been supposed. Indeed, in many respects the new Wales differed little from the old. It was still a land of small, independent states, each governed by its own customs and inhabited by a Welsh-speaking population, among whom the old Welsh culture flourished. Edward was no friend to marcher privileges; in 1291 he brought the lords of Brecknock and Glamorgan to book for exercising the right of private war, and in 1301 he revived the principality of Wales in the person of his son, seemingly in order to create a Welsh authority which could bridle the barons. But tradition was more potent than the royal will; under the weak rule of Edward II., Wales became the battleground of baronial factions and, when Edward III. in 1343 again created a Prince of Wales, it was with a less ambitious purpose; the Black Prince was hardly more than the chief Welsh landlord, the master of Welsh archers and lancemen who fought with distinction under him at Crécy and Poitiers.

There had been revolts of the Welsh under Rhys ap Maredudd of Dryslwyn (1287), Madog ap Llywelyn of Meirionydd (1294) and Llywelyn Bren of Senghenydd (1316). But, in the course of the fourteenth century, resistance died down; even Anglesey, that ancient focus of liberty, produced defenders of the crown such as the Penmynydd family, ancestors of the Tudors, and Sir Howel of the Horseshoes, men who never forgave the murderers of Edward II. The country was growing more prosperous and a thriving trade sprang up at ports like Rhuddlan, Beaumaris, Haverfordwest and Carmarthen. It is therefore startling to find, at the opening of the 15th century, Wales convulsed by a new revolt, more widespread than any of its predecessors.

Owain Glyn Dwr was the direct male representative of the line of Northern Powys, with claims through his mother to the lands of the Lord Rhys. At the accession of Henry IV., he held a portion of this inheritance on the banks of the Dee and of the Teify. When in 1400 he broke into rebellion, it was mainly to vindicate personal wrongs. But Henry underestimated both the hereditary prestige and the high abilities of this warrior of courage and genius, with the result that Owain's power grew from year to year and he was ere long emboldened to proclaim himself independent prince of Wales. The capture of his enemy Reginald Grey gave him financial resources, that of Edmund Mortimer a valuable ally. He concluded a treaty with Charles VI. of France, won the castles of Harlech and Aberystwyth, held parliaments of his subjects, and exercised in a large part of Wales the powers of a ruling prince. The downfall of his friends, the Percys, at Shrewsbury (1403) was not fatal to the movement; more serious was the failure of the French at Woodbury Hill (1405) and the loss of the two castles (1408). As the difficulties of Henry IV. gradually disappeared, Owain's cause became hopeless and he died in hiding in 1416. He has never ceased to be the darling hero of Welsh popular tradition.

The Glyn Dwr movement left Welsh society in ruins and during the rest of the century recovery was but slow. Disorder returned with the Wars of the Roses, in which Welshmen such as Owen Tudor (d. 1461) and William Herbert, earl of Pembroke (d. 1469), were deeply involved. It was a Tudor who at last brought peace alike to England and Wales on the field of Bosworth, with a large Welsh following who reckoned that they had avenged in this victory the wrongs of foreign rule.

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(J. E. L.; X.)

HISTORY: II. 1485 TO THE 20TH CENTURY

Political and Legal Changes.—With the Tudor dynasty firmly established, certain constitutional changes intended to place Welsh subjects on a complete social and political equality with Englishmen have to be recorded. The Act of Union 1536 (27 Henry VIII.) converted the whole of the marches of Wales into shire ground and also created five new shires, Denbigh, Montgomery, Radnor, Brecknock and Monmouth. At the same time, remaining lordships were added to the existing Welsh shires of Cardigan, Carmarthen, Glamorgan and Pembroke, to the further

enlargement of their boundaries. Clause 26 of the same act likewise decreed that the 12 Welsh shires should return 24 members to the English parliament; one for each shire, and one for the boroughs in each shire (except Merioneth), and one for the town and county of Haverfordwest. It is probable that Welsh members attended the parliaments of 1536 and 1539, and it is certain that they were present at the parliament of 1541 and every parliament subsequently held. This Act of Union was followed in 1542 by an "Act for certain Ordinances in the King's Majesty's dominion and Principality of Wales" (34 and 35 Henry VIII.), which placed the court of the president and council of Wales and the marches on a legal footing. This court, with a jurisdiction akin to that of the Star Chamber, had originally been set up under Edward IV. with the object of suppressing private feuds and other illegalities amongst the lords-marcher and their retainers. The council of Wales, with its headquarters at Ludlow, undoubtedly did good service on behalf of law and order under such capable presidents as Bishop Rowland Lee and William Herbert, earl of Pembroke; but it had become an obsolete engine of oppression by the time of the Commonwealth, although it was not definitely abolished until the revolution of 1688. The act of 1542 also enacted that courts of justice under the title of "the king's great sessions in Wales" should sit twice a year in every county of Wales, except Monmouth, which was thus formally declared an English shire. For this purpose four circuits, two for North and two for South Wales, were created; whilst justices of the peace and lords-lieutenant for each shire were now appointed. At the same time, all ancient Welsh laws and customs, which were at variance with the recognized law of England, were now declared illegal, and the old Cymric tenure by gavelkind, which had been respected by Edward I., was expressly abolished and its place taken by primogeniture. It was also enacted that all legal procedure must henceforth be conducted in English, an arrangement that fell very heavily on poor monoglot Welshmen and a curiously ungracious measure from a Welsh-born sovereign. Under this system of the great sessions justice was administered throughout the 12 shires of Wales for nearly 300 years, and it was not until 1830 that these Welsh sessions were abolished (not without some protest from Welsh members at Westminster), and the existing North and South Wales circuits were brought into being.

The Welsh Bible.—With the peaceful absorption of the principality into the realm of the Tudors, the subsequent course of Welsh history assumes mainly a religious and educational character. As early as the reign of Henry VIII. there were to be found at court and in the universities a number of ardent and talented young Welshmen, adherents mostly of the reforming party in Church and State, who were destined to bring about a brilliant literary revival in their native land. Of this distinguished band the two most memorable names are those of Bishop Richard Davies (*c.* 1501–1581), and of William Salesbury, the scholar-squire of Llanrwst (*c.* 1520–1600) in Denbighshire, who is commonly accounted the author of the first printed book in the Welsh language, a small volume of proverbs with the title "Oll Synnwyr pen Kembero," printed in London in or about 1545. With the accession of Elizabeth a vigorous ecclesiastical policy on truly national lines was now started in Wales itself, chiefly through the influence of Richard Davies, then bishop of St. David's, who was doubtless responsible for the act of parliament of 1563 which charged the bishops of St. David's, Bangor, Llandaff, St. Asaph and Hereford to prepare with all speed for public use Welsh translations of the Scriptures and the Book of Common Prayer. Of the five prelates thus named, Davies alone was competent to perform the allotted task, and for assistance in his work of translation he summoned his old friend and former neighbour, William Salesbury. The pair laboured together at Abergwili palace, near Carmarthen, with such diligence that before the close of 1567 the Welsh translations of the Liturgy and the New Testament were published in London; the Liturgy being the exclusive work of Bishop Davies, whilst the New Testament was translated by Salesbury, with the exception of certain epistles from the pen of the bishop and the Book of Revelation, which was contributed by Thomas Huet (d. 1591), precentor of St. David's cathedral. But the honour of presenting his countrymen with a complete Welsh translation of the Bible was reserved for William Morgan (*c.* 1547–1604), vicar of Llanrhaidar-yn-Mochnant in Denbighshire, and afterwards bishop successively of Llandaff and of St. Asaph. For eight years Morgan was busied with his self-imposed task, being greatly helped and encouraged thereto by Archbishop Whitgift, by Bishop William Hughes (d. 1600) of St. Asaph, and by other leading dignitaries of the Church. In Dec. 1588 the first complete Welsh Bible was issued from the royal press at Westminster under the patronage of queen and primate, some 800 to 1,000 copies being supplied for distribution, to be read in all the parish churches of Wales. This famous *editio princeps* of the Welsh Bible was supplanted later under James I. by the Authorized Version, translated by Bishop Richard Parry (1560–1623) of St. Asaph, with the help of Dr. John Davies of Mallwyd (1570–1644), the first great Welsh lexicographer. At the tercentenary of "Bishop Morgan's Bible," in 1888, a memorial cross was erected in the cathedral close of St. Asaph in order to perpetuate the names and services of the eight leading Welsh translators: Bishops Davies, Morgan and Parry; William Salesbury; Thomas Huet; Dr. John Davies of Mallwyd; Archdeacon Edmund Prys (1541–1624), author of a popular Welsh metrical version of the Psalms; and Gabriel Goodman, dean of Westminster (1528–1601), a native of Ruthin, who had greatly assisted Bishop Morgan in the work of printing and editing.

These translations of the Bible and Liturgy definitely fixed the standard of classical Welsh.

Puritanism and the Civil Wars.—The growth of Puritanism in Wales, where the people still clung largely to Catholic tradition, was neither strong nor speedy, although the year 1588 (which saw the publication of Bishop Morgan's Bible) gave birth to two fierce appeals to parliament, urging a drastic puritanical policy in Wales, from the pen of the celebrated John Penry, a native of Brecknock (1559–1593). Far more influential than Penry were Rhys Prichard (? 1579–1644), the famous vicar of Llandovery, Carmarthenshire, and William Wroth (d. 1642), the puritan rector of Llanfaches, Monmouthshire. Of these two divines, Vicar Prichard, who was essentially orthodox, forms an interesting connecting link between the learned Elizabethan translators and the great revivalists of the 18th century, and his moral rhymes in the vernacular, collected and printed after his death under the title of *The Welshman's Candle* (Canwyll y Cymry), still retain some degree of popularity. Prichard rose to become chancellor of St. David's cathedral; but the indiscreet Wroth, "the founder and father of nonconformity in Wales," being suspended in 1638 by Bishop Murray of Llandaff, founded a small community of Independents at Llanfaches, which is thus commonly accounted the first dissenting chapel in Wales. The effects, however, of the great literary revival of Elizabeth's reign were by no means exhausted, for during this period Wales certainly possessed many native divines who were at once active parish priests and good scholars, many of them having been educated at Jesus college, Oxford, the Welsh college endowed by Dr. Hugh Price (d. 1574) and founded under Elizabeth's patronage in 1573. So striking was the devotion shown throughout the principality to Charles I., who fought his last disastrous campaigns in the friendly counties of Wales and the marches, that on the final victory of the Parliament there was passed within a month of the king's execution (perhaps as a special measure of punishment) an "Act for the Better Propagation and Preaching of the Gospel in Wales," by the terms of which a packed body of 70 commissioners was given practically unlimited powers to deal with all matters ecclesiastical in Wales. To assist these commissioners in their task of enquiry and ejectment, a body of 25 "approvers" was likewise constituted, with the object of selecting itinerant preachers to replace the dismissed incumbents. Some 330 out of a possible total of 520 incumbents were ejected in St. David's and Llandaff, and there is every reason to suppose that the beneficed clergy of Bangor and St. Asaph suffered equally. A monster petition of protest, signed alike by moderate Puritans and by High Churchmen, was prepared for presentation to parliament in 1652 by Col. Edward Freeman, the attorney-general for South Wales. Despite the fierce efforts of

Vavasor Powell and his friends to thwart the reception of this petition at Westminster, Col. Freeman was able to urge the claims and complaints of the petitioners, or "anti-propagators" as they were termed, at the bar of the House of Commons, openly declaring that by the late policy of ejectment and destruction "the light of the Gospel was almost extinguished in Wales." At the Restoration all the ejected clergy who survived were reinstated in their old benefices under the Act of Uniformity of 1662, while many Puritan incumbents were in their turn dismissed for refusing to comply with various requirements of that act. Amongst these latter, Stephen Hughes of Carmarthen (1623–1688), a devoted follower of Vicar Prichard and an editor of his works, was ejected from his living of Mydrim in Carmarthenshire, whereby the valuable services of this eminent divine were gained by the Nonconformists, whose numbers had increased since the Civil Wars. The old Church policy on national lines, begun by Elizabeth and productive of so much good work in Wales, was now gradually relaxed under the later Stuarts, and definitely abandoned under their Hanoverian successors.

Popular Education and the Methodist Revival.—All contemporary writers agree that the mass of the Welsh people at the close of the 17th century were illiterate. English was little understood or spoken amongst the rural population, and there was a marked dearth of Welsh educational books. Some efforts to remedy this dark state of things had already been made by Thomas Gouge, with the assistance of Stephen Hughes, and also by the newly-founded Society for the Promotion of Christian Knowledge. But it was Griffith Jones (1683–1761), rector of Llanddowror in south Carmarthenshire, who was destined to become the true pioneer of Welsh education, religious and secular. Early in the reign of George I. this excellent man, whose name and memory will ever be treasured in Wales, began a system of catechizing in the vernacular among the children and adults of his own parish. With the help of Sir John Philipps (d. 1736), of Picton castle, and Mrs. Bridget Bevan of Laugharne (d. 1779), who is still affectionately remembered in Wales as the pious donor of "Madam Bevan's charity," Griffith Jones was enabled to extend his scheme of popular education throughout South Wales, where numerous "circulating charity schools," as they were called, were set up in rural parishes with the approval of their incumbents. The results obtained by the development of these schools were speedy and successful beyond the wildest hopes of their founder. This novel educational system in 1760 numbered 215 schools, with a total number of 8,687 scholars; and by the date of Jones's death, in 1761, over 150,000 persons of every age and of either sex—nearly a third of the whole population of Wales at that date—had been taught to read the Scriptures in their own language by means of these circulating schools. With this newly acquired ability to read the Bible, the many persons so taught were not slow to express a keen demand for Cymric literature, which was met by a supply from local presses in Wales. The success, in fact, of the Welsh circulating schools created the Welsh vernacular press.

Meanwhile, the writings and personal example of the pious rector of Llanddowror were stirring other Welshmen in the work of revival, chief amongst them being Howell Harris of Trevecca (1713–1773), a layman of brilliant abilities but of erratic temperament, and Daniel Rowland (1713–1790), curate of Llangeitho in Cardiganshire, who soon became the most eloquent and popular preacher in all Wales. Two other clergymen who figure prominently in this Methodist movement and whose influence has proved lasting were Peter Williams of Carmarthen (1722–1796), the Welsh Bible commentator, and William Williams of Pantycelyn (1717–1791), the celebrated Welsh hymn-writer.

The Methodist Secession.—During the lifetime of Griffith Jones the course of Welsh Methodism had run in orthodox channels, and had been generally supported by the Welsh clergy and gentry. But after 1761 the tendency to exceed the bounds of conventional Church discipline grew so marked as to excite the alarm of the English bishops in Wales. Yet the bulk of the Methodists continued to receive the Sacraments from regularly ordained parish priests, although a schism was threatened. Towards the close of the 18th century the Methodist revival spread to North Wales, through the influence of the celebrated Thomas Charles, commonly called Charles of Bala (1755–1814), formerly curate of Llanymawddwy and founder of Welsh Sunday schools. Relations rapidly grew strained between the English rulers of the Church and the Methodists, and in 1811 the long-expected schism took place, much to the regret of Charles himself, who had ever professed himself a devoted disciple of Griffith Jones. The bulk of the farming and labouring members of the Church definitely seceded from their "ancient mother," to whom, however, the Welsh gentry still adhered. Later history of the subject is treated under *Religion,* above.

Other Movements.—In the Rebecca riots (*q.v.*) of 1843 in South Wales, many toll gates were destroyed by mobs of country men disguised in female garb as "the daughters of Rebecca about to possess the gates of their enemies." In 1885–86 the anti-tithe agitation—largely traceable to the violent language about clerical tithe employed by certain organs of the vernacular press—led to some disorderly scenes between the distraining police and the country folk, especially in the Cardigan district. That peculiar movement of religious enthusiasm known as a revival (*diwygiad*) occurred from time to time, notably in 1859 and 1904.

National Institutions.—In July 1911, shortly after the investiture by King George V of the prince of Wales at Caernarvon castle with much pomp, the foundation stone of the National Library of Wales was laid by the king at Aberystwyth. It acquired a world-wide reputation, the completed buildings being opened in state by King George VI in 1937. In April 1927 the splendid buildings of the National Museum of Wales were formally opened by the king in Cardiff.

Welsh Societies.—In the National Eisteddfod (*q.v.*), revived in the middle of the 19th century and held every August at some important centre of North or South Wales alternately, the most fervent element of Welsh nationalism is to be found. Meetings are held in connection with the National Eisteddfod by the Honourable Society of Cymmrodorion (founded in 1751 and revived in 1873), which encourages Welsh literature, science and art. Other societies which foster the feeling of nationality include Cymreigyddion, Cymdeithas and Gymraeg; in 1913 these and others formed themselves into a union (*Undeb Cenedlaethol y Cymdeithasau Cymraeg*).

The Welsh Language in the Schools.—The creation of a Welsh department of the board of education in 1907 admitted the special claims of the Welsh language in the schools. That the study of the Welsh language and literature was an essential element in the educational system of Wales was further emphasized by appointment in 1925 of a departmental committee to inquire into the question, its report being published in 1927 under the title *Welsh in Education and Life.* Except in the areas where Anglicization is most complete (Radnorshire, south Pembrokeshire, east Monmouthshire, and parts of Flintshire, Denbighshire, Glamorgan and the Montgomeryshire border), Welsh continues to be taught in the schools as the mother tongue or second language. Welsh is the medium for instruction in infants' schools in Welsh areas, English rarely being introduced until junior stage. In bilingual areas, children in infants' schools (and in some junior schools) are classified according to the language they speak at home, Welsh groups then being taught in Welsh and English groups in English. The census of 1931 showed that there still were 197,932 persons of the age of three and upwards in Wales and Monmouthshire who spoke only Welsh. The publication of Welsh books for children is on the increase.

The Welsh Language in the Courts.—In accordance with the policy of the Tudor dynasty to bring Welsh subjects into complete equality with Englishmen, section 17 of the Act of Union, 1536 (27 Henry VIII) had made the use of English compulsory in all courts of justice. The act was amended in 1887 (50 & 51 Vict. c. 55) to permit the use of Welsh by sheriffs and their officers, and in sheriff's courts, and in order to remove doubt as to the right of Welsh-speaking persons to testify in the Welsh language in courts of law in Wales, the Welsh Courts act, 1942, repealed the restrictive section altogether (27 Henry VIII, c. 26, s.

17); it also permitted the administration of oaths and affirmations in the Welsh language and provided for the employment and payment of interpreters in Welsh courts.

Preservation of Scenic and Historic Wales.—Much has been done to conserve places of natural beauty and buildings of historic interest. The National Trust acquired in 1895 4½ ac. of cliff land above the town of Barmouth, overlooking Cardigan bay, and subsequently, in addition to its activities in England, that pioneer private organization purchased or received by gift more than 10,000 ac. in Wales and Monmouthshire. Cilgerran castle in Pembrokeshire, Skenfrith castle in Monmouthshire, Segontium (a Roman station on the outskirts of Caernarvon), mediaeval houses at Conway and Tenby, the summit of Skirrid Fawr ("Holy Mountain") and Sugar Loaf near Abergavenny, and 4,500 ac. on the coast of Pembrokeshire are among the properties now secured in perpetuity for public enjoyment. Preservation was greatly stimulated by the National Trust acts of 1937 and 1939.

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WALEWSKI, ALEXANDRE FLORIAN JOSEPH COLONNA, COMTE (1810–1868), French politician and diplomatist, was born at Walewice near Warsaw on May 4, 1810, the son of Napoleon I. and his mistress Marie, Countess Walewski. At fourteen Walewski refused to enter the Russian army, escaping to London and thence to Paris, where the French government refused his extradition to the Russian authorities. Louis Philippe sent him to Poland in 1830, and he was then entrusted by the leaders of the Polish revolution with a mission to London. After the fall of Warsaw he took out letters of naturalization in France and entered the French army, seeing some service in Algeria. In 1837 he resigned his commission and began to write for the stage and for the press. The accession of Louis Napoleon to the supreme power in France guaranteed his career. He was sent as envoy extraordinary to Florence, to Naples and then to London, where he announced the *coup d'état* to Palmerston (*q.v.*). In 1855 Walewski succeeded Drouyn de Lhuys as minister of foreign affairs, and acted as French plenipotentiary at the Congress of Paris next year. When he left the Foreign Office in 1860 it was to become minister of state, an office which he held until 1863. Senator from 1855 to 1865, he entered the Corps Législatif in 1865, and was installed, by the emperor's interest, as president of the Chamber. A revolt against his authority two years later sent him back to the Senate. He died on Oct. 27, 1868.

WALKER, FRANCIS AMASA (1840–1897), American soldier and economist, was born in Boston, Mass., on July 2, 1840. His father, Amasa Walker (1799–1875), was also a distinguished economist whose principal work, *The Science of Wealth,* attained great popularity as a textbook. Francis Walker graduated at Amherst college in 1860, studied law and fought in the Northern army during the whole of the Civil War, being a prisoner in the famous Libby prison, Richmond. After the war he became editorial writer on the Springfield, Mass., *Republican,* and in 1869 was made chief of the Government bureau of statistics. He was superintendent of the ninth and tenth censuses (those of 1870 and 1880), and (1871–72) commissioner of Indian affairs. From 1873 to his death his work was educational, first as professor (1873–81) of political economy in the Sheffield scientific school at Yale, and then as president of the Massachusetts Institute of Technology, Boston. In other fields he promoted common-school education (especially in manual training), the Boston park system, and the work of the public library, and took an active part in the discussion of monetary, economic, statistical and other public questions. As an author he wrote on governmental treatment of the Indians, *The Wages Question* (1876), *Money* (1878), *Land and its Rent* (1883), *General Political Economy* (1883–84), and various other works. As an economist, from the time of the appearance of his book on the subject, he so effectively combated the old theory of the "wage-fund" as to lead to its abandonment or material modification by American students; while in his writings on finance, from 1878 to the end of his life, he advocated international bimetallism. He died in Boston Jan. 5, 1897.

See James Phinney Munroe, *A Life of Francis Amasa Walker* (1923).

WALKER, FREDERICK (1840–1875), English subject painter, the son of a designer of jewellery, was born in Marylebone, London, on May 24, 1840. His earliest book illustrations appeared in 1860 in *Once a Week.* In the *Cornhill Magazine,* his illustrations to Thackeray's *Adventures of Philip* and *Denis Duval,* are spirited works. He was elected an associate of the Society of Painters in Water Colours in 1864 and a full member in 1866; and in 1871 he became an associate of the Royal Academy and an honorary member of the Belgian Society of Painters in Water Colours. His first oil picture, "The Lost Path," was exhibited in the Royal Academy in 1863. In 1871 he exhibited his tragic life-sized figure of "A Female Prisoner at the Bar," a subject which now exists only in a finished oil study, for the painter afterwards effaced the head and was prevented by death from again completing the picture. On June 5, 1875 he died of consumption at St. Fillan's, Perthshire.

See G. Marks *Life and Letters of Frederick Walker, A.R.A.,* (1896); *Frederick Walker and his Works,* by Claude Phillips (1897).

WALKER, GEORGE (*c.* 1618–1690), hero of the siege of Londonderry, son of George Walker, rector of Kilmore and chancellor of Armagh (d. 1677). In the Irish war of 1688, Walker, though in Holy Orders and advanced in years, raised a regiment and endeavoured to concert measures with Robert Lundy, the acting governor of Londonderry, for the defence of Dungannon who, however, ordered the abandonment of the place on March 14, 1689.

On the approach of the enemy (April 13) Walker hurried to Londonderry to inform Lundy, but was unable to convince him of his danger. He returned to his men at Lifford, where, on the 14th, he took part in a brush with the enemy, afterwards following the retreat of the army to Londonderry. The town was in great confusion, and Walker found the gates shut against him and his regiment. He was forced to pass the night outside, and only entered the next day "with much difficulty and some violence upon the Centry." Immediately on his arrival he urged Lundy to take the field and refused the demand to disband his own soldiers. On the 17th of April Lundy determined to give up the town to James, and called a council from which Walker and others were especially excluded; but the next day the king and his troops, who had advanced to receive the surrender, were fired upon from the walls contrary to Lundy's orders, and the arrival of Captain Adam Murray with a troop of horse saved the situation. Lundy was deprived, and allowed to escape in disguise. On April 19 Walker and Baker were chosen joint-governors. Walker commanded fifteen companies, amounting to 900 men, and to him was also entrusted the supervision of the commissariat. He showed great energy, courage and resource throughout the siege, and led several successful sallies. At the close of the siege, which lasted 150 days, the town was at the last extremity; but at length, on July 30, Walker preached the last of the sermons by which he had helped to inspire its defence. An hour afterwards the ships were seen approaching, and the town was relieved.

Walker was received by William and Mary at Hampton court on Aug. 9, and presented with £5,000, part of which he appears to have given to Baker's widow. He was nominated to the bishopric of Londonderry, but was shot at the Boyne (July 1, 1690).

While in London Walker had published *A True Account of the Siege of Londonderry* (1689), dedicated to the king, which went through several editions and was translated for perusal abroad.

In the *Siege of Derry* (1893) the Rev. Philip Dwyer has collected

the most essential facts and materials relating to Walker and the siege, and has reprinted in his volume Walker's *True Account* and *Vindication*, together with Walker's sermons, various other documents and valuable notes.

WALKER, HENRY OLIVER (1843–1929), American artist, was born at Boston (Mass.) on May 14, 1843. He was a pupil of Léon Bonnat, Paris, and painted the figure and occasional portraits, but later devoted himself almost exclusively to mural decoration. His paintings, symbolizing lyric poetry, for the Congressional library, Washington, and his decorations for the Appellate Court house, New York city, the enlarged State house, Boston, the Court house, Newark (N.J.) and the Capitol at St. Paul (Minn.), are among his most important works. He died in Belmont (Mass.) on Jan. 14, 1929.

WALKER, HORATIO (1858–1938), American artist, was born at Listowel, Ontario, Canada, May 12, 1858. When he was a child his family settled at Rochester, N.Y. Although entirely self-taught, he became a distinguished painter of animals, the figure and landscape. His pictures, principally of Canadian peasant life and scenes, show the influence of Troyon and Millet, mainly in their feeling for largeness of composition, in solidity of painting and in the choice of themes. He was a member of the National Academy of Design, New York, and of the American Water Color Society.

See F. Newlin Price, *Horatio Walker* (1930).

WALKER, OBADIAH (1616–1699), master of University College, Oxford, born at Darfield near Barnsley, Yorkshire, was educated at University College, Oxford, becoming a fellow and tutor. In 1648 he was deprived of his academic appointments, but he returned to Oxford at the restoration of 1660. In June 1676 he was elected to the headship of this foundation. After the accession of James II. he declared himself a Catholic, being partly responsible for the tactless conduct of James in forcing a quarrel with the fellows of Magdalen College. Mass was said in his residence, and later a chapel was opened in the college for Roman worship. He died on Jan. 21, 1699.

WALKER, ROBERT (d. *c.* 1658), British painter, was a contemporary and to a slight extent a follower of Van Dyck. The date of his birth is uncertain, and no details are known of his early life. His greatest vogue was at the time of the Commonwealth, for in addition to several portraits of Cromwell he painted others of Lambert, Ireton, Fleetwood, and many more members of the Parliamentarian party. In 1652 he was given rooms in Arundel House in the Strand, London, where he resided for the rest of his life. He died either in 1658 or in 1660, the authority for the earlier date being an inscription on an engraved portrait by Lombart. His work was vigorous and showed sound study of character. Several of his paintings, among them the portrait of William Faithorne the elder, are in the National Portrait Gallery, and there are others of notable importance at Hampton Court and in the University galleries at Oxford. One of his portraits of Cromwell is in the Pitti Palace, where it is ascribed to Lely. Another is at Warwick castle.

WALKER, ROBERT JAMES (1801–1869), an American lawyer, economist, statesman and financial expert, probably rendered his greatest public service when as secretary of the Treasury under President Polk he proposed, during the summer of 1845 while the Oregon question endangered Anglo-American relations, a reduction of the American tariff in anticipation of the repeal of the British Corn Laws. His treasury report of Dec. 3 was a masterly presentation of the situation, and has been regarded as the most powerful attack upon the protective system ever made in an American State paper. He practically formulated and secured the passage of the "revenue" Walker Tariff Act of 1846 in conjunction with the repeal of the Corn Laws in Great Britain, while the Oregon question, which had thus been forced into a position of secondary importance, was "amicably" settled. Consequently, during the next 15 years before the outbreak of the Civil War (1861), Anglo-American commercial and investment and political and social relations grew into a bond rivalling that which had already developed between Lancashire and the cotton-growing South, while the grain-growing North-west became an element of strength in the struggle for the Union.

After the close of Polk's administration (1849), Mr. Walker became an agent in England for the Illinois Central railroad, a company in which Richard Cobden and some of his friends became deeply interested; and during the Civil War, as the agent of S. P. Chase, secretary of the Treasury, did valuable work in Great Britain and Germany, destroying the credit of the Confederate States in the former, and borrowing $250,000,000 in the latter. Mr. Walker's political career had begun during the nullification excitement of 1832–33, when at Natchez, Miss., on the first Monday of Jan. 1833, he delivered an able Union speech which attracted President Jackson's support and led to his election to the U.S. Senate on Jan. 8, 1836. As an ardent expansionist, he advocated the recognition of the republic of Texas (1837), took a leading part in the movement for annexation, and at one time during the war with Mexico wanted to acquire all of that country; but in the case of Oregon, while ostensibly supporting President Polk in a bold stand, he took the action mentioned above and offered no opposition to acceptance of the 49th parallel. In 1867–68 he rounded out his expansionist career by assisting with great profit to himself in the Russian sale of Alaska to the United States. As a constructive statesman, he was an important factor in the reorganization of the American treasury system during the 'forties, financed the war with Mexico, and advocated and drafted the bill (1849) for the establishment of the Department of the Interior. He was appointed territorial governor of Kansas in the spring of 1857 by President Buchanan, but in November of the same year resigned in disgust over the Lecompton constitution. From the beginning of his career he had been consistently opposed to slavery, but favoured gradual rather than immediate emancipation and as early as 1838 had freed his own slaves. Mr. Walker was, indeed, more Northern than Southern in his general inclinations. He was born, reared and educated in Pennsylvania, and he graduated with honours in the University of Pennsylvania (1829).

There is no biography of Robert J. Walker; but *see* sketches in *The Granite Monthly*, XII. 90–91; *The Green Bag*, XV. 101–106; and the detailed American histories covering the period of his life.

WALKER, WILLIAM (1824–1860), American adventurer, was born in Nashville, Tenn., on May 8, 1824. He graduated at the University of Nashville in 1838, and in 1843 received his M.D. from the University of Pennsylvania. Later he studied law and was admitted to the bar in New Orleans. On Oct. 15, 1853, he sailed from San Francisco with a filibustering force for the conquest of Mexican territory. He landed in Lower California, and on Jan. 18, 1854, he proclaimed this and the neighbouring State of Sonora an independent republic. Starvation and Mexican attacks led to the abandonment of this enterprise, and Walker resumed his journalistic work in California. On May 4, 1855, with 56 followers, Walker sailed for Nicaragua, where he had been invited by one of the belligerent factions to come to its aid. In October Walker seized a steamer on Lake Nicaragua belonging to the Accessory Transit Company, a corporation of Americans engaged in transporting freight and passengers across the isthmus, and was thus enabled to surprise and capture Granada and to make himself master of Nicaragua. Peace was then made; Patricio Rivas, who had been neutral, was made provisional president, and Walker secured the real power as commander of the troops. At this time two officials of the Accessory Transit Company determined to use Walker as their tool to get control of that corporation, then dominated by Cornelius Vanderbilt. They advanced him funds and transported his recruits from the United States free of charge. In return Walker seized the property of the company, on the pretext of a violation of its charter, and turned over its equipment to the men who had befriended him. On May 20, 1856, the new government was formally recognized at Washington by President Pierce. Walker managed to maintain himself against a coalition of Central American States, led by Costa Rica, which was aided and abetted by agents of Cornelius Vanderbilt, until May 1, 1857, when, to avoid capture by the natives, he surrendered to Commander Charles Henry Davis, of the U.S. Navy, and returned to the United States. In Nov. 1857

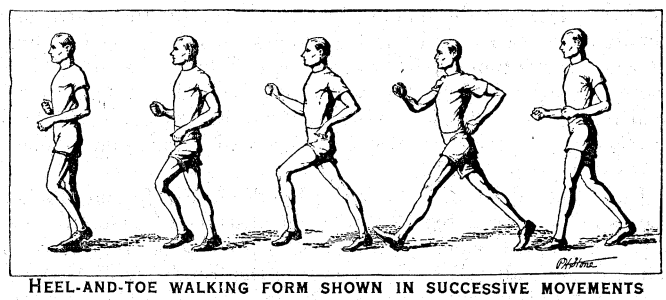
he sailed from Mobile with another expedition, but soon after landing at Punta Arenas he was arrested by Commander Hiram Paulding of the American Navy, and had to return to the United States as a prisoner on parole. On his arrival he was released by order of President Buchanan. After several unsuccessful attempts to return to Central America, Walker finally sailed from Mobile in Aug. 1860 and landed in Honduras. Here he was taken prisoner by Capt. Salmon, of the British Navy, and was surrendered to the Honduran authorities. He was executed Sept. 12, 1860.

See Walker's own narrative, accurate as to details, *The War in Nicaragua* (Mobile, 1860); also William V. Wells, *Walker's Expedition to Nicaragua* (1856); Charles William Doubleday, *Reminiscences of the "Filibuster" War in Nicaragua* (1886); James Jeffrey Roche, *The Story of the Filibusters* (1891), revised and reprinted as *Byways of War* (1901); and William O. Scroggs, *Filibusters and Financiers* (1916). (W. O. S.)

WALKING, the art of progression by setting one foot methodically before the other, is the most venerable and universal way of locomotion among mankind, and has been for a million years. Walking in the nobler sense is a measured progress inspired by the woods and hills, by rivers and the flowers of the field, a serene partaking of the enduring sources of joy. Walking conduces to meditation. Or perhaps it should be said that only those of philosophic spirit truly walk, receptive of the beauty which is everywhere in nature unmarred by man. Walking and meditative thought are bound together in the very name Peripatetic. As they walked they pondered, and as they pondered they walked. When the father of Chryseis walked silent along the shore of the much-resounding sea, he was inspired to seek aid of the lord of the silver bow, thereby recovering his beloved daughter. In the Orient, land of innumerable pilgrims, serene walking and worthy thinking go together. A *Sutta* tells us how the Buddha, descending from Vulture peak, came to the verge of the lotus lake where the peacocks were fed, and walked to and fro taking the air on the lawn of the peacocks.

Walking in the finest sense is for joy. It is notable that an early example of one who walked because he preferred to walk is Paul of Tarsus. He was on his way for the last time to Jerusalem, having come by boat from Philippi to the Troad. Then he sent his company by ship around the peninsula to Assos, "for so had he appointed, minding himself to go afoot."

Walking for love of a noble form of exercise, to enjoy the companionship of natural beauty, is hardly known in the classics. Xenophon and his companions trudged sturdily, but not for pleasure. Cicero has much to say, in the dialogue concerning *Old Age,* of the happiness of walking in a garden or among trellised vines, but we must await another age for the right celebration of the Euganean hills. So through the middle ages. There were roads and men traversed them, but the Canterbury pilgrims journeyed on horseback. Goldsmith, in *The Traveller,* records



HEEL-AND-TOE WALKING FORM SHOWN IN SUCCESSIVE MOVEMENTS

an inspiring tour through storied lands, but his mood was melancholy and friendless; nor is it recorded that he found solace afoot among the fields and woods of England. Rousseau is a more convinced walker. "What I most regret," he says, "is that I kept no records of my journeyings. Never have I thought so much, existed so much, lived so much, been so much myself, if I may dare to say it, as when I went alone and afoot." Long-legged Thomas Carlyle was a mighty walker, and he often went alone, given up to reflection in the silence of the moors and hills. Going forth in the white of the dawn from Muirkirk, where Duneaton water crosses the border of Ayr, he made his way through the heather of the Lowther hills, coming by nightfall to Dumfries, a good four and fifty miles. Wordsworth was untiring. His friend De Quincey held that with those identical legs Wordsworth must have traversed a distance that would have taken him seven times around the world, adding that to this mode of exertion "he was endebted for a life of unclouded happiness, and we for much of what is most excellent in his writings."

Walking merges into mountain climbing. The countrymen of Wordsworth have scaled notable peaks. James Bryce may stand as the type of these vigorous islanders, whether he was striding up Mount Ararat, or gaining a summit of the Basuto hills, or sturdily threading the trails of the New Hampshire uplands. Hudson holds a high place among famous walkers. The uplands and moors and beech woods of England, the stern reaches of Cornwall, live and breathe in his books.

Emerson's Monadnock journey is notable, but Thoreau is the best of American walkers and the worthiest recorder of the enduring worth of walking. His wandering through the White mountains, when he saw the pine grosbeaks, breathes the spirit of the ancient hills. The pilgrimage along Cape Cod is good history and excellent writing. The ascent of Katahdin carries the fragrance of primeval woods. Even more characteristic of his spirit are the walks about his own Concord, for which he has wrought an enduring monument.

WALKING RACES, an athletic sport, on road or track. These enjoyed a greater popularity in England than in any other country up to the time of the fourth Olympiad held in London in 1908. When the English championships were instituted in 1866 a 7m. walk was incorporated in the programme, the first title holder being J. G. Chambers, C.U.A.C., who covered the distance in 59mins. 32secs. Despite this initial success of a university athlete, walking races have never figured in the programme of the Oxford and Cambridge sports. In 1893 the English championship distance was reduced to 4m., but in 1901 the programme was again revised; the 4m. distance was reduced to 2m. and the 7m. walk was reinstated.

When the American championships were instituted in 1876 walking races were included at 1, 3 and 7m. The 7m. walk was dropped in 1878, replaced in 1879, dropped again in 1885, and again replaced in 1912. The 3m. was dropped in 1897 and resumed in 1907, while the 1m. walk survived until 1898, was restored in 1907 and finally abandoned in 1909.

Walking has never attained to any degree of popularity in the United States and there is no doubt that, once abandoned, the championship events would not have been revived but for the circumstance of the inclusion, for the first time, of walking races in the Olympic Games of London, 1908. This addition having been decided upon, American sportsmen set out to produce national champions as potential Olympic points scorers. The British dominions overseas, Denmark and Italy also began to take an interest in this form of athletics. Walking races at 3,500 metres (3,827yds.), and 10m. formed part of the Olympic programme in 1908. Both events were won by a Brighton policeman, G. E. Larner, with E. J. Webb, who had been both sailor and soldier, second. In the 3,500 metres, H. E. Kerr, Australasia, was third; G. Goulding, Canada, fourth; A. E. M. Rowland, Australasia, fifth; C. P. M. Westergaard, Denmark, sixth; and E. Rothman, Sweden, seventh. At the longer distance all six places were filled by representatives of Great Britain. The fifth Olympiad at Stockholm included only one walk, *i.e.,* 10,000 metres (6m. 376¼yds.). Goulding, Canada, won from Webb, Great Britain, in 46mins. 28⅗secs. This race was notable by the fact that A. Rasmussen, Denmark, finished third and F. Altimani, Italy, fourth. Neither of these men ever won an Olympic contest, but in 1913 Altimani achieved "noteworthy performances," not accepted as records, since there were only two time-keepers, at all distances from a half-mile in 3mins. 7secs., to 8m. in 57mins. 43⅖secs., while Rasmussen in 1918 set up world's records at 3,000 metres, 12mins. 53⅘secs.; 5,000 metres, 21mins. 59⅘secs.; 10,000 metres, 45mins. 26⅖secs.; and 15,000 metres, 1hr. 10mins. 23secs. At the seventh Olympiad, Antwerp, 1920, two walks were again included and

the growing fame of Italy was finally established by Ugo Frigerio, who won the 3,000 metres race in 13mins. 14⅘secs., and the 10,000 metres in 48mins. 6⅕secs. The 10,000 metres walk at Paris, 1924, was again won by Frigerio in 47mins. 49secs.

In 1932, when the Olympic Games were held at Los Angeles, U. S. A., walking was restored, after having been dropped in 1928. T. W. Green, Great Britain, won the new Olympic event, a road walk of 50km. (31m. 220yds.), in world's record time of 4hrs. 50mins. 10secs. This time was beaten at Berlin in 1936 by H. Whitlock, Great Britain (4hrs. 30mins. 38secs.), and in 1937 by Sibert of Alsace (4hrs. 24mins. 54secs.) during a walk from Dijon to Beaune.

Between 1932 and 1936 numerous world's records were established by the Englishmen A. Cooper, A. H. G. Pope and A. E. Plumb, and J. Dalinsh of Latvia. In 1936 the records were:—

Distance or time	Record		Holder	Country	Date
	hrs. mins.	secs.			
1 mile	6	25.8	G. H. Goulding	Canada	1910
3,000 metres	12	38.2	A. A. Cooper	Gt. Britain	1935
2 miles	13	11.8	G. Larner	" "	1904
3 miles	20	25.8	" "	" "	1905
5,000 metres	21	52.4	A. A. Cooper	" "	1935
4 miles	27	14.0	G. Larner	" "	1905
5 miles	35	47.2	A. H. G. Pope	" "	1932
6 miles	43	7.0	" " " "	" "	1932
10,000 metres	44	42.8	" " " "	" "	1932
7 miles	50	28.8	" " " "	" "	1932
8 miles	58	4.6	" " " "	" "	1932
9 miles	1 7	37.8	G. Larner	" "	1908
15,000 metres	1 10	23.0	G. Rasmussen	Denmark	1918
10 miles	1 15	57.4	G. Larner	Gt. Britain	1908
20,000 metres	1 34	26.0	J. Dalinsh	Latvia	1933
15 miles	1 56	9.8	" "	"	1933
20 miles	2 43	38.6	A. E. Plumb	Gt. Britain	1932
25 miles	3 32	26.0	J. Dalinsh	Latvia	1932
	miles	yards			
1 hour	8	474	A. H. G. Pope	Gt. Britain	1932
2 hours	15	768	J. Dalinsh	Latvia	1933

See S. A. Mussabini, *The Complete Athletic Trainer* (1913); Silfverstrand and Rasmussen, *Illustrated Text Book of Athletics* (1926).

(F. A. M. W.)

WALKLEY, ARTHUR BINGHAM (1855–1926), English dramatic critic, son of Arthur Hickman Walkley, was born at Bristol on Dec. 17, 1855. He was educated at Warminster school, Balliol and Corpus Christi colleges, Oxford. In 1877 he entered the Post Office in a junior capacity, rising to become assistant secretary in 1911. He was dramatic critic to the *Star*, the *Speaker* and the *Times*.

His criticism was none the less serious for being shrewd and witty, and was given greater value by his determination "that his work was the creative art of letters not the writing of news." Two volumes have been published of his collected *Times* articles. He died at Brightlingsea, on Oct. 7, 1926.

WALL, RICHARD (1694–1778), diplomatist and minister in the Spanish service, belonged to a family settled in Waterford. Debarred from public service at home as a Roman Catholic, he served in an Irish regiment—probably—of the Spanish army during the expedition to Sicily in 1718. Appointed secretary to the duke of Liria, his knowledge of languages, his adaptability, his Irish wit and self-confidence made him a favourite not only with the duke of Liria, but with other Spanish authorities. He became known to Jose Patiño, minister to Philip V., and was sent by him on a mission to Spanish America. In 1747 he was employed in the peace negotiations at Aix-la-Chapelle, and in 1748 was named minister in London, where he was popular. A partisan of an English alliance, his views recommended him to the favour of Ferdinand VI. (1746–59), whose policy was resolutely peaceful. From 1752–64 he was minister of foreign affairs at Madrid. Charles III. (1759–88) continued Wall in office, but the king's close relations with the French branch of the House of Bourbon made Wall's position very trying: as a foreigner he was suspected of favour to the English. Charles, however, detested changing his ministers and Wall only extorted leave in 1764 by feigning a disease of the eyes. He was given a handsome allowance and a grant for life of the crown land near Granada, which afterwards became Godoy's and finally, the duke of Wellington's.

See Coxe, *Memoirs of the Kings of Spain of the House of Bourbon* (London, 1815); *Documentos inéditos para la historia de España*, vol. xciii. (Madrid, 1842 *et seq.*).

WALLABY or **BRUSH KANGAROO,** names applied to the smaller kangaroos with naked muffle frequenting forests and scrubs, belonging to the subfamily Macropodinae. (*See* KANGAROO.)

WALLACE, ALFRED RUSSEL (1823–1913), British naturalist, was born at Usk, Monmouthshire, on Jan. 8, 1823. After leaving school he worked as a land surveyor and architect. About 1840 he began to take an interest in botany, and began the formation of a herbarium. In 1844–1845, while an English master in the Collegiate School at Leicester, he met H. W. Bates, through whose influence he became a beetle collector, and with whom he started in 1848 on an expedition to the Amazon. In March 1850 the two naturalists separated, and each wrote an account of his travels and observations. Wallace's *Travels on the Amazon and Rio Negro* was published in 1853. On his voyage home from South America the ship was burnt and his collections lost, except those which he had despatched beforehand. In 1854–62 he made a tour in the Malay Archipelago. His deeply interesting narrative, *The Malay Archipelago,* appeared in 1869. The chief parts of his vast insect collections eventually passed into the Hope Collection of the university of Oxford and the British Museum. Wallace divided the Malay Archipelago into a western group of islands, which in their zoological affinities are Oriental, and an eastern, which are Australian. The Oriental Borneo and Bali are respectively divided from Celebes and Lombok by a narrow belt of sea known as "Wallace's Line," on the opposite sides of which the indigenous mammalia are as widely divergent as in any two parts of the world. Wallace originated the theory of natural selection during these travels.

Origin of Species.—In February 1855, staying at Sarawak, in Borneo, he wrote an essay "On the Law which has regulated the Introduction of New Species" (*Ann. and Mag. Nat. Hist.*, 1855, p. 184). He states the law as follows: "Every species has come into existence coincident both in time and space with a pre-existing closely-allied species." For three years, so he tells us, "the question of *how* changes of species could have been brought about was rarely out of my mind." Finally, in February 1858, during a severe attack of intermittent fever at Ternate, in the Moluccas, he began to think of Malthus's *Essay on Population,* and, to use his own words, "there suddenly flashed upon me the *idea* of the survival of the fittest." The theory was thought out during the rest of the ague fit, drafted the same evening, written out in full in the two succeeding evenings, and sent to Darwin by the next post. Darwin in England at once recognized his own theory in the manuscript essay sent by the young and almost unknown naturalist in the tropics, then a stranger to him. "I never saw a more striking coincidence," he wrote to Lyell on the very day, on June 18, when he received the paper: "if Wallace had my ms. sketch written out in 1842, he could not have made a better short abstract! Even his terms now stand as heads of my chapters."

Under the advice of Sir Charles Lyell and Sir Joseph Hooker, the essay was read, together with an abstract of Darwin's own views, as a joint paper at the Linnean Society on July 1, 1858. The title of Wallace's section was "On the Tendency of Varieties to depart indefinitely from the Original Type." The "struggle for existence," the rate of multiplication of animals, and the dependence of their average numbers upon food supply, are very clearly demonstrated, and the following conclusion was reached: "Those that prolong their existence can only be the most perfect in health and vigour; . . . the weakest and least perfectly organized must always succumb."

The difference between Lamarck's theory and natural selection is very clearly pointed out. "The powerful retractile talons of the falcon and the cat tribes have not been produced or increased by the volition of those animals; but among the different

varieties which occurred in the earlier and less highly organized forms of these groups, *those always survived longest which had the greatest facilities for seizing their prey.* Neither did the giraffe acquire its long neck by desiring to reach the foliage of more lofty shrubs, and constantly stretching its neck for the purpose, but because any varieties which occurred among its antitypes with a longer neck than usual *at once secured a fresh range of pasture over the same ground as their shorter-necked companions, and on the first scarcity of food were thereby enabled to outlive them.*" With such clear statements as these in the paper of July 1, 1858, it is remarkable that even well-known naturalists should have failed to comprehend the difference between Lamarck's and the Darwin-Wallace theory. Wallace also alluded to the resemblance of animals, and more especially of insects, to their surroundings, and points out that "those races having colours best adapted to concealment from their enemies would inevitably survive the longest."

Natural Selection.—In 1870 Wallace's two essays, written at Sarawak and Ternate, were published with others as a volume, *Contributions to the Theory of Natural Selection.* In the additional essays, the new theory is applied to the interpretation of certain classes of facts. In this and other works, Wallace differs from Darwin on certain points. Thus the two concluding essays contend that man has not, like the other animals, been produced by the unaided operation of natural selection, but that other forces have also been in operation. We here see the influence of his convictions on the subject of "spiritualism." He expressed his dissatisfaction with the hypothesis of "sexual selection" by which Darwin sought to explain the conspicuous characters which are displayed during the courtship of animals. The expression of his opinion on both these points of divergence from Darwin will be found in *Darwinism* (1889).

Darwin died before the controversy upon the possibility of the hereditary transmission of acquired characters arose over the writings of Weismann, but Wallace freely accepted the general results of the German zoologist's teaching, and in *Darwinism* has presented a complete theory of the causes of evolution unmixed with any trace of Lamarck's use or disuse of inheritance, or Buffon's hereditary effect of the direct influence of surroundings. *Tropical Nature and other Essays* appeared in 1878, since republished combined with the 1871 *Essays,* of which it formed the natural continuation. His *Geographical Distribution of Animals* (1876), is a monumental work, which justifies its author's hope that it may bear "a similar relation to the eleventh and twelfth chapters of the *Origin of Species* as Mr. Darwin's *Animals and Plants under Domestication* bears to the first." *Island Life,* a supplement to the last-named work, appeared in 1880.

Miscellaneous Works.—Wallace published *Miracles and Modern Spiritualism* in 1875 (new ed. 1896). Here is given an account of the reasons which induced him to accept beliefs which are shared by so small a proportion of scientific men. These reasons are purely experimental, and in no way connected with Christianity, for he had long before given up all belief in revealed religion. In 1882 he published *Land Nationalization,* in which he argued the necessity of state ownership of land, a principle which he had originated long before the appearance of Henry George's work. In *Forty-five Years of Registration Statistics* (1885) he maintained that vaccination is useless and dangerous. Wallace also published an account of what he held to be the greatest discoveries as well as the failures of the 19th century, *The Wonderful Century* (1898; new ed. 1903). His later works include *Studies, Scientific and Social* (1900), *Man's Place in the Universe* (1903) and his *Autobiography* (1905). Later works were *The World and Life* (1910) and *Social Environment and Moral Progress* (1912). Possessed of a bold and original mind, his activities radiated in many directions, apparently rather attracted than repelled by the unpopularity of a subject. A non-theological *Athanasius contra mundum,* he has the truest missionary spirit.

Wallace was married in 1866 to the eldest daughter of the botanist, William Mitten, of Hurstpierpoint, Sussex. In 1871 he built a house at Grays, Essex, in an old chalk-pit, and after living there five years, moved successively to Croydon (two years) and Dorking (three years). In 1881 he built a cottage at Godalming near the Charterhouse school, and grew nearly 1,000 species of plants in the garden which he made. In 1889 he moved to Dorsetshire. After his return to England in 1862 Wallace visited the continent, especially Switzerland, for rest and change (1866, 1896) and the study of botany and glacial phenomena (August 1895). In 1910 he received the Order of Merit. Wallace died at Broadstone, Dorset, on Nov. 7, 1913.

See A. R. Wallace, *My Life* (new ed., 1908); J. Marchant, *A. R. Wallace: letters and reminiscences* (2 vols., 1916); L. T. Hogben, *A. R. Wallace* (1918); B. Petronijevic, *C. Darwin and A. R. Wallace* (1925).

WALLACE, SIR DONALD MACKENZIE (1841–1919), British author and journalist, was born on Nov. 11, 1841. He was educated at the universities of Glasgow, Edinburgh, Berlin and Heidelberg and at the École de Droit, Paris. When 28 years of age he was invited by a friend to visit Russia, and became so much interested that he remained there for six years. His *Russia* (1877) had a great success, and was at once recognized as a classic. Mackenzie Wallace acted as correspondent of *The Times* in St. Petersburg (Leningrad), Berlin and Constantinople, and after the battle of Tell-el-Kebir (1882) in Egypt. From 1884–89 he was in India as private secretary to the viceroy, Lord Dufferin, and to his successor, Lord Lansdowne. From 1891–99 he was director of the foreign department of *The Times.* In 1899 he undertook the editorship of the New Volumes (issued in 1902 as the 10th edition) of *The Encyclopædia Britannica.* He was created K.C.I.E. in 1887, and K.C.V.O. in 1901. Wallace died at Lymington, Hants, on Jan. 10, 1919.

WALLACE, HENRY AGARD (1888–), American statesman, born in Adair county, Ia., on Oct. 7, 1888, is the son of H. C. Wallace, secretary of agriculture under Harding and Coolidge. After graduation from Iowa State college (1910) Henry became associate editor of his grandfather's paper *Wallace's Farmer* and full editor in 1924. In 1932 he was given the post of secretary of agriculture. He is the author of *America Must Choose* (1934), *New Frontiers* (1934) and *Whose Constitution?* (1936). Wallace was vice-president of the U.S. during Roosevelt's 3rd term, 1941–44, and in 1945 was appointed secretary of commerce.

WALLACE, LEWIS (LEW) (1827–1905), American soldier and author, was born at Brookville (Ind.), April 10, 1827. He abandoned law in Indianapolis to recruit volunteers for the Mexican War, and served in 1846–47. In the Civil War he served in the West Virginia campaign. After the capture of Fort Donelson as major-general, he was engaged at Shiloh, and commanded the Eighth Corps at Baltimore. By delaying the Confederate general J. A. Early at Monocacy he saved Washington from almost certain capture. General Wallace served as president of the courts of inquiry which investigated the conduct of General D. C. Buell and condemned Henry Wirz, commander of the Confederate prison at Andersonville (Ga.). He was also a member of the court which tried the alleged conspirators against President Lincoln. He resigned from the Army in 1865 to return to the bar. He served as governor of New Mexico Territory (1878–81) and as minister to Turkey (1881–85), but declined the mission to Brazil under President Harrison. He died at Crawfordsville (Ind.), Feb. 15, 1905. His literary reputation rests upon three historical romances: *The Fair God* (1873), a story of the conquest of Mexico; *The Prince of India* (1893), dealing with the Wandering Jew and the Byzantine empire; and his greatest popular success, *Ben Hur* (1880), an absorbing tale of the coming of Christ, which was translated into several languages, and provided spectacular entertainment on the stage and in moving pictures, the chariot scene being famous. *Lew Wallace: An Autobiography* was published in 1906.

WALLACE, SIR RICHARD, BART. (1818–1890), English art collector and philanthropist, was born in London on July 26, 1818, and died in Paris on July 20, 1890. He was a natural son of the fourth Marquess of Hertford and Agnes Jackson and was educated, mainly at Paris under the auspices of his father's mother, Maria, wife of the third marquess. At Paris he was well known in society, and became an assiduous collector of all sorts of valuable *objets d'art.* From 1857 Wallace devoted himself to assisting his

father, in Paris, to acquire a magnificent collection of the finest examples of painting, armour, furniture and *bric-à-brac*. In 1870 the Marquess of Hertford died unmarried, bequeathing to Wallace Hertford house and its contents, the house in Paris, and large Irish estates. Some of the finest things in the collection were then transferred to Hertford house. In 1871 he was created a baronet for his services in relief and hospital equipment during the siege of Paris. From 1873 to 1885 he sat in parliament for Lisburn, but he lived mostly in Paris among his art treasures. In 1878 he was one of the British commissioners at the Paris Exhibition, and he was also a trustee of the National Gallery and a governor of the National Gallery of Ireland. He married in 1871 the daughter of a French officer, and Lady Wallace, who died in 1897, bequeathed his great art collection to the British nation. It is now housed in Hertford house, Manchester square, London, which was acquired and adapted by the government.

See biography in *Catalogue of the Wallace Collection.*

WALLACE, SIR WILLIAM (*c.* 1270–1305), the popular national hero of Scotland, is believed to have been the second son of Sir Malcolm Wallace of Elderslie and Auchinbothie, in Renfrewshire. The only authority for the events of his early life is the metrical history of Blind Harry, who lived about two centuries later than Wallace, during which a considerable body of legend had probably gathered round the name. At the same time he professes to follow as his "autour" an account that had been written in Latin by John Blair, the personal friend and chaplain of Wallace himself. Blair's account has perished.

In his boyhood, according to the usual accounts, he resided for some time at Dunipace, in Stirlingshire, with an uncle, who is styled "parson" of the place. His education was continued at Dundee, where he made the acquaintance of John Blair. On account of an incident that happened at Dundee—his slaughter of a young Englishman named Selby, for an insult offered to him—he is said to have been outlawed, and so driven into rebellion against the English. He gradually gathered round him a body of desperate men whom he led in various attacks upon the English. Several of the more patriotic nobles—including the steward of Scotland, Sir Andrew Moray, Sir John de Graham, Douglas the Hardy, Wishart, bishop of Glasgow, and others—joined him. An attack was made upon the English justiciar, Ormsby, who was holding his court at Scone. The justiciar himself escaped, but many of his followers were captured or slain. The burning of the Barns of Ayr, the quarters of English soldiers, in revenge for the treacherous slaughter of his uncle, Sir Ronald Crawford, and other Scottish noblemen, followed.

The success of these exploits induced the English king to send an army, under the command of Sir Henry Percy and Sir Robert Clifford, against the insurgents. The English came up with Wallace at Irvine, when all Wallace's titled friends left him and made submission to Edward, except the ever faithful Sir Andrew Moray. The treaty of Irvine by which these Scottish nobles made submission, is printed in Rymer's *Foedera.* It is dated July 9, 1297, and is the first public document in which the name of Sir William Wallace occurs. Wallace retired to the north, and although deserted by the barons was soon at the head of a large army. In a short time he recovered almost all the fortresses held by the English to the north of the Forth. He had begun the siege of Dundee when he heard that an English army, led by the earl of Surrey and Cressingham the treasurer, was on its march northward.

Battle of Stirling.—Leaving the citizens of Dundee to continue the siege of the castle, he made a rapid march to Stirling. Encamping in the neighbourhood of the Abbey Craig—on which now stands the national monument to his memory—he watched the passage of the Forth. After an unsuccessful attempt to bring Wallace to terms, the English commander, on the morning of Sept. 11, 1297, began to cross the bridge. When about one half of his army had crossed, and while they were still in disorder, they were attacked with such fury by Wallace, that almost all—Cressingham among the number—were slain, or driven into the river and drowned. Those on the south side of the river were seized with panic and fled tumultuously, having first set fire to the bridge. The Scots, however, crossed by a ford, and continued the pursuit as far as Berwick. Sir Andrew Moray was killed.

Its results were important. The English were everywhere driven from Scotland. To increase the alarm of the English, as well as to relieve the famine which then prevailed, Wallace organized a great raid into the north of England, in the course of which he devastated the country to the gates of Newcastle. On his return he was elected guardian of the kingdom. In this office he set himself to reorganize the army and to regulate the affairs of the country. His measures were marked by much wisdom and vigour, and for a short time succeeded in securing order, even in the face of the jealousy and opposition of the nobles.

Battle of Falkirk.—Edward was in Flanders when the news of this successful revolt reached him. He hastened home, and at the head of a great army entered Scotland in July 1298. Wallace slowly retired before the English monarch, driving off all supplies and wasting the country. The nobles as usual for the most part deserted his standard. Edward, compelled by famine, had already given orders for a retreat when he received information of Wallace's position and intentions. The army, then at Kirkliston, was immediately set in motion, and next morning (July 22, 1298) Wallace was brought to battle in the vicinity of Falkirk. After an obstinate fight the Scots were overpowered and defeated with great loss. Among the slain was Sir John de Graham, the bosom friend of Wallace, whose death, as Blind Harry tells, threw the hero into a frenzy of rage and grief. The account of his distress is one of the finest and most touching passages in the poem. With the remains of his army Wallace found refuge for the night in the Torwood—known to him from his boyish life at Dunipace. He then retreated to the north, burning the town and castle of Stirling on his way. He resigned the office of guardian, and betook himself again to predatory warfare against the English.

Betrayal.—At this point his history again becomes obscure. He is known to have paid a visit to France, with the purpose of obtaining aid for his country from the French king. This visit is narrated with many untrustworthy details by Blind Harry; but the fact is established by other and indisputable evidence. When in the winter of 1303–1304 Edward received the submission of the Scottish nobles, Wallace was expressly excepted from all terms. A price was set upon his head, and the English governors and captains in Scotland had orders to use every means for his capture. On Aug. 5, 1305 he was taken—as is generally alleged, through treachery—at Robroyston, near Glasgow, by Sir John Menteith, carried to the castle of Dumbarton, and thence conveyed in fetters and strongly guarded to London. He reached London on the 22nd of August, and next day was taken to Westminster Hall, where he was impeached as a traitor by Sir Peter Mallorie, the king's justice. To the accusation Wallace made the simple reply that he could not be a traitor to the king of England, for he never was his subject, and never swore fealty to him. He was found guilty and condemned to death. The sentence was executed the same day with circumstances of unusual cruelty.

For bibliography *see* the article in the *Dict. Nat. Biog.* The principal modern lives are James Moir's (1886), and A. F. Murison's (1898). (A. F. Hu.; X.)

WALLACE, WILLIAM VINCENT (1812–1865), Irish composer, was born at Waterford, Ireland, on Mar. 11, 1812. He led a roving and adventurous career in Australia, the South Seas, India, and S. America. In 1845 he settled in London and in November of that year his opera *Maritana* was played at Drury Lane theatre with great success. This was followed by *Matilda of Hungary* (1847), *Lurline* (1860), *The Amber Witch* (1861), *Love's Triumph* (1862), and *The Desert Flower* (1863). He also composed for the piano. He died on Oct. 12, 1865.

WALLACE, a city of Idaho, on the Coeur d'Alene river. Population in 1940, 3,839. The city lies in a cup in the mountains, at an altitude of 2,733 ft., and is the trading centre for the Coeur d'Alene mining district, which produces 19·4% of the lead, 23·2% of the silver and 8·1% of the zinc mined in the U.S. and had in 1939 an output valued at $22,805,024. About 25 mi. W. is the old Mission of the Sacred Heart, built in 1853 without nails by three Jesuit priests, aided by the Coeur d'Alene Indians. Wallace was settled in 1884 and incorporated in 1892.

WALLACK, JAMES WILLIAM (1795–1864), Anglo-American actor and manager, born in London Aug. 24, 1795. His parents and their four children were all actors of merit. From 1807 to 1818 he appeared chiefly at the Drury Lane Theatre in London. Between 1818 and 1852 he frequently crossed and recrossed the Atlantic, playing alternate engagements at London and New York. He settled in New York permanently in 1852 and opened the first Wallack's Theatre at the corner of Broadway and Broome streets. Here he remained with a notable company until 1861 and then removed to the second Wallack's Theatre which he himself built at 13th Street and Broadway. His was the best-known house in the city. Thackeray praises his Shylock, and Joseph Jefferson, his Don Caesar de Bazan. He married the daughter of John H. Johnstone, a comedian long popular in England.

Their son, JOHN LESTER WALLACK, was born in New York City Jan. 1, 1820. After playing on the Dublin and London stage he made his first New York appearance in 1847 at the Broadway Theatre.

Wallack played here two years, then at the Bowery, Niblo's Garden, Brougham's Lyceum, and finally, beginning in 1852, in leading parts at his father's theatre. He succeeded to the management of Wallack's Theatre in 1861, continuing it in the traditions of his father. In 1882 he opened the third Wallack's Theatre at 30th street and Broadway. He afterwards conducted both theatres with marked success until his death, Sept. 6, 1888, at Stamford, Conn.

He had one of the largest repertoires of any American actor, and showed particular aptitude for light comedy and romantic parts.

He wrote his own *Memories of Fifty Years* (1889).

WALLASEY, county and parliamentary borough, Cheshire, England. Pop. (1938) 94,220. Area, 9.2 sq.mi. It is served by the L.M.S. and G.W. railways, and ferries which carry about 19,000,000 passengers annually connect it with Liverpool and other points. The church of St. Hilary, a foundation of the 10th century, was rebuilt in 1759 and again in 1858 after a fire. In the west is Leasowe castle, supposed to have been built by the 5th earl of Derby. The Birkenhead docks were built on Wallasey Pool, when remains of a submerged forest with animal skeletons were found. New Brighton in the north is a watering place and residential area.

A promenade traverses the river front and there are piers at New Brighton and Egremont. Wallasey was incorporated in 1910, became a county borough in 1913 and a parliamentary borough in 1918.

WALLA WALLA, a city in the southeastern part of Washington, U.S.A. Walla Walla is served by the Northern Pacific and the Oregon Railroad & Navigation Co.'s (Union Pacific) lines and an air line. Pop. (1940) 18,109 federal census. It is the metropolis of the fertile Walla Walla valley, stretching away to the Blue mountains on the east, which produces large crops of wheat, alfalfa, vegetables, apples, prunes, cherries and melons and large quantities of live stock and poultry. The canning of peas is a major industry in this area. It is the seat of Whitman college (chartered 1859) and Walla Walla college (Adventist; 1891). A mission of the American Board at Waiilatpu, 5 mi. west, was attacked by Indians in 1847, who massacred the missionary, Whitman, his wife, and 12 others, carrying off the rest of the residents as prisoners. In 1857 Ft. Walla Walla was built by the U.S. Government on the site of the present city. About the fort in 1857–58 a settlement grew up. Walla Walla was laid out and organized as a town in 1859 and in 1862 it was chartered as a city. The name is a Nez Percé Indian term meaning "many waters."

WALL-CREEPER, a bird (*Tichodroma muraria*) allied to the tree-creeper (*q.v.*), but larger and more brilliantly coloured. It inhabits central Europe. The wall-creeper belongs to the passerine family *Certhiidae*.

WALLENBERG, MARCUS (1864–1943), Swedish financier, brother of Knut Agathon Wallenberg, financier and Swedish foreign minister (1914–18), began his career as a naval officer, and then studied and practised law. He afterwards became a member of the managerial board of the Stockholm Enskilda Bank, being appointed managing director in 1911, vice-chairman in 1920 and chairman in 1938. He founded, or reorganized, a number of industrial undertakings in Sweden, and also, in 1905, the Norsk Hydro-elektrisk Kvaelstof Aktieselskab in Norway. In 1916 and 1917, and in 1917–18, he took part in the negotiations with the Allied Powers concerning trading matters. He became a member of the neutral Powers' economic section of the Supreme Economic council at Paris in 1919, took part in the Amsterdam meeting in 1919, and was Swedish representative at the Brussels Economic conference in 1920. He was finance delegate at the Genoa conference in 1922, a member of the finance committee of the League of Nations from 1920–30, and chairman of the committee for arranging the tax on German industry under the Dawes plan. From 1931 he was chairman of the arbitration committee appointed by the Bank for International Settlements in connection with its agreement concerning German credits. He died in Stockholm July 22, 1943.

WALLENSTEIN (properly WALDSTEIN), **ALBRECHT WENZEL EUSEBIUS VON,** duke of Friedland, Sagan and Mecklenburg (1583–1634), German soldier and statesman, was born of a noble but by no means wealthy or influential family at Herrmanic, Bohemia, on Sept. 15, 1583. After the death of his parents he was sent by his uncle, Slawata, to the Jesuit college of nobles at Olmütz, after which he professed, but hardly accepted, the Roman Catholic faith. In 1599 he went to the university of Altdorf, which he had to leave in consequence of some boyish follies. Afterwards he studied at Bologna and Padua, and visited many places in southern and western Europe. While in Padua he gave much attention to astrology, and during the rest of his life he never wavered in the conviction that he might trust to the stars for indications as to his destiny. For some time Wallenstein served in the army of the emperor Rudolph II in Hungary, which was commanded by a methodical professional soldier, Giorgio Basta. His personal gallantry at the siege of Gran won for him a company without purchase. In 1606 he returned to Bohemia, and soon afterwards married an elderly widow, Lucretia Nikossie von Landeck, whose great estates in Moravia he inherited after her death in 1614. His new wealth enabled him to offer two hundred horse, splendidly equipped, to the archduke Ferdinand for his war with Venice in 1617. Wallenstein commanded them in person, and from that time he enjoyed both favour at court and popularity in the army. He made a wealthy marriage with Isabella Katharina, daughter of Count Harrach.

In the disturbances which broke out in Bohemia in 1618 and proved to be the beginning of the Thirty Years' War, advances were made to Wallenstein by the revolutionary party; but he preferred to associate himself with the imperial cause, and he carried off the treasure-chest of the Moravian estates to Vienna, part of its contents being given him for the equipment of a regiment of cuirassiers. At the head of this regiment Wallenstein won great distinction under Buquoy in the war against Mansfeld. He was not present at the battle of the Weisser Berg, but he did brilliant service as second-in-command of the army which opposed Gabriel Bethlen in Moravia, and recovered his estates which the nationalists had seized. The battle of the Weisser Berg placed Bohemia at the mercy of the emperor Ferdinand, and Wallenstein turned the prevailing confusion to his own advantage. He secured the great estates belonging to his mother's family, and the emperor sold to him on easy terms vast tracts of confiscated lands. His possessions he was allowed to form into a territory called Friedland, and he was raised in 1622 to the rank of an imperial count palatine, in 1623 to that of a prince. In 1625 he was made duke of Friedland. Meantime he fought with skill and success against Gabriel Bethlen, and so enhanced his reputation at the dark moment when Vienna was in peril and the emperor's general Buquoy dead on the field of battle. He was not only the detached visionary with vast ambitions, but also the model ruler of his principality. He placed the administration of justice on a firm basis, founded schools, and developed agriculture and mining and manufactures.

When the war against the Bohemians had become a widespread

conflagration, Ferdinand found he had no forces to oppose to the Danes and the Northern Protestants other than the Army of the League, which was not his, but the powerful and independent Maximilian's, instrument. Wallenstein saw his opportunity and early in 1626 he offered to raise not a regiment or two, but a whole army for the imperial service. After some negotiations the offer was accepted, the understanding being that the troops were to be maintained at the cost of the countries they might occupy. Wallenstein's popularity soon brought great numbers of recruits to his standard. He soon found himself at the head of 30,000 (not long afterwards of 50,000) men. For the campaigns of this army in 1625, 1626 and 1627, against Mansfeld, the Northern Protestants and Gabriel Bethlen *see* THIRTY YEARS' WAR.

Having established peace in Hungary, Wallenstein proceeded, in 1627, to clear Silesia of some remnants of Mansfeld's army; and at this time he bought from the emperor the duchy of Sagan, his outlay in the conduct of the war being taken into account in the conclusion of the bargain. He then joined Tilly in the struggle with Christian IV., and afterwards took possession of the duchy of Mecklenburg, which was granted to him in reward for his services, the hereditary dukes being displaced on the ground that they had helped the Danish king. He failed to capture Stralsund, which he besieged for several months in 1628. This important reverse caused him bitter disappointment, for he had hoped that by obtaining free access to the Baltic he might be able to make the emperor as supreme at sea as he seemed to be on land. It was a part of Wallenstein's scheme of German unity that he should obtain possession of the Hanseatic towns, and through them destroy or at least defy the naval power of the Scandinavian kingdom, the Netherlands and England. This plan was completely frustrated by the resistance of Stralsund, and even more by the emperor's "Edict of Restitution," which not only rallied against him all the Protestants but brought in a great soldier and a model army, Gustavus and the Swedes.

At the same time the victory of the principles of the League involved the fall of Wallenstein's influence. By his ambitions, his high dreams of unity and the incessant exactions of his army, he had made for himself a host of enemies. He was reported to have spoken of the arrogance of the princes, and it appeared probable that he would try to bring them, Catholics and Protestants alike, into rigid subjection to the crown. Again and again the emperor was advised to dismiss him. Ferdinand was very unwilling to part with one who had served him so well; but the demand was pressed so urgently in 1630 that he had no alternative, and in September Wallenstein was removed.

Wallenstein accepted the decision calmly, gave his army to Tilly, and retired to Gitschin, the capital of his duchy of Friedland. There, and at his palace in Prague, he lived in an atmosphere of mysterious magnificence, the rumours of which penetrated all Germany.

Gustavus Adolphus had landed in Germany, and it soon became obvious that he was formidable. Tilly was defeated at Breitenfeld and on the Lech, where he received a mortal wound, and Gustavus advanced to Munich, while Bohemia was occupied by his allies the Saxons. The emperor entreated Wallenstein to come once more to his aid. Wallenstein at first declined; he had, indeed, been secretly negotiating with Gustavus Adolphus, in the hope of destroying the League and its projects and of building his new Germany without French assistance. However, he accepted Ferdinand's offers, and in the spring of 1632 he raised a fresh army as strong as the first within a few weeks and took the field. This army was placed absolutely under his control, so that he assumed the position of an independent prince rather than of a subject. His first aim was to drive the Saxons from Bohemia—an object which he accomplished without serious difficulty. Then he advanced against Gustavus Adolphus, whom he opposed near Nuremberg and after the battle of the Alte Veste dislodged. In November came the great battle of Lützen (*q.v.*), in which the imperialists were defeated, but Gustavus Adolphus was killed.

To the dismay of Ferdinand, Wallenstein made no use of the opportunity provided for him by the death of the Swedish king, but withdrew to winter quarters in Bohemia. In the campaign of 1633 much astonishment was caused by his apparent unwillingness to attack the enemy. He was in fact preparing to desert the emperor. In the war against the Saxons he had offered them as terms of peace the revocation of the Edict. Religious toleration and the destruction of the separatist régime, as well as not inconsiderable aggrandisements for his own power, formed his programme, so far as historians have been able to reconstruct it, and becoming convinced from Ferdinand's obstinacy that the Edict would never be rescinded, he began to prepare to "force a just peace on the emperor in the interests of united Germany." With this object he entered into negotiations with Saxony, Brandenburg, Sweden and France. He had vast and vague schemes for the reorganization of the entire constitutional system of the empire, with himself as supreme authority.

Irritated by the distrust excited by his proposals, and anxious to make his power felt, he at last assumed the offensive against the Swedes and Saxons, winning his last victory at Steinau on the Oder in October. He then resumed the negotiations. In December he retired with his army to Bohemia, fixing his headquarters at Pilsen. It had soon been suspected in Vienna that Wallenstein was playing a double part, and the emperor, encouraged by the Spaniards at his court, anxiously sought for means of getting rid of him. Wallenstein was well aware of the designs formed against him, but displayed little energy in his attempts to thwart them. This was due in part, no doubt, to ill-health, in part to the assurances of his astrologer, Battista Seni.

His principal officers assembled around him at a banquet on Jan. 12, 1634, when he submitted to them a declaration to the effect that they would remain true to him. This declaration they signed. More than a month later a second paper was signed; but on this occasion the officers' expression of loyalty to their general was associated with an equally emphatic expression of loyalty to their emperor. On Jan. 24 the emperor had signed a secret patent removing him from his command, and imperial agents had been labouring to undermine Wallenstein's influence. On the 7th two of his officers, Piccolomini and Aldringer, had intended to seize him at Pilsen, but finding the troops there loyal to their general, they had kept quiet. But a patent charging Wallenstein and two of his officers with high treason, and naming the generals who were to assume the supreme command of the army, was signed on Feb. 18, and published in Prague.

Wallenstein realized the danger, and on Feb. 23, accompanied by his most intimate friends, and guarded by about 1,000 men, he went from Pilsen to Eger, hoping to meet the Swedes under Duke Bernhard. After the arrival of the party at Eger, Colonel Gordon, the commandant, and Colonels Butler and Leslie agreed to rid the emperor of his enemy. On the evening of Feb. 25, Wallenstein's supporters Illo, Kinsky, Terzky and Neumann were received at a banquet by the three colonels and then murdered. Butler, Captain Devereux and a number of soldiers hurried to the house where Wallenstein was staying, and broke into his room. He was instantly killed by a thrust of Devereux's partisan. Wallenstein was buried at Gitschin, but in 1732 the remains were removed to the castle chapel of Münchengrätz. The murderers were handsomely rewarded for their so-called act of justice.

See Förster, *Albrecht von Wallenstein* (1834); Aretin, *Wallenstein* (1846); Helbig, *Wallenstein und Arnim, 1632–1634* (1850), and *Kaiser Ferdinand und der Herzog von Friedland, 1633–1634* (1853); Hurter, *Zur Geschichte Wallensteins* (1855); Fiedler, *Zur Geschichte Wallensteins* (1860); L. von Ranke, *Geschichte Wallensteins* (6th ed. Leipzig, 1910); Gindely, *Geschichte des dreissigjährigen Kriegs* (1869); S. R. Gardiner, *Thirty Years' War* (1874); P. Wiegler, *Wallenstein* (1920); H. V. Sebik, *Wallensteins Ende . . .* (Vienna, 1920).

WALLER, AUGUSTUS VOLNEY (1816–1870), English physiologist, was born at Faversham, Kent, on Dec. 21, 1816, and died at Geneva on Sept. 18, 1870. He studied in Paris and carried out researches at Bonn and Paris in neurology. The "Wallerian theory of degeneration" (*see* MEDICINE, HISTORY OF) was propounded by him in 1850 in a paper in *Philosophical Transactions*.

WALLER, EDMUND (1606–1687), English poet, was born on March 9, 1606, the eldest son of Robert Waller of Coleshill and Anne Hampden, his wife. Early in his childhood his father moved to Beaconsfield. Waller was educated at Eton and King's

College, Cambridge. He left without a degree, and it is believed that in 1621 he sat as a member for Agmondesham (Amersham) in the last parliament of James I. Clarendon says that Waller was "nursed in parliaments." In that of 1624 he represented Ilchester, and in the first of Charles I. Chipping Wycombe. The first act by which Waller distinguished himself, however, was his surreptitious marriage with a wealthy ward of the Court of Aldermen, in 1631. He was brought before the Star Chamber for this offence, and heavily fined. After bearing him a son and a daughter at Beaconsfield, Mrs. Waller died in 1634. It was about this time that the poet was elected into Falkland's "Club."

It is supposed that about 1635 he met Lady Dorothy Sidney, eldest daughter of the earl of Leicester, who was then eighteen years of age. He formed a romantic passion for this girl, whom he celebrated under the name of Sacharissa. She rejected him, and married Lord Spencer in 1639. In 1640 Waller was once more M.P. for Amersham; later, in the Long Parliament, he represented St. Ives. Waller had hitherto supported the party of Pym, but he now left him for the group of Falkland and Hyde. An extraordinary and obscure conspiracy against Parliament, in favour of the king, which is known as "Waller's Plot," occupied the spring of 1643, but on May 30 he and his friends were arrested. In the terror of discovery, Waller was accused of displaying a very mean poltroonery, and of confessing "whatever he had said, heard, thought or seen, and all that he knew . . . or suspected of others." Waller was called before the bar of the House in July, and made an abject speech of recantation. His life was spared and he was committed to the Tower, whence, on paying a fine of £10,000, he was released and banished the realm in Nov. 1643. He married a second wife, Mary Bracey of Thame, and went over to Calais, afterwards taking up his residence at Rouen.

In 1645 the *Poems* of Waller were first published in London, in three editions. Many of the lyrics were already set to music by Henry Lawes. In 1646 Waller travelled with Evelyn in Switzerland and Italy. During the worst period of the exile Waller managed to "keep a table" for the Royalists in Paris, although in order to do so he was obliged to sell his wife's jewels. At the close of 1651 the House of Commons revoked Waller's sentence of banishment, and he was allowed to return to Beaconsfield, where he lived very quietly until the Restoration.

In 1655 he published *A Panegyric to my Lord Protector,* and was made a Commissioner for Trade a month or two later. He followed this up, in 1660, by a poem *To the King, upon his Majesty's Happy Return.* Being challenged by Charles II. to explain why this latter piece was inferior to the eulogy of Cromwell, the poet smartly replied, "Sir, we poets never succeed so well in writing truth as in fiction." He entered the House of Commons again in 1661, as M.P. for Hastings, and Burnet has recorded that for the next quarter of a century "it was no House if Waller was not there." His sympathies were tolerant and kindly, and he constantly defended the Nonconformists. One famous speech of Waller's was: "Let us look to our Government, fleet and trade, 'tis the best advice the oldest Parliament man among you can give you, and so God bless you." After the death of his second wife, in 1677, Waller retired to his house called Hall Barn at Beaconsfield. In 1661 he had published his poem, *St. James' Park;* in 1664 he had collected his poetical works; in 1666 appeared his *Instructions to a Painter;* and in 1685 his *Divine Poems.* The final collection of his works is dated 1686, but there were posthumous additions made in 1690. He died at Hall Barn, with his children and his grandchildren about him, on Oct. 21, 1687.

Waller's lyrics were at one time admired to excess, but with the exception of "Go, lovely Rose" and one or two others, they have greatly lost their charm. His fancy was plain and trite. He made writing in the serried couplet the habit and the fashion. It was this regular heroic measure which was carried to so high a perfection by Dryden and Pope.

The only critical edition of Waller's *Poetical Works* is that edited, with a careful biography, by G. Thorn-Drury, in 1893. (E. G.; X.)

WALLER, SIR WILLIAM (*c.* 1597–1668), English soldier, son of Sir Thomas Waller, lieutenant of Dover, was educated at Magdalen Hall, Oxford, and served in the Venetian army and in the Thirty Years' War. He was knighted in 1622 after taking part in Vere's expedition to the Palatinate. In 1640, he became member of parliament for Andover and supported the parliament when the Civil War broke out in 1642. As colonel, he captured Portsmouth, Farnham, Winchester and other places and in 1643 as major-general he operated around Gloucester and Bristol (*see* GREAT REBELLION), winning a victory at Highnam and capturing Hereford. He then opposed the advance of Sir Ralph Hopton and the Royalist western army, and though defeated at Lansdown (near Bath) he shut up the enemy in Devizes. However, Hopton and a relieving force from Oxford completely defeated Waller's army at Roundway Down, many reproaching Essex, the commander-in-chief, for allowing the Oxford royalists to turn against Waller. The Londoners, who had called him "William the Conqueror," raised a new army, but the forces were distinctively local, and resented long marches and hard work far from their own counties. At the first siege of Basing House, they mutinied in face of the enemy, and their gallantry at critical moments, such as the surprise of Alton in December 1643 and the recapture of Arundel in January 1644, but partially redeemed their general bad conduct. Waller himself, a general of the highest skill, "the best shifter and chooser of ground" on either side, was, like Turenne, at his best at the head of a small and highly-disciplined army.

Though successful in stopping Hopton's second advance at Cheriton (March 1644), he was defeated by Charles I. in the war of manoeuvre which ended with the action of Cropredy Bridge (June), and in the second battle of Newbury in October his tactical success at the village of Speen led to nothing. His last expeditions were made into the west for the relief of Taunton, and in these he had Cromwell as his lieutenant-general. By this time the confusion in all the armed forces of the parliament had reached such a height that reforms were at last taken in hand. The original suggestion of the celebrated "New Model" army came from Waller (July 2, 1644). Simultaneously came the Self-Denying Ordinance, which required all members of parliament to lay down their military commands. Waller had already requested to be relieved—and his active military career came to an end. Embittered and a Presbyterian, he was constantly engaged in opposing the Independents and the army politicians, and in supporting the Presbyterian-Royalist opposition to the Commonwealth.

He was several times imprisoned between 1648 and 1659. He promoted the final negotiations for the restoration of Charles II. and sat in the Convention Parliament. He died on the 19th of September 1668.

See Wood's *Athenae Oxonienses,* ed. Bliss, iii. 812, and two partial autobiographies, "Recollections by General Sir William Waller" (printed in *The Poetry of Anna Matilda,* 1788), and *Vindication of the Character,* etc. (1797).

WALLINGFORD, a town and borough of Berkshire, England, on the Thames, 55 m. W. of London by the G.W. railway. Pop. (est. 1938) 3,068. Area 1.2 sq.mi.

The site of Wallingford was occupied by a Romano-British settlement. Wallingford was a fortified town before the Conquest, and, though burned by Sweyn in 1006, was the most important borough in Berkshire at the time of the Domesday Survey. The town suffered greatly from the Black Death, and its decline was accelerated by the building, in the early 15th century, of two bridges near Abingdon, which diverted the main road between London and Gloucester from Wallingford. The earliest charters were given by Henry I. and Henry II., the latter confirming the ancient privileges of the borough. These charters were confirmed and enlarged by Henry III. in 1267 and by Philip and Mary in 1557–58. The governing charter until 1835 was that given by Charles II. in 1663. Wallingford Castle was one of the last fortresses to hold out for Charles I. During the Commonwealth it was demolished by order of the Government. The church of St. Leonard's retains some Norman work. The ancient castle has left only its mound and earthworks, and other works may be traced surrounding the town on the landward side.

WALLINGFORD, a borough of New Haven county, Connecticut, U.S.A., 12 m. N.N.E. of New Haven, on the Quinnipiac

river and the New York, New Haven and Hartford railroad. Pop. (1940) 11,425. It is the seat of the Gaylord farm tuberculosis sanatorium, and of a Masonic home, built on property occupied (1851–80) by a branch of the Oneida community. The manufactures include silverware, brass goods, hardware, fire-arms, rubber goods, insulated wire and edge tools. The town of Wallingford was settled in 1670. In Jan. 1766, it adopted resolutions protesting against the Stamp Act, and imposed a penalty of 20s. on any one who should introduce or use stamped paper or parchment. Wallingford was incorporated in 1853.

WALLINGTON: *see* BEDDINGTON AND WALLINGTON.

WALLIS, JOHN (1616–1703), English mathematician, logician and grammarian, was born on Nov. 23, 1616, at Ashford, Kent, where his father was rector. He went up to Emanuel college, Cambridge, in 1632, became a fellow of Queen's, and took holy orders. He gained much credit with the parliamentarians by his talent in deciphering intercepted Royalist documents, and was presented in 1643 to the living of St. Gabriel, Fenchurch street, London, exchanged later for that of St. Martin, Ironmonger lane. Although he signed the Remonstrance against the execution of Charles I. he was appointed Savilian professor of geometry at Oxford in 1649, a chair which he held for over 50 years, until his death at Oxford on Oct. 28, 1703.

Works.—The works of Wallis relate to a multiplicity of subjects. His *Institutio logicae,* published in 1687, was very popular, and his *Grammatica linguae Anglicanae* indicates an acute and philosophic intellect. The mathematical works are published, some of them in a small 4to volume (Oxford, 1657) and a complete collection in three thick folio volumes (Oxford, 1693–99). The third volume includes, however, some theological and other material. The mathematical works contained in the first and second volumes occupy about 1,800 pages.

The *Arithmetica infinitorum* (1655) is the most important of his works. It relates chiefly to the quadrature of curves by the so-called method of indivisibles established by Bonaventura Cavalieri (*q.v.*) in 1629. (*See* GEOMETRY.) He extended the "law of continuity" as stated by Johannes Kepler; regarded the denominators of fractions as powers with negative exponents; and deduced from the quadrature of the parabola $y=x^m$, where m is a positive integer, the area of the curves when m is negative or fractional. As he was unacquainted with the binomial theorem, he attempted the quadrature of the circle by interpolation, and arrived at the remarkable expression known as *Wallis's Theorem.* (*See* article on CIRCLE.) In the same work Wallis obtained an expression for the length of the element of a curve, which reduced the problem of rectification to that of quadrature.

The *Mathesis universalis* (1658) a more elementary work, contains dissertations on algebra, arithmetic and geometry.

The *De algebra tractatus* (Eng. 1685) contains (chapters lxvi.–lxix.) the idea of the interpretation of imaginary quantities in geometry. This is given somewhat as follows: the distance represented by the square root of a negative quantity cannot be measured in the line backwards or forwards, but can be measured in the same plane above the line, or (as appears elsewhere) at right angles to the line either in the plane, or in the plane at right angles thereto. Considered as a history of algebra, this work is scrupulously fair to his predecessors in all cases where he was able to trace original discoveries.

The two treatises on the cycloid and on the cissoid, etc., and the *Mechanica* (three parts 1669–71) contain many results which were then new and valuable. The latter work contains elaborate investigations in regard to the centre of gravity, and in it Wallis employs the principle of virtual velocities.

For the prolonged conflict between Hobbes and Wallis, *see* HOBBES, THOMAS.

WALLIS ARCHIPELAGO (UVEA or UEA): *see* PACIFIC ISLANDS.

WALLON, HENRI ALEXANDRE (1812–1904), French historian and statesman, was born at Valenciennes on Dec. 23, 1812. Wallon succeeded Guizot as professor at the Sorbonne in 1846. Returning to politics in 1871 he immortalized himself by carrying his proposition for the establishment of the Republic with a president elected for seven years, and then eligible for re-election, which, after violent debates, was adopted by the Assembly on Jan. 30, 1875. "Ma proposition," he declared, "ne proclame pas la République, elle la fait." Upon the definitive establishment of the Republic, Wallon became Minister of Public Instruction, and effected many useful reforms, but his views were too conservative for the majority of the Assembly, and he retired in May 1876. He had been chosen a life senator in December 1875.

Returning to his historical studies, Wallon produced four works of great importance, though less from his part in them as author than from the documents which accompanied them: *La Terreur* (1873); *Histoire du tribunal révolutionnaire de Paris avec le journal de ses acts* (6 vols., 1880–82); *La Révolution du 31 mai et le fédéralisme en 1793* (2 vols., 1886); *Les Réprésentants du peuple en mission et la justice révolutionnaire dans les départements* (5 vols., 1880–1890). Besides these he published a number of articles in the *Journal des savants;* for many years he wrote the history of the Académie des Inscriptions (of which he became perpetual secretary in 1873) in the collection of *Memoirs* of this Academy. He died at Paris on Nov. 13, 1904.

WALLOON LITERATURE. Walloon is a Romance dialect, belonging to the same group as the Picard, Lorrain and Francian, of which the latter, under the name of French, has had such a notable development. The several varieties of Walloon are spoken in the southern part of Belgium, in that region generally called "Wallonie" (from a word coined about 1858), of which Liége is the chief centre of dialectal literature.

This literature has its historical monuments. To the north-east belong the cantilena of *Eulalie,* one of the oldest Romance texts (11th century), *Li Ver del Jüise* (the Last Trial), the *Dialogues du Pape Grégoire* (the Dialogues of Pope Gregory), commentaries on *Job, Lent Sermons* and the *Poème Moral,* a critical edition of which, prepared by Alph. Bayot, is to be published shortly. There are also the delightful song fable of *Aucassin and Nicolette,* one of the masterpieces of the middle ages, and the copious, but somewhat fastidious chronicles of Jean le Bel, Jacques de Hemricourt, Jean d'Outremeuse and Jean de Stavelot. Lastly, the edition by J. Cohen, in 1920, of the *Mystères et Moralités du XIVe S.,* has enriched the ancient literary patrimony of the Walloon country. The two Nativities to be found in Cohen's edition are undoubtedly the ancestors of *Noëls Wallons* (edit. by Doutrepont in 1909), which are still alive in the popular minds. It may be objected that those works were not written in the dialect spoken by the people at that time, but in a literary language of Picard rather than of French character. However, their dialectal features reveal the anonymous origin of the texts.

We must wait till the beginning of the 17th century before we can find works written in dialect. The three oldest texts written in the dialect of Liége are an *Ode,* dated 1620, a *Sonnet,* dated 1622, and a *Morality,* dated 1623. They were published in 1921 by Jean Haust. A pasquinade on *Women and Marriage* (edit. Jean Haust, 1925) is, unfortunately, undated, but might be assigned to about 1600. Of the 17th and 18th centuries we possess, in all, some 50 lyrical pieces; complaints of peasants about the devastations caused by foreign soldiers, speeches on the topics of the time, satires against the affectations of women, pamphlets about political troubles or religious controversies, humorous compliments on the occasion of a clerical promotion, etc. Their literary value is, on the whole, rather mediocre. An exception must be made, however, for the lyrical satire, *Les Ewes di Tongue* (the Waters of Tongres, 1700), by Lambert Rickmann, perhaps the best Walloon satire in existence, of astonishing verve, rich in somewhat gross but striking images.

In the middle of the 18th century, four comic operas were composed. They constitute the so-called *Théâtre Liégeois* (edit. Bailleux, 1854). A literary circle used to meet at Chevalier S. de Harlez's; its members (canons, deans, lords and rich bourgeois) amused themselves by writing burlesques, and a composer of great talent, Jean Noël Hamal, provided a lively and picturesque music to the libretti written by his friends. The performance achieved a tremendous success. The four plays in question are entitled *Li Voyedje di Tchaudfontaine* (the Journey

to Chaudfontaine), a delightful farce (edit. Haust, 1924); *Li Ljîdjwes Egadî* (the Enlisted Liégeois), a touching picture of local customs; *Li Fiesse di Houte-s'i-Ploût* (the Festival of H.), a village idyll with a somewhat weak plot; and above all, the most original piece of the collection, *Les Hypocondes* (the Hypochondriacs), a diverting picture of the whims and torments of imaginary invalids who go to Spa to drink the waters. A farce in two acts entitled *Li Mâlignant* (the Malevolent) closes this first series, which, although really remarkable for its local colour and veracity, is naturally deprived of high moral feeling.

The revolution of 1789 and the troubles it brought inspired numerous patriots of Liége with popular and satirical songs. Albin Body edited more than 250 of these, but they are now forgotten, with the exception of a song against *The Prussians,* written by the lawyer, J. J. Velez (1817), the popularity of which was revived by the World War.

Few names deserve notice in the first half of the 19th century. Among these may be mentioned *Li Côpareye* (1822) by Ch. N. Simonon, which celebrates the ancient clock-tower of the Cathedral of Saint-Lambert and the glorious deeds of the history of Liége; *Li Ktapé Manedje* (the Disordered Household) 1830, by H. J. Forir, a lively satire of the confusion produced in the commonwealth by carelessness and improvidence; *Li Pantalon Trawé* (the Torn Trousers) 1839, by Ch. Du Vivier, an epos, in a few stanzas, of the fighter of 1830, the humble soldier who served under different régimes without any personal profit; *Li Bourgoyne* (1846) by Jos. Lamage, a bacchic song which still enjoys popularity among the Walloon population.

A touching elegy *Leyiz-m'plorer* (Let Me Cry), 1854, and a graceful idyll *L'avez-v'-veyou passer?* (Did you see her pass?) 1856, revealed in Nicolas Defrecheux a true poet. The Walloon people were delighted to hear their patois express such sincerity so delicately. In 1856 the *Société Liégeoise de Littérature Wallonne* was founded. It grouped intellectuals, scholars, writers and folklorists into a kind of small provincial academy, held yearly competitions and published "Bulletins" and "Annuaires."

In 1857 it awarded a prize to *Li Galant dil Servante,* a play written by André Delchef, which opens the revival of the Walloon stage. In 1884, the Société awarded a prize to *Tîtâ l' Periquî,* by Edouard Remouchamps, a play which, because of its caustic vein and the admirable manner in which it was acted, led to a prodigious development of Walloon literature.

But everywhere the spoken dialect is losing ground to French; the dialect is considered as vulgar, especially in the Hainaut district, along the French frontier. However, the written dialect is used more than ever before. In nearly all villages, dramatic societies perform Walloon plays. In more important centres, writers are grouped in societies which award prizes and publish papers and periodicals: at Tournai, the *Théâtre* of Arthur Hespel, and the *Cabaret Wallon;* at Mons, the *Ropïeur* and its circle; at La Louvière, the *Mouchon d'Aunias;* at Charleroi, the *Association Littéraire;* at Namur, the society *Les Rèlîs* and its organ *Le Guetteur Wallon;* in Liége, the *Société de Littérature Wallonne,* the *Caveau Liégeois,* the *Auteurs Wallons,* the *Wallonne* and many others; and so at Verviers, at Malmedy, etc. Liége has two theatres which, every night, perform Walloon plays before a fairly large audience; humour and wit is their chief feature, except when such writers as Henri Hurard or Louis Lekeu, helped by excellent native actors, offer important plays. Poetry includes joyful songs, satirical pasquinades, sentimental ballads, and descriptive or narrative poems. Such works as *Li Panèd Bon Diu* (the Bread of God) by Henri Simon, the somewhat nostalgic poems of Joseph Vriendts, the love elegies of Emile Wiket, the lyrics of Martin Lejeune, Louis Lagauche, Marcel Launay, Jean Wisimus and many others, combine a real respect for style and prosody with true poetic feeling. Fiction has produced interesting works, such as the *Houlot* (1888) by D. D. Salme, *La Famille Tassin* (1900) by Ad. Tilkin, and the delicate *Solia d'Amour* (1928) by Joseph Laubain. Let us also mention *Cadet* by Jean Lejeune, who, with wonderful realism, relates incidents in the life of a rabbit, *Li Brak'nî* (the Poacher) by Joseph Calozet, a masterpiece that reminds the reader of the rustic stories of George Sand, and the tales *Pou Dire à l'Eschrienne* (Hearth Tales), to mention only a few. Walloon literature to-day is most vivid, and it is to be hoped that, like Gaelic literature, it will remain popular in its inspiration.

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WALL PAPER: *see* INTERIOR DECORATION: *Wall Paper.*

WALL PAPER MANUFACTURERS LTD. This British joint stock company was formed in 1899 to combine the undertakings of many of the large wall paper manufacturers of Great Britain. Later, in 1915, and again in 1934, other manufacturers joined the company, and it became the largest firm of its kind in the world.

The company manufactures not only paper and what are commonly known as wall papers, but also fancy papers, crepe paper, enamel papers, paper transparencies, paint, cretonnes, and brushes. According to the returns the United Kingdom in 1937 exported printed and embossed paper hangings to the extent of 84,826 cwt., value for export f.o.b. at £257,272. In 1938 the company had a share capital of £5,800,000, made up of £1,600,000 5% cumulative preference stock, £1,800,000 ordinary stock, and £2,400,000 deferred stock. (L. C. M.)

WALLQVIST, OLAF (1755–1800), Swedish statesman and ecclesiastic, was ordained in 1776, became doctor of philosophy in 1779, court preacher to Queen Louisa Ulrica in 1780, and bishop of Vexiö in 1787. He attracted the attention of Gustavus III. by his eloquent preaching at the fashionable St. Clara church at Stockholm and he was a bishop at thirty-two.

Gustavus placed him at the head of the newly appointed commission for reforming the ecclesiastical administration of the country. His political career began during the mutinous *riksdag* of 1786, when he came forward as one of the royalist leaders. At the stormy *riksdag* of 1789 it was very largely due to his cooperation that the king was able to carry through the famous "Act of Unity and Security" which converted Sweden from a constitutional into a semi-absolute monarchy. During the brief *riksdag* of 1792, as a member of the secret committee, Wallqvist was at the very centre of affairs and rendered the king essential services. Indeed it may be safely said that Gustavus III., during the last six years of his reign, mainly depended upon Wallqvist and his colleague, Carl Gustaf Nordin, who subordinated their private enmity to the royal service. During the Reuterholm (*q.v.*) administration, Wallqvist, like the rest of the Gustavians, was kept remote from court. In 1800 he was recalled to the political arena, but died on April 30. As bishop of Vexiö, he was remarkable for his administrative ability. He did much for education and for the poorer clergy, and endowed the library of the gymnasium with 6,000 volumes. His *Ecclesiastica Samlingar* testify to his skill and diligence as a collector of mss., while his *Minnen och Bref,* ed. E. V. Montan (Stockholm, 1878), is one of the most trustworthy authorities on the Gustavian era.

See R. N. Bain, *Gustavus III* and his Contemporaries (London, 1895, vol. ii.); *O. Wallqvists Själfiografiska anteckningar* (Upsala, 1850); and J. Rosengren, *Om O. Wallqvist såsom Biskop och Eforus* (Vexiö, 1901). (R. N. B.)

WALL RIB, in architecture, the rib of a groined vault connecting two adjacent piers on the same side of the vaulted area. Wall ribs seem to have belonged to the vaulting system from the very beginning, for they exist in what is probably the earliest ribbed vaulted nave, that of S. Ambrogio at Milan (generally attributed to the second half of the 11th century).

WALLSEND, municipal and parliamentary borough, Northumberland, England, 4 mi. E.N.E. from Newcastle on the L.N.E.Ry. Pop. (1938) 43,970. Area 5.5 sq.mi. There are remains of the Transitional church of the Holy Cross. At an early period Wallsend was famous for its coal, but the name is now used for coal that does not go through a sieve with meshes five-

eighths of an inch in size. The shipbuilding yards are important and there are engineering works, lead and copper smelting works, cement works and brick and tile works. There are two pontoon docks and an immense dry dock. Wallsend was incorporated in 1901 and in 1918 became a parliamentary borough. Wallsend is at the east end of Hadrian's Wall. During the depression of the 1930s Wallsend had extensive unemployment, over 26% of the insured population being out of work in June 1934.

WALL STREET, a street in the lower part of New York city on which or near which are concentrated the chief financial institutions of the United States. It corresponds to the London financial district in Threadneedle, Throgmorton and Lombard streets, and is rivalled only by that centre in its importance as an international money market. The street itself is narrow and short, extending only some seven blocks from Broadway to East river, and the financial houses occupy only the upper or western half of the street. The Wall Street financial district, however, extends several blocks north and south of the street and also includes an area west of Broadway. Already before the Civil War the Street was recognized as the financial capital of the country and most of the major banking houses have sought to maintain headquarters there, amidst the offices of insurance companies, railway corporations, steamship, iron, coal and copper companies and several hundred other large industrial corporations. Companies with securities listed on the Stock exchange maintain at least a transfer office conveniently near. Besides the Stock exchange there are in the neighbourhood the Cotton exchange, Coffee exchange, Metal exchange, Produce exchange, the Curb exchange and lesser exchanges. The district is the headquarters of most brokerage firms. Private bankers are also established in the street, the famous house of J. P. Morgan and Co. occupying its own building at the corner of Wall and Broad streets.

Wall Street owes its name to Peter Stuyvesant, who, in 1652, as governor of the little Dutch settlement of New Amsterdam, ordered a palisade built on the site to protect the town from feared invasions of the English. The last of the wall was removed in 1699 and both sides of the street were quickly built up. The street was famous in the political life of the country after the Revolution when for a brief period the governmental offices of the city, state and nation were all located there. At the old Federal building, on the site of the present sub-treasury building George Washington in 1789 was first inaugurated president and there the first United States congress met.

See F. T. Hill, *The Story of a Street* (1908) for history, and S. S. Pratt, *The Works of Wall Street* (3rd ed., 1921) for an analysis of the financial activities.

WALMER, a watering-place of Kent, England. Pop. (1931), 5,324. It was transferred to the borough of Deal in 1935. Lower Walmer, the portion most frequented by visitors, extends northward along the coast so as to be contiguous with Deal. Upper Walmer is a short distance inland, and below it Walmer castle lies close to the sea. This was a blockhouse built for coast defense by Henry VIII, but became the official residence of the Lords Warden of the Cinque Ports. It ceased to be the official residence in 1905, when the prince of Wales (afterwards George V) was appointed Lord Warden, and the public was given access to those rooms which possess historical associations with former holders of the office, such as the duke of Wellington, who died there in 1852, William Pitt and others. Walmer is a member of the Cinque Port of Sandwich.

WALMISLEY, THOMAS ATTWOOD (1814–1856), English musician, was born in London on Jan. 21, 1814. He was the eldest son of Thomas Forbes Walmisley (1783–1866), a well-known organist and composer of church music and glees. Thomas Attwood (*q.v.*), his godfather, taught him composition. He became organist at Trinity and St. John's colleges, Cambridge, in 1833, and in 1836 was made professor of music. He died at Hastings on Jan. 17, 1856. His *Cathedral Music* was edited after his death by his father, and published in 1857. Some fine examples of his work are to be found in the "Service in B flat," the Dublin Prize anthem and the madrigal "Sweete flowers."

See the article by A. D. Coleridge in Grove's *Dictionary of Music and Musicians.*

WALNUT, the common name for the genus *Juglans,* which is widely known throughout the world because of the nuts and timber it produces. About 17 species are recognized although some are distinguished only by their fruits, and in some cases there are intermediate forms hard to classify. Walnut plants, among the noblest of all hardwoods, may live for several centuries and become huge trees from 100 to 150 ft. tall with proportionate spread of crown and with trunk diameters of 4 to 6 ft. Sometimes growth is in bush or shrub form but this is believed due more to environmental factors than to species limitation. All walnuts furnish food for many forms of wild life; some produce nutritious, wholesome and palatable food for man. The product of one, the Persian walnut, is of greater importance as a food crop than that of any other nut tree outside of the tropics. It and the eastern black walnut together furnish two of the world's most valuable and popular woods, used in making furniture and gunstocks and in interior decoration.

The Persian Walnut.—The Persian (English) walnut, *Juglans regia,* is a large growing tree, attaining heights of more than 100 ft. and trunk diameters of 5 or 6 ft. The bark is light to whitish in colour while young, and very smooth, but becomes gray and fissured with advanced age. The leaves are glossy and yellowish-green; there are from 5 to 9 leaflets as a rule but sometimes as many as 11 or 13. The surface is glossy and the margins entire. The nut hulls are also smooth and glossy and about $\frac{1}{3}$ in. in thickness. The nuts are of straw colour and the shells of varying thickness, sometimes being thick, hard and bony but in the case of nuts grown for market use, thin enough to break easily with a light stroke of a hammer.

This walnut has been under cultivation for so many centuries and in so many countries that there is much uncertainty as to its exact place of origin and dates of introduction. One opinion is that the original home was in the mountains of western and northern China. Another view is that it was native throughout much of southeastern Europe, east to the Himalayas, and that it was carried from there to China, where it is cultivated to a wide extent and sometimes is naturalized to altitudes in excess of 8,000 ft. It is little cultivated in Japan, although it has long been grown there to some extent.

Some authorities are uncertain that this walnut was in England before 1562, which appears to be the earliest date at which its presence there is definitely recorded. Others contend that it must have been taken there during the Roman occupation, A.D. 43 to 410. During modern times, production in that country has been of slight importance. Following World War I, increased planting in England and Wales was advocated. This was supported by the East Malling Research station, which then instituted a general investigation to determine the best varieties, rootstocks and methods of culture.

There is no certainty as to when this walnut was first taken to North America, although it is logically assumed to have been introduced by colonists during the 17th century. Environmental conditions in neither eastern nor southern regions of the United States are favourable for its commercial development. While there are many sites in the eastern states where the trees may grow well and bear good nuts with considerable regularity for several decades or even, in rare cases, a century or longer, the great majority of all that are planted perish before reaching bearing age. Stocks from Europe, Russia and China have been tried many times, only to fall short in so far as adaptability for commercial production was concerned. In 1943, there were scattered trees throughout the general region between Long Island and Norfolk on the east and Wisconsin and Arkansas on the west.

An attempt to establish the Persian walnut in the eastern states was inaugurated in 1923 by P. C. Crath of Toronto, Canada, who as a retired Presbyterian missionary in Poland personally made selections from the hardiest and choicest trees in localities of the Carpathian mountains with which he had long been intimately familiar. Thousands of his trees were later planted in Ontario, western British Columbia and throughout the northern United States. By 1943, a fair percentage was reported to be giving promise of being valuable for home planting in many localities

where others had failed.

Cultural methods of the old world and new world differ radically, in harmony with economic necessity. In the former, where farm units are small and the primary object is to produce food for the home and a small surplus for sale to obtain money with which to purchase family necessities, trees are used in a general utility capacity. In some regions, there are sizeable orchards, but throughout most of Europe and Asia, planting is mainly in conjunction with other crops, or along farm borders, highways, and about home grounds. The trees are often scattered about the fields in such manner that the landscape greatly resembles any typical pastoral view of eastern United States. Prunings and dead branches serve as fagots for fuel.

The trees are headed high—18 to 20 ft.—in order to develop maximum length of trunk and also that they may interfere as little as possible with other crops to which the land is devoted. Important production is not expected in less than 20 years from the time of planting. On the whole, production is mainly from seedling trees, although there have been many grafted trees in France since probably before 1800. When for any reason these high-headed trees are cut, if fairly sound, the long trunks have value for furniture making.

It is on the Pacific coast of the United States, where the estimate of the 1943 crop was 57,000 tons for California and 5,700 for Oregon, that the industry of both producing and marketing Persian walnuts is conducted most intensively. Established in the first place (during the latter half of the 19th century) by able pioneers and later encouraged by state and federal research agencies and motivated by a strongly organized co-operative, the California Walnut Growers association, walnut growing there has long been on a plane rarely attained by any agricultural industry.

Secrets of successful walnut culture in California and the Pacific northwest call for strict use of well-chosen varieties including suitable pollinizers; trees grafted on stocks of the Hinds black walnut; spacing the trees at not less than 60 ft. each way (12 to the acre); fertile soil; regular use of soil improvement crops; fertilization and irrigation as necessary; spraying or dusting to control pests and diseases; heading the trees low so as to provide shade for the trunks and thus lessen the danger of sunscald and also to bring about full bearing in 10 to 12 years; orchard heating in frosty areas; harvesting the nuts as soon as about 10% of the hulls have broken open; treating the nuts immediately with ethylene gas or with what is known as the "water sweat" process in order to loosen the hulls; and prompt hulling and drying (preferably by dehydration). The nuts are later graded with extreme care as to type and size, bleached so as to bring all to a common, bright, attractive colour, and each nut is stamped to show its brand designation. All that do not attain the required standard for sale "in-shell" are rated as "culls" and sold in the "shelled" condition, that is, as kernels. During years of overproduction, surplus nuts are also shelled.

The leading varieties are Placentia, Franquette, Payne, Eureka, Mayette and Concord.

The official November estimate of the 1943 crop in the United States was 62,700 short tons. Including this, the 5-year average for the period 1939–43 was 57,680 short tons. The estimated averages (in short tons) for the next seven leading countries for the 5-year period 1935–39 were, France, 38,385 tons; Italy, 16,500 tons; Rumania, 14,190 tons; Turkey, 8,030 tons; Yugoslavia, 7,491 tons; Bulgaria, 4,712 tons; and Hungary, 2,123 tons. Other important countries of production are China, India, Chile and Australia.

Other Species of Walnut.—The Eastern black walnut, *J. nigra,* is the largest grower of the genus, and heights to 150 ft. and trunk diameters to 6 ft. were not unusual in the original virgin forests of the northeastern United States. Its native range included practically all regions where soil conditions were favourable, from lower New England, southern Ontario and southeastern Minnesota on the north to central parts of Georgia and the gulf states, westward to San Antonio, Texas. It was most abundant from the mountain valleys of western Pennsylvania, the Virginias, and North Carolina, westward through the basin drained by the Ohio and Mississippi rivers to eastern Kansas and Nebraska. Outside of this general region, there are many small districts where it has always grown equally well. What is believed to have been the largest walnut tree of any species ever recorded grew near Lake Erie in western New York. This tree was said to have been 150 ft. tall and to have had a trunk girth of 36 ft. It was 80 ft. to the first limbs and was five ft. through at that point. It was blown over during a gale in April 1822. The largest tree of the species known in 1943 overlooked Chesapeake bay, a few miles south of Annapolis, Maryland. In 1941, its girth at breast height was 19 ft., 9 in. and its estimated height 100 ft.

It is as a timber tree that this walnut is best known throughout the world. The value of its lumber together with its beauty and nobility in an ornamental capacity so impressed the American colonists that it became one of the first new world introductions to be established in Europe; it is known to have been taken there during the 17th century. Its abundance, the ease with which it could be worked with carpenter's tools, its freedom from warping and checking, together with its lasting qualities when exposed to weather or in contact with soil, led to its use in countless ways. Farm residences, barns, bridges, railroad ties, canoes, boats and even ships were sometimes made of this wood. Because of the beauty of its grain, it is a great favourite in making furniture, pianos, organs, sewing machines, caskets and many other products. From early times, it has been the preferred wood for making gunstocks in the United States.

Export of black walnut logs to Europe, chiefly to England and Germany, in both of which countries the lumber was long used for both civilian and military purposes, constituted a heavy drain on the total supply. During World War I, this wood served a vital end as material for making propellers for military planes, first in England and later in the United States. The extent to which it was used in making gunstocks during World War II resulted in the greatest drain on the supply that the country ever experienced. This led to the launching, late in 1943, by the American Walnut Manufacturers association of Chicago, of a national campaign to stimulate walnut tree planting about the entire country, wherever soil and economic conditions might appear favourable.

Beginning with the first propagation of the Thomas variety in Pennsylvania about 1880, this species began slowly to work its way into U.S. orcharding. During the next third of a century, small numbers of grafted Thomas trees were planted in widely scattered gardens of many states, mainly to be lost sight of. Concerted interest began to show results in the way of commercial numbers of grafted trees from nurseries soon after the organization in 1910 of the Northern Nut Growers association, Inc. Other varieties were soon brought to light, largely as a result of cash prize contests conducted by that association for the best entries of seedling nuts. By 1943, many hundreds of seedling black walnut trees had been top-worked with scions from the new selections, and there were a number of orchard plantings ranging in size from a few trees each to a thousand or more. These were in various states, especially Pennsylvania, Michigan, Indiana, Illinois, Iowa and others south to the Carolinas and Arkansas.

Varieties which in 1943 were considered of greatest promise were: Adams, Allen, Creitz, Cresco, Edmunds, Edras, McMillen, Myers, Ohio, Sifford, Snyder, Stabler, Stambaugh, Tasterite, Ten Eyck, Thomas, Todd and Wiard.

Kernels of this walnut are a much favoured product in making ice cream and candies, and to some extent sweet breads. Together with kernels of the butternut, a close relative, also indigenous to the eastern United States, the kernels not only add body to such food products but retain their flavour during the cooking process to a remarkable degree. The sale of walnut kernels in many parts of the country annually returns a good many thousands of dollars to rural communities. Shelling is largely by use of hand-power lever machines, although in a few instances motor-driven machines are used in small factories.

The Arizona black walnut, *J. major,* is a tree of medium size, reaching its maximum height at about 50 ft. and its greatest diameter of trunk at about 4 ft. It occurs at altitudes of 1,500 to 6,000 ft. in alluvial plains and mountain valleys of Arizona and

New Mexico, southward to Durango, Mexico. Its leaves are sometimes as much as a foot long and its leaflets typically 9 to 13 in number, although occasionally there are 17 or 19. The margins are distinctly serrate. The nut is edible but too small to be of value. The tree is seldom planted except in botanical gardens.

The (Southern) California black walnut, *J. californica,* is a peculiar tree in that it seldom develops a trunk of more than a few feet but puts out many branches from near the ground to form a rather bushy appearing crown. Its maximum height is about 50 ft. The nut is too small to have economic value. Stumps are reported to have been dug and sold by the pound to good advantage for use by veneer concerns. One stump is said to have weighed 500 lb. The tree is planted very little. In dry calcareous soils, this species often becomes a mere shrub of but a few feet in height.

The Hinds (Northern California) black walnut, *J. hindsi,* is much the more valuable of the two species of *Juglans* indigenous to California. Its usual maximum height is 50 to 60 ft. and its greatest trunk diameter about 3 ft. It is said, however, that in certain localities there are specimen trees 100 ft. or more in height with diameters of 44 to 48 in. The tree is much used in roadside planting in northern California and as an ornamental both there and in northwestern Oregon. Hinds walnuts are about equal in size to those of eastern black and to an important extent they are shelled and the kernels sold readily to confectioners. This species, because of its resistance to the oak wood rot fungus, affords the stocks used almost exclusively in grafting varieties of the Persian walnut.

The wood of this walnut, although the grain is somewhat coarse, takes a high polish and to the limited extent that trees are available for cutting, the lumber is used in similar manner to that of the eastern and Persian walnuts. There are a few clons, but these are little propagated.

The heartnut or cordate walnut, *J. sieboldiana cordiformis,* a native of Japan, is a small or medium-sized tree, rarely attaining heights of more than 50 ft. or trunk diameters greater than 2 ft. In moderately severe regions of the north temperate zone, it grows rapidly and tends to develop a broad-spreading, low crown with luxuriant foliage, considered by some as tropical in aspect. While it is normally precocious, and under favourable conditions may bear moderately for several decades, it is rarely prolific. It usually has 13 to 15 leaflets per leaf and yields its fruits in racemes of 5 to 9 each. The nut is small, heart-like in shape, sharply pointed at the apex, flattened on the sides, flat-rounded at the base, and grooved from the middle of the sides to the apex. By being placed on a block and tapped with a hammer, either on an edge or on the end, the shell readily splits into halves along the sutures, and although this is crosswise to the kernel, it enables it to be extracted without injury. Several varieties have been made available by U.S. nurserymen for limited use in garden planting. The best known of these are Bates, Fodermaier, Lancaster, Stranger, Walters and Wright.

The Siebold walnut, *J. sieboldiana,* a variant form of heartnut, differing from it only in fruit, has been planted in the United States to about the same extent. As a tree, its habits and features are identical. Seedlings of either are likely to produce nuts of the other or of an intermediate type which might be classified either way. Siebold walnuts are larger than heartnuts, being from 1 to 2 in. long. They are roundish at the base and conical from below the middle to the apex. The shell is smooth to the hand but distinctly fissured; it is hard and difficult to crack so as to release the kernels except in particles. The kernel greatly resembles that of butternut in appearance, texture and flavour, except that it is usually more mild.

It is said that in Japan both this and heartnut trees are used as sources of lumber for gunstocks and furniture. Neither has indicated special possibilities in such capacity under U.S. conditions. However, both make very satisfactory ornamentals in the northeastern states, where growth and longevity are both better than in the south. Neither has been found commercially profitable in the United States since the nuts do not compete well with others on the market. Their most satisfactory use is as decorative trees and as producers of nuts for the home table. Both forms hybridize readily with Persian walnut and butternut.

The Texas black walnut, *J. rupestris,* is a shrubby or small-growing tree, rarely attaining more than 30 ft. in height or a trunk diameter greater than 30 in. The leaves are 9 to 12 in. long and the leaflets 13 to 23 in number, slender and with finely serrate margins. The nuts are small, roundish, thick-walled and of little value, although sweet. It commonly occurs on limestone soils, especially along streams of western Texas, southwestern Oklahoma and southeastern New Mexico. Wood from the largest stumps and butt log cuts makes a beautiful veneer and is much prized.

Miscellaneous Walnuts.—Other native walnuts of the new world which by 1943 had received little world attention include the Argentine black walnut, *J. australis;* the Bolivian black walnut, *J. boliviana;* the Colombian black walnut, *J. columbiensis;* the Ecuador walnut, *J. honorei;* the Cuban walnut, *J. insularis;* and the Guatemalan walnut, *J. mollis.* In the United States, there are a number of hybrid forms, of which none bears evidence of promise for either nut or timber production. Both the California and Hinds walnuts hybridize freely with the eastern black; the Persian with any black or with butternut, and also with the heartnut. Some of these have been regarded as having potential value for forestry plantings, but none has been so used. The costs of procuring suitable seed in quantity and the expense of securing land suitable for walnut trees of any kind are effective barriers against growing hybrid walnut trees in quantity for timber production.

The term "Claro" is applied to wood of any hybrid walnut grown in California. It is probable that it is also applied to wood of the Hinds walnut, since the number of walnut trees of any kind that are available for cutting in California is not large and the wood is not always readily distinguished.

There are three walnuts in northeastern China, much alike, which are recognized as being separate species. These are the Cathay walnut, *J. cathayensis,* the Manchu walnut, *J. mandshurica,* and one which appears to have no common name, *J. stenocarpa.* None is believed to offer special inducement to practical planters, except possibly in cold regions having a maritime climate.

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(C. A. RD.)

WALPOLE, HORATIO or HORACE (1717–1797), English politician and man of letters, 4th earl of Orford—a title to which he only succeeded at the end of his life—was born in London, on Sept. 24, 1717. He was the youngest of the five children of the 1st earl of Orford (Sir Robert Walpole) by Catherine Shorter, but by some scandal-mongers, Carr, Lord Hervey, has been called his father.

He was educated at Eton, where he formed what was known as the "Quadruple Alliance," with Thomas Gray, Richard West and Thomas Ashton, and became very intimate with Henry Seymour Conway, George Augustus Selwyn and the two Montagus; and at King's College, Cambridge.

Walpole was returned to parliament in May 1741 for the Cornish borough of Callington. He retired from parliament, probably because his success in political life had not equalled his expectations, but he continued until the end of his days to follow and to chronicle the acts and the speeches of both houses of parliament. Through his father's influence he had obtained three lucrative sinecures in the exchequer, and for many years (1745–1784) he enjoyed a share, estimated at about £1,500 a year, of a second family perquisite, the collectorship of customs. He acquired in 1747 the lease and in the next year purchased the reversion of the villa of Strawberry Hill, near Twickenham, on the banks of the Thames. He established a printing press there, which he called "Officina Arbuteana," where many of the first editions of his own works were printed. His nephew, the reckless 3rd earl, died on Dec. 5, 1791, and Horace succeeded to the peerage, but he never took his place in the house of lords. All his life long he was a victim of the gout, but he lived to extreme old age and died unmarried, in Berkeley Square, London, on March 2, 1797. All Walpole's printed books and manuscripts were left to Robert Berry and his two daughters, Mary and Agnes, and Mary Berry edited the five volumes of Walpole's works which were published in 1798.

The pen was ever in Horace Walpole's hands, and his entire compositions would fill many volumes. His *Castle of Otranto* (1764) is the prototype of the romantic novel. The *Mysterious Mother* (1768) is the least bad of tragedies when tragedy was at its worst. Walpole's antiquarian works merit praise. The volume of *Historic Doubts on the Life and Reign of King Richard the Third* (1760), one of the earliest attempts to rehabilitate a character previously stamped with infamy, showed acuteness and research. A work of more lasting reputation is *Anecdotes of Painting in England* (first edition, 4 vol., 1762–1771). A cognate volume, also based on the materials of Vertue, is entitled the

Catalogue of Engravers Born and Resident in England (1763), also often reprinted. As a senator himself, or as a private person following at a distance the combats of St. Stephen's, Walpole recorded in a diary the chief incidents in English politics. If he was sometimes prejudiced, he rarely distorted the acts of those whom he disliked; and his prejudices, which lie on the surface, were mainly against those whom he considered traitors to his father. These diaries extend from 1750 to 1783, and cover a period of momentous importance. The *Memoirs of the Last Ten Years of the Reign of George II.* was edited by Lord Holland (1846); its successor, *Memoirs of the Reign of King George III.*, was edited by Sir Denis Le Marchant (4 vols., 1845), and re-edited in 1894 by G. F. Russell Barker; the last volumes of the series, *Journal of the Reign of George III. from 1771 to 1783*, were edited and illustrated by John Doran (2 vols., 1859), and were edited with an introduction by A. F. Steuart (London, 1909). To these works should be added the *Reminiscences* (2 vols., 1819), which Walpole wrote in 1788 for the Misses Berry. But Walpole was above all a letter-writer. His correspondents were numerous and widespread, but the chief of them were William Cole (1714–1782), the clerical antiquary of Milton; Robert Jephson, the dramatist; William Mason, the poet; Lord Hertford during his embassy in Paris; the countess of Ossory; Lord Harcourt; George Montagu, his friend at Eton; Henry Seymour Conway (1721–1795) and Sir Horace Mann. The *Letters* were published at different dates, but the standard collection is that by Mrs. Paget Toynbee (1903–1905), and to it should be added the volumes of the letters addressed to Walpole by his old friend Madame du Deffand (4 vols., 1810). A selection has been edited by W. S. Lewis (New York and London, 1926). Walpole has been called "the best letter-writer in the English language." His political estimates are more acute than his literary ones.

Abundant information about Horace Walpole will be found in the *Memoirs* of him and of his contemporaries edited by Eliot Warburton (1851), J. H. Jesse's *George Selwyn and his Contemporaries* (4 vols., 1843–44) and the extracts from the journals and correspondence of Miss Berry (3 vols., 1866); also *Horace Walpole and his World*, by L. B. Seeley (1884) and Austin Dobson, *Horace Walpole* (1890). It would be unpardonable to omit mention of Macaulay's sketch of Walpole's life and character. *See* also P. Yvon, *Horace Walpole, 1717–97. Essai de biographie psychologique et littéraire* (1924), and *Horace Walpole as Poet* (Paris, 1924); H. B. Wheatley in *Cambridge History of English Literature*, vol. 10 (1913); D. M. Stuart, *Horace Walpole* in *English Men of Letters* (1927).

WALPOLE, SIR ROBERT: *see* ORFORD, ROBERT WALPOLE, 1ST EARL OF.

WALPURGIS (WALPURGA or WALBURGA), **ST.** (d. *c.* 780), English missionary to Germany, was born in Sussex at the beginning of the 8th century. She was the sister of Willibald, the first bishop of Eichstätt in Bavaria, and Wunnibald, first abbot of Heidenheim. Her father, Richard, is thought to have been a son of Hlothere, 9th king of Kent; her mother, Winna or Wuna, a sister of St. Boniface. At the instance of Boniface and Willibald she went about 750 with some other nuns to found religious houses in Germany. Her first settlement was at Bischofsheim in the diocese of Mainz, and two years later (754) she became abbess of the Benedictine nunnery at Heidenheim in the diocese of Eichstätt. On the death of Wunnibald in 760 she succeeded him in his charge also, retaining the superintendence of both houses until her death. Her relics were translated to Eichstätt, where she was laid in a hollow rock, from which exuded a kind of bituminous oil afterwards known as Walpurgis oil, and regarded as of miraculous efficacy against disease. The cave became a place of pilgrimage, and a church was built over the spot. Walpurgis is commemorated at various times, but principally on the 1st of May, her day taking the place of an earlier heathen festival which was characterized by various rites marking the beginning of summer. She is regarded as the protectress against magic arts. (*Cf.* the Walpurgis-Nacht dance in Goethe's *Faust.*) In art she is represented with a crozier, and bearing in her hand a flask of balsam.

Her life was written by the presbyter Wolfhard and dedicated to Erkenbald, bishop of Eichstätt (884–916). *See* the Bollandist *Acta sanctorum*, vol. iii. February 25. On Walpurgis, Willibald and Wunnibald *see* G. F. Browne, *Boniface of Crediton and his Companions* (London, 1910), vii.

WALRUS or **MORSE** (*Odobenus rosmarus*), a large marine mammal allied to the seals. Characterized by the prolongation, in both sexes, of the upper canine teeth into tusks, which may reach a length of 2 ft., the adult walrus measures about 10 or 11 ft. and is a heavily-built animal. The head is rounded, the eyes small, external ears absent. The short broad muzzle bears on each side a group of stiff, bristly whiskers. The tail scarcely projects beyond the skin. The fore limbs are only free from the elbow and the fore flipper is broad, flat and webbed. The hind limbs, free from the heel, are fan-shaped. The skin is covered with short, rufous hair, which becomes very scanty in old animals. There are deep folds on the shoulder.

FROM A GROUP IN THE AMERICAN MUSEUM OF NATURAL HISTORY

PACIFIC WALRUS (O. R. DIVERGENS)

The walrus inhabits the northern circumpolar region in small herds. It prefers the coastal portions or ice floes and feeds largely on bivalve molluscs which it digs up from the bottom of the sea with its tusks. Normally inoffensive and affectionate, when attacked the walrus can use its tusks with terrible effect and the herd usually combine against an enemy. Its principal foe, apart from man, is the polar bear, and its flesh is an important article of food to the Eskimo and Chukchi. Commercially the walrus is valuable for its oil, its hide and its ivory. The Pacific walrus, with longer and more slender tusks, has been separated as *O. r. divergens*. Like the Atlantic form, its numbers have been much reduced within recent years. Fossil walruses are known from the late Tertiary of the U.S.A., England, France and Belgium.

WALSALL, municipal, parliamentary and county borough of Staffordshire, England, in the "Black Country," 6 mi. E. from Wolverhampton. Pop. (1938) 107,300. Area 13.7 sq.mi. The town stands high on a ridge on which is also the 15th century church of St. Matthew, now rebuilt.

Queen Mary's Schools are a foundation of 1554 and here were educated John Hough (1651–1743), the president of Magdalen College, Oxford, whom James II sought to eject from office, afterwards Bishop of Oxford, Lichfield, and Worcester; and John, Lord Somers (1651–1716), lord keeper and lord chancellor of England. Walsall was the scene of the charitable work of Sister Dora (Miss Pattison), whom a statue commemorates. Coal, limestone and ironstone are mined in the neighbourhood. Walsall, essentially an industrial town, specializes in leather goods, saddlers' and coach ironmongery and hardware. There are also iron and brass foundries. Three annual fairs are held. The parliamentary borough returns one member. Walsall (Waleshales, Walshall, Walsaler) was given in 996 to the church of Wolverhampton, which, however, did not retain it long. Later the manor passed to the Bassets and the Beauchamps, and Warwick the king-maker held it in right of his wife. Henry VIII granted it (1538) to Dudley, afterwards duke of Northumberland. Privileges were granted to the town by William Ruffus in the reign of John, and charters by Henry IV, Charles I (1627) and Charles II (1661) by which latter the town was governed until 1835. It was not represented in parliament till 1832. Walsall had a merchant gild in 1390; in the 17th century it was already known for its manufacture of iron goods and nail-making. In the 18th century the staple industry was the making of chapes and shoe-buckles. Two fairs were granted in 1399. The Tuesday market, which is still held and two fairs on October 28 and May 6, were granted in 1417 to Richard Beauchamp, earl of Warwick.

WALSH, THOMAS JAMES (1859–1933), American lawyer and senator, was born in Two Rivers, Wis., on June 12, 1859, and educated at the University of Wisconsin (LL.B., 1884).

In 1912 he was elected U.S. senator from Montana, going to the Senate chamber from the lawyer's office without previous experience in public office. He was re-elected in 1918 and in 1924. He was five times a delegate to the Democratic national convention previous to 1924, in which year he presided as chairman of the convention. He was a presidential possibility in 1924, and was

offered the vice-presidency on the ticket with John W. Davis, but he declined. He was even more seriously spoken of in 1928 as the only strong alternative candidate to Alfred E. Smith, but before the convention met he signified his desire not to be considered. In the Senate he became an outstanding figure. His speeches, replete with facts and packed with close reasoning, made him a formidable adversary in debate. As an expert lawyer he was constantly called upon for advice. He aided in drafting the Prohibition and Woman-Suffrage amendments to the Constitution, and was also author of that part of the Federal Reserve Act which requires national banks to subscribe for stock in the Federal Reserve banks. He also formulated the case against the seating of Senator Truman H. Newberry, of Michigan. He is chiefly noted, however, for the tireless tenacity with which he prosecuted the investigation of circumstances surrounding the illegal leasing of Government oil reserves during Harding's Administration. His energetic although unsuccessful struggle in 1928 to secure a Senate investigation of power companies earned him Roosevelt's first choice for Attorney General. Unfortunately his death on March 2nd closely followed the wide popular approval of the preliminary announcement of his appointment.

WALSH, WILLIAM JOHN (1841–1921), Roman Catholic divine, was born in Dublin Jan. 30, 1841. Educated in Dublin and at St. Patrick's college, Maynooth, in 1867 he was appointed professor of dogmatic and moral theology at Maynooth. In 1878 he became vice-president of the college and in 1881 succeeded Dr. Russell as president. Dr. Walsh served on several committees and commissions. He was partly responsible for the appointment of the commission to enquire into the working of the Queen's Colleges, and he became a member of the senate of the university. In 1885 he was summoned to Rome by the Pope and given the appointment of archbishop of Dublin. This office he continued to hold till his death in Dublin, on April 9, 1921. Dr. Walsh was a commissioner for education in Ireland (1891) and, a member (1908) of the Dublin statutory commission which established the Catholic National University, with himself as chancellor. In politics he was a Nationalist, but he strongly opposed compromise with the British Government, and after the rebellion of 1916 he supported the Sinn Feiners.

Dr. Walsh's published works include *A Plain Exposition of the Irish Land Act of 1881* (1881); *The Queen's Colleges and the Royal University of Ireland* (1883–84); *The Irish University Question* (1890).

WALSINGHAM, SIR FRANCIS (*c.* 1530–1590), English statesman, was the only son of William Walsingham, common serjeant of London (d. March 1534), by his wife Joyce, daughter of Sir Edmund Denny of Cheshunt. Francis matriculated as a fellow-commoner of King's college, Cambridge, of which Sir John Cheke was provost, in Nov. 1548; and he studied there amid strongly Protestant influences until Michaelmas 1550, when he appears to have gone abroad to complete his education. Returning in 1552 he was admitted at Gray's Inn on Jan. 28, 1553, but in 1555–56 he was at Padua, where he was admitted a "consiliarius" in the faculty of laws. Walsingham was twice married; in Jan. 1562 to Anne (d. 1564), daughter of George Barnes, lord mayor of London, and to Ursula, daughter of Henry St. Barbe and widow of Sir Richard Worsley. By his second wife Walsingham had a daughter who married firstly Sir Philip Sidney, secondly Robert Devereux, 2nd earl of Essex, and thirdly, Richard de Burgh, earl of Clanricarde.

Walsingham sat in Elizabeth's first and second parliaments for Banbury, and was attached to the party of Cecil. In 1567–70 he was supplying Cecil with information about the movements of foreign spies in London. Ridolfi, the conspirator, was committed to his custody in Oct. 1569. In the summer of 1570 he was, in spite of his protestations, designated to succeed Norris as ambassador at Paris. Walsingham was the ablest of the new men whom Cecil, having triumphed over the older aristocracy, brought to the front.

Embassy to Paris.—An essential element in the new policy was the substitution of an alliance with France for the old Burgundian friendship. The affair of San Juan de Ulua and the seizure of the Spanish treasure-ships in 1568 had been omens of the inevitable conflict with Spain; Ridolfi's plot and Philip II.'s approaches to Mary Stuart indicated the lines upon which the struggle would be fought; and it was Walsingham's business to reconcile the Huguenots with the French Government, and upon this reconciliation to base an Anglo-French alliance which might lead to a grand attack on Spain, to the liberation of the Netherlands, to the destruction of Spain's monopoly in the New World and to making Protestantism the dominant force in Europe. Walsingham threw himself heart and soul into the movement. He was the anxious fanatic of Elizabeth's advisers; he lacked the patience of Burghley and the cynical coolness of Elizabeth. He supplied the momentum which was necessary to counteract the caution of Burghley and Elizabeth; but it was probably fortunate that his headstrong counsels were generally overruled by the circumspection of his sovereign. He would have plunged England into war with Spain in 1572, when the risks would have been infinitely greater than in 1588, and when the Huguenot influence over the French Government, on which he relied for support, would probably have broken in his hands.

Walsingham, however, was an accomplished diplomatist, and he reserved these truculent opinions for the ears of his own Government, incurring frequent rebukes from Elizabeth. In his professional capacity, his attitude was correct enough; and, indeed, his anxiety for the French alliance and for the marriage between Elizabeth and Anjou led him to suggest concessions to Anjou's Catholic susceptibilities which came strangely from so staunch a Puritan. Although a defensive alliance was concluded between England and France in April 1572, the French Government perceived that public opinion in France would not tolerate an open breach with Spain in Protestant interests. The massacre of St. Bartholomew ruined all such hopes.

He was recalled in April 1573, and eight months later he was admitted to the privy council and made joint secretary of State with Sir Thomas Smith. He held this office jointly or solely until his death; in 1577 when Smith died, Dr. Thomas Wilson was associated with Walsingham; after Wilson's death in 1581 Walsingham was sole secretary until July 1586, when Davison began his brief and ill-fated seven months' tenure of the office. After Davison's disgrace in Feb. 1587 Walsingham remained sole secretary, though Wolley assisted him as Latin secretary from 1588 to 1590. He was also returned to parliament at a by-election in 1576 as knight of the shire for Surrey in succession to Charles Howard, who had become Lord Howard of Effingham, and he was re-elected for Surrey in 1584, 1586 and 1588. He was knighted on Dec. 1, 1577, and made chancellor of the order of the Garter on April 22, 1578.

State Secretary.—As secretary, Walsingham could pursue no independent policy; he was rather in the position of permanent under-secretary of the combined home and foreign departments, and he had to work under the direction of the council, and particularly of Burghley and the queen. He continued to urge the necessity of more vigorous intervention on behalf of the Protestants abroad, though now his clients were the Dutch rather than the Huguenots. In June 1578 he was sent with Lord Cobham to the Netherlands, mainly to glean reliable information on the complicated situation. In Aug. 1581 he was sent on a second and briefer mission to Paris. Its object was to secure a solid Anglo-French alliance against Spain without the condition upon which Henry III. insisted, namely a marriage between Elizabeth and Anjou. The French Government would not yield, and Walsingham came back, followed by Anjou, who pressed his claims in person. Walsingham's last embassy was to the court of James VI. in 1583, and here his vehement and suspicious Protestantism led him astray. Elizabeth and Burghley were inclined to try an alliance with the Scottish king, and the event justified their policy, which Walsingham did his best to frustrate, although deserted on this occasion by his chief regular supporter, Leicester.

For the rest of his life Walsingham was mainly occupied in detecting and frustrating the various plots formed against Elizabeth's life. He raised the English system of secret intelligence to a high degree of efficiency. At one time he is said to have had in his pay 53 agents at foreign courts, besides 18 persons whose

functions were even more obscure. Some of them were double spies, sold to both parties, whose real sentiments are still conjectural; but Walsingham was more successful in seducing Catholic spies than his antagonists were in seducing Protestant spies, and most of his information came from Catholics who betrayed one another. The most famous of the plots frustrated by Walsingham was Anthony Babington's, the discovery of which enabled him to bring pressure to bear upon Elizabeth to ensure Mary's execution. Walsingham died deeply in debt on April 6, 1590.

See K. Stählin, *Sir Francis Walsingham und seine Zeit* (Heidelberg, 1908, etc.); and C. Read, *Mr. Secretary Walsingham and the policy of Queen Elizabeth* (3 vols., 1925).

WALSINGHAM, THOMAS (d. *c.* 1422), English chronicler, was probably educated at the abbey of St. Albans and at Oxford. He became a monk at St. Albans, where he appears to have passed the whole of his monastic life except the six years between 1394 and 1400 during which he was prior of another Benedictine house at Wymondham, Norfolk. At St. Albans he was in charge of the scriptorium, or writing room, and he died about 1422. Walsingham's most important work is his *Historia Anglicana,* covering the period between 1272 and 1422. Some authorities hold that Walsingham himself only wrote the section between 1377 and 1392, but this view is controverted by James Gairdner in his *Early Chroniclers of Europe* (1879).

His most important works are *Historia Angliae brevis,* edit. by H. T. Riley (1863–64); *Chronicon Angliae,* edit. Sir E. M. Thompson (1874); *Gesta Abbatum Monasterii S. Albani,* edit. by T. H. Riley (1867–69); *Ypodigma Neustriae,* edit. by T. H. Riley (1876). All these editions are in the Rolls series.

WALTER, BRUNO (1876–), eminent German conductor, was born in Berlin on Sept. 15, 1876. He studied under Ehrlich, Buszler and Robert Radecke; and first appeared as conductor of opera at the Municipal theatre in Cologne. He then filled the same position in Hamburg, Breslau, Pressburg (Bratislava), Riga and Berlin, while from 1901 to 1912 he conducted the Court opera in Vienna. From 1913 to 1922, Walter was musical director at the Munich opera, and from 1925 until May 1929 he was the general musical director of the three Berlin opera houses. In Sept. 1938 Walter became a naturalized French citizen.

WALTER, HUBERT (d. 1205), chief justiciar of England and archbishop of Canterbury, was a relative of Ranulf de Glanvill, the great justiciar of Henry II., and rose under the eye of his kinsman to an important position in the Curia Regis. In 1184 and in 1185 he appears as a baron of the exchequer. He was employed, sometimes as a negotiator, sometimes as a justice, sometimes as a royal secretary. He received no clerical promotion from Henry II., but Richard I. appointed him bishop of Salisbury, and by Richard's command he went with the third crusade to the Holy Land. He gained the respect of all the crusaders, and acted as Richard's principal agent in all negotiations with Saladin, being given a place in the first band of pilgrims that entered Jerusalem. He led the English army back to England after Richard's departure from Palestine; but in Sicily he heard of the king's captivity, and hurried to join him in Germany. In 1193 he returned to England to raise the king's ransom. Soon afterwards he was elected archbishop of Canterbury and made justiciar. He was very successful in the government of the kingdom, and after Richard's last visit he was practically the ruler of England. He had no light task to keep pace with the king's constant demand for money. He was compelled to work the administrative machinery to its utmost, and indeed to invent new methods of extortion. To pay for Richard's ransom, he had already been compelled to tax personal property, the first instance of such taxation for secular purposes. The main feature of all his measures was the novel and extended use of representation and election in government.

His chief measures are contained in his instruction to the itinerant justices of 1194 and 1198, in his ordinance of 1195 for the conservation of the peace, and in his scheme of 1198 for the assessment of the carucage. The justices of 1194 were to order the election of four coroners by the suitors of each county court. These new officers were to "keep," *i.e.,* to register, the pleas of the crown, an important duty hitherto left to the sheriff. The juries, both for answering the questions asked by the judges and for trying cases under the grand assize, were to be chosen by a committee of four knights, also elected by the suitors of each county court for that purpose. In 1195 Hubert issued an ordinance by which four knights were to be appointed in every hundred to act as guardians of the peace, and from this humble beginning eventually was evolved the office of justice of the peace. His reliance upon the knights, or middle-class landowners, who now for the first time appear in the political foreground, is all the more interesting because it is this class who, either as members of parliament or justices of the peace, were to have the effective rule of England in their hands for so many centuries.

In 1198, to satisfy the king's demand for money, Hubert demanded a carucage or plough-tax of five shillings on every ploughland (carucate) under cultivation. This was the old tax, the Danegeld, in a new and heavier form and there was great difficulty in levying it. To make it easier, the justiciar ordered the assessment to be made by a sworn jury in every hundred, and one may reasonably conjecture that these jurors were also elected. Hubert negotiated a peace with Scotland in 1195, and in 1197 another with the Welsh. But the carucage was not a success, and the Great Council refused to equip a force of knights to serve abroad.

In 1198 Hubert, who had inherited from his predecessors in the primacy a fierce quarrel with the Canterbury monks, gave these enemies an opportunity of complaining to the pope, for in arresting the London demagogue, William Fitz Osbert, he had committed an act of sacrilege in Bow Church, which belonged to the monks. The pope asked Richard to free Hubert from all secular duties, and he did so, thus making the demand an excuse for dismissing Hubert from the justiciarship. On May 27, 1199, Hubert crowned John, making a speech in which the old theory of election by the people was enunciated for the last time. He also took the office of chancellor and cheerfully worked under Geoffrey Fitz Peter, one of his former subordinates. In 1201 he went on a diplomatic mission to Philip Augustus of France, and in 1202 he returned to England to keep the kingdom in peace while John was losing his continental possessions. In 1205 he died. Hubert was an ingenious, original and industrious public servant, but he was grasping and perhaps dishonest.

See W. Stubbs, *Constitutional History,* vol. i. (1897); Miss K. Norgate's *England under the Angevin Kings,* vol. ii. (1887); W. Stubbs, preface to vol. iv. of Roger of Hoveden's *Chronicle* ("Rolls" series, 1868–71).

WALTER, JOHN (1738/9–1812), founder of *The Times* newspaper, London, was born in 1738/9, probably in London, and from the death of his father, Richard Walter (about 1755/6), until 1781 was engaged in a prosperous business as a coal merchant. He played a leading part in establishing a Coal Exchange in London; but shortly after 1781, when he began to occupy himself solely as an underwriter and became a member of Lloyd's, he over-speculated and failed. In 1782 he bought from one Henry Johnson a patent for a new method of printing from "logotypes" (*i.e.,* founts of words or portions of words, instead of letters), and made some improvements in it. In 1784 he acquired an old printing office in Blackfriars, which formed the nucleus of the Printing-house Square of a later date, and established there his "Logographic Office." At first he only undertook the printing of books, but on Jan. 1, 1785 he started a small newspaper called *The Daily Universal Register,* which on reaching its 940th number on Jan. 1, 1788 was renamed *The Times.*

The printing business developed and prospered, but the newspaper at first had a somewhat chequered career. In 1789 Walter was tried for a libel in it on the duke of York, and was sentenced to a fine of £50, a year's imprisonment in Newgate, to stand in the pillory for an hour and to give surety for good behaviour for seven years; and for further libels the fine was increased by £100, and the imprisonment by a second year. On March 9, 1791, however, he was liberated and pardoned. In 1799 he was again convicted for a technical libel, this time on Lord Cowper. He had then given up the management of the business to his eldest son, William, and had (1795) retired to Teddington, where he died on Nov. 16, 1812. In 1759 he had married Frances Landen (died 1798), by whom he had six children. In 1803 William Walter

transferred the sole management to his younger brother, John.

JOHN WALTER (2) (1776–1847), who really established the great newspaper of which his father had sown the seed, was born on Feb. 23, 1776, and was educated at Merchant Taylors' School and Trinity College, Oxford. He found *The Times* one of a number of unconsidered journals whose opinions counted for little. He left it in 1847 a great organ of public opinion, deferred to and even feared throughout Europe, consulted and courted by cabinet ministers at home, and in intimate relations with the best sources of independent information in every European capital. On taking over the management in 1803, he signalized the new spirit of the direction by his opposition to Pitt, which cost him the withdrawal of government advertisements and the loss of his appointment as printer to the Customs, and exposed him to the not too scrupulous hostility of the official world. He let the government do its worst and held on his way. From about 1810 he delegated to others editorial supervision (first to Sir John Stoddart, then to Thomas Barnes, and in 1841 to J. T. Delane), though never the supreme direction of policy. In 1832 Mr. Walter, who had purchased an estate called Bear Wood, in Berkshire (where his son afterwards built the present house), was elected to Parliament for that county, and retained his seat till 1837. In 1841 he was returned to Parliament for Nottingham, but was unseated next year on petition. He was twice married, and by his second wife, Mary Smythe, had a family. He died in London on July 28, 1847.

JOHN WALTER (3) (1818–1894), his eldest son, was born at Printing-house Square in 1818, and was educated at Eton and Exeter College, Oxford, being called to the bar in 1847. On leaving Oxford he took part in the business management of *The Times*, and on his father's death became sole manager, though he devolved part of the work on Mowbray Morris. It was under him that the successive improvements in the printing machinery, begun by his father in 1814, at last reached the stage of the "Walter Press" in 1869, the pioneer of modern newspaper printing-presses. In 1847 he was elected to parliament for Nottingham as a moderate Liberal, and was re-elected in 1852 and in 1857. In 1859 he was returned for Berkshire, and though defeated in 1865, was again elected in 1868, and held the seat till he retired in 1885. He died on Nov. 3, 1894. He was twice married, first in 1842 to Emily Frances Court (d. 1858), and secondly in 1861 to Flora Macnabb. His eldest son by the first marriage, John, was accidentally drowned at Bear Wood in 1870; and he was succeeded by Arthur Fraser Walter (1846–1910), his second son by the first marriage. A. F. Walter remained chief proprietor of *The Times* till 1908, when it was converted into a company. He then became chairman of the board of directors, and on his death was succeeded in this position by his son John, who entered the *Times* office in 1898, and was chairman of the directors from 1910 to 1923. John Walter's son, Hubert Walter (b. 1870) joined the staff in 1894 and has acted as special representative in Paris and elsewhere.

(For changes in the management of *The Times* since 1908 *see* NEWSPAPERS: *British*.) (H. C.; X.)

WALTER, LUCY (*c.* 1630–1658), mistress of the English king Charles II. and mother of the duke of Monmouth (*q.v.*), was born at Roch Castle, near Haverfordwest. Her home having been captured and burned by the Parliamentary forces in 1644, Lucy Walter found shelter first in London and then at The Hague. There, in 1648, she met Charles, possibly renewing an earlier acquaintance. Their intimacy lasted with intervals till the autumn of 1651, and Charles claimed the paternity of a child born in 1649, whom he subsequently created duke of Monmouth.

See Steinmann, *Althorp Memoirs* (1869), pp. 77 *seq.* and *Addenda* (1880); J. S. Clarke, *Life of James II.* (2 vols., 1816); *Clarendon State Papers*, vol. iii. (Oxford, 1869–76); John Evelyn, *Diary*, edited by W. Bray (1890); and Mme. d'Aulnoy, *Memoirs of the Court of England in 1675*, edited by G. D. Gilbert (1913).

WALTER OF COVENTRY (*fl.* 1290), English monk and chronicler, who was apparently connected with a religious house in the province of York, is known to us only through the historical compilation which bears his name, the *Memoriale fratris Walteri de Coventria*. The word *Memoriale* is usually taken to mean "commonplace book." Some critics interpret it in the sense of "a souvenir," and argue that Walter was not the author but merely the donor of the book; but the weight of authority is against this view. The author of the *Memoriale* lived in the reign of Edward I., and mentions the homage done to Edward as overlord of Scotland (1291). Since the main narrative extends only to 1225, the *Memoriale* is emphatically a second-hand production. But for the years 1201–1225 it is a faithful transcript of a contemporary chronicle, the work of a Barnwell canon. A complete text of the Barnwell work is preserved in the College of Arms (Heralds' College, ms. 10), and was collated by Bishop Stubbs for his edition.

The Barnwell annalist, living in Cambridgeshire, was well situated to observe the events of the barons' war, and is our most valuable authority for that important crisis. He is less hostile to John than are Ralph of Coggeshall, Roger of Wendover and Matthew Paris. He praises the king's management of the Welsh and Scottish wars; he is critical in his attitude towards the pope and the English opposition; he regards the submission of John to Rome as a skilful stroke of policy, although he notes the fact that some men called it a humiliation. The constitutional agitation of 1215 does not arouse his enthusiasm; he passes curtly over the Runnymede conference, barely mentioning Magna Carta. Probably, the middle classes, whom he represents, regarded the designs of the feudal baronage with suspicion.

See W. Stubbs's edition of Walter of Coventry ("Rolls" series, 2 vols., 1872–73); R. Pauli, in *Geschichte von England* (Hamburg, 1853), iii. 872. (H. W. C. D.)

WALTHAM, a city of Middlesex county, Massachusetts, U.S.A., on the Charles river. Pop. in 1920, 30,915 (26% foreign-born white); 1940 federal census, 40,020. The city occupies a series of rugged hills rising on both sides of the river. Prospect hill (482 ft.), in a park of 218·91 ac., commands a magnificent view.

There is a large central common, and parts of the Beaver Brook reservation (including the "Waverley Oaks") and the Charles River reservation are within the limits. It is a city of diversified industries and precision instrument factories, including Waltham Watch company (1854), one of the large watch factories of the world.

The first power mill in America for the manufacture of cotton cloth was established there in 1814; the first paper mill was established in 1788; and America's first training school for nurses was started in 1885. It is the site of Middlesex university, chartered 1850.

The town was incorporated in 1738, and in 1884 it was chartered as a city.

WALTHAM ABBEY or **WALTHAM HOLY CROSS,** a market town and urban district in Essex, England, on the Lea and on the Cambridge branch of L.N.E.R. Pop. (1938 est.) 7,164. Area 17.1 sq.mi. Of the former magnificent cruciform abbey church the only portion of importance now remaining is the nave, forming the present parish church, the two easternmost bays being converted into the chancel. It is a very fine specimen of ornate Norman. On the south side is a lady chapel containing some good Decorated work, with a crypt below, thought to date from *c.* 1316. Of the monastic buildings there remain only a bridge and gateway and other slight fragments. At Waltham Cross, about 1 mi. W. of Waltham in Hertfordshire, is the beautiful cross erected (1291–94) by Edward I at one of the resting-places of the corpse of Queen Eleanor on its way to burial in Westminster abbey. The royal gun-powder factory is in the immediate vicinity; government works were built in 1890 at Quinton Hill, ½ mi. W. of the town, for the manufacture of cordite; and the town possesses gun-cotton and percussion-cap factories, flour-mills, malt kilns and breweries, besides light industries. Watercress is extensively grown in the neighbourhood, and there are market gardens and nurseries.

WALTHAMSTOW, a municipal and parliamentary borough of Essex, England, and a suburb of London. Pop. (1938 est.) 130,800. Area, 6.79 sq.mi. The present church of St. Mary was built in 1535. Besides other old brasses it contains in the north aisle the effigies in brass of Sir George Monoux (d. 1543) and Anne, his wife. There are several educational institutions, in-

cluding a school of art; Forest school, founded in 1834 in connection with King's college, ranks as a public school. Brewing is extensively carried on. In the reign of Edward the Confessor Walthamstow belonged to Waltheof, son of Siward, earl of Northumbria, who married Judith, niece of William I, who betrayed him to his death in 1076. The estate passed in 1309 to Guy de Beauchamp, earl of Warwick. It is supposed to have been the birthplace of George Gascoigne the poet (d. 1577). The town, which was incorporated in 1929, returns two members to parliament.

WALTHARIUS, a Latin poem founded on German popular tradition, relates the exploits of the west Gothic hero Walter of Aquitaine. Our knowledge of the author, Ekkehard, a monk of St. Gall, is due to a later Ekkehard (Ekkehard IV., d. 1060), who gives some account of him in the *Casus Sancti Galli* (cap. 80). The poem is said to have been by Ekkehard I. (d. 973) in his schooldays for his master Geraldus. If so, he must have possessed precocious powers. *Waltharius* was dedicated by Geraldus to Erchanbald, bishop of Strasbourg (*fl.* 965–991), but mss. were in circulation before that time. Ekkehard IV. stated that he corrected his namesake's Germanisms. The poem was probably based on epic songs now lost.

Walter was the son of Alphere, ruler of Aquitaine, which in the 5th century was a province of the west Gothic Spanish kingdom. On Attila's invasion the western princes are represented as offering tribute and hostages. Gibich, here described as a Frankish king, gave Hagen as a hostage in place of his son Gunther; the Burgundian Herirh, his daughter Hiltegund; and Alphere, his son Walter. Hagen and Walter became brothers in arms, fighting for Attila, while Hiltegund was put over the queen's treasure. Presently Gunther succeeded his father and refused the tribute, whereupon Hagen fled from Attila's court. Walter and Hiltegund, who had been betrothed in childhood, also escaped, taking with them a great treasure. The story of their flight forms one of the most charming pictures of old German story. At Worms, however, the treasurer excited the cupidity of Gunther. Taking 12 knights, among them the reluctant Hagen, he overtook them at the Wasgenstein (Vosges). Walter engaged the Nibelungs one at a time, until all were slain but Hagen, who held aloof and was only persuaded by Gunther on the second day to attack his comrade. Luring Walter from the strong position of the day before, Gunther and Hagen attacked. All three were incapacitated, but their wounds were bound up by Hiltegund.

The essence of the story is the series of single combats. The incoherences make it likely that many changes have been introduced in the legend. *Thidreks Saga* makes the story more probable by representing the pursuers as Huns. Probably Hagen was originally the father of Hiltegund, and the tale was a variant of the saga of Hild in *Skaldskaparmál*. Hild, daughter of King Högni, was carried off by Hedinn. The fight between father and lover only ceased at sundown, to be renewed on the morrow, since each evening Hild raised the dead by her incantations. This is obviously a mediaeval variant of the ancient myth of the struggle between light and darkness.

BIBLIOGRAPHY.—*Waltharius* was first edited by Fischer (Leipzig, 1780). Later and more critical editions are by Jacob Grimm (*Lat. Gedichte des Mittelalters,* Göttingen, 1838); R. Peiper (1873); V. Scheffel and A. Holder (Stuttgart, 1874); German translations by F. Linnig (Paderborn, 1885), and H. Althof (Leipzig, 1896). *See* also Scheffel's novel of *Ekkehard* (Stuttgart, 1887). The A.S. fragments of *Waldere* were first edited by G. Stephens (1860), afterwards by R. Wülker in *Bibl. der angel-sachs. Poesie* (Cassel, 1881); by F. Holthausen in *Göteborgs Högskolas Årsskrift* (vol. v., 1899), with autotype reproductions of the two leaves which have been preserved. *See* also A. Ebert, *Allg. Gesch. der Lit. des Mittelalters im Abendlande* (Leipzig, 1874–87); R. Koegel, *Gesch. der deutschen Literatur bis zum Ausgange des Mittelalters* (vol. i., pt. ii., Strasbourg, 1897); M. D. Larned, *The Saga of Walter of Aquitaine* (Baltimore, 1892); B. Symons, *Deutsche Heldensage* (Strasbourg, 1905). With *Waltharius* compare the ballads "Earl Brand" and "Erlinton" (F. J. Child, *English and Scottish Popular Ballads,* i. 88 *seq.*); and *see* R. W. Chambers, *Widsith* (1912).

WALTHEOF (d. 1076), earl of Northumbria, was a son of Earl Siward of Northumbria, and, although he was probably educated for a monastic life, became earl of Huntingdon and Northampton about 1065. After the battle of Hastings he submitted to William the Conqueror; but when the Danes invaded the north of England in 1069 he joined them and took part in the attack on York, only, however, to make a fresh submission after their departure in 1070. Then, restored to his earldom, he married William's niece, Judith, and in 1072 was appointed earl of Northumbria. In 1075 Waltheof joined the conspiracy against the king arranged by the earls of Norfolk and Hereford; but soon repenting of his action he confessed his guilt to Archbishop Lanfranc, and then to William, who was in Normandy. Returning to England with William he was arrested, and after being brought twice before the king's court was sentenced to death. On May 31, 1076, he was beheaded on St. Giles's Hill, near Winchester. Weak and unreliable in character, Waltheof, like his father, is said to have been a man of immense bodily strength. Devout and charitable, he was regarded by the English as a martyr, and miracles were said to have been worked at his tomb at Crowland. The earl left three daughters, the eldest of whom, Matilda, brought the earldom of Huntingdon to her second husband, David I., king of Scotland. One of Waltheof's grandsons was Waltheof (d. 1159), abbot of Melrose.

See E. A. Freeman, *The Norman Conquest,* vols. ii., iii. and iv. (1870–76).

WALTHER VON DER VOGELWEIDE (*c.* 1170–*c.* 1230), the most celebrated of mediaeval German lyric poets. For all his fame, Walther's name is not found in contemporary records, with the exception of a solitary mention in the travelling accounts of Bishop Wolfger of Passau—"Walthero cantori de Vogelweide pro pellicio V. solidos longos"—"To Walther the singer of the Vogelweide five shillings to buy a fur coat," and the main sources of information about him are his own poems and occasional references by contemporary Minnesingers. It is clear from the title *hêr* (Herr, Sir) these give him, that he was of noble birth; but it is equally clear from his name Vogelweide (Lat. *aviarium,* a gathering place or preserve of birds) that he belonged not to the higher nobility, who took their titles from castles or villages, but to the nobility of service (*Dienstadel*), humble retainers of the great lords, who in wealth and position were little removed from non-noble free cultivators. For a long time the place of his birth was a matter of dispute, until Professor Franz Pfeiffer established beyond reasonable doubt that he was born in the Wipthal in Tirol, where, not far from the little town of Sterzing on the Eisak, a wood—called the Vorder- und Hintervogelweide—preserves at least the name of his vanished home.

Tirol was at this time the home of several noted Minnesingers; and the court of Vienna, under the enlightened duke Frederick I. of the house of Babenberg, had become a centre of poetry and art. Here it was that the young poet learned his craft under the renowned master Reinmar the Old, whose death he afterwards lamented in two of his most beautiful lyrics; and in the open-handed duke he found his first patron. This happy period of his life, during which he produced the most charming and spontaneous of his love-lyrics, came to an end with the death of Duke Frederick in 1198. Henceforward Walther was a wanderer from court to court in many Germanic countries, singing for his lodging.

For material success in this profession he was hardly calculated. His criticism of men and manners was scathing; and even when this did not touch his princely patrons, their underlings often took measures to rid themselves of so uncomfortable a censor. Thus he was forced to leave the court of the generous duke Bernhard of Carinthia (1202–1256); after an experience of the tumultuous household of the landgrave of Thuringia he warns those who have weak ears to give it a wide berth; and after three years at the court of Dietrich I. of Meissen (reigned 1195–1221) he complains that he had received for his services neither money nor praise. Walther was, in fact, a man of strong views; and it is this which gives him his main significance in history, as distinguished from his place in literature. From the moment when the death of the emperor Henry VI. (1197) opened the fateful struggle between empire and papacy, Walther threw himself ardently into the fray on the side of German independence and unity. Though his religious poems sufficiently prove the sincerity of his catholicism, he remained to the end of his days opposed to the extreme claims of the popes, whom he attacks with a bitterness

which can only be justified by the strength of his patriotic feelings. His political poems begin with an appeal to Germany, written in 1198 at Vienna, against the disruptive ambitions of the princes:—

Crown Philip with the Kaiser's crown
And bid them vex thy peace no more.

He was present, on Sept. 8, at Philip's coronation at Mainz, and supported him till his victory was assured. After Philip's murder in 1209, he "said and sang" in support of Otto of Brunswick against the papal candidate Frederick of Staufen; and only when Otto's usefulness to Germany had been shattered by the battle of Bouvines (1212) did he turn to the rising star of Frederick II., now the sole representative of German majesty against pope and princes. From the new emperor his zeal for the empire at last received recognition; and a small fief in Franconia was bestowed upon him, which, though he complained that its value was little, gave him the home and the fixed position he had so long desired. That Frederick gave him an even more signal mark of his favour by making him the tutor of his son Henry VII., is more than doubtful. Walther's restless spirit did not suffer him to remain long on his new property. In 1217 we find him once more at Vienna, and again in 1219 after the return of Duke Leopold VI. from the crusade. About 1224 he seems to have settled on his fief near Würzburg. He was active in urging the German princes to take part in the crusade of 1228, and may have accompanied the crusading army at least as far as his native Tirol. In a beautiful and pathetic poem he paints the change that had come over the scenes of his childhood and made his life seem a thing dreamed. He died about 1230, and was buried at Würzburg, after leaving directions, according to the story, that the birds were to be fed at his tomb daily.

Historically interesting as Walther's political verses are, their merit has been not a little exaggerated. Of more lasting value are the beautiful lyrics, mainly dealing with love, which led his contemporaries to hail him as their master in song (*unsers sanges meister*). He is of course unequal. At his worst he does not rise above the tiresome conventionalities of his school. At his best he shows a spontaneity, a charm and a facility which his rivals sought in vain to emulate. His earlier lyrics are full of the joy of life, of feeling for nature and of the glory of love. Greatly daring, he even rescues love from the convention which had made it the prerogative of the nobly born, and puts the most beautiful of his lyrics—*Unter der linden*—into the mouth of a simple girl.

A certain seriousness, which is apparent under the joyousness of his earlier work, grew on him with years. Religious and didactic poems become more frequent; and his verses in praise of love turn at times to a protest against the laxer standards of an age demoralized by political unrest. Throughout his attitude is healthy and sane. He preaches the crusade; but at the same time he suggests the virtue of toleration, pointing out that in the worship of God

Christians, Jews and heathen all agree.

He fulminates against "false love"; but pours scorn on those who maintain that "love is sin." In an age of monastic ideals and loose morality there was nothing commonplace in the simple lines in which he sums up the inspiring principle of chivalry at its best:—

Swer guotes wîbes liebe hât
Der schamt sich ieder missetât.[1]

The *Gedichte* were edited by Karl Lachmann (1827). This edition of the great scholar was re-edited by M. Haupt (3rd ed., 1853). *Walther v. d. Vogelweide,* edited by Franz Pfeiffer, with introduction and notes (4th edition, by Karl Bartsch, Leipzig, 1873). *Glossarium zu d. Gedichten Walther's, nebst e. Reimverzeichnis,* by C. A. Hornig (Quedlinburg, 1844). There are translations into modern German by B. Obermann (1886), and into English verse *Selected poems of Walter von der Vogelweide* by W. Alison Phillips, with introduction and notes (London, 1896). The poem *Unter der Linden,* not included in the latter, was freely translated by T. L. Beddoes (*Works,* 1890), more closely by W. A. Phillips in the *Nineteenth Century* for July 1896 (ccxxxiii. p. 70). *Songs and Sayings* contains English translations of Walther's poems, by F. Belts (1917). *Leben u. Dichten Walther's von der Vogelweide,* by Wilhelm Wilmanns (Bonn, 1882), is a valuable critical study of the poet's life and works. *See* also E. Gaertner, *Die Epitheta bei Walther von der Vogelweide* (1901); R. Wustman, *Walther von der Vogelweide* (1913); A. Debrit-Vogel, *Die Gedichte Walthers von der Vogelweide in neuhochdeutscher Form* (1922).

(W. A. P.)

[1]He who has the love of a good woman
Is ashamed of every misdeed.

WALTON, IZAAK (1593–1683), English writer, author of *The Compleat Angler,* was born at Stafford on Aug. 9, 1593; the register of his baptism gives his father's name as Jervis, and nothing more is known of his parentage. He settled in London as an ironmonger, and at first had one of the small shops, 7½ ft. by 5 ft., in the upper storey of Gresham's Royal Burse or Exchange in Cornhill. In 1614 he had a shop in Fleet Street, two doors west of Chancery Lane. Here, in the parish of St. Dunstan's, he gained the friendship of Dr. John Donne, then vicar of that church. His first wife, Rachel Floud, great-great-niece of Archbishop Cranmer, died in 1640. He married again soon after, his second wife being Anne Ken—the pastoral "Kenna" of *The Angler's Wish*—step-sister of Thomas Ken, afterwards bishop of Bath and Wells. After the Royalist defeat at Marston Moor, he retired from business. He had bought some land near his birthplace, Stafford, and he went to live there; but, according to Wood, spent most of his time "in the families of the eminent clergymen of England, of whom he was much beloved"; and in 1650 he was again living in Clerkenwell.

In 1653 came out the first edition of his famous book, *The Compleat Angler.* His second wife died in 1662, and was buried in Worcester cathedral church, where there is a monument to her memory. One of his daughters married Dr. Hawkins, a prebendary of Winchester. The last forty years of his long life seem to have been spent in ideal leisure and occupation, the old man travelling here and there, visiting his "eminent clergymen" and other brethren of the angle, compiling the biographies of congenial spirits, and collecting here a little and there a little for the enlargement of his famous treatise. After 1662 he found a home at Farnham Castle with George Morley, bishop of Winchester, to whom he dedicated his *Life* of George Herbert and also that of Richard Hooker; and from time to time he visited Charles Cotton in his fishing house on the Dove. He died in his daughter's house at Winchester on Dec. 15, 1683, and was buried in the cathedral. It is characteristic of his kindly nature that he left his property at Shalford for the benefit of the poor of his native town.

Walton hooked a much bigger fish than he angled for when he offered his quaint treatise, *The Compleat Angler,* to the public. There is hardly a name in English literature, even of the first rank, whose immortality is more secure, or whose personality is the subject of a more enthusiastic cult. *The Compleat Angler,* dedicated to his friend John Offley, was published in 1653, but Walton continued to add to its completeness in his leisurely way for a quarter of a century. Later editions appeared during his lifetime, in 1655, 1661, 1668 and 1676. In the 1676 edition the thirteen chapters of the original had grown to twenty-one, and a second part was added by his brother angler Charles Cotton, who took up "Venator" where Walton had left him and completed his instruction in fly-fishing and the making of flies.

Walton did not profess to be an expert with the fly; the fly-fishing in his first edition was contributed by Thomas Barker, a retired cook and humorist, who produced a treatise of his own in 1659; but in the use of the live worm, the grasshopper and the frog "Piscator" himself could speak as a master. The famous passage about the frog—often misquoted about the worm—"use him as though you loved him, that is, harm him as little as you may possibly, that he may live the longer"—appears in the original edition. The additions made as the work grew were not merely to the technical part; happy quotations, new turns of phrase, songs, poems and anecdotes were introduced as if the leisurely author, who wrote it as a recreation, had kept it constantly in his mind and talked it over point by point with his numerous brethren. There were originally only two interlocutors in the opening scene, "Piscator" and "Viator"; but in the second edition, as if in answer to an objection that "Piscator" had it too much his own way in praise of angling, he introduced the falconer, "Auceps," changed "Viator" into "Venator" and made

the new companions each dilate on the joys of his favourite sport.

Although *The Compleat Angler* was not Walton's first literary work, his leisurely labours as a biographer seem to have grown out of his devotion to angling. It was probably as an angler that he made the acquaintance of Sir Henry Wotton, but it is clear that Walton had more than a love of fishing and a humorous temper to recommend him to the friendship of the accomplished ambassador. At any rate, Wotton, who had intended to write the life of John Donne, and had already corresponded with Walton on the subject, left the task to him. Walton had already contributed an *Elegy* to the 1633 edition of Donne's poems, and he completed and published the life, much to the satisfaction of the most learned critics, in 1640. Sir Henry Wotton dying in 1639, Walton undertook his life also; it was finished in 1642 and published in 1651. His life of Hooker was published in 1662, that of George Herbert in 1670 and that of Bishop Sanderson in 1678.

The Lives of Dr. John Donne, Sir Henry Wotton, Mr. Richard Hooker, Mr. George Hooker, etc., was published in 1670. This, together with the life of Robert Sanderson was edited by George Saintsbury in 1927. All these subjects were endeared to the biographer by a certain gentleness of disposition and cheerful piety; three of them at least—Donne, Wotton and Herbert—were anglers. Their lives were evidently written with loving pains, in the same leisurely fashion as his *Angler,* and like it are of value less as exact knowledge than as harmonious and complete pictures of character. Walton also rendered affectionate service to the memory of his friends Sir John Skeffington and John Chalkhill, editing with prefatory notices Skeffington's *Hero of Lorenzo* in 1652 and Chalkhill's *Thealma and Clearchus* a few months before his own death in 1683. His poems and prose fragments were collected in 1878 under the title of *Waltoniana.*

The best-known old edition of the *Angler* is J. Major's (2nd ed., 1824, repr. 1927). A facsimile of the first edition was reprinted in 1928 by A. and C. Black. The book was edited by Andrew Lang in 1896, and various modern editions have appeared. The standard biography is that by Sir Harris Nicolas, prefixed to an edition of the *Angler* (1836). There are notices also, with additional scraps of fact, annexed to two American editions, Bethune's (1847) and Dowling's (1857). An edition of Walton's *Lives,* by G. Sampson, appeared in 1903. *See* also T. Westwood, *The Chronicle of the "Compleat Angler" of Izaak Walton and C. Cotton* (1864); *Izaak Walton and his Friends,* by S. Martin (1903); E. Marston, *Thomas Ken and Izaak Walton: etc.* (1908); R. B. Marston, *Walton and some earlier writers on Fish and Fishing* (1909).

WALTON-LE-DALE, urban district, in the Fylde parliamentary division, Lancashire, England. Pop. (1938) 13,530, area 7.4 sq.mi. The church of St. Leonard was originally erected in the 11th century, the earliest portions of the present building being Perpendicular in style. Cotton-spinning is carried on. Roman remains have been found there, probably indicating a roadside post. The manor of Walton was granted by Henry de Lacy about 1130 to Robert Banastre. It afterwards passed to the Langtons and about 1592 to the Hoghtons of Hoghton. Walton was the principal scene of the great battle of Preston (Aug. 17, 1648). In 1715 the passage of the Ribble was bravely defended against the Jacobites by Parson Woods and his parishioners of Atherton (*q.v.*).

WALTON-ON-THAMES, a town and, with Weybridge, an urban district in Surrey, England, on the right bank of the Thames, 17 mi. W.S.W. from London by the S. railway. Pop. (1938) 30,040. Area 14.2 sq.mi. The church of St. Mary has late Norman portions, and contains numerous memorials, including examples of the work of Chantrey and Roubiliac. A verse inscribed upon a pillar is reputed to be Queen Elizabeth's profession of faith as regards transubstantiation. The queen was a frequent resident at Henry VIII's palace of Oatlands park, which was destroyed during the civil wars of the 17th century.

WALTON-ON-THE-NAZE or WALTON-LE-SOKEN, a watering-place in Essex, 71½ mi. E.N.E. from London. Pop. (1931) 3,234. This portion of the coast has suffered from encroachment of the sea, and a part of the old village of Walton, with the church, was engulfed towards the end of the 18th century. On the east side of the town is the open North sea, with a fine stretch of sand and shingle, affording good bathing. To the west is an irregular inlet studded with low islands, known as Hanford water. The Naze is a promontory 2 m. N. by E. of the town, and in the vicinity of Walton are low cliffs exhibiting the fossiliferous red crag formation.

WALTZ, a popular round dance, introduced from Germany into France at the end of the 18th century and into England in 1812. It is written in ¾ time and has enlisted the musical interest of many composers. Among these Chopin is supreme. As regards waltzes written expressly to be danced to, the two Johann Strausses (father and son), the famous Viennese composers, may be particularly mentioned. (*See* also DANCE.)

WALVIS BAY, a harbour on the coast of south-west Africa. When separated politically from the hinterland, practically no development took place. South-west Africa, under the former German rule, relied on Swakopmund. Now that the area is administered as part of the mandated territory, the port of Walvis Bay is beginning to develop. Vessels can now lie alongside a concrete wharf, 1,500 ft. long, to which leads a channel, 30 ft. deep. The wharf is fitted with electric cranes. A cold storage and refrigerating plant has been erected, capable of dealing with 150 cattle and 200 or 300 sheep *per diem;* and considerable quantities of chilled meat are exported. Whaling and fishing are also carried on. Walvis Bay is now a regular port of call for mail steamers of British, Dutch and German lines. In consequence of the development of Walvis Bay, Swakopmund has been permanently closed as a port. The population of Walvis Bay in 1936 was 2,035, including 523 whites.

WALWORTH, SIR WILLIAM (d. 1385), lord mayor of London, belonged to a good Durham family. He was apprenticed to John Lovekyn, a member of the Fishmongers' Gild, and succeeded his master as alderman of Bridge ward in 1368, becoming sheriff in 1370 and lord mayor in 1374. He is said to have suppressed usury in the city during his term of office as mayor. His name frequently figures as advancing loans to the king, and he supported John of Gaunt, duke of Lancaster, in the city, where there was a strong opposition to the king's uncle. His most famous exploit was his encounter with Wat Tyler in 1381, during his second term of office as lord mayor. In June of that year, when Tyler and his followers entered south London, Walworth defended London Bridge against them; he was with Richard II. when he met the insurgents at Smithfield, and assisted in slaying their leader (*see* TYLER, WAT), afterwards raising the city bodyguard in the king's defence; for which service he was rewarded by knighthood and a pension. He subsequently served on two commissions to restore the peace in the county of Kent. He died in 1385, and was buried in St. Michael's, Crooked Lane.

See William Herbert, *The History . . . of St. Michael, Crooked Lane, London . . .* (1831); W. and R. Woodcock, *Lives of Illustrious Lord Mayors* (1846); an account of Wat Tyler's rebellion in a fragment printed by G. H. Trevelyan in the *Eng. Hist. Review* (July 1898).

WAMPUM or **WAMPUM-PEAGE** (Amer. Ind. *wampam,* "white"; *peag,* "bead"), the shell-money of the North American Indians. It consisted of beads made from shells, and required a considerable measure of skill in its manufacture. Wampum was of two colours, dark purple and white, of cylindrical form, averaging a quarter of an inch in length, and about half that in diameter. Its colour determined its value. The term wampum or wampum-peage was apparently applied to the beads only when strung or woven together. They were ground as smooth as glass and were strung together by a hole drilled through the centre. Dark wampum, which was made from a "hard shell" clam (*Venus mercenaria*), popularly called quahang or quahog, a corruption of the Indian name, was the most valuable. White wampum was made from the shell of whelks. Wampum was employed most in New England, but it was common elsewhere. By the Dutch settlers of New York it was called *seawan* or *zeewand,* and *roenoke* in Virginia, and perhaps farther south, for shell-money was also known in the Carolinas, but whether the *roenoke* of the Virginian Indians was made from the same species of shell as wampum is not clear. Cylindrical shell-beads similar to the wampum of the Atlantic coast Indians were made to some extent by the Indians of the west coast. In the trading between whites and Indians, wampum so completely took the place of

ordinary coin that its value was fixed by legal enactment, three to a penny and five shillings a fathom. The fathom was the name for a count, and the number of shells varied according to the accepted standard of exchange. Thus where six wampum went to the penny, the fathom consisted of 360 beads; but where four made a penny, as under the Massachusetts standard of 1640, then the fathom counted 240. Wampum circulated in the remote districts of New England through the 17th century, and even into the beginning of the 18th. It was current with silver in Connecticut in 1704.

Wampum was also used for personal adornment, and belts were made by embroidering wampum upon strips of deerskin. These belts or scarves were symbols of authority and power and were surrendered on defeat in battle. Wampum also served a mnemonic use as a tribal history or record. "The belts that pass from one nation to another in all treaties, declarations and important transactions are very carefully preserved in the chiefs' cabins, and serve not only as a kind of record or history but as a public treasury. According to the Indian conception, these belts could tell by means of an interpreter the exact rule, provision or transaction talked into them at the time and of which they were the exclusive record. A strand of wampum, consisting of purple and white shell-beads or a belt woven with figures formed by beads of different colours, operated on the principle of associating a particular fact with a particular string or figure, thus giving a serial arrangement to the facts as well as fidelity to the memory. These strands and belts were the only visible records of the Iroquois, but they required the trained interpreters who could draw from their strings and figures the acts and intentions locked up in their remembrance" (Major Rogers, *Account of North America,* London, 1765).

See Holmes, "Art in Shell of the Ancient Americans" in *Annual Report of Bureau of Ethnology, Washington, for 1880–1881;* W. B. Weeden, *Indian Money as a Factor in New England Civilization* (Baltimore, 1884); E. Ingersoll, "Wampum and its History," in *American Naturalist,* vol. xvii. (1883); Horatio Hale, "On the Origin and Nature of Wampum," in *American Naturalist,* vol. xviii. (1884); C. L. Norton, "The Last Wampum Coinage," in *American Magazine* for March, 1888; David Ives Bushnell, *The Origin of Wampum* (1906); New York State Museum, *Wampums of the Iroquois Confederacy,* 61st Ann. Rept. Pt. I (Albany, New York, 1907); Frank A. Speck, "The Penn Wampum Belts" (Leaflet of the Museum of the American Indian No. 4, 1925); J. C. Storms, *The Story of Wampum* (1936).

WANA, a valley and frontier outpost of Waziristan in the North-West Frontier Province of India. It lies to the west of the Mahsud country, and to the north of the Gomal river, and is inhabited by the Waziri tribe. Lying on the border of Afghanistan, it is conveniently placed for dominating Waziristan on the north and the Gomal pass on the south, and occupies very much the same strategic position as the Zhob valley holds in Baluchistan. In 1894, when the Indo-Afghan boundary commission was delimiting the Waziri border, the Mahsud Waziris, thinking their independence to be threatened, made a night attack on the camp of the commission at Wana. The result was the Waziristan Expedition of the same year, and the occupation of Wana by British troops. On the formation of the North-West Frontier Province in 1901 it was decided to replace the troops by militia, and Wana was handed over to them in 1904. It was abandoned during the third Afghan War, and has not been re-occupied.

WANAMAKER, JOHN (1838–1922), American dry goods merchant, was born in Philadelphia (Pa.), on July 11, 1838. He attended a public school in that city until he was 14, when he became an errand boy for a book store. He was a retail clothing salesman from 1856 until 1861, when he established with Nathan Brown (who afterwards became his brother-in-law) the clothing house of Wanamaker and Brown, in Philadelphia, the partnership continuing until the death of Brown in 1868. In 1869 Wanamaker founded the house of John Wanamaker & Co. In 1875 he bought the Pennsylvania Railroad company's freight depot at 13th and Market streets, and in the following year opened it as a dry goods and clothing store. In Sept. 1896 he acquired the former New York store of A. T. Stewart, of which his partner, R. C. Ogden, had the management. This and the Philadelphia store are among the largest department stores in the United States. Wanamaker was postmaster-general in President Benjamin Harrison's cabinet in 1889–93, and brought about the establishment of post-offices on ocean-going vessels. He died in Philadelphia on Dec. 12, 1922. Wanamaker early identified himself with religious works in Philadelphia; was the first paid secretary, in 1857–61, of that city's Young Men's Christian Association, of which he was president in 1870–83, and in 1858 founded, and thereafter served as superintendent of, the Bethany (Presbyterian) Sunday school. He took an active part in the movement which resulted in the formation of the U.S. Christian commission in 1861.

WANDERU or **WANDEROO,** the name for langur monkeys (*Semnopithecus*) inhabiting the island of Ceylon; in India, commonly misapplied to the lion-tailed macaque, *Macaca silena* (*see* LANGUR; PRIMATES).

WANDSWORTH, a south-western metropolitan borough of London, England. Population (1938) 340,100; area 14.2 sq.mi. The name, which occurs in Domesday, indicates the position of the village on the river Wandle, a small tributary of the Thames. Wandsworth is the largest in area of the metropolitan boroughs, including the districts of Putney by the river, part of Clapham in the north-east, Streatham in the south-east, Balham and Upper and Lower Tooting in the centre and south. These are mainly residential districts, and the population has increased greatly during the 20th century with the tendency for more and more people to reside away from the city. The increase is also associated with the rise of industries, chiefly oil-mills, dyeworks, paperworks, calico-printing and hatmaking. Towards the west, along the Upper Richmond and Kingston roads, there is considerable open country. It is to a great extent preserved in the public grounds of Putney Heath, which adjoins Wimbledon Common, outside the borough, on the north; and Richmond Park and Barnes Common, parts of which are in the borough. Other public grounds are parts of Wandsworth Common (193 acres) and Clapham Common, both extending into Battersea, Tooting Bec (147 acres) and Streatham Common (66 acres), and Wandsworth Park bordering the Thames. The borough returns five members to Parliament. New municipal buildings were opened in 1937.

WANGANUI, a seaport of New Zealand, on the S.W. coast of North island. Pop. (1936) 23,178 (25,795 with suburbs). The town is situated at the foot of low hills, from the summit of which a splendid panorama is seen, including the snow-clad Mount Ruapehu to the northeast. The river bar is from 21 ft. to 23 ft. deep at high water. The district is chiefly pastoral, and wool is exported, as well as meat and dairy produce, for which there are large refrigerating works. The Wanganui Collegiate School (Church of England) is one of the largest boarding schools in New Zealand. The district was the scene of conflicts with the natives in 1847, 1864 and 1868, and in the beautiful Moutoa gardens a monument commemorates the battle of that name (May 14, 1864). The settlement was founded in 1842.

WANGARA, the name of districts in the western and central Sudan. According to Idrisi (writing in the 12th century), the Wangara country was renowned for the quantity and the quality of the gold it produced. The country formed an island about 300 mi. long by 150 in breadth, which the Nile (*i.e.,* Niger) surrounded on all sides and at all seasons. This description corresponds fairly accurately with the tract of country between the Niger and its tributary the Bani. Idrisi's account of the annual inundation of the land by the rising of the Niger agrees with the facts. He states that on the fall of the waters natives from all parts of the Sudan assembled to gather the gold which the subsiding waters left behind. The discoveries of Hornemann, Mungo Park and others revived stories of Wangara's richness in gold. Rennell and others (early 19th century) shifted the Wangara country far to the east and confused Idrisi's description with accounts which probably referred to Lake Chad. The Wangara territory was again moved westward, and was located within the Niger bend, as knowledge increased. The name has disappeared from maps, save that a town in the hinterland of Dahomey is named Wangara (French, Ouangara). Wangara is also the Hausa name (variants are Wangarawa, Wongara, Ungara, Wankoré and

Wakore) for the Mandinga (*q.v.*), a people of west Africa.

WANGARATTA, a town of Victoria, Australia, at the junction of the Ovens and King rivers, 145½ mi. by rail N.E. of Melbourne. Pop. (1933) 4,795. It is in an agricultural district and is the see of an Anglican bishop. A good deal of dredging for gold is carried out along the Ovens river.

WANSTEAD AND WOODFORD, a municipal borough in the Epping parliamentary division of Essex, England, on a branch of the L.N.E.R., 7 mi. N.E. of London (Liverpool st. station). Pop. (1938) 54,810. Area, 6 sq.mi. Wanstead park, 184 ac. in extent, was opened in 1882. Northward extend the broken fragments of Epping forest. Wanstead flats, adjoining the park form another open ground. In Saxon times Wanstead was owned by the monks of St. Peter's, Westminster, and afterwards by the bishop of London. In the reign of Henry VIII it came into the possession of the crown, and in 1549 it was bestowed by Edward VI on Lord Rich, whose son sold it in 1577 to Queen Elizabeth's favourite, Robert Dudley, earl of Leicester. Two town planning schemes cover the borough, which was formed in 1937 by combining the urban districts of Wanstead and Woodford.

WANTAGE, a market town and urban district, Berkshire, England. Pop. (est. 1938) 4,177. Area 4.37 sq.mi. The church of SS. Peter and Paul is Perpendicular and Early English. The grammar school preserves a Norman door from another church, which formerly stood in the same churchyard with St. Peter's. In the market-place is a great statue of King Alfred, executed by Prince Victor of Hohenlohe-Langenberg and unveiled in 1877, for Wantage is famous as the birthplace of the king in 849.

WAPAKONETA, a city of western Ohio, U.S.A. Pop. (1940) 5,225. It is in a grain-growing region, with deposits of gas and oil. The city manufactures machine knives, steel stampings, farm and garden tools, shovel handles, soles and heels for shoes, cheese and dairy products, etc.

WAPENSHAW (M.E. for "weapon-show"), a periodical muster or review of troops formerly held in every district in Scotland, the object having been to satisfy the military chiefs that the arms of their retainers were in good condition. Scott's *Old Mortality* gives a description of one. The name is still given to rifle meetings held annually in some parts of Scotland.

WAPENTAKE, anciently the principal administrative division of the counties of York, Lincoln, Leicester, Nottingham, Derby, and Rutland, corresponding to the hundred in the southern counties of England. In many cases, however, ancient wapentakes are now called hundreds.

The word wapentake, of Scandinavian origin, originally signified the clash of arms by which the folk assembled in a local court expressed their assent to its decisions. Wapentakes are not found outside the parts of England which were settled by the Danes.

WAPITI, the name applied to several deer of the red deer group. The true wapiti is *Cervus canadensis* of North America, where it is often called "elk." It is somewhat larger than the red deer, with big antlers characterized by the large fourth tine.

The name wapiti is also applied to several eastern Asiatic red deer characterized by large size and antlers lacking the crown of points usually developed in the typical red deer. *C. elaphus xanthopygus* and *C. e. congaricus* are such. (J. E. Hl.)

WAQIDI [Abū 'Abdallah Mahommed ibn 'Umar ul-Wāqidī] (747–823), Arabian historian, was born at Medina, where he became a corn-dealer but was compelled to flee from his creditors (owing largely to his generosity) to Baghdad. Here the Barmecide vizier Yahyā b. Khālid (*see* Barmecides) gave him means and made him cadi in the western district of the city.

In 819 he was transferred to Rosafa (Rusāfa) on the east side. His greatest work is the *Kitāb ul-Maghāzi,* on Mahomet's campaigns.

The first third of the *Kitab ul-Maghāzi* (one leaf missing) was published by A. von Kremer from a Damascus ms. (Calcutta, 1856). Sprenger in his *Leben Muhammad's* used a British Museum ms. containing the first half, all but one leaf. J. Wellhausen published an abridged German translation from another British Museum ms. under the title *Muhammad in Medina* (Berlin, 1882).

Ascribed to Wāqidī, but probably written at the time of the Crusades to incite the Moslems against the Christians, are several further works on the conquests of Islam. *See* Arabic Literature. (G. W. T.)

WAR. War is the use of organized force between two human groups pursuing contradictory policies, each group seeking to impose its policy upon the other. This is so even when the policy of one side is purely defensive; a group which resists subjugation at the hands of an invader is seeking to impose upon that invader its own policy of remaining independent.

War differs from the forcible repression of crime only because the resistance of criminals is seldom strong enough to deserve the name of organized force. When the criminals or any other armed opponents of the law gather strength, you have the beginning of a civil war. Pure pacifism would mean anarchy; pacifists who denounce all war but approve of police work contradict themselves. In effect, they say that a community has the moral right to protect itself against a few enemies but not against the greater evils to be feared from many enemies.

Conflict, with death for its ultimate sanction, is a universal law of life. All individual living things must find food and must in one way or another defend themselves against germs within them, or against other forms of life of which the survival threatens their own. Even among closely planted trees the stronger growth of some upwards toward the light will often stunt and finally kill some weaker or less fortunate specimen. Almost all animals must compete actively, while the flesh-eaters must be continually killing others in order to live. Moreover, an active struggle for life tends to keep creatures up to the mark. When by what superficially appears to be good fortune, an animal gets food easily and need make no great effort to escape from or defend itself against powerful enemies, then that animal tends to degenerate and will probably die quickly if its favourable environment changes to its disadvantage—the power of individual organisms to resist change is obviously limited. This tendency to degenerate in too easy conditions is implied in the proverb: "Who is my best friend? My worst enemy; he keeps me up to the mark." Surveying the struggle for life in general, the old Greek philosopher Heraclitus wrote, "War is father and king of all; and some he made gods and some men, some slaves and some free."

Both man and the social animals who have the instinct for mutual aid transfer much of the struggle for life from the plane of the individual to that of the group. Man, as Aristotle noted, is "a political animal" whose nature is to form groups possessing at least the rudiments of government and law. In such groups "without authority there is no life," for societies must always struggle against criminals who if unchecked would destroy them. Thus force is a necessary corollary of government, and when authority becomes uncertain or unduly weakened then the survival of the group in competition with other groups becomes doubtful. Somewhere there must be a head to compel obedience, as is true in the smallest ultimate group, the family. We may compare the weakening of the monogamous family based upon permanent marriage in the Protestant societies which limit or abolish the legal authority of the husband as head of the family.

Under any but the most primitive conditions, however, the human groups which use force against each other are composed of many families. They are states of which the government, although often partially patriarchal in its nature, depends upon an idea of authority which goes beyond the patriarchate. Thus we have the paradox that men who may either have no personal knowledge and no individual quarrel with each other or may be full blood brothers, find themselves fighting against each other in obedience to the orders of their respective governments. Even those who begin an insurrection or civil war find themselves obliged to set up a sort of government if their movement survives for any length of time.

It would be a mistake to exaggerate the function of force in government. The chief instrument of government is not force but persuasion. The chief function of political authority is to assure the peace and safety of the community, and as far as domestic difficulties are concerned, this is done by discouraging the use of force between the citizens. Most men obey the law and co-operate with one another partly from habit and partly because reason

shows them the advantages of doing so. Even in war time persuasion does not cease; it is then called "propaganda." Nor is force all-powerful; it is more likely to produce a peace advantageous to the victor if the victory is won without excessive cruelty or treachery and is used with moderation. Only a peace of reconciliation based upon moderate terms, or a peace of destruction which permanently wipes out the political existence of the conquered, really deserves the name of peace, and the former is usually easier to achieve than the latter. Even a peace of political destruction which does not in the end reconcile the conquered to their condition may leave the victor insecure.

On the other hand the irreducible minimum of disagreement and therefore of potential strife among men cannot be stated in purely materialistic terms of advantage. There are clashes of ideas which in themselves have nothing to do with material values and may even be hostile to the survival of the individuals concerned. It would be hard to conceive a god who was really worshipped and yet was not in some sense a jealous god. Wars of the word tend to become wars of the sword. In general the potential of war within any society rises and falls with the amount of disagreement and therefore of discontent present in that society, and also with the hope of the discontented forcibly of remedying the causes of their discontent.

We shall see this last law in action presently when we glance at the historical phases of war with reference to the large or small amounts of armed strife which each phase has suffered or enjoyed.

THE THREE ELEMENTS OF WAR

War has two elements which though closely connected are distinct: first the political, which includes the nature of the contending groups, their respective governments, policies and resources; second the tactical, which includes all that we may call the mechanism of combat A third element, strategy, connects the first two and considers the respective situation of the two parties and the best means of using tactics to accomplish the political purpose.

War and Politics.—To classify wars and to understand the general characteristic of any particular war, one must begin with the political factor. In Clausewitz' famous phrase war is "a continuation of politics by other means"; the two parties fight battles instead of making speeches and writing diplomatic notes. The nature of the clash between the two opposing policies determines the intensity of the conflict. As a man threatened with murder will resist more fiercely than one threatened only with defeat in a boxing or wrestling match, so a group facing extermination or enslavement will make more effort than one which fears only the loss of a distant colony or a frontier fortress. In either sort of war the actual fighters will of course do their utmost, for no man ever killed or risked being killed wholly in cold blood. The difference will be the extent to which the furious emotions of combat will spread throughout the nation or other fighting group and the corresponding proportion of the available resources which will be diverted to military purposes.

In practice, wars of extermination are rare. Sometimes small and brief instances have occurred; we may compare the extermination of the Amalekites directed by the Jewish Prophet Samuel and described in the 15th chapter of the First Book of Samuel in the Old Testament.

In general, however, victors prefer to ease their own task by giving the vanquished something to hope for in case of surrender. Prolonged slaughter both frightens and disgusts normal men; they begin to fear the consequences to themselves should it continue indefinitely. Also, irrespective of consequences, they turn from it with disgust. Another check upon war is what may be called the irreducible minimum of individualism. Wars are community affairs in which individuals willingly participate only to the extent that they can identify themselves with their community through national patriotism or any other sort of loyalty. If you push any community too hard, then the moral forces of loyalty and consequent self-sacrifice become exhausted and are replaced by the desire for peace at any price. These three, rational fear, disgust, and the irreducible minimum of individualism combine to form a moral limitation upon all wars other than those of extermination—that is, upon almost all wars known to history.

In addition to the moral limitation, all wars which do not end in the permanent political destruction of the conquered group may be called politically limited. Politically unlimited conflicts, although not so exceptional as wars of extermination, are historically rare. Even wars which temporarily reduce the conquered to impotence are greatly outnumbered by those in which the political aim of the conqueror is only to weaken the conquered without depriving them of their independence in any way. Recent instances are the Spanish-American War in which the American aim of destroying Spanish sovereignty in Cuba was accomplished without the necessity for invading Spain itself, and the Russo-Japanese War of 1904 in which the Japanese aim of driving the Russians from Manchuria was accomplished without invading Russia proper.

At the opposite extreme from wars of extermination you have conflicts which are hardly more than police operations on a large scale, or "wars of nerves" in which the object is to persuade another state to modify its policy and yield some political point by the mere threat of war without any actual fighting or casualties whatsoever.

Almost all wars are obviously intermediate between the war of extermination and the war of nerves. Between the two, the possible gradations are almost infinite; we may compare them to the colours of the spectrum with extermination for the infra red, and with encounters, which are all threats and no casualties, for the ultra violet. Another parallel would be the scale of a piano with extermination for the lowest bass note and wars of nerves for the high treble.

The historical phases of war are distinguished by the comparative strength or weakness of the moral and political limitations upon conflict. Phases in which these limitations are strong enough to prevent the scale and intensity of armed strife from threatening the social order of one or both of the contending groups, are periods of limited war, more accurately of strictly limited war. On the other hand, when these limitations are so weak as to permit the social order to be strained by encounters on a great scale and of high intensity, then the period may be loosely called one of absolute or unlimited war, more correctly, imperfectly limited war.

The economic factor of war has nothing to do with its degree of limitation. Purely in the abstract, it is a limiting factor. Economically, fighting men cannot get their own living but must be supported either by the non-combatant parts of their own community or by seizing wealth belonging to their enemies. In practice, however, the moral and political limitations almost invariably create an imperative desire for peace long before the economic resources of the fighting group have been exhausted to the point of famine and pestilence. Nor is the degree of limitation concerned with the wealth or poverty of the fighting group. The question is entirely one of proportion, of whether or not the social order is strained by the diversion of a dangerous percentage of the available wealth to military and therefore to economically unproductive purposes. Simple societies and high, complex civilizations have the same choice: they may be either militarily extravagant, liberal, thrifty or miserly. Thus the degree of limitation is economic only in form; moral and political in essence.

The technical factor, which includes the nature and the destructiveness of weapons, the level of tactical and strategic knowledge and the degree of peace-time preparedness, affects the extent to which historical eras suffer from armed strife only in so far as it may lengthen or shorten any one particular conflict. The often-heard opinion which makes the social destructiveness of war depend upon the physical destructiveness of weapons—for instance, high explosives, bombing planes, etc.—ignores both military history and clear thought. Historically, periods of strictly limited and of imperfectly limited war have followed each other alternately without the slightest change in weapons. In every period the tools of peace are the weapons of war; in other words, the scientific knowledge and manufacturing skill which is available for the design and manufacture of arms equals that which is available

for construction and for the other forms of producing wealth. Gunpowder was discovered toward the beginning of the early modern scientific development which so extended and enriched European civilization. In general, a society which can manufacture poison gas can also produce anti-gas defence. On the other hand, two unarmed groups could kill each other off to the last man if they chose.

At the same time the function of the technical factor in shortening or lengthening wars is of enormous effect. Better armament, or organization, or a more skilful commander may effect a rapid victory in a struggle between two powers of which the general resources are approximately equal, so that the social order of neither side is strained as it would have been by the losses resulting from a prolonged contest. Similarly, technical superiority may permit a small, weak group to resist for a long time, sometimes even to conquer a group stronger than itself in every other respect. Thus, although the policies and resources of the belligerent groups determine the scale and intensity of every war at its beginning, nevertheless the technical factor plays a great part in determining how far both sides will have been injured before the struggle ends.

Tactics.—The term "tactics" is derived from a Greek word meaning to arrange or set in order. Its military meaning includes the formations, prescribed movements and training of organized forces with a view to combat.

Tactics are fundamentally affected by weapons; for instance, the close clump or deep infantry mass frequently used with some effect in ancient and mediaeval land fighting was seen to be a death-trap within a few generations after the beginning of the effective and general use of gunpowder in mobile warfare. Nevertheless the tactical influence of weapons is chiefly that of enabling or forbidding the use of this or that formation. New tactical uses may be found for weapons which have long been familiar; a famous example is that of the skirmishing tactics of the American and French revolutionary armies. The general armament of infantry with the musket at the beginning of the 18th century and the frequency of battles on the open, unfenced fields, then common to central and western continental European agriculture, had resulted in shallow, close order lines which were expected to develop the maximum of musketry fire power by marching in rigid formation close up to their enemy and then firing volleys at command from a standing position. The untrained revolutionary levies, incapable of the discipline and steadiness necessary for such procedure, frequently proved the effectiveness of the aimed fire of skirmishers who took individual cover behind obstacles, found good targets in the hostile close formations, and retreated easily when the latter tried to advance toward close quarters. Accordingly, skirmishing order became the accepted French Revolutionary-Napoleonic formation for an infantry fire-fight.

The mechanism of combat has nothing directly to do with the political factor in war. Weapons and formations are things in themselves which can be intelligently discussed without reference to the particular political purpose which they are intended to serve, except in so far as that purpose depends for its accomplishment on a measure of successful fighting. Indeed, attempts have been made, although without success, to deduce all the characteristics of war at any given time from the tactics then in use.

To paraphrase the French Colonel Ardant Du Picq, "Man fights not for the sake of fighting, but for victory, doing all that he can to diminish the first and to ensure the second." Accordingly, what General J. F. C. Fuller has well called "the constant tactical factor," *i.e.,* the attempt to overcome one's enemy with the least possible injury to one's self, runs through the whole history of war. Hence the continual effort to improve weapons and protective devices, and to increase mobility in order to avoid or parry an enemy's blows and in order to strike blows one's self which can neither be avoided nor parried. Further than this, one can hardly carry tactical analysis without differentiating between land, sea and air warfare.

Strategy.—The term "strategy" comes from a Greek word meaning "the leading of an army." We have already called it a bridge or connecting link between politics and tactics. It has been most variously defined. Clausewitz called it the art of "combining the combats which make up a war with a view to attaining the object of the war." It is perhaps best understood by distinguishing it from tactics. Thus one might say that tactics tells us how we should fight, and strategy where we should fight to the best advantage. A more inclusive definition would be that strategy is the leadership of armed forces up to the point of contact with the enemy.

As we have seen, strategy "considers the respective situation of the two parties" to a war, *i.e.,* their resources, geographical location, and policies, and then seeks "the best means of using tactics to accomplish the political purpose" of its own side. Since the purpose of every war is the forcible persuasion of the enemy to surrender, *i.e.,* to give up his policy in so far as it conflicts with ours, the true objective of strategy is to gain opinion. Whatever means we may use, all are intended to bring the enemy to the opinion that the evils of further resistance will be greater than those of yielding to us.

This principle is not wholly inapplicable even to cases of extermination. Military history records instances in which the surviving members of a defeated force, although still capable of a certain amount of further fighting, were so demoralized that they unresistingly submitted to massacre.

Opinion may be directly affected by what has become known as "propaganda"; that is, by the systematic circulation of statements intended to discourage the enemy and to encourage our own side. Propaganda can also be directed toward neutrals so that they may be persuaded to join or favour us, and not to join or favour the enemy. Sometimes the commander of a force which might have escaped or successfully resisted has been bluffed into surrender by persuading him that his position was hopeless, so that further fighting would serve no useful purpose and would only cause unnecessary bloodshed. On one famous occasion, shortly before the surrender of the Austrian Marshal Mack to Napoleon at Ulm, Marshals Murat and Lannes were admired for having talked a strongly posted Austrian bridge-guard out of fighting, thus permitting the French to cross the Danube. On a small scale, such bluffs may be compared with "wars of nerves."

Usually, however, the strategy of direct attack by means of persuasion in the form of propaganda and bluff is insufficient by itself and must be combined with more forcible means. This brings us to the second strategical objective: the persuasion of the enemy to surrender by seizing his resources. If we can devastate or occupy a considerable part of his country so that the men and materials in that territory are no longer available to him—in case of occupation those resources will be available to us—or if we can sufficiently distress him by a blockade against the movement of supplies essential to the life of his community, then in either case we can paralyze the determination of his government and people to continue the war.

Sometimes hostile resources can be seized by raiding; that is, by the action of forces which act by evasion and do not attempt to defeat the hostile organized forces. Successful evasion usually, but not always, implies speed. In the old land wars raiders were usually cavalry; in the old naval wars, fast surface ships, while today we have the submarine and the bombing aeroplane. Organized forces can seldom protect all valuable resources which are exposed to raiding.

On the other hand, this form of war has practically never succeeded alone. Raiding has often been an effective diversion, in that comparatively small raiding forces have compelled the assignment of considerably larger forces to the direct protection of hostile rear areas or merchant shipping. Today between neighbouring states the great diversionary effect of air bombing or the threat of it is obvious. Nevertheless there seems to be not one important case in the whole history of war in which raiding by itself has been decisive. Whenever it has come close to achieving a decision, its measure of success has been due to the failure to take adequate, appropriate and feasible methods of defence against it. Had the German submarines been able to go on sinking as many Allied merchant ships as they did in the month of April 1917, capitulation would have followed; but the adoption of

the depth bomb, and especially the convoy system, soon checked them. For another case, in which raiding alone came close to being decisive, one would have to go back more than a thousand years to the 9th century Viking raids, which will be found in the survey of military history. Without being rash enough to prophesy, we may surmise that in the long run the history of air raiding will probably be much the same.

The indecisiveness of raiding is that the enemy's organized forces, although as we have seen they can seldom cover all valuable objectives, can usually give an effective measure of direct or indirect protection to most such objectives as long as those organized forces remain undefeated and effective.

This brings us to the third object of strategy: the "destruction" of the hostile armed forces in battle. Just as the seizure of resources is a means toward the end of gaining opinion, *i.e.*, of persuading the enemy to surrender, so the "destruction" of the armed forces is a means to the end of seizing, or at least threatening to seize, resources by devastation, occupation or blockade. If not promptly followed by such seizure or by the immediate threat of it, then it would be indecisive because the enemy, being still possessed of the resources which are the springs or foundations of his power, would in time organize new forces to replace those "destroyed," and would thus be able to continue the war. Nevertheless, "destruction" by battle is of first importance because, if successful, it is the quickest and surest means of achieving the second and first strategical objectives in turn. Single battles have often decided campaigns and even entire wars. Thus in the war of 1914–18 it was said of Jellicoe, the commander of the British fleet at Jutland, that he was the only man on either side who could have lost the war in an afternoon, for if the British fleet had been "destroyed," which might conceivably have happened in a few hours' fighting, while the greater part of the German fleet might have remained in being, then the Allies would have been defeated. This third strategical objective is also in a sense the most economical of the three because it alone may bring prompt results, whereas raiding or blockade can act slowly. All told, therefore, it is so important that Clausewitz, the great Prussian philosopher of war, makes it precede the other two. Although victory in any single battle or even in a series of battles may not be decisive—it may cost the victor losses which proportionately weaken him more than those which he inflicts on his defeated enemy—nevertheless hardly any war was ever won without a large measure of successful fighting which "destroyed" a considerable part of the hostile armies or fleets or both.

The military meaning of the word "destruction," which is here framed in quotation marks to emphasize this particular point, must be clearly distinguished from its general meaning of actual physical destruction. Indeed, the military "destruction" of an armed force which resists could hardly be accomplished without a minimum of actual destruction of life and property and has probably never been so accomplished, but the proportion of actual destruction may vary enormously and is in any case not the essence of the matter. In the military sense, a force is "destroyed" when it is no longer an effective instrument of war in the hands of its commander. This may be achieved by the total massacre of its officers and men, or again by mere panic. When men are so confused and bewildered that they no longer obey orders, or when the chain of command itself is broken by hostile action, then for the time being the force in question is as effectively "destroyed" as if its members had all been killed. It is easy to imagine an extreme case of the total "destruction" of a force by means of a non-lethal gas which permitted all its men to be taken prisoners without killing or wounding a single one.

On the other hand, should excessive actual destruction of life and property result from attempts to "destroy" the enemy in a military sense, then the pursuit of this third objective may prove the most costly of all. Victory may be bought too dearly; an extreme case is one in which a victorious duellist bled to death on the dead body of his victim. Further, if both parties are members of a single economic system dependent upon commercial intercourse for prosperity, a conqueror may injure or even ruin himself by inflicting heavy, permanent losses upon an enemy who would otherwise have been a valuable customer during the subsequent peace.

LAND, SEA AND AIR WARFARE

From immemorial time man has lived and fought on land and sea. Recently he has learned to fly in the air. As all wars may be considered in terms of the three elements of policy, tactics and strategy, so the operations of any particular war are conditioned by the geographical element or elements in which they take place.

Man is a land animal. All his sea and air voyages start from the land; if successful they finally return to it, and in the last analysis they are undertaken in order to affect land affairs. Land is therefore the primary geographical element. Armies can not only blockade, they can also assault and occupy hostile territory.

On the other hand, nearly three-quarters of the surface of the planet is covered by water, which offers peculiar facilities for movement and transportation. Whereas the land presents many obstacles, the sea has practically none. A ship which remains seaworthy and under the control of her crew can go wherever there is water enough to float her. Although she needs harbours at each end of her voyages, she is independent of roads. Since her weight is carried by the water, she can transport large and bulky objects economically. Accordingly, wars between maritime powers are affected by the extent to which one can use sea communications while denying them to the other by means of blockade.

The air is the one universal element. Within the limitations of aircraft, both as to air ports and bases, fatigue of their crews, time of flight, and power to carry heavy or bulky objects, it presents no obstacles whatsoever. Moreover, the average speed of planes, which is reckoned in hundreds of miles per hour, is far greater than that of movement by sea or land.

The relative importance of sea and land warfare in any particular contest has always depended upon the geographical position of the two parties. Air power is already most important, but just how great a part it will play in the future is still uncertain.

OFFENSIVE AND DEFENSIVE

All military operations are either offensive or defensive in form. In general it may be said that the offensive is the weaker form but aims at a positive object, while the defensive is the stronger but aims only at a negative object. Nevertheless, the relation of the two forms is so affected by the geographical elements on or in which operations take place that it is hardly worth while to discuss them without reference to these geographical elements.

Very roughly, the offensive seeks to conquer the enemy or at least to oust him from some position, while the defensive seeks to avoid being conquered and usually seeks to hold some position against him.

Practically, however, the two forms are always somewhat mixed. Thus offensive weapons are those with which an enemy can be disabled, while purely defensive ones, such as shields, armour, fortifications or gas masks, are intended to prevent the disablement of the users. Nevertheless, even among weapons there is a certain overlap between the two sorts; for instance, a sword can be used either to thrust and cut or to parry. In tactics the mixture or overlap is still greater, for no forces on the defensive confine themselves to parrying blows. Practically always they also seek to injure and inflict loss upon the enemy who is attacking them, and often by counterattack they try to drive him from positions which he has occupied. At the same time the attackers try to protect themselves as best they can consistently with their offensive mission. In large land engagements one side is often attacking in one part of the field and at the same time is defending in another part. In naval war the tactical defensive is extremely rare, except in the form of mines anchored to the bottom; in rare cases ships can usefully be anchored to defend a narrow channel or a harbour. In aerial combat no defensive positions can exist except in the form of balloons attached to the ground.

In strategy the mixture or overlap is still more marked. One may be on the offensive strategically and on the defensive tactically when one invades hostile territory and takes up defen-

sive positions therein, where one's presence is so inconvenient for the enemy that he is compelled to try to put one out. A good example is the conduct of Sherman in the Atlanta campaign of 1864. Again, one is strategically defensive and at the same time tactically offensive when one retires into one's own territory before an enemy in order to attack him to better advantage, as the French retreated from their frontier to the Marne in 1914. At sea and in the air both sides are usually, in one sense or in another, on the offensive.

Notwithstanding these mixtures, the difference between the offensive and the defensive spirit is marked. The mere sensation of going forward to seek the enemy raises the spirit or morale of the forces. Nevertheless a successful defensive which inflicts heavier losses than one suffers one's self raises the spirit of one's own side and may prepare the way for a later offensive of one's own.

Without sooner or later attacking an enemy one can never conquer him. At most one can sometimes persuade him that it is not worth his while to go on trying to conquer you.

THE COMPOSITION OF ARMIES

For thousands of years armies have included four arms: infantry, artillery of one sort or another, cavalry, and fighting vehicles.

Infantry are foot soldiers armed with weapons which can be carried and fought by a single man. Artillerymen serve weapons which require a team of two or more men to transport and fight them, so that the artillery fighting unit is not a single man, but a gun or other weapon with its crew. By this definition ancient and mediaeval catapults were artillery, and many soldiers today called "infantry" are really artillerymen, since they are not armed with true infantry weapons, but with heavy machine guns, trench mortars or anti-tank guns. Cavalry are horsemen who normally fight mounted. When mounted men use their horses chiefly for transport and normally fight on foot they are mounted infantry. Fighting vehicles were chariots and are armoured cars and tanks; when they carry a single artillery weapon they approximate to mobile artillery.

The strength of infantry, the most primitive arm, is its cheapness and versatility. It can either attack or defend. Its weakness is the limitation of human physical strength which restricts the weight that can be carried and therefore forbids the use of heavy protective armour, heavy or bulky weapons, and large quantities of missiles. The strength of artillery is that its weapons, not being restricted in weight and bulk like those of infantry, are more powerful and of greater range than the latter. Its weakness has been that the weight and bulk of its pieces and of their ammunition make it both expensive and difficult to move. It has always dominated siege or position warfare in which its low mobility is not a handicap. The strength of mounted men has always been their mobility and the great moral effect of their charge against infantry in the open. Their weakness has been that they must dismount to stand on the defensive. Their horses then become vulnerable encumbrances. Today modern fire power has reduced the fighting value of true cavalry almost to zero.

The chief recent development of land weapons and tactics has been the development of fighting vehicles propelled by the internal combustion engine, and known as tanks when fitted with caterpillar tractors. The mobility of automotive vehicles is far greater than that of any of the older arms, while their power to carry guns and protective armour gives them considerable fighting value. Although vulnerable to artillery, yet in motion they are practically invulnerable to true infantry weapons. Accordingly, as modern fire power has destroyed, so the tank already has greatly reduced the fighting value of infantry and seems destined to reduce it still further.

THE COMPOSITION OF NAVIES

The unit of sea fighting is and has always been the ship. Ships have so changed in design, motive power and methods of fighting that the composition of ancient, mediaeval and early modern navies, together with their method of fighting, will be better discussed in connection with military history. One cannot say, as one can with armies, that the development of the different sorts of naval vessels has followed any regular course.

Navies today are armed chiefly with the gun, secondarily with the torpedo, and in a sense with planes when these are based upon ships. In general they are composed of battleships, aeroplane carriers, cruisers, destroyers, submarines and auxiliary craft. The battleship is individually the most powerful and usually the largest sort of fighting ship. She is heavily gunned and strongly protected by armour. The aeroplane carrier is a new type, serving chiefly as a base or vehicle for planes and characterized by a flat and open "flying deck" to enable planes to take off and land. Smaller numbers of planes can be carried by battleships or cruisers without flying decks. Cruisers are usually smaller than battleships, faster and more lightly gunned and armoured. Destroyers, originally called "Torpedo Boat Destroyers" and intended to act against torpedo boats smaller than themselves, are today small cruisers, faster and much lighter than cruisers properly so called, and dependent for protection upon their speed. Their sea-going qualities are not those of the battleship or cruiser, for they must stop and "lie to" in heavy storms. Also, their cruising radius—determined by the fuel and stores that they can carry—is less than that of larger fighting ships. They are armed with guns and torpedoes. Submarines depend for their effectiveness upon their ability to evade enemies by diving. Apart from their faculty of evasion they are vulnerable. They are armed with torpedoes and with one or more guns. Auxiliary craft are of many sorts; some combatant like small torpedo boats, submarine chasers and gunboats, others non-combatant, such as tankers for carrying fuel, repair ships, hospital ships and mine sweepers.

COMPOSITION OF AIR FORCES

The unit of aerial warfare is the plane. Military planes are of three main types, intended respectively for pursuit, bombing and observation.

The pursuit plane is small and very fast, armed with one or more machine guns, and intended for aerial combat against other planes and also for attacking hostile personnel on the ground. The necessity for speed limits its radius of action by restricting the weight of fuel which it can carry.

Bombing planes are larger, designed chiefly for weight-carrying capacity and cruising radius, and intended for bombing attack upon ground objectives and surface ships. The other armament of heavy and medium bombers—machine guns and sometimes a light cannon in the heavy type—serves to prevent interference with their bombing missions by hostile planes. Light bombers often operate by diving, and with their machine guns they frequently attack personnel on the ground or in ships.

Observation planes, designed to have a good view of the ground or sea below them, are for reconnaissance and for regulating the fire of ground or naval artillery at ranges so long as to prevent observers at or near the guns from seeing the fall of the shot. They must be able to see the shot strike and to report the point of impact to those at the firing point, today usually by radio. They fight only to prevent interference with their missions from other planes.

PHYSICAL AND MORAL FACTORS

The greater part of artillery preparation and theory is inevitably concerned with the physical factors in war. Weapons and equipment, organization, tactical and strategical study, etc., all seek means of achieving physical superiority over an enemy within a desired area.

Moreover, the history of war, the laboratory record of actual military experiment, finds it comparatively easy to set down the approximate numbers present in well-recorded campaigns and the relative position of the different units. These positions can be classified in geometrical fashion. For instance, ground forces not in immediate contact with an enemy move best in columns, the units following behind one another. Such columns can avoid many of the innumerable obstacles to movement on the earth's surface and are easily directed by following the leading element, while combatants must spread out in some sort of line in order to

use their weapons. Since the flanks and rear of a line are weaker than its front, the history of combat is filled with efforts to turn an enemy's flanks or to pierce his front, both efforts being intended to get at his vulnerable rear. Geometric elements also figure in strategy. For instance, it was a part of the strategic weakness of Napoleon's position at Moscow in the autumn of 1812 that, on the map, Moscow was the point of an acute-angled triangle of occupied territory which Napoleon had thrust eastward into Russia. Consequently, Russian forces pressing inward on either side of this triangle near its base needed to advance only comparatively short distances in order to cut off the French at Moscow.

At the same time the physical factors in war are inextricably mingled with moral factors. If we do not carry the assertion too far we may truly say that they are dominated by these moral factors. War is not only a glorified chess game; it is also, in a famous phrase of Jomini's, "a bloody and impassioned drama." Its hardships and risks demand high courage and self-sacrifice. Its innumerable chances alternately depress and exalt the spirit. It has been satirically but in a sense well said that war is divided between long periods of intense boredom and short periods of intense fear.

Military firmness can be greatly cultivated by training, which gives some familiarity with real war. Trained men will act vigorously and with a measure of intelligence under circumstances which would paralyze their wills were they untrained. In turn, vigorous contact raises the spirits of one's own side, while the enemy's courage is best shaken by inflicting upon him some form of surprise; that is, by a sudden shock to his mind.

ANCIENT WAR

Using history in the sense of record sufficient to show the fundamental political element in war, *i.e.*, its degree of limitation, the ancient history of the European or western civilization now dominant in the world begins with the Greeks about 500 B.C. and ends about A.D. 500.

The early Greeks were in touch with the older Oriental civilizations concerning which we have considerable information. One of the earliest Sumerian sculptures from Babylonia, probably about 6,000 years old, shows soldiers fighting in close order, wearing helmets and carrying spears and shields. The chief technical innovation in Oriental warfare of which we have knowledge was the introduction of the horse, by the aid of which powerful and originally terrifying beast an Asiatic and probably nomadic tribe, the Hyksos, temporarily conquered Egypt about 2000 B.C. When first known to the Greeks, the Orientals had long possessed organized and disciplined armies equipped with metal weapons, and to some extent with metal armour. They had all four arms, strong fortification, and warships of a specialized sort, distinguished from the merchant ships of the day by sharp prows or rams and propelled like those merchantmen by oars, with sails as auxiliary power. Existing Egyptian models show companies of soldiers uniformly equipped and marching in step. One Oriental people, the Assyrians, had made conquest their chief business, specializing in war waged with great energy and cruelty until they themselves had been annihilated. Otherwise we know little of the degree of limitation in early Oriental war.

The Greek civilization, which afterwards became Graeco-Roman, entered in 431 B.C. a period of great and destructive wars lasting until 29 B.C. The Greek political unit was the City State, which worshipped gods which were primarily local deities, consequently, when the increasing pressure of population in 5th century Greece could no longer be eased by colonization, there was no moral unity either political or religious sufficient to limit strife strictly. The first of the great Greek internal struggles, the Peloponnesian War between confederacies of City States, led respectively by Athens and Sparta, continued for 27 years with two short pauses, producing such a crop of atrocities that thereafter the tone of Greek life was permanently lowered. No lasting peace resulted from Athens' defeat. The rise of the half-Greek kingdom of Macedonia to dominance in Greece and the rapid conquest of the vast Persian Empire by the Macedonian, Alexander the Great, enormously extended the area of Greek culture without ending its internal conflicts. The conquest and assimilation of the Mediterranean world by Rome, of which the chief military incident was the defeat of the Semitic, North African power of Carthage in spite of the temporarily successful invasion of Italy by a Carthaginian army under Hannibal, unified Graeco-Roman civilization in what was, in a sense, a confederation of City States. The last century of Roman expansion, however, saw a series of Roman civil wars which, although they did not affect the unity of the State, were accompanied by disgusting massacres and bred an intense longing for peace.

Technically the art of war improved throughout the period, with armies gradually changing from civic militias to mercenary forces. Although all free citizens seem to have been legally liable for service in these militias, the recruiting field was narrowed by the universality of slavery and because the citizens had to find their equipment. It was not worth while to mobilize more than a handful of those too poor to buy armour, since (except for a brief interval under Alexander and his immediate successors) heavy infantry were the chief arm. The principal weapon of the Greek heavy infantryman was a thrusting spear, the formation being a single deep line called the phalanx. During the pre-Roman period light infantry, cavalry and siege artillery improved; indeed, catapults were sometimes used in open warfare as "field artillery." The Romans returned to dependence upon a civic militia of heavy infantry, but in a new form, the legion. They replaced the thrusting spear with two heavy throwing spears, and fought at close quarters with a short thrusting sword which could be effectively used in formations more flexible than the phalanx, which could therefore be out-manoeuvred. Also, the legion stood in three lines, permitting successive shots and keeping the reserves out of the moral strain of being close behind the immediate combatants. Distant campaigning compelled the professionalizing of the legion coincidentally with the beginning of the Roman civil wars.

In A.D. 29 Augustus made himself emperor and established a strict limitation of war. He reduced the numbers of the professional army, which he set at about a third of a million, and this tiny constabulary long guarded and policed the Roman world from the Atlantic to the Euphrates and from the Rhine to upper Egypt. He systematically disarmed the free civilians, who became unwarlike and remained so until long after ancient times.

The gradual decline of ancient civilization from within may in part have been caused by this almost total disarmament; perhaps men of European stock become sluggish when thoroughly and long divorced from arms.

The internal decline was accompanied by a lowering of the quality of the Roman troops, which could no longer be paid or disciplined as regularly as before. Consequently, increased numbers had to be raised, the support of which burdened the diminishing revenues. By about A.D. 400 numbers may have reached three-quarters of a million. The army became chiefly barbarian in personnel, partly because barbarians were cheap compared with civilized men; partly because the latter were increasingly unwarlike. Meanwhile two combined causes made armoured cavalry superior to infantry: first, the need for mobility in an army used chiefly for running down raiders; second, the lowering of military quality made infantry unable to resist cavalry charges without massing in close formations covered by hedges of thrusting spears. In turn, these close formations lowered infantry offensive power, making cavalry the offensive arm.

Nevertheless, except for the south and east coasts of Britain and perhaps a strip along the Danubian frontier, the Roman armies everywhere prevented the permanent occupation of Imperial territory by the outer barbarians. In the 5th century, as the material side of civilization continued to decline, the reality of local government in the western provinces was taken over by barbarian hereditary commanders of barbaric auxiliary units in the Roman army. This process, however, is now generally recognized by historical scholarship to have differed greatly from successful invasion. The commanders in question were usually Romanized or at least half-Romanized; in every case except the mutinous Vandal chieftain in Africa they acted legally as deputies of the Emperors, and none except the Vandal ever made war on an Emperor.

MEDIAEVAL WAR

The Middle Ages, from about A.D. 500 to 1500, strictly limited warfare within Christendom by a new moral unity centring in the Catholic, *i.e.*, Universal, Church. Early in the period the Empire gradually became Christendom, as the moral authority of the Church increased, while the power of the emperors declined.

Technically, armoured cavalry remained the chief arm throughout the period, but before A.D. 800 the typical soldier in the west was no longer a professional, but a feudal militiaman. Professional armies, being expensive, are always small compared with the populations which support them. To be effective they must be regularly paid and capable of rapid movement over long distances, which conditions the debased Roman society, too impoverished to maintain its road system, could no longer fulfil. After the loss of many provinces to the fanatical Moslems, the western part of the diminished remnant of Christendom—its peoples still disarmed as they had been since Augustus—had to meet a new trial: devastation by mobile and ferocious raiders, Scandinavian sea pirates called Vikings, Magyar horsemen, and Moslems. Just in time, a remedy was found by organizing western Christendom for local defence on an aristocratic militia system under hereditary leaders, most of whom were descended from the wealthy class of the earlier Dark Ages, although some were "self-made."

Superficially, it is hard to recognize mediaeval wars as limited; not only were all rich laymen soldiers, but mediaeval literature is

full of battles, and mediaeval art of every sort of military symbol. Nevertheless the evidence is clear: the frequent armed strife between mediaeval Christians was socially trivial. The Plantagenet and Valois families could squabble over the crown of France through the "Hundred Years' War" without general and lasting strain to the social order in France through such prolonged hostilities. Large armies operating far from their bases were exceptional, volunteer forces raised for special occasions, usually crusades against non-Christians. The 50,000 volunteers with whom William the Conqueror is recorded to have invaded England were numerous for such a campaign. Private wars between nobles seem to have troubled general public order less than the violence incidental to labour strikes today.

The essence of the strict mediaeval limitation of war was that prolonged offensive campaigns on a large scale within Christendom were made impossible. In general, Christians felt Christendom to be one country, the differences within which were unimportant compared with the gulf between Christian and non-Christian. Technically, limitation was assured by the nature of the military obligation and the taxing system. All freemen except the highest were bound by oath to serve an immediate superior in arms and at their own expense, but except for the defence of their own locality they need serve only for 40 days in each year. Beyond that time their superior had to pay them, and this the law and custom of the time forbade. The ordinary expenses of government had to be met by the hereditary ruler from the rents and dues from lands which he individually owned, which rents and dues he could not increase because they were fixed by custom. Emergency taxation was a free grant to the feudal superior by his inferiors, usually to a king by his great vassals, which they could refuse at will. Consequently most mediaeval armies were tiny. In the Albigensian Crusade the decisive battle of Muret was won by a striking force of 900 armoured cavalry, supported only by an even smaller body of ill-armed infantry; while in famous fights like Poitiers and Agincourt the victors, the Black Prince and Henry V of England, commanded numbers of less than 8,000 and 15,000 respectively.

Through the early and central Middle Ages a typical army consisted primarily of armoured cavalry. Usually, but not always, infantry were ill-armed and of secondary value. On the defensive the armoured horsemen would habitually dismount, as Harold's élite did at Hastings, and form the front rank or ranks, while the lesser men stood behind them in a deep mass. On the offensive, although archers might support mounted charges with their fire, the average value of foot soldiers was slight. City militias were usually better than peasant infantrymen. Fortification was prevalent, while siege-work declined, so that sieges remained long until near the end of the period.

Warships, in part, remained rowing vessels fighting by ramming, and, in part, retrograded to sailing ships fighting by the primitive method of boarding.

Although the aristocratically-commanded feudal militias followed up their success in repelling the Vikings and other raiders of the Dark Ages by crushing the Spanish Moslems and the pagan Prussians and Lithuanians, and by long maintaining themselves against the Moslems in distant Syria, nevertheless their military shortcomings were obvious. Their character made high training and discipline impossible. Consequently, western sovereigns often chose to use their scanty revenues to hire mercenaries with some professional skill who would at least remain while paid. These mercenaries were usually of a cosmopolitan sort, tough fellows, frequently unemployed and generally hated as savage plunderers. Throughout most of the period the East Roman or Byzantine emperors of Constantinople kept up a professional standing army which long maintained much of the high Roman military tradition.

In the 14th and still more in the 15th century the mediaeval limitation of war began to weaken. The moral authority of the Church diminished through the corruption of the higher clergy. Sovereigns became more cynical and cruel, and war, although remaining small in scale, became more ferocious with the increasing employment of the mercenaries just described.

At the same time military technique developed. The rise of mercenaries, although socially harmful, was technically a symptom of greater wealth and a more specialized economy. The English longbowman, drawing his bow to the ear, became a valuable auxiliary to the armoured man-at-arms. The Swiss, whose poverty made armour and horses rare among them, developed a true attacking infantry for the first time since the ancient Romans. Although armed chiefly with clumsy long pikes, their great attention to drill made their deep formations both mobile and manoeuvrable. The appearance of disciplined infantry diminished the importance of cavalry, and by improving pioneer work would in any case have shortened sieges. The first effective use of gunpowder was in siege artillery which, against fortifications unsuited to counter battery work, made 15th-century sieges rapid affairs. That of Constantinople, the most strongly fortified of mediaeval cities, in 1453 by the Turks, lasted only 55 days.

Toward the end of the period the French and Turkish governments raised small, permanent standing armies.

MODERN WAR I: THE RELIGIOUS WARS

Modern war from about 1500 to 1940 has three phases, each of nearly a century and a half. In the first phase, ending in 1648, the chief military events are the religious wars. After about 50 years, during which the diminishing limitation of war inherited from the Middle Ages further weakened, the moral unity upon which that limitation had rested was destroyed by the appearance of various Protestant religious bodies determined upon the reform of the church. When added to the permanent and universal human struggle for power, the fearful popular passions due to this theological conflict produced a series of savage and destructive wars culminating in the Thirty Years' War, the most horrible single military episode in western history.

Throughout the phase, armies remained small in proportion to population, because much of the mediaeval feeling against taxation continued. The Spanish army which invaded Holland in 1566, and proved invincible to the Dutch in mobile warfare, numbered only 11,000; the peace strength of the largest early 17th century standing armies in Christendom, the French and Swedish, was only 15,000 each; and until after the end of the religious wars concentrations of 20,000 men were seldom seen on either side in a battle.

The destructiveness and horror of the wars of the time resulted from the nature of the troops and from the absence of a regular supply system. Militias of the mediaeval sort still existed, but continued to decline, and were seldom used for serious fighting, except in the case of civic militias defending towns. The typical soldier was the temporarily-hired and ruffianly-cosmopolitan mercenary, socially similar to his late-mediaeval predecessors in evil. The irregularity of his employment seldom permitted his higher commanders to control him firmly. Indiscipline was increased by irregularity in pay, due to the temptation upon sovereigns to enlist more men than they could long support. The high discipline in the armies of Spain, the first military power of the period, owed much to the constant stream of bullion from Mexico and Peru. Worst of all was the chronic lack of an efficient commissariat. In the French and German religious struggles even a commander desirous of controlling his men was usually compelled to let them scatter to forage in order to live. The hardened scoundrels who ordinarily composed these foraging parties became a curse to the civil population.

No such ghastly and monotonous series of orgies of wanton destruction and violent crime as those of the Thirty Years' War had been seen in Europe since the Viking raids of the 9th century. The constant ravaging bred famine and pestilence. Cannibalism was frequent; usually it was the dead bodies of executed criminals which were eaten, but once, in Alsace, prisoners were actually killed for food. Historians long held that three-quarters of the German-speaking peoples perished, and the more recent estimate of a loss of one-third puts the dead at 7,000,000.

Tactically the wars of the time show a rapid development of the revolutionary influence of gunpowder. Both siege and field artillery became handier and more mobile. In the early 16th century, before fortifications suitable both for resisting shot and for mounting cannon of their own were designed, sieges were lightning affairs. In 1523 the strong but old-fashioned defences of Landstühl in the Rhineland were battered down in one day. Later, however, earthworks and stone towers of a new type, capable of offering a long resistance, were developed. Field artillery scored its chief successes early in the period; at Ravenna in 1512 both French and Spanish guns played a great part, the French pieces contributing greatly to the final victory; and at Marignano in 1515 the French field pieces, firing upon the deep Swiss formations, prepared the way for the last great success of armoured cavalry of the mediaeval type. Increasing poverty, due to the religious wars, seems later to have reduced the proportionate number of guns available. Both infantry and cavalry were increasingly armed with hand firearms. Late 16th century horse somewhat unwisely tended to abandon the lance for the pistol, although afterwards a wholesome return to shock action took place. Infantry muskets which could kill a horse at 400 paces—if they chanced to hit him—are found early in the period, and before its end about three-fifths of the average infantry unit were musketeers, the rest being pikemen for close combat. The use of armour steadily decreased; to be strong enough to turn bullets it had to be unbearably heavy.

In naval warfare the gun became the chief weapon. Since many guns made ships too heavy to be rowed, sails became the chief propellant outside of the Mediterranean where some row galleys were still found useful in the frequent summer calms. Tactics under sail, however, developed only slowly.

During the middle phase of the agonizing Thirty Years' War, Gustavus Adolphus of Sweden, in his brief but brilliant career, showed that the efficiency of armies could be increased and the social destructiveness of war simultaneously decreased by a regular supply service which permitted the men to be kept with the colours. Toward the end of that struggle, just before its indecisive end which left Europe permanently divided in religion, the weakness of governments compared with those of today permitted the appearance of peace propaganda by broadsheets and other means.

MODERN WARFARE II: THE 18TH CENTURY LIMITED WARS

From the end of the Thirty Years' War in 1648 to the attempt of the revolutionary French Republic to enforce universal compulsory

service in 1793, a strict limitation of war, which we may loosely call the 18th-century limitation, prevailed.

After the horrors of the Thirty Years' War Europe was sick of blood, as ancient Rome had been after the vile civil wars before Augustus, and as the 20th century world was to be after 1918. The mediaeval idea of legitimate, hereditary government remained, together with much of the mediaeval social order and institutions. Upon these foundations, especially upon the classical culture then common to all educated men, a new moral unity was built by means of a humanist cult of moderation, reason and decorum. Anything, so felt the men of Louis XIV's day, was better than the destructive passions which they despised under the common name of "enthusiasm."

The late 17th and 18th century conduct of land warfare carried further the military reforms of Gustavus Adolphus. Although a certain "floating supply" of irregularly-employed cosmopolitan mercenaries remained, armies became permanent standing forces loyal to their sovereign who in Western Europe was also their national leader. Uniforms seem first to have been introduced under Louis XIV. Compared with the straggling and usually criminal plunderers who had preceded them, the new standing armies were habitually and fully supplied by an elaborate system of magazines, and were at the same time most strictly disciplined, both to increase their tactical efficiency and to prevent their harming either friendly or nominally hostile civilians. General Gage, commanding for England in Boston in 1774–75, actually hanged two of his own soldiers merely for breaking into a colonist's shop. Under such conditions service in the ranks was little better than honourable slavery, so that only the more adventurous individuals of the poor would enlist, while the frequent desertions furnished another argument in favour of the strict control. Outside of Prussia, militia service as a citizen-soldier almost disappeared. Only in Prussia was there a real system of training reserves for the standing army by a partial and highly selective system of compulsory service which spared the middle class and all artisans, taking only such peasants as could be spared from necessary farm labour.

Until about 1700 a dwindling proportion of infantry still carried pikes, but after that date the introduction of the bayonet made the musket and bayonet the universal weapons of infantry, and infantry tactics were directed toward developing the greatest possible fire-power. A highly specialized tactical system adapted to the unfenced open-field agriculture of most of Central and Western Europe was devised. When deployed for battle the men stood in shallow formations usually three deep, and marched slowly forward to close with the enemy, carefully keeping their alignment, because any who advanced beyond their comrades would have their ears blown in by the detonation of the coming discharge. The high point of the art was to "reserve fire" until very near, to compel the enemy to throw away his fire by firing too soon, and then to pour in one's own volley at murderously close range while he was reloading. All firing was supposed to be by volleys at command, and a single "perfect volley," like Wolfe's at Quebec in 1759, might decide a general action. The point about "reserving fire" explains the much misunderstood incident of the English officer who, at Fontenoy in 1745, taunted the French guards to fire first. Although he may have been drunk, he was by no means merely playing the fool; behind his bravado lay a sound tactical principle. The disappearance of the pike somewhat increased the combative value of cavalry. On the other hand, the shallow infantry formations diminished that of artillery; in no important battle do guns seem to have been decisive.

Although military numbers increased, especially around 1700 toward the end of Louis XIV's reign, in accordance with the general increase in population, aggregate wealth and strictness of political organization, nevertheless those numbers remained far inferior in proportion to population as compared with conscript forces today. Louis XIV's France of about 19,000,000 souls if fully mobilized under universal service would have given him nearly 2,000,000 soldiers, whereas his greatest numbers were far less than half a million and may not have exceeded 300,000. Eighteenth century governments, although stronger than their early modern and mediaeval predecessors, had only limited authority over the persons and purses of the governed.

The humanist reverence for moderation and reason, together with the restricted numbers of armies, their professional character and the high standard of training and discipline necessary for the tactics of the day, resulted in an economical conduct of war. Since governments seldom desired to destroy a rival government, but only to gain concessions from it, wars were for limited political objectives. Generals could not rashly expend soldiers trained for many years and not easily to be replaced. Accordingly, as in most professional armies throughout history, he who won by skill and craft was more admired than he who won by mere pounding. Superficially this seems contradicted by the amazing battle losses—the Russians at Zorndorf in 1758 had no less than 37% and the Prussians 30% casualties in a few hours—and also by the extreme boldness of commanders like Marlborough, Charles XII of Sweden, and Frederick. The contradiction is more apparent than real: Marlborough was relieved for incurring excessive losses; Charles XII was admittedly rash to folly; and Frederick through all his daring offensives was always careful to keep his army in being to fight another year. Although in weak hands such methods degenerated into slackness and formalism, the essential reasonableness of the effort to win without excessive bloodshed is today increasingly recognized.

The same desire for economical warfare was reflected in the great part played by fortresses and entrenched lines. The great military engineer Vauban constantly insists that besieging troops should keep covered, advance by sapping, and wear down the garrison by their fire instead of assaulting. His chief technical invention was that of "parallels," successive entrenched lines to shelter the besieging infantry.

Naval tactics appropriate to the sailing ship fighting by gunfire were devised. Since ships are always much longer than they are broad, they can mount more guns on the broadside than either ahead or astern. Consequently the best formation of such a fleet is in line ahead which permits all broadsides to fire. Before 1700, warships had become specialized into ships of the line and lighter craft, the former being more stoutly constructed and mounting heavier batteries. Throughout most of the period naval battles were fought in parallel lines. Toward the end, however, the frequently indecisive results of such engagements and their disadvantage to the fleet which, being to windward, must receive hostile broadsides without effective reply while bearing down to close quarters, led to the more decisive procedure of attempting to break the hostile line by cutting it in pieces.

EARLY MODERN WAR III: REVOLUTIONARY OR TOTALITARIAN WAR

The great and destructive wars from 1793 to 1940 have been characterized by the widely extended authority of governments over the governed, the expression of this authority being the universal compulsory-service mass army with its corollaries of almost unlimited taxation and the regimentation of civilian life. All these things were first attempted by the revolutionary French, and few prolonged wars of this sort have ended otherwise than in the destruction of the government of the defeated side by revolution. The vast authority necessary for such colossal efforts has recently been called total or totalitarian, which name might well be applied to the whole period.

Since the destruction of the 18th century humanistic moral unity, which had insufficiently appealed to the imagination and had therefore attracted no strong loyalty, no moral force able to end or moderate potential strife has been found. The driving force of interclass struggle has been the idea of political and more recently of economic equality. That of international conflict has been intense local patriotisms, unmodified by any more universal attachment. One may compare the unhappy ancient City States with their local gods.

The first episode of the period is that of the Revolutionary-Napoleonic wars between France on one side and on the other, England, supported by a series of temporary coalitions, the last of which finally crushed Napoleon in 1815. In August 1793 the French revolutionary politicians, justly fearing for their lives because of what all Europe felt to be their crimes and terrified by the threatened dissolution of the French regular army, passed the first universal compulsory-service law in history. Although the immediate, tangible result of this law has been much debated, it was, very logically, accompanied by attempts to control and compel the labour of the civilian population. Meanwhile a new tactics and strategy were developed. The raw revolutionary levies could not be sufficiently disciplined to stand in close formations and fire volleys at command. Profiting perhaps by the experience of French officers who had served in the American Revolution, those levies discovered the effectiveness of fire at will by agile swarms of skirmishers who offered no target for the volleys of the hostile regulars. For bayonet charges the revolutionaries formed in tumultuous columns of shouting men. At the same time their very deficiencies helped them to march well; the chaos of their supply system freed them from the slow movement and distribution of food to and from magazines, and compelled them to live off the country. Their lack of tents and baggage wagons left them unencumbered. Their new formations and their mobility, together with favourable chances of war against the sluggishly-led armies of the First Coalition, just saved the Republic.

The high talent of Napoleon brilliantly systematized the new procedure. For years his rapid marches, bold attacks, and contempt for the accepted rules of war bewildered opponents. Under him the French, who had already taken the offensive before his rise to power, entered every capital in Europe from Madrid to Moscow. Preoccupied with numbers, on becoming master, first of France and then of most of the continent, he used the conscription law of 1798, which had replaced the original law of 1793 and had made men liable from their twentieth to their twenty-fifth year, to give him constantly larger armies. Another innovation was the concentration of guns in great batteries, thus making artillery again a decisive arm.

Nevertheless his successes only increased his difficulties. England, secure from invasion through her superior fleet, he would probably have worn down had he achieved a true peace on the continent, but this he could not do. Although the Revolutionary-Napoleonic ideas appealed to certain elements, Europe could neither be revolutionized nor permanently cowed. His constant aggressions, his violations of neutral states and the humiliating treaties imposed upon temporarily

helpless enemies bred permanent distrust and desire for revenge. Chronic looting by the French angered the peoples. Rivals began to learn his methods; Austria, and to some extent Prussia, copied the French mass army.

In vain he increased his numbers. Feeling himself constantly driven to advance still further while an undefeated continental power remained, in 1812 he led into Russia the largest field army yet known to history, nearly half a million men. When inflexible Russian national spirit and the climate brought disaster, his political position at once began to crumble, as one by one every continental power turned against him. Although exhausted France raised another almost equally large army, French military quality was now declining, and in the autumn of 1813 the victory of overwhelming Allied numbers at Leipzig was the beginning of the end.

The military history of the 99 years from Napoleon's fall to 1914 was determined by the survival of the mass army and by the absence, except for the American Civil War, of prolonged mass warfare.

At first universal service survived only precariously through military theory and through the action of Prussia. In a Europe as sick of blood as after the Thirty Years' War, a moderate peace was made with France and a short-lived attempt was made to renew the 18th century limitation. France and Austria, although both retained universal legal liability for service, drafted so few men and for such long terms that their armies became professional in spirit. When in 1830 a Dutch force besieged the citadel of Antwerp, a mutual agreement to spare the town by confining firing and active operations to the side of the citadel which faced the open country was made in 18th century fashion. For a full generation Europe saw no war between great powers.

Nevertheless, 18th century humanistic moderation could not really be revived. The closely connected forces of democracy and nationalism, both intertwined with the rise of the commercial middle class and with the romantic movement in thought and letters, soon again became active. A capital instance of romanticism was the undue admiration for Napoleon. Dazzled by his victories and moved by the melodrama of his meteoric rise and fall, men insufficiently considered the proved weaknesses of his political and military system. The work of both great 19th century theorists of war, the French-Swiss, Jomini, and still more the Prussian, Clausewitz, is sometimes at least a little touched with this error. Clausewitz, although a profounder philosopher than Jomini, too often calls Napoleon "the god of war." Meanwhile Prussia, a poor but vehemently ambitious power, carried the revolutionary French idea of universal service even further by adding universal peace-time training.

When toward the middle of the 19th century wars between the great European powers recommenced, in the absence of any true limitation of strife, mere chance long kept those conflicts from becoming general or prolonging themselves to the point of straining social order in the belligerent countries. The American Civil War, a four years' war of exhaustion in which the defeated South fought to the last gasp, showed that fearful struggles were still possible. Socially, 1861–65 followed the Revolutionary-Napoleonic pattern of fierce popular passions and of mass armies raised by compulsory service. Technically, however, this was the first of the industrial wars. Machine industry and ease of communication by steamship and railway specialized the economy of various regions, making them vulnerable to blockade. Of these regions the South was one. It had imported manufactured goods from the North and from Europe, paying for them by exporting tobacco and especially cotton, so that the cutting of its external communications by the North distressed it. Railroads also made it possible to supply large armies more easily and these armies capable of rapid strategic movement; while steamships made movement at sea independent of winds, at the same time tying fleets more closely to their bases by necessitating regular supplies of fuel. Other effects of industrialism upon naval warfare were ironclad ships, anchored mines, torpedoes, and a rudimentary submarine. The first effect of industrialism upon land tactics was to strengthen the defensive by arming the infantry of both sides with rifles, thus suddenly increasing the effective range of hand firearms from less than 100 to more than 600 yards. Cavalry charges, close infantry formations, and volleys at command became equally impossible, and toward the close of the struggle troops in the presence of an enemy formed a habit of entrenching in order to live at all. The combination of rifle fire and entrenchment helped to postpone tactical decisions, thus tending toward a strategy of exhaustion.

The significance of the new, strong defensive, however, was lost upon Europe. The able Prussian chief-of-staff, von Moltke, is said to have contemptuously called the American Civil War, "a struggle between two armed mobs . . . from which nothing could be learned." European soldiers continued to believe in rapid decisions obtained by dashing, Napoleonic offensives, which belief was fortified by the rapid Prussian victories of 1866 and 1870. In 1866 Austria was beaten in seven weeks. In 1870 the French regular army was put out of action in four weeks. The real significance of both cases was the political weakness and bad command of the victims. Austria was a dynastic state with no general patriotism; the France of 1870 was riddled with faction, while von Moltke had developed a decentralized system of command well suited to large scale operations, since it left subordinate commanders free to act according to circumstances.

The moderate peace made in 1866 eventually led to an Austro-Prussian alliance, but the immoderate terms of 1871—by which not only German-speaking Alsace, but also French-speaking Lorraine were taken from France—produced lasting political strain.

Meanwhile every continental European power and also Japan hastened to organize a mass army on Prussian lines and to imitate von Moltke's system of command and general staff method. Although no two great European powers fired a shot at each other until 1914, the expense of the colossal armies and of the increasingly large and complicated warships which made up the battle fleets resulted in heavy political and financial strain.

During the 43 years of the armed peace there developed an exaggerated cult of the offensive, regardless of the defensive strength of existing weapons. In vain did the Russo-Turkish, Anglo-Boer, Russo-Japanese and Balkan Wars repeat the lesson of entrenchment and a postponed decision. Before 1866 the rifle had become a breech loader; it became a magazine rifle and was next supplemented by the machine gun. Soldiers closed their minds and continued to estimate the strength of armies chiefly in terms of infantry numbers.

After six weeks' fighting in 1914, the two largest field armies ever seen, each of nearly 2,000,000 men and both seeking a rapid decision by means of a neo-Napoleonic offensive, found themselves stalemated in trench lines which soon stretched from Switzerland to the North Sea. As the most extreme measures, including the violation of neutral Belgium by the Germans in order to turn the French left, proved indecisive throughout this first phase of movement, so the failure to break this trench barrier determined the entire course of the war. Without room to manoeuvre and thus condemned to frontal attacks, for more than four years the neo-Napoleonic generals who had despised fortification failed to solve the problem in siege warfare set them by modern fire power, especially by the machine gun, combined with trenches and barbed wire. Notwithstanding delusive instances in which success repeatedly seemed within reach, every assault finally failed in mud and blood. Attempts to crush the defensive by multiplying guns and shells finally resulted in bombardments so severe as to tear up the whole surface of the earth, so that assaulting troops themselves could not advance across the chaos of shell craters.

All sieges are decided by exhaustion of fighting and blockade combined, and this enormous siege was decided after the exhaustion and bankruptcy of most of the planet. Although every people had declared war in a mood of solemn exaltation astonishing to us today, the most intense official propaganda could not keep the spirit of the original belligerent from being worn down by the long, grinding struggle. The enormous authority of governments and the use made of the credit system merely hastened collapse by intensifying the various war efforts. In 1917 the comparatively primitive social order of Russia dissolved after something like 8,000,000 casualties at least had been inflicted upon her ill-equipped armies, and France threatened to break down as large sections of her army mutinied. In 1918, first the government of Austria and then that of Germany were overthrown by revolution, while their armies, although on the verge of dissolution, were still in the field. The total losses, which will never be fully known, have been estimated at 13,000,000 soldiers and an equal number of civilians dead or presumed dead, and 20,000,000 wounded.

Statesmen, soldiers and peoples everywhere agreed that such results must not be repeated. A feeble political attempt was made to limit war by a League of Nations, but, to anticipate events, this body was impotent because no nation which joined it sought to use it except to further national policies. Except for class feeling, nationalism remained the sole moral reality in politics. Meanwhile a treaty was imposed upon Germany which followed the evil precedent of those made by the French Revolution and Napoleon in that it neither reconciled the two parties nor politically destroyed the defeated.

Simultaneously there began an active discussion of military theory. On the one hand, serious military efforts would henceforward require even further extensions of governmental regimentation of all life. All policy must concentrate on success. On the other hand, a victory won by the methods and at the ruinous cost of 1914–18 was worth winning only on the melancholy assumption that the consequences of defeat might perhaps have been even worse. Thus the war of gigantic efforts and sacrifices was to be politically intensified and at the same time militarily moderated.

In general, the French and British authorities hoped to avoid undue loss by relying upon naval blockade while acting on the defensive by land, to which end the French strongly fortified their frontier with Germany. The Germans, on the contrary, planned to achieve a quick decision. Under a dictatorial government they rearranged their entire national life, both to resist blockade and to build powerful striking forces.

The means by which the Germans hoped to gain a rapid and economical decision were based upon certain technical developments of the latter part of 1914–18, especially the high training of a military élite and the use of new, highly mobile military instruments. High training alone had made possible the considerable success of their new offensive method of 1917–18, which involved extraordinary secrecy in the approach march, then a sudden and short bombardment without preliminary ranging shots, and finally a dashing advance in which the protection of the flanks of the leading units was left

to the reserves at the disposal of the higher command. The motive power of the two new instruments, the tank and the plane, was the internal combustion engine. In Nov. 1917 several hundred British tanks, fighting vehicles running on caterpillar tractors and effectively armoured against both infantry weapons and machine guns, without preliminary bombardment had suddenly broken through the German front in an attack which if adequately supported by the British higher command might have ended the war. Planes, originally used only for reconnaissance and regulating long-range artillery fire, had presently been fitted with bombs for attacking surface targets and with machine guns useful either against such targets or against other planes. The use of tanks and planes in highly trained hands and in co-operation with the older ground arms promised abundant opportunity for the rapidity and surprise which are the soul of manoeuvre.

In July 1940, the war which began in Sept. 1939 between England, France and Poland on one side and Germany and, later, Italy, on the other was still undecided; its chief incidents were rapid and cheaply bought German successes. After the opening of the Polish campaign on Sept. 1, 1939, the Poles were virtually defeated by the 10th, and the last embers of resistance had been stamped out before the end of the month, although without the Russian invasion of Eastern Poland an unimportant guerrilla warfare might have been briefly prolonged. Between April 9 and June 22, 1940, Germany totally defeated Norway, Holland and France, active operations against the last three countries having begun only on May 10. According to German official statements these resounding victories cost only the losses shown in the following table in round numbers to the nearest thousand:

	Killed	Wounded	Missing	Total
Polish Campaign .	11,000	30,000	3,000	44,000
Norway . . .	1,000	2,000	2,000	5,000
Western Front May 10—July 1	27,000	111,000	18,000	156,000
Totals . . .	39,000	143,000	23,000	205,000

We may compare these figures with those given above for 1914–18 or with those for individual operations in that war. For instance, at Verdun in 1916 the French lost nearly half a million, the Germans somewhat more than half that number, and the British over 60,000 on the first day of the Somme attack alone. Returning to the losses of 1939–40, the Germans claim to have captured about 400,000 prisoners in Poland, and between one and two-thirds and two and a half millions in the west. Even assuming the German admissions to be far too low, the contrast with 1914–18 is striking. One might multiply the admitted German dead by five, making them nearly 200,000, still the figure is comparatively insignificant as against the results obtained.

In general, the German method has been to make every effort to achieve surprise, closely co-ordinating the action of planes and mechanized ground forces with each other and with infantry and artillery. A prominent feature has been the rapid division and envelopment of large hostile forces through the sudden creation of deep salients thrust forward by mechanized columns. Throughout, the aim has been to win by speed and manoeuvre, confusing the hostile command and troops, rather than pounding on the latter in 1914–18 fashion.

Unhappily the successes of the technically excellent German operations have been accompanied and furthered by political conduct of a sort which traditional civilizations have agreed to call morally base. The attack upon Poland without warning while negotiations were still going on, and the wanton invasion of Holland and Belgium shortly after the German government had solemnly pledged respect for their territory, cannot be called other than treacherous. Such things can be excused only on the plea that duty to their own nation relieves men of all moral obligation toward foreigners.

Whether the increasing technical moderation of war or its increasing political degradation will determine the future, we do not know. One thing only seems certain: war, whether imperfectly or strictly limited, will in one form or another remain an integral and inevitable part of social life, affecting society and affected by it. We may conclude with a quotation from Clausewitz: "Every war is produced by and also receives its form from the ideas, feelings and political relations which exist at the time of its outbreak." And another from Sherman: "The legitimate object of war is a more perfect peace."

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WAR, ARTICLES OF. A code of regulations for the disciplinary government of armed forces. The terms "Laws and Ordinances of War," "Military Law," "Military Discipline Act," "Mutiny Act" and "Military Penal Code" are synonyms for "Articles of War," although this term is still in use in the United States. They all denote the system of rules, superadded to the common law of a country, which regulate the conduct and life of a citizen in his character as a member of the armed forces of his country. The "Statutes, Ordinances and Customs" of Richard II., issued about 1385, appear to be the earliest complete code—*see* the *Manual of Military Law* (Great Britain) and *The Journal of the Society of Army Historical Research,* vol. iv.

WAR, LAWS OF: *see* LAWS OF WAR.

WARANGAL, an ancient town of India, in the Nizam's Dominions or Hyderabad state, 86 m. N.E. of Hyderabad city. It was the capital of a Hindu kingdom in the 12th century, but little remains to denote its former grandeur except a fort and four gateways of a temple of Siva. Warangal has given its name to a district and a division of the state.

WARBECK, PERKIN (*c.* 1474–1499), pretender to the throne of England, was the son of Jehan de Werbecque, a poor burgess of Tournay in Flanders and of his wife Katherine de Faro. The exact date of his birth is unknown, but he represented himself as having been nine years old in 1483. The names of his father and other relations whom he mentions have been found in the muncipal records of Tournay, and the official description of them agrees with his statements in the confession made at the end of his life. According to this version, which may be accepted as substantially true, he was brought up at Antwerp by a cousin Jehan Stienbecks, and served various employers as a boy servant. He was for a time with an Englishman John Strewe at Middleburg, and then accompanied Lady Brampton, the wife of an exiled partisan of the House of York, to Portugal. He was for a year employed by a Portuguese knight whom he described as having only one eye, and whom he names Vacz de Cogna. In 1491 he was at Cork as the servant of a Breton silk merchant Pregent (Pierre Jean) Meno. Ireland was strongly attached to the house of York. Perkin says that the people seeing him dressed in the silks of his master took him for a person of distinction, and insisted that he must be either the son of George, duke of Clarence, or a bastard of Richard III. He was more or less encouraged by the earls of Desmond and Kildare. At this time he spoke English badly.

In 1492 he was summoned to Flanders by Margaret, sister of Edward IV., who was the main support of the Yorkist exiles. The suppositions that he was the son of Clarence or of Richard III. were discarded in favour of the more useful idea that he was Richard, brother of Edward V. Charles VIII., king of France, the counsellors of the youthful duke of Burgundy, Maximilian, king of the Romans, and James IV. of Scotland, none of whom can have been really deceived, took up his cause. He was entertained in France and at Vienna as the lawful king of England. The English Government knew his real history, and tried to seize him.

In July 1495 he was provided with a few ships and men by Maximilian, now emperor, and he appeared on the coast of Kent. No movement in his favour took place. A few of his followers who landed were cut off, and he went to Ireland to join the earl of Desmond in Munster. After an unsuccessful attack on Waterford in August, he fled to Scotland. Here James IV. showed him favour, and arranged his marriage with Catherine Gordon, daughter of the earl of Huntly. He made a short inroad into Northumberland, but the intervention of the Spanish Government brought peace between England and Scotland. In 1497 Perkin was sent on his travels again with two or three small vessels. After some obscure adventures in Ireland, he landed at Whitesand bay, near the Land's End, on Sept. 7, and was joined by a crowd of the country people. He advanced to Exeter, but on the approach of

the royal troops he deserted his followers, and ran to the sanctuary of Beaulieu in Hampshire. He then surrendered. His wife was kindly treated and placed in the household of Henry's queen, Elizabeth. Perkin was compelled to make two ignominious public confessions at Westminster, and in Cheapside on June 15 and 19, 1498. On Nov. 23, 1499 he was hanged for endeavouring to escape from the Tower with the imprisoned earl of Warwick.

See James Gairdner, *Richard the Third, and the Story of Perkin Warbeck* (Cambridge, 1898).

WARBLER, the general name for all birds of the Passerine families *Sylviidae* and *Mniotiltidae,* the *Mniotiltidae* being unrelated to the *Sylviidae* and being confined to the new world. The *Sylviidae* are small birds with weak, slender bills, feeding on insects and fruit. The song is clear and sweet and often metallic; the nest is usually cup-shaped, containing from three to six white eggs. Apart from the American kinglets and gnatcatchers (*q.v.*) the family is confined to the old world. The sedge-warbler (*Acrocephalus schoenobaenus*) is one of the commonest British species. It is a small olive-brown bird, with a yellowish eye-streak and a chattering song. It inhabits bushes and reed-beds usually close to water. The nearly allied reed-warbler (*A. scirpaceus*) lacks the eye-streak and rarely leaves reed-beds; its nest is built between and supported by several reed-stems.

The European great reed-warbler (*A. arundinaceus*) is larger. The Dartford warbler (*Sylvia undata*) is one of few warblers resident in Britain, though migratory on the continent. It is locally distributed in the south of England, central Europe and the Mediterranean region. The grasshopper warbler (*Locustella naevia*) inhabits tangled and thick herbage; its reeling song distinguishes it. The allied Savi's warbler (*L. luscinoides*) is confined to marshy country and has a higher pitched song. The icterine warbler (*Hypolais icterina*) is a straggler to Britain; it has a loud song, and the eggs are brownish pink, spotted with purplish black. The wood warbler or wood-wren (*Phylloscopus sibilatrix*) haunts woods of oak and beech and has a peculiar loud song. The willow-warbler or willow-wren (*P. trochilus*) is one of the commonest British species. *See* also GOLDCREST, WHITETHROAT, WREN, BLACKCAP.

The American or wood warblers are, on the whole, a more brightly coloured group and are distributed throughout North and South America and the Antilles. The yellow warbler (*Dendroica aestiva*) breeds throughout North America, wintering in South and Central America. The Cerulean warbler (*D. cerulea*) is less abundant and haunts the tree-tops. The Maryland yellow-throat (*Geothlypsis trichas*), in which the male has a black mask, is another familiar American form. The oven-bird (*Seiurus aurocapillus*) is a common woodland species; its song has been described as a crescendo repetition of the word "teacher." The shy water-thrush (*S. motacilla*) possesses a melodious song. The American redstart (*q.v.*) also belongs to this group.

See E. Howard, *British Warblers* (1913); F. M. Chapman, *Warblers of North America* (1914); *see* also issues of *Bird Lore.*

WARBURTON, ELIOT [BARTHOLOMEW ELLIOTT GEORGE] (1810–1852), British traveller and novelist, was born in 1810 near Tullamore, Ireland. He was educated at Trinity college, Cambridge, and was called to the Irish bar in 1837. He made a hit with his first book, *The Crescent and the Cross,* an account of his travels in 1843 in Turkey, Syria, Palestine and Egypt. His most substantial work was a *Memoir of Prince Rupert and the Cavaliers* (1849), enriched with original documents, and written with eloquent partiality for the subject. Warburton was on his way to explore the isthmus of Darien, when the ship in which he sailed was destroyed by fire (Jan. 4, 1852).

His other works include two historical novels: *Reginald Hastings* (1850), and *Darien, or the Merchant Prince* (1851).

WARBURTON, COLONEL SIR ROBERT (1842–1899), Anglo-Indian soldier and administrator, was the son of an artillery officer who had been taken prisoner at Kabul in 1842, and married an Afghan princess. Warburton entered the Royal Artillery in 1861, took part in the Abyssinian War of 1867–68, and then joined the Bengal Staff Corps. He served with distinction in the expedition against the Utman Khel in 1878 and in the Afghan War of 1878–80. Warburton was political officer in the Khyber between 1879 and 1882 with intervals of other duty, and continuously from 1882 until 1890. He turned the rude levies which formed the Khyber Rifles into a fine corps, made the road safe, and kept the Afridis friendly. When the Afridis began to cause anxiety in 1897, Colonel Warburton was sent for by the government, but he arrived too late to check the rising. He retired after the campaign. He died at Kensington on April 22, 1899.

See his *Eighteen Years in the Khyber* (1900).

WARBURTON, WILLIAM (1698–1779), English critic and divine, bishop of Gloucester, was born at Newark Dec. 4, 1698, son of the town clerk of Newark. William was articled an attorney, left the law and in 1727 was ordained priest by the bishop of London. At Brant Broughton, Lincolnshire, of which parish he became incumbent in 1728, Warburton spent eighteen years in study, the first result of which was his treatise on the *Alliance between Church and State* (1736). The book brought Warburton into favour at court, and he probably only missed immediate preferment by the death of Queen Caroline. His next and best-known work, *Divine Legation of Moses demonstrated on the Principles of a Religious Deist* (2 vols., 1737–1741), preserves his name as the author of a daring and ingenious theological paradox. The deists had made the absence of any inculcation of the doctrine of a future life an objection to the divine authority of the Mosaic writings. Warburton boldly admitted the fact and turned it against the adversary by maintaining that no merely human legislator would have omitted such a sanction of morality.

He now entered on a defence of Pope's *Essay on Man* against the *Examen* of Jean Pierre de Crousaz, in a series of articles (1738–1739) contributed to *The Works of the Learned.* These articles brought him the friendship of Pope, whom he persuaded to add a fourth book to the *Dunciad,* and encouraged to substitute Cibber for Theobald as the hero of the poem in the 1743 edition published under the editorship of Warburton. Pope bequeathed him the copyright and the editorship of his works, and introduced him to Murray, afterwards Lord Mansfield, who obtained for him in 1746 the preachership of Lincoln's Inn, and to Ralph Allen, who, says Johnson, "gave him his niece and his estate, and, by consequence, a bishopric." After his marriage Warburton resided principally at his father-in-law's estate at Prior Park, Gloucestershire, which he inherited on Allen's death in 1764.

In 1747 appeared his edition of Shakespeare, into which, as he expressed it, Pope's earlier edition was melted down. He had previously entrusted notes and emendations on Shakespeare to Sir Thomas Hanmer, whose unauthorized use of them led to a heated controversy. As early as 1727 Warburton had corresponded with Theobald on Shakespearean subjects. He now accused him of stealing his ideas and denied his critical ability. Theobald's superiority to Warburton as a Shakespearean critic has long since been acknowledged. Warburton was further kept busy by the attacks on his *Divine Legation* from all quarters, by a dispute with Bolingbroke respecting Pope's behaviour in the affair of Bolingbroke's *Patriot King,* by his edition of Pope's works (1751) and by a vindication in 1750 of the alleged miraculous interruption of the rebuilding of the temple of Jerusalem undertaken by Julian, in answer to Conyers Middleton. Warburton's manner of dealing with opponents was both insolent and rancorous, but it did him no disservice. He became prebendary of Gloucester (1753), chaplain to the king (1754), prebendary of Durham (1755), dean of Bristol (1757) and in 1759 bishop of Gloucester. He toiled to complete the *Divine Legation* but failed. He wrote a defence of revealed religion in his *View of Lord Bolingbroke's Philosophy* (1754), and Hume's *Natural History of Religion* called forth some *Remarks* . . . "by a gentleman of Cambridge" from Warburton, in which his friend and biographer, Richard Hurd, had a share (1757). He made in 1762 a vigorous attack on Methodism under the title of *The Doctrine of Grace.* He died at Gloucester on June 7, 1779.

Warburton's works were edited (7 vols., 1788) by Bishop Hurd with a biographical preface, and the correspondence between the two friends—an important contribution to the literary history of the period—was edited by Dr. Parr in 1808. Warburton's life was also written

by John Selby Watson in 1863, and Mark Pattison made him the subject of an essay in 1889. *See* also I. D'Israeli, *Quarrels of Authors* (1814); and especially John Nichols, *Literary Anecdotes* (1812–15), vol. v., and *Illustrations* (1817–58), vol. ii., for his correspondence with William Stukeley, Peter des Maizeaux, Thomas Birch, John Jortin and Lewis Theobald.

WAR COLLEGE, an institution for the instruction of officers in the higher branches of the military art. The French École de Guerre corresponds to the British Staff College, and trains staff officers. First founded in 1821, it was established in 1881 in its present location in Paris. It trains about one hundred candidates a year. Admission is by competitive examination open to officers of all arms between the ages of 28 and 38. The period of the course is two years, and the curriculum includes lectures and exercises on every branch of the art of war, and on kindred subjects such as politics, economics, naval questions, geography, and international law, together with war games, visits, tours and staff rides. At the end of the course officers satisfactorily reported on become eligible for staff posts.

The United States Army War College at Washington forms part of the General Service Schools and trains officers in high command and for General Staff duty in the War Department. The course forms the fourth and last year of the period of four years at the Schools and only those officers who have satisfactorily completed the prior courses are eligible to attend.

WAR CONTROL OF FOOD. During World War I practically all the belligerent and neutral countries of Europe experienced a shortage in the supply of food and other necessaries. The shortage was traceable to three distinct causes: first, the diversion of productive power to destruction or to making the means of destruction; second, the increased rate of consumption of those who were fighting or were undertaking harder physical labour than usual in the production of munitions; third, the deliberate blockades which with varying success the belligerents directed against one another and against neutrals. The blockades had as one feature a destruction of shipping. Food control became a feature of the war, and the food controller had three main problems to consider, namely, the maintenance of supplies, the regulation of prices and the control of consumption by distribution and rationing. The three problems are naturally connected. A solution of the first of them so complete as to keep supplies up to or above the prewar standard would prevent the other two from arising at all or at least in any serious form; this happened with bread-stuffs in Great Britain. On the other hand an attempt to fix prices without controlling supplies would lead either to a disappearance of supplies or to their distribution in an unjust and wasteful manner.

I. IN GREAT BRITAIN

For the first two years of the war questions of food control attained little prominence in Great Britain. The cutting off of the central European sources of sugar supply led to the anticipation of a considerable shortage of that particular food, and a royal commission was established in Aug. 1914, which undertook on Government account the purchase and importation of all sugar from that time onwards. A special organization for securing meat for the army from abroad was also found necessary from the beginning; this involved control of refrigerated tonnage under the Board of Trade. The use of cereals and sugar for brewing was limited by an Output of Beer Restriction Act, coming into force on April 1, 1916.

By the autumn of 1916, prices, which had risen more or less steadily from the beginning of the war, reached a level which began to evoke acute discontent and the prospects of an intensified submarine campaign caused anxieties for the future. Two important steps were taken. The first was the establishment in Oct. 1916 of a royal commission on wheat supplies, parallel to that on the sugar supplies. This commission almost immediately took on an international character through the signing in Nov. 1916 of the "Wheat Executive Agreement" between Great Britain, France and Italy, under which the purchase, importation, distribution and shipping not only of wheat but of all cereals was arranged on a common basis for the three Allies, the administrative work being undertaken in London. The wheat executive gradually extended its activities to other Allies and even to neutrals.

The second step was the making on Nov. 16 of an Order in Council under the Defence of the Realm Act which practically empowered the Board of Trade to introduce a complete system of food control, by regulating the importation, production, distribution, prices and quality of all kinds of food or articles necessary for the production of food.

The first holder of the new post, Lord Devonport, who actually began work on Dec. 11, gave valuable support to the wheat commission in securing adequate tonnage and foreign credits, and carried a stage further the policy of conservation of cereals already embodied in the Output of Beer Restriction Act and a Board of Trade order lengthening the extraction of flour. To facilitate this the whole of the flour-mills were taken over and run on Government account as from April 1917.

Apart from cereals, no substantial extension of food control took place till the appointment of the second food controller—Lord Rhondda—who succeeded Lord Devonport in June 1917, and at once prepared himself and the Ministry of Food to deal thoroughly with the three problems of supplies, prices and distribution. First he attacked prices. In Sept. 1917 the price of bread was lowered from 1s. or 1s.1d. to 9d. for the quartern loaf, the difference being paid by the Government as a subsidy. At about the same time there was fixed a scale of prices for meat and for live-stock, descending month by month from 74s. per cwt. in Sept. 1917 to 60s. in the following January. The fixing of meat and live-stock prices needed to be and was intended to be accompanied by measures for regulating slaughter and marketing, but for various reasons the latter measures did not become effective till the end of 1917. The scale of prices standing by itself gave the farmers a strong inducement to hurry on their beasts to market, so as to profit by the early high prices and avoid the later low ones; too many beasts were thrown on the market before Christmas and too few were kept for the new year; how the ensuing shortage, aggravated by large purchases of home-grown meat for the army and by other circumstances, was dealt with by rationing in the early part of 1918 is described below.

On the general principle of controlling supplies of all essential foods as a condition of fixing prices Lord Rhondda never hesitated. This policy was carried out most completely in the case of imports. Cereals and sugar were already being imported by the two commissions. Under Lord Rhondda all bacon, ham, lard, cheese, butter and similar provisions, all oils and fats (edible and otherwise), condensed milk, canned meat and fish, eggs, tea and even such extras as apples, oranges, jam and dried fruits, brought into Great Britain came to be directly imported by the Ministry of Food or requisitioned on arrival. All home-produced meat and cheese and most of the butter passed through the hands of the ministry, as also, through the control of flour-mills, did all the wheat and most of the barley. Even the whole potato crop of 1918 was taken over under a scheme framed in the time of Lord Rhondda, though not put into force till after his death. The only important exceptions were milk, fresh fish and fresh vegetables. The total turnover of the ministry's trading (including the two royal commissions) was at the rate of nearly £900,000,000 a year.

A British Food Budget.—Lord Rhondda made a budget of the food required for the country as a whole, and then took steps to see that that amount of food was available. This was partly a matter of securing imports; for there was needed, on the one hand tonnage, and on the other finance, that is to say, foreign credits. The Ministry of Food acting through or with the Governments concerned made bargains with the producers for the whole exportable surplus of Canadian cheese or Australian wheat or American bacon. It was partly a matter of encouraging food production at home. A vigorous food production campaign was started under the Ministry of Agriculture, and the Ministry of Food co-operated with the agricultural departments, in fixing only such prices as appeared likely to secure adequate supplies. In effect, in fixing prices for home produce, it made bargains with the farmers as to the prices at which, with whatever show of reluctance or grumbling, they would be able and willing to produce and to deliver

their produce to the ministry or its agents. The legal power of the ministry to fix any prices it thought good was absolute; the prices for home produce were actually fixed only after apparently interminable consultations, and were prices which could be expected to secure production of the required supplies, and did in fact do so.

The largest single source of imported supplies was the United States. Here a special department of the ministry was established (Oct. 1917), to purchase on its behalf all food-stuffs other than cereals, for which an organization already existed in the Wheat Export Co.; a branch in Toronto dealt with Canadian supplies. The department speedily grew into an international organization of vast scope; the "Allied Export Provisions Commission" purchased between Oct. 1917 and Feb. 1919 nearly $2\frac{1}{4}$ million tons of food valued at £267,000,000, at a cost for administration amounting to about $\frac{1}{15}$ of 1% on this turnover. All these figures exclude cereals and sugar.

The success of this policy of ensuring supplies by direct purchase abroad and consultation at home was unquestionable. Great Britain came nearer than any other European country to maintaining during the war a pre-war standard of supplies, and at the same time achieved a far more equitable distribution.

Control of Prices and Consumption.—Upon control of supplies was founded control of prices. Once goods were in the hands of the ministry it remained only to fix the margins of profit to be allowed to the various classes of distributors and the resulting prices to the public. Ultimately out of everything consumed in Great Britain by way of food and drink, 94% was subject to fixed maximum prices. Almost the only articles untouched were fresh vegetables, canned fruits, honey, salt, vinegar, spices, aerated waters and meals in restaurants.

After two years of comparative plenty the sugar commission in Nov. 1916 cut down the supplies it would issue to any wholesaler to 60% of the amount issued in 1915, and required each wholesaler to pass on supplies to retailers, manufacturers and others in the same proportion. This "datum period" principle of distribution represented a stage through which not only sugar, but most other foods (notably meat, bacon, butter and tea) passed as scarcity developed. For dealing with any acute shortage of supplies it soon proved unsatisfactory, partly because it made no allowance for changes in the channels of trade or in the distribution of the population, but mainly because it gave no assurance at all of supplies to any individual consumer. That could be given only by issuing to each consumer a ration book or other document as authority to purchase a fixed ration, requiring him to register with a particular retailer and authorizing the retailer in turn to purchase from his suppliers week by week or month by month enough to meet the rations of his registered customers. After prolonged delay, due to changes of policy and the war cabinet's fear of causing industrial unrest and encouraging Germany to believe in the success of the submarines, compulsory rationing was introduced for sugar on Jan. 1, 1917, and worked smoothly. Just before that date acute shortage of butter and margarine and tea had begun to show itself and led to the formation of "queues" of would-be purchasers before any shop that was thought to have supplies. Just after that date the temporary abundance of meat, caused or intensified by the descending scale of live-stock prices, ended suddenly and was replaced by something like a famine. Outside London the problem of the queues was at first dealt with by giving the food committees described below power to introduce local rationing schemes under the Food Control Committees (Local Distribution) Order of Dec. 22, 1917. For London a single rationing scheme for butter, margarine and meat, covering the home counties also and a total population of nearly 10,000,000, was put into force on Feb. 25, 1918.

Success of Food Rationing.—The scheme had an instant and almost unqualified success. During January and February the London food queues had attained gigantic proportions; about 500,000 were counted by the police standing in them every Saturday, and another 1,000,000 on the other days of the week. In the first week of rationing the numbers fell to about 200,000 and in the fourth to 14,000, that is to say, they practically vanished. On April 7, 1918, meat rationing on the London model was applied successfully to the whole country.

Finally on July 14, 1918, after nearly four years of the war and less than six months from its end, all the varying schemes were consolidated. To buy any of the necessities, the consumer had to have a ration book with coupons for the amounts that he might buy, to register with a particular shop and to present the ration book on making a purchase, so that the retailer could detach the appropriate coupons. The amount represented by each coupon and also the amount of the ration varied from time to time. Thus for sugar the weekly ration was usually 8 oz. a head, but was 12 oz. during most of 1919, and as low as 6 oz. from Jan. to March 1920. For butchers' meat till the end of 1918 the ration varied from $14\frac{1}{2}$ oz. to about 1 lb., with half for children.

When Lord Rhondda died (July 3, 1918), British control on a national basis was practically complete. Soon after, food control was placed, like shipping and finance, on an international basis by the setting up in Aug. 1918 of an Allied Food Council consisting of the four food controllers of Britain, France, Italy and the United States, with a standing "Committee of Representatives." There was thus extended to food generally the plan already in force in respect of cereals (and to a less extent sugar and one or two other articles).

Effect of Atlantic Concentration.—By the latter part of 1918, the submarine menace had been practically mastered by the convoy system, and the limits of the food problem had been defined by the success of rationing. The greatest pinch of all, however, was apparently still to come. Considerations of shipping dictated an unusual concentration of traffic on the shortest possible route—in other words the North Atlantic—and the abandonment similarly so far as possible of any attempt to get supplies from the Far South and the Far East. Financial considerations by a natural reaction dictated the exact opposite; the British Treasury had relatively ample sterling credit for purchases in Australia, very few pesos in South America and hardly a cent to spare in the United States or Canada. The Ministry of Food, and other supply departments, constantly found themselves being offered ships only where they could not get credit, and credit only where they could not get ships. On top of this difficulty came, in Sept. 1918, the necessity, as it then appeared, of hastening the transport of the American army so as to deliver a decisive blow in the coming spring. The framing of shipping programmes had by that time reduced itself to a division of two lions' shares between the Ministry of Munitions and the Ministry of Food (or their international extensions), with a few scraps for import of raw cotton or fertilizers and the like; each of these departments was compelled to accept for the winter of 1918–19 a provisional import programme totally inadequate for its needs and to hope that the war would end before its stocks ran out.

This hope was realized. But the Armistice of Nov. 11, 1918, though it ended for the victorious countries the fear of starvation, did not bring food shortage or food control to an end, either in those countries or elsewhere. J. R. Clynes, who from being parliamentary secretary had become food controller on Lord Rhondda's death in July 1918, resigned when the Labour Party left Lloyd George's coalition after the Armistice, but the Ministry of Food continued its work. Cereal prices did not fall to a point allowing the bread subsidy to be dropped and the control of flour-mills abandoned till after the harvest of 1920; the wheat commission continued executive work till the autumn of 1921, and liquidation of accounts till 1925. Sugar prices reached fantastic heights in the first half of 1920 (on decontrol by the American Government) and the sugar ration at the same time reached its lowest point; sugar rationing continued till the following November and the sugar commission till March 1921.

A reason for not hastening the end of food control in 1919 appeared in the disturbed condition of industry and the perpetual threat of paralysis in the essential services of coal or transport. The success with which, during the railway strike of Oct. 1919, the supplies and distribution even of perishable foods were maintained by the Ministry of Food shed lustre on its closing period.

Prior to the crisis, a fresh registration of consumers for rationing was carried through in Sept. 1919. In the following

winter, the ministry was again under attack and after the resignation of the fourth food controller—G. H. Roberts—in Feb. 1920, was left for a month without any controller at all. The appointment of C. A. McCurdy as the fifth controller marked a return of the spirit of control. The ministry secured in July the passage of a Continuance Act, only to be swept out of existence by a parliamentary storm. It ended formally in March 1921.

Supplies and Prices.—At the end of 1918 the Ministry of Food issued a short memorandum with tables and diagrams illustrating its work under the four main heads of supplies, stocks, prices and rationing. A comparison is made in the accompanying table of the amounts of the principal food-stuffs available per head for consumption in 1918, and before the war, in Germany and Holland:—

Weekly Domestic Consumption of Bread, Meat, Fats and Sugar per Head per Week in Great Britain, Germany and Holland. Pre-war and 1918

Food-Stuff	Great Britain		Germany.		Holland.	
	Pre-war.	1918.	Pre-war.	1918.	Pre-war.	1918.
	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.
Bread and flour	6·12	6·57	6·44	4·06	7·25	3·06
Meats	2·50	1·54	2·25	0·49	1·50	0·44
Sugar	..	0·50		0·33	.	0·52
Fats	0·51	0·45	0·56	0·15	0·70	0·37

The consumption during 1918 is based on the rations, except in the case of bread in Great Britain, where the actual consumption is taken. In the case of sugar no figure of pre-war domestic consumption is given by the Ministry of Food; it is commonly estimated at about 1 lb. per head per week.

It appears from the table that in 1918 Great Britain "had half as much bread again as Germany, three times as much meat and fat and substantially more sugar. As compared with Holland, Great Britain had twice as much bread, three times as much meat, more fats and practically the same amount of sugar."

The course of prices is shown in two stages: one from July 1914 to July 1917, when the main development of food control in Great Britain began, and the other from July 1917 to Oct. 1918.

Rise in Price of Food and Other Necessary Articles in Great Britain. (*Price in July 1914 = 100.*)

Classification	July 1917.	Oct. 1917.	July 1918.	Oct. 1918.	Average monthly increase between	
					July, 1914 and July, 1917.	July, 1917 and Oct., 1918.
Principal controlled foods	205	194	202	216	2·92	0·73
Principal controlled foods assuming no subsidy on bread	205	205	208	232	2·92	1·86
Principal uncontrolled foods	186	229	311	347	2·39	10·73
All principal foods	203	198	213	229	2·87	1 73
Textiles, leather, etc.	234	245	294	313	3·72	5·27
Coal	135	135	163	177	0·97	2·80
Soap	133	150	233	233	0·92	6·67
Candles	184	184	329	348	2·33	10·93
Household oils	215	286	319	319	3·20	6·93

The machinery required for "control" was very extensive. The staff numbered at its maximum over 8,000. In addition the local food control committees employed varying numbers, rising at times of exceptional pressure to as many as 25,000 persons. The printing and stationery bill for a single year exceeded £1,500,000. Expenditure, however, did not fall on the taxes but was covered by a trifling percentage on the price of the articles in which the ministry dealt. Apart from the wheat commission which as a matter of policy was compelled to make a loss on the bread subsidy (amounting to £138,000,000 net) and the sugar commission which also as a matter of policy was not allowed to raise its prices sufficiently in 1919 and 1920 (so that it ended £22,000,000 to the bad in 1921 instead of being £6,000,000 to the good as at the Armistice), the Ministry of Food proper on all its transactions from 1917 to 1921 made a net profit of about £7,000,000 after paying expenses, on its turnover of £1,200,000,000. Two minor features may be mentioned as having simplified the British task. One is the concentration of the great bulk of flour-milling in Great Britain in a small number of important mills (less than 700), which could be easily controlled. Next, there was the limited power of the British municipal authorities. In Germany it was the natural thing for the separate municipal councils to act as independent organs of food control, making their own contracts with neighbouring rural districts for the supply of food to their citizens, fixing prices in their markets and rationing when need arose. This made possible competition, confusion and difference of standard between the authorities, and made difficult a survey of the nation's needs and resources as a whole. In Great Britain, Lord Rhondda, as house-keeper for a family of forty millions, made single bargains.

There were about 2,000 food control committees, which were technically independent of the ministry, being appointed by the local sanitary authorities, but their expenses were paid by the ministry. In building up his own staff Lord Rhondda used men of outstanding experience in their own trades, as individuals or on committees, to deal with each particular food, but he placed the experts always under the control of laymen.

The Food Ministry had its own newspaper, the *National Food Journal*, placed on sale fortnightly, giving the text of all the ministry's orders, tables of maximum prices, reports of parliamentary debates and questions and of prosecutions for food offences, and everything else that could help the public to know what the food controller required of them and why. Lord Rhondda was fond of describing himself as "on the side of the consumer and particularly of the poor consumer." An interesting feature of the ministry was a "consumers' council" established in Jan 1918. This was an advisory body, consisting mainly of representatives of trade unions and co-operative societies, which did a great deal to keep the ministry in touch with the feelings and grievances of working-class consumers.

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II. IN THE UNITED STATES

Three years of war in Europe had brought the world's food supply to a crisis when the United States entered the conflict in April, 1917. Already the reduced production and increased demand in the warring countries was being felt in America. The price index of food products at wholesale had risen from 100 in 1913 to 148 in March, 1917. Wheat, which had averaged $0.91 per bushel in 1913, was selling at $2 in the Chicago market, and many other products had risen in proportion.

Even before declaration of war by Congress, the newly organized Council of National Defense had, at the request of President Wilson, cabled to Herbert Hoover asking him to assist in drawing up plans to protect American food supplies. Hoover at that time was in Europe, where he had been directing the work of the commission for the relief of Belgium and northern France. The success with which the delicate task of feeding nearly 10,000,000 civilians within the enemy lines had been accomplished had made him known throughout the world as an authority on international food matters. He delayed his return long enough to make an investigation of food control methods in Europe. He returned early in May, 1917, and at the President's request began to lay

the foundation for the future food administration. It was not until August 10, 1917, that a Food Control Bill was signed by the President.

On June 10, 1917, President Wilson had authorized Mr. Hoover to build up a voluntary organization particularly directed toward the conservation of food. Under this authority a considerable organization was built up, and plans were perfected for the control of food commodities as soon as the necessary authority should be granted by Congress. The Food Control Act of Aug. 10, 1917, gave the President very broad powers. Among other things it authorized him to create agencies, to accept voluntary services, to license all firms engaged in the manufacture, transportation, and distribution of foodstuffs excepting only common carriers, farmers and retailers doing less than $100,000 worth of business annually. It authorized him to provide rules and regulations for licenses, with drastic penalties for firms which failed or refused to obey these. It prohibited hoarding or wasteful destruction of foods. It authorized the President to requisition supplies needed for the public welfare, to take over and operate food manufacturing, storage, or distributing plants, to purchase, store, and sell for cash certain commodities, and to establish a minimum price for wheat, which for the crop of 1918 must be not less than $2 per bushel.

Immediately after signing the Food Control Act, the president issued an executive order establishing the United States Food Administration and appointing Hoover Food Administrator. By early September, 1917, presidential proclamations had been issued requiring Food Administration licenses. The rules related to the prevention of hoarding and guarding against unfair, unjust, or discriminatory margins of profit. The administration of the regulatory functions was decentralized as far as possible.

Aside from the regulatory functions which were applied to practically all food commodities, three classes of foodstuffs—cereals, sugar and fats—presented the most important problems. The Allied supply of cereals, particularly breadstuffs, had been greatly reduced by inability to secure imports from Russia, the Balkans, or from the Southern Hemisphere, in the last of which the difficulty was the shortage of ocean shipping. In the face of this the United States harvested in 1917 its second successive short crop of wheat. Prior to the American declaration of war, the Allies, by bidding against each other, had forced the price of wheat in the United States to an abnormally high figure. This had caused much hardship to consumers and resulted in exorbitant prices by dealers and millers in attempts to protect themselves against these rapid advances. In the meantime, however, the Allies pooled their buying in a single hand and were in a position to dominate the world market.

In order to assure a fair price to the American farmer and at the same time protect the consumer and provide the Allies with all the cereals that could be spared, Hoover proposed to President Wilson that the Government should create a consolidated cereal selling organization and should determine upon a fair price at which the Government would purchase wheat. This plan was accepted by the President and an independent commission was appointed, with farmer representatives in the majority. This commission recommended a price of $2.20 per bushel for No. 1 Northern wheat at Chicago with differentials for other grades and markets. By executive order the President also created the Food Administration Grain Corporation with a capital of $50,000,000, which in July, 1918, was increased to $150,000,000. He directed the Grain Corporation to purchase all wheat offered to it at the fair price and to resell at the same price such amounts as were needed by the American people and to supply to the Allies the utmost that could be spared.

It was with the greatest difficulty that supplies were obtained to meet the urgent necessities of the Allies in the spring of 1918. By calling upon the people to use substitutes to the utmost and to conserve all the wheat possible, the Food Administration was able to furnish approximately 138,000,000 bushels to the Allied countries from the small 1917 crop. This, together with supplies from Canada and small quantities from the Southern Hemisphere, proved to be sufficient to carry the Allies through. With a relatively large crop in 1918 the question of supplies was largely solved. The Grain Corporation then became chiefly an instrument through which the President's guarantee of a minimum price was maintained. Before the Armistice was signed, this guarantee was extended to the 1919 crop, and the Grain Corporation, with its name changed to the United States Grain Corporation, was designated as the agency to make this effective. The corporation was thus in active existence for 33 months (Sept., 1917, to June, 1920), handling the major portion of three wheat crops. During this time its purchases of wheat and flour were equivalent to about 751 million bushels. It also dealt in other cereals and food products for the Allies. The total value of all commodities purchased during its period of active existence was more than $3,763,000,000.

In the case of sugar, the Allied countries, before the war, were supplied largely by the beet crops of southern and eastern Europe. With this supply cut off by the war, the Allies found it necessary to draw upon Cuban sugar. Cuba had always been the chief source of sugar for the United States. The unexpected demands from Europe quickly demoralized the Cuban market and in addition to a greatly increased price also threatened an acute shortage in this country. Hoover proposed a separate corporation which should purchase the whole of the Cuban crop as well as the American sugar beet crop and should then sell this in accordance with established requirements. In accordance with this plan, the Sugar Equalization Board, incorporated under the laws of Delaware, handled the entire sugar supply of the United States during 1918 and furnished large quantities to the Allied governments. The purchases of sugar by the board amounted to approximately 4,500,000 tons valued at about $712,000,000.

The shortage in fats gave the Allied governments much concern. After some consideration it seemed that the most practical way of increasing these supplies was to stimulate hog production in the United States. Under arrangements in connection with the United States Treasury loans to the Allies, the Food Administration was able to stipulate the price at which pork products were sold for export. Hoover also arranged with the Army, the Navy, the Belgian Relief authorities, and some other buyers to abide by prices to be determined by the Food Administration. With this control of a considerable portion of the market, Hoover next arranged with the packers to pay a fair reflection of these prices to the farmers for their hogs. In return for this assurance, the production of hogs was increased very greatly. Exports of pork products were increased from a pre-war annual average of 930,000,000 pounds to 2,251,000,000 pounds in 1918. No serious difficulty was experienced in maintaining these prices until after the armistice, when the Allies no longer desired such large amounts but when stimulated production had reached its greatest heights. By making huge advance purchases of pork through the Food Administration Grain Corporation and the Commission for the Relief of Belgium, and by his efforts to open up the neutral market, Hoover was able to avert the catastrophe which once threatened the American market. He was later able to dispose of this surplus pork by sales to Germany in return for gold, by sales to the neutrals, and by caring for the relief needs of central Europe.

One of the outstanding accomplishments of the Food Administration was in connection with the conservation of food. The whole country was organized to prevent waste in foodstuffs and to substitute more perishable foods for those which could be shipped to the Allies. These voluntary efforts were guided by widespread publicity and in certain commodities were supplemented by regulations such as requiring the retailer to sell a pound of substitute cereals with every pound of flour and limiting the sugar to two pounds a week for each person. (F. M. Su.)

WAR CONTROL OF SHIPPING. In July, 1914, of 8,000 ocean-going vessels the British Empire owned over 4,000; France, Italy, Belgium and Portugal together owned about 1,000; a further 1,000 were owned by Germany and Austria and were either immobilized or captured; some 2,000 covered the rest of the world. When therefore the Allied organization was developed, in the last year of the war, it was natural that it should be built on the basis of the British system; and the countries associated in this organization, which included the United States, ultimately controlled, with the addition of the neutral tonnage which they had

chartered or requisitioned, some 90% of all ocean-going tonnage.

The control was thus simple in character by comparison with those exercised by the Ministries of Munitions or of Food. The total pre-war value of all ocean-going ships before the war was not more than £300 million, that is, less than the capital invested in two English railway companies. The total amount of steel sunk in the ships lost during the war was only some 5 million tons, that is, not more than 12% of the steel production of America alone in a single year. On the other hand, the allocation of ships involved choosing between different supply services, giving a preference to wheat over munitions, or coal over ore or vice versa. It involved decisions of policy affecting a vastly wider range.

This world fleet must be conceived as in peace time sailing under private ownership and management, subject only to official regulations to secure safety and protect the conditions of the seamen's employment. Half of the British tonnage was under the control of less than a score of the big "liner" companies, which were usually leading members in the International Liner Conferences. The other half, the tramps, were under a much more varying management; they were owned by several hundreds of companies and persons ranging from large and wealthy firms to individual owners of single ships.

The allocation of tonnage was, when the war broke out, effected by the intricate but automatic process of the freight market. Merchants, estimating the demands of their own particular markets in wheat, in wool, in coal and cotton, made their purchases and then looked round for the freight to carry them. Some were able to wait, others must ship at once. Each gave orders to his agent in London on freight exchanges of other ports, such as the Baltic to bid for tonnage within specified quantities, dates and rates. Similarly the owners of disposable tonnage gave instructions to their brokers to accept within specified conditions the best offers available. So the haggle of the market excluded the marginal need and allotted the available tonnage in exact accordance with the relative strength of the economic demand.

Before the war two departments of the British administration were concerned with merchant shipping, the Marine Department of the Board of Trade and the Transport Department of the Admiralty. The first named exercised the whole of such general responsibility as was at that time entrusted to the Government with regard to merchant ships. The Transport Department of the Admiralty, was solely responsible for arranging the transport required by the Government itself and for preparing plans for its more extended requirements in time of war. It chartered passenger vessels to transport troops to and from South Africa, India, Egypt and British garrisons elsewhere. It booked passages for individual officers. It chartered, through local commercial agents, some three or four hundred colliers a year, mostly on single voyage charters, for the supply of the Fleet and the naval bases. It managed a few vessels, a hospital ship, some colliers and oil-fuel vessels owned directly by the Admiralty. It was this little Department, with its limited but varied experience, which was gradually thrust by circumstances and by the submarine into the central position in prominence.

When the war broke out shipping was for the moment paralysed. The risk was unknown and at first almost prohibitive. But the early losses were slight, a carefully prepared system of war insurance was ready and in a short time ordinary business dependent on ocean transport renewed its normal demands, while the new and rapidly increasing call upon shipping made by direct Government requirements forced freights up.

State Requisitions, August, 1914.—From the first it was recognized that the Government could not act as it did in the South African war, and go into the market as an ordinary charterer. In August 1914, a proclamation was issued to requisition ships with compensation to the owner.

The powers were chiefly exercised by the Transport Department. They were limited to the transport of troops from Canada, Australia, India and New Zealand, and to the carriage of supplies from England to France and the Front. But though the tonnage requisitioned in the first six months did not exceed some 20% of the British mercantile marine, it was enough to push freights up. Other causes were tending to the same result. Losses by enemy action were indeed more than offset by new building. But a large mass of enemy tonnage was withdrawn from world tonnage and the delays inevitably caused by naval precautions reduced the average amount of transport a vessel could accomplish in a given time. In July 1914 the normal price for a six-months' charter of an ordinary tramp steamer was 3 shillings a month on the deadweight. By December it had reached 6 shillings. By the end of the first year, in the summer of 1915 it had reached 15 shillings. This increase not only made the goods carried more expensive. It reflected the fact that some goods were shut out altogether for want of freight carriage. And so far the effect of the submarine had scarcely been felt.

Blue Book Rates.—These rates did not apply to ships requisitioned by the Government. For these ships standard rates—the so-called blue book rates—were fixed on the advice of a committee which met in the first months and, with slight modifications, were applied throughout the war without regard to the outside freight market. They were somewhat in excess of the market when they were introduced (the rate for an ordinary tramp was equivalent to about 7 shillings per month on the deadweight) but they were moderate by comparison with the arrangements made by the Government in the industries and would have given profits not exceeding those of a boom year in peace. Shipowners' profits became in 1916 the subject of severe and legitimate criticism. On a capital value of some £172 millions in 1914 British shipping had by the autumn of 1916 made a net profit of some £262 millions (after deducting all payment of taxes). This resulted however not from excessive payments by the Government but from competition in the ordinary freight market for the inadequate tonnage left over when the Government had taken what it needed. Indeed the misfortune which the British shipowner feared most was to have his vessels requisitioned.

Shipping in the Second Year.—The strain upon shipping was constantly increasing. Losses increased, averaging 87,000 tons gross per month as compared with 55,000 in the first year. Building fell from a million tons in the first year to half a million in the second. Naval and military demands increased and the proportion of British tramp tonnage rose steadily from 20% to 30%. The demands upon the freight market for the raw materials required for munitions were also serious, and the standard time charter rate (which had been 3 shillings in July 1914) rose to 27 shillings in Dec. 1915 and to nearly 40 shillings by the summer of 1916. The Government was during this year forced into further measures of control of both supplies and of shipping.

Ship Licensing Committee, Nov. 1916.—In Nov. 1916, a Ship Licensing Committee was appointed by the Board of Trade, with the power to exercise a license control over British tonnage. The intention was to force ships out of employment that were serving no British or Allied interest, and so make it easier for more important requirements to find their transport. The principle was obviously a sound one as far as it could be applied. But the Committee, which was composed of well-known shipowners under the chairmanship of an eminent lawyer, were unable to find, after some months of investigation, more than a negligible amount of tonnage engaged in work that was obviously unimportant; and they were unwilling to prohibit any other employment; therefore they brought no substantial relief to the general situation. However, ineffective for its original purpose, the committee soon assumed a rôle for which it was much better fitted. It was not qualified either by its authority or its constitution to measure or judge between the country's needs. But it was admirably qualified in both respects to apply a policy determined elsewhere to individual ships. It became the executive for putting policy into effect as regards all British tonnage not under requisition. When a "limitation" of freight rates was imposed on the French coal trade it was the Ship Licensing Committee which made it effective by refusing licenses to ships trying to escape from that trade to more lucrative employment. When the Ministry of Munitions was anxious about ore imports from Spain or South Africa because colliers found it profitable to hasten back in ballast for another coal cargo, the Committee refused licenses for

such ballast voyages. When the Cabinet fixed a limit to the tonnage to be chartered to the Allies the committee enforced the decision as regards chartered ships in conjunction with the Transport Department which enforced it as regards requisitioned ships. This last duty had some importance in the development of Allied relations. The limitation of charters involved constant and detailed negotiations with Allied representatives in London as to particular charters.

The second committee established by the Board of Trade at the same time—the Requisitioning (Carriage of Foodstuffs) Committee—had a shorter life. The committee had power, under order in Council, to requisition or direct the employment of British ships so as to assist the importation of food or other accessories. In practice it confined its action to the importation of grain (mainly wheat) and to a novel and limited form of requisition. It did not take a ship, pay so much for it and run it. It merely required the owner to charter in a particular market, *e.g.* (since it was anxiety about wheat imports which had caused the committee to be appointed) to bring a cargo of wheat.

The committee began timidly by directing a smaller amount of tonnage into the wheat trade than the unfettered market was itself attracting. This action was entirely ineffective, the vessels named not being additional to, but merely replacing, others which would have gone if no orders had been given. There were no results upon either imports or freight rates.

The committee then directed more vessels than the market by itself was capable of attracting. The effect was immediate and dramatic. North Atlantic freight rates dropped in five months from 16 shillings to 8. Weekly imports increased from 510,000 quarters to 665,000 quarters. But at the moment when the committee was achieving its objects its activities had to be first restricted and then stopped. The reasons are interesting and instructive. Wheat was getting more than its share of tonnage.

Shipping Control Committees.—Of these the most interesting was the appointment in Jan. 1916 of the Shipping Control Committee, presided over by Lord Curzon and including two well-known shipowners and an eminent financier. A survey led them to the conclusion that a reduction of 13 million tons must be made in British imports, and they therefore recommended the temporary prohibition of all imports, except specified essentials, amounting to a total rate of 13 million tons per annum; the withdrawal of vessels from naval and military service; and the limitation of British tonnage allotted to the Allies to the amount in their service on April 1, 1916. Little came of their three recommendations. A scheme of import prohibitions which, even if fully enforced, would have shut out not 13 million but 4 million tons was approved but in actual application excluded less than 2 million tons.

Imports Restriction.—In 1917 the Government appointed an Imports Restriction Committee, presided over by Sir Henry Babington Smith and consisting of the principal officials of the Board of Trade, the Ministry of Shipping (into which the Transport Department had now expanded) and the chief departments demanding tonnage: the War Office, Ministry of Munitions, Food Commission, etc. The instructions given to the committee were to reduce the supply programmes by about half a million tons a month. It is possible that they would have been practicable and would have met the situation. But just as the committee was beginning its work, the intensive submarine campaign began; shipping losses increased very seriously; and it became clear that the reduction now required must be at least a million tons. The task of selecting commodities for exclusion on this scale was beyond the capacity of the committee, and once more the hope that programmes would be reduced within the limits of transport was deceived.

Shipping in the Third Year.—From the summer of 1916 to that of 1917, the shipping situation was more serious than at any previous period. Its gravity was reflected in the increasing freight rates and shipowners' profits, which had reached their maximum. British time-charter rates rose to 40/– a ton d.w. a mark, and even touched 50/–, as compared with 3/– immediately before the war. In Feb. 1917, the new submarine campaign began and met with immediate success. Within a few months the submarine blockade became a greater danger to the Allies than the surface blockade was to Germany. It was countered partly by the convoy system, which had scarcely however demonstrated its efficacy by the end of this year, and partly by an improved system of organizing shipping.

Throughout the year the control over commodities was developing both in range and in character. To sugar and wheat, which were already controlled by the Sugar and Wheat Commissions, were added all the main articles of food, and the whole was centralized under a newly established Ministry of Food. The Ministry of Munitions extended its effective control over all the raw materials of munitions manufacture and indeed over all metals required for all purposes, over their purchase, their importation, their allotment within the country for every form of manufacture. The War Office developed a similar control over flax, hemp, jute, leather, wool and other materials. The Board of Trade, under somewhat less drastic and more commercial methods, covered the bulk of the remaining imports.

These developments had important consequences on the shipping problem. In the first place, all the imports of the commodities so controlled were Government cargoes, and it was natural that they should be transported in requisitioned tonnage. The War Office could ask the shipping authority to arrange to carry wool or flax (for whatever purpose it might be used) just as it asked for transport of supplies destined direct for the army. But, in the second place, the incorporation within the Government machine of the specialists from the business world who were needed for these intricate and detailed controls, meant that the Government had, for the first time, in its service the advice of experts in the activities affected.

The Ministry of Shipping.—The Coalition Government formed at the end of 1916 established a Ministry of Shipping, under a Shipping Controller, Sir Joseph (now Lord) Maclay who had a seat in the Cabinet, with statutory powers. The Transport Department was absorbed in the new Ministry, while the Shipping Control Committee became an advisory committee to the Controller.

It was shortly afterwards decided to extend requisition at rates based upon blue book terms over all British ships. The comparatively moderate profits on requisitioned ships only made the fantastic profits on free ships more of a public scandal.

Liner Requisition.—A new and ingenious system of liner requisitioning was therefore devised. All liners were formally requisitioned and paid at blue book rates. But the owners continued to run them, taking first any Government supplies, then following any other direction they might receive, and if any space remained, offering freight on the market, the freight, however, being henceforth paid to the Government. The liner cargoes thus became an integral part of the general transport and supply programme, and indeed an increasingly important part of it, amounting at the end to four-fifths of the country's imports.

This new system was devised by a well-known liner owner and was a good instance of the association of the permanent official and the business man.

An Inter-Allied Shipping Committee was created in Jan. 1917. It included representatives of Great Britain, France and Italy. It was unsuccessful. (*See* ALLIED MARITIME TRANSPORT COUNCIL.)

Tonnage Priority Committee.—The second committee, the Tonnage Priority Committee, was of more importance. It was a national Committee, consisting of the actual executive officers from the different departments who were handling the several supply arrangements, and its chairman was the parliamentary secretary of the Ministry of Shipping (Sir Leo Chiozza Money). It met normally once a week throughout 1917 and a part of 1918. It brought those who were making competing, and in their total effect impossible, demands upon the shipping authorities into direct contact with each other and thus facilitated the reduction of their demands.

The new and intensive submarine campaign began in Feb. 1917. It converted the shipping difficulties from a serious inconvenience into a grave menace. The tonnage of the world was

scarcely less at the end of 1916 than in 1913; the tonnage at the disposal of the Allies was not very seriously less.

But this situation was immediately and dramatically altered by the new form of warfare. In the first twelve months 470 ocean-going ships (1,000 if we count all sizes) had been lost. In a single fortnight in April, 122 ocean-going vessels were lost (and all the ocean-going vessels in the world did not exceed 8,000). The continuance of loss at this rate would have brought disaster upon all the Allied campaigns and might well have involved unconditional surrender. At this stage, after much hesitation and conflict of opinion, the convoy system was introduced, and found an immediate success. The actual loss already incurred and the dangers of the future, however, obviously compelled a much more drastic handling of the whole shipping and supply problem. (*See* SHIPPING, WAR LOSSES OF.)

It may be well, at this crucial moment, to attempt a bird's-eye view of the situation from the angle of one responsible for requisitioning and allotting British tonnage. In France, in Belgium, in Salonika, in the Dardanelles, in Palestine, British soldiers were facing the enemy. Their transportation from the United Kingdom, from Australia, from Canada and from India needed about 70 ships. To supply them with food, munitions and clothing; medical attention for invalids and wounded; material for new railways; timber for trenches and huts, meant another 335 ships. Behind them in England, in Canada and in America the raw materials of the industries which made their munitions and their clothes had to be imported (350 ships). At the same time the British Navy had to be supplemented by auxiliaries (100 ships), to be coaled, fuelled and supplied (300 ships). Meantime the Allies had corresponding needs for which their own ships did not suffice (500 ships). And the home population required to be fed and supplied with other necessities of life (750 ships).

The Fourth Year.—By the autumn the situation had become less desperate but more immediately difficult. Two great events had happened. America entered the war. Finance was at once displaced as the governing consideration in the Allies' policy. Henceforward the Alliance as a whole, was practically self-sufficient. It was certain henceforth that money would be available for as many imports as shipping could carry. Shipping became definitely the limiting factor. Nor did America's entry relieve the actual shortage of tonnage. Her potential building capacity gave a different perspective to the future, but it was undeveloped. And her military effort, so vital a factor in the strategical position, necessarily increased the strain on shipping. So rapidly indeed did her military effort develop that it more than absorbed the ships she could put into service in spite of her amazing building achievement. At no time during the rest of the war were there as many American ships in war service as those required to carry her own men and stores. The second great event was the striking and dramatic success of the convoy system. From its first introduction it more than counteracted the effect of the new submarine method; and losses were reduced to less than the rate of 1916. But it could not restore vessels already lost, and new building only gradually overtook current losses. In spite therefore of the much greater hope for the future given by both America's building capacity and the convoy system, the actual disparity between the shipping available and the demands upon it was greater in the autumn of 1917 than it had ever been. 17 million tons deadweight of the world's tonnage had been lost and less than half had been replaced. Great Britain alone had lost 10 million tons, and, even allowing for ships she had bought, built or captured, her net loss was over 4 million tons. France and Italy had lost about 2 million tons and had built practically nothing. Nor had America yet begun to build seriously. At the same time the demands upon shipping were greater than at any previous period. All the distant expeditions (except the long abandoned one to the Dardanelles) were fully maintained. The scale of the war in France was continually increasing. The Navy was at its maximum strength. Serious food troubles were anticipated in Great Britain, France and Italy. The American military effort, with its great demands on transport, was beginning.

By this time, however, the mechanism for securing economical compression of the British supply demands on transport, for selecting only the most essential, for making the utmost use of shipping available was being rapidly perfected. The ultimate needs of scores of millions were sifted through a series of sieves of small and smaller mesh. The big control departments, the Food and Munitions Ministries and the War Office, examined and pruned down the demands of their many branches, with the expert knowledge that had been obtained by the incorporation of numberless experts from the different trades now brought within the area of control. The Ship Licensing Committee was (to some limited extent) pruning off the more obviously useless employment of ships. The Tonnage Priority Committee was examining the demands in more detail and contributing to the same end. Special committees like the Imports Restrictions Committee of January 1917 and the later Cabinet committees of the same year were forcing the departments to make reductions and to impose them on their subordinate organizations. The rationing of neutrals for blockade reasons; the system of prohibition and limited license of certain imports; the diminished purchasing power of most of the world; the pressure on neutral ships by the supply of bunker coal on condition that they should enter employment useful to the Allies—these were all contributing to the same effect—to reduce the excessive demands made on the shipping departments.

And in this national system the final authority now consisted in a Cabinet committee (presided over by Lord Milner) consisting of the Ministers in charge of the great Ministries concerned, on the one hand of Shipping and on the other of the great supply departments particularly the War Office and the Ministries of Munitions and Food, attended by their chief officials.

But by this time the problem was more than national. And the national system required to be supplemented by an international organization which could incorporate the needs of France and Italy and to some extent America, with those of Great Britain and devise a common shipping policy. Controls similar in general character and purpose had been established in France and Italy, but while they remained isolated they afforded no common measure of comparison. There was nothing to show whether the standard of compression imposed in the different commodities was at all equal. A British Cabinet committee could not judge between British and French or Italian needs of sugar or of wheat. Nor could a British Shipping department do so. Obviously the persons best qualified were the sugar and the wheat experts of the different countries. On this principle the Allied system was based. "Programme Committees" were formed of the experts in each main supply (wheat, sugar, meat and fats, oils and seeds, nitrates, hides, wool, flax, hemp and jute, paper, etc.). This was not a system parallel, or conflicting, with the national system; for the officials were the same as those we have seen in the national organization. These committees submitted their demands first severally to Allied Councils of Ministers (food and munitions), and then all together to a supreme Allied shipping authority, formed on the same principle (*see* ALLIED MARITIME TRANSPORT COUNCIL).

Shipbuilding.—Here Great Britain's supremacy before the war was unchallenged. She built some 2 million tons gross a year, twice as much as the rest of the world put together. Claims on men and material however reduced the figure to 660,000 in 1915 and to 630,000 in 1916. By this time, the losses were becoming serious and building looked like falling ever lower. It became necessary for the Government to take vigorous measures. The responsibility was entrusted at different periods to the Admiralty, to the Ministry of Shipping, and to an independent Controller-General. But throughout the last two years of the war a consistent and effective policy was pursued. Better supplies of steel were secured, workmen were withheld, or withdrawn, from the Army. Private yards were specialized and each yard, instead of building several types of vessel, concentrated upon one—twelve types of standard ships being selected and built in considerable numbers. By these means launchings increased to 1,229,000 tons in 1917 and 1,579,000 in 1918. The figure would have been much greater but for the immensely increased work of building and repairing both naval and merchant ships.

But the most notable achievement of shipbuilding during the war was North America's. In 1913, her yards had built only 276,000 tons; and when she declared war she had only 61 yards, with 234 shipways. By the armistice she had 223 yards with 1,099 shipways. By the end of 1918 she was building 3 million tons gross and in 1919 about 4 millions. The rest of the world's building during the war, outside Great Britain and North America, needs little comment. It averaged 600,000 tons a year.

Atlantic Concentration.—Concentration of shipping on the shortest routes was another increasingly important device. We find a great withdrawal of ships from more distant routes and their concentration in the Atlantic. Of a total of 681 British vessels loaded as liners in Oct. 1917 no less than 336 were in the Atlantic (four-fifths of them in the North Atlantic). By Oct. 1918 the proportion had risen even higher, 385 out of a total of 656.

The convoy was introduced in the spring of 1917, and proved an instant and surprising success. Losses which before had averaged over long periods more than 10%, and at times rose to over 20%, of ocean vessels at risk, fell for the subsequent period to the end of the war to less than 1%. The long contest between attack and defence was decided conclusively before the war ended and on its own merits, not as an incidental result of the military successes of the Allies. By the third quarter in 1918 the losses were less than the world's increased building, and by September of that year the world gained even without America's building.

See C. E. Fayle, *Sea-borne Trade and Merchant Shipping in the War* (1920–24); Sir A. Salter, *Allied Shipping Control, an Experiment in International Administration* (1921). (A. Sa.)

WARD, ARTEMUS, the pen-name of Charles Farrar Browne (1834–1867), American humorous writer, who was born in Waterford (Maine), April 26, 1834. He began life as a compositor and became an occasional contributor to the daily and weekly journals. In 1858 he published in the Cleveland *Plain Dealer* the first of the "Artemus Ward" series, which attained great popularity both in America and England. His works include: *Artemus Ward: his Book* (1862); *Artemus Ward: his Travels* (1865); *Artemus Ward in London* (1867); and *Artemus Ward's Lecture* (1869). In 1866 he visited England, where he became exceedingly popular. He died of consumption at Southampton March 6, 1867.

Bibliography.—A good edition of his works was edited with a biographical sketch by M. D. Landon in 1876; *Artemus Ward's Best Stories* (1912) was edited by Clifton Johnson and *Selected Works* (1924) by A. J. Nock. The *Letters of Artemus Ward* were printed in 1900. *See* also E. P. Hingston, *The Genial Showman* (1870), and D. C. Seitz, *Artemus Ward, A Biography and Bibliography* (1919).

WARD, DAME GENEVIEVE (1837–1922) (D.B.E., 1921), English actress, was born in New York on March 27, 1837, and at the age of 18 married Count Constantine de Guerbel. She studied singing in Italy and in Paris, and made her first appearance under the stage name of Ginevra Buerrabella at Bergamo in the opera *Stella di Napoli* (1855). After the loss of her voice in 1862 she taught singing in New York, but in 1873 she came to London and began a long dramatic career, appearing first at Manchester as Lady Macbeth.

She published with Richard Whiting a volume of reminiscences, *Before and Behind the Curtain* (1918).

WARD, JAMES (1843–1925), English psychologist and metaphysician, was born at Hull on Jan. 27, 1843. He was educated at the Liverpool Institute, at Berlin and Göttingen, and at Trinity College, Cambridge; he also worked in the physiological laboratory at Leipzig. He studied originally for the Congregational ministry, and for a year was minister of Emmanuel Church, Cambridge. Subsequently he devoted himself to psychological research, became fellow of his college in 1875 and university professor of mental philosophy in 1897. He was Gifford lecturer at Aberdeen in 1895–97, and at St. Andrews in 1908–10. His work shows the influence of Leibnitz and Lotze, as well as of evolution. His views are further worked out, through criticism of pluralism and as a theistic interpretation of the world, in his Gifford Lectures (*The Realm of Ends*) (1911, 3rd ed. 1920). Ward died on March 4, 1925.

Ward published *Naturalism and Agnosticism* (1899, 3rd ed. 1907); *Heredity and Memory* (1913); *Psychological Principles* (1918, 2nd ed. 1920); *A Study in Kant* (1922); and *Essays in Philosophy* ed. W. R. Sorley and G. F. Stout, with memoir by O. W. Campbell (1927); numerous articles in the *Journal of Physiology*, in *Mind*, and in *The British Journal of Psychology*.

WARD, JOHN QUINCY ADAMS (1830–1910), American sculptor, born in Urbana, Ohio, June 29, 1830. He studied under Henry K. Brown, of New York, in 1850–1857, and by 1861, when he opened a studio in New York, he had executed busts of Joshua R. Giddings, Alexander H. Stephens, and Hannibal Hamlin, prepared the first sketch for the "Indian Hunter," and made studies among the Indians themselves for the work. In 1863 he became a member of the National Academy of Design (New York), and he was its president in 1872–1873. He died in New York on the 1st of May 1910.

WARD, SIR JOSEPH GEORGE, 1ST BART., cr. 1911, (1856–1930), New Zealand politician, was born at Emerald Hill, Melbourne on April 26, 1856, son of a merchant. At 13 he entered the Post and Telegraph Department. In 1887 he entered parliament as Liberal member for Awarua. Appointed treasurer in the Seddon cabinet of 1893, he was the prime minister's chief lieutenant until Seddon died in 1906, and he then succeeded to the premiership and the leadership of the Liberal party. He pioneered several important reforms, such as loans to settlers, the All-Red cable service, and penny postage for New Zealand.

His ministry was defeated in the February of 1912, but Ward returned to office as minister of finance in the National (War) cabinet of 1915–19. In 1919 he represented New Zealand at the Peace Conference; in that same year he was defeated at Awarua and in 1923 in a by-election for Tauranga. In 1925 he was elected for Invercargill and in Dec. 1928 took office as Prime Minister. He resigned in May 1930 and died on July 7, 1930.

WARD, LESTER FRANK (1841–1913), American geologist and sociologist, was born in Joliet, Ill., on June 18, 1841. He graduated at Columbian (now George Washington) university in 1869 and from the law school in 1871, his education having been delayed by his service in the Union army during the Civil War. In 1865–72 he was employed in the United States Treasury department, and became assistant geologist in 1881 and geologist in 1888 to the U. S. geological survey. In 1884-86 he was professor of botany in Columbian university. He wrote much on palaeobotany, including *A Sketch of Palaeobotany* (1885), *The Geographical Distribution of Fossil Plants* (1888) and *The Status of the Mesozoic Floras of the United States* (1905). His more important works are: *Dynamic Sociology* (1883, 2nd ed. 1897), *Psychic Factors of Civilization* (1897), *Outlines of Sociology* (1898), *Sociology and Economics* (1899), *Pure Sociology* (1903), and with J. Q. Dealy, *Text-Book of Sociology* (1905). He died in Washington, D.C., on April 18, 1913.

WARD, MARY AUGUSTA [Mrs. Humphry Ward] (1851–1920), British novelist, was born on June 11 1851, at Hobart, Tasmania, where her father, Thomas Arnold (1824–1900), was then an inspector of schools. She was brought up mainly at Oxford, and her early associations with a life of scholarship and religious conflict are deeply marked in her own later literary career. She was brought into close connection during this period with Edward Hartopp Cradock, who was principal of Brasenose college from 1853 till his death in 1886, some of whose characteristics went to the portrait of the "Squire" in *Robert Elsmere*. In 1872 she married Thomas Humphry Ward (1845–1926), then fellow and tutor of Brasenose, and one of the authors of the *Oxford Spectator*.

Mrs. Humphry Ward at first devoted herself to Spanish literature, and contributed articles on Spanish subjects to the *Dictionary of Christian Biography*, edited by Dr. William Smith and Dr. Henry Wace. In 1881 she published her first book, *Milly and Olly*, a child's story illustrated by Lady (then Mrs.) Alma-Tadema. This was followed in 1884 by a more ambitious, though slight, study of modern life, *Miss Bretherton*, the story of an actress. In 1885 Mrs. Ward published an admirable translation of the *Journal* of the Swiss philosopher Amiel, with a critical introduction, which showed her delicate appreciation of the

subtleties of speculative thought. In Feb. 1888 appeared *Robert Elsmere,* a powerful novel, tracing the mental evolution of an English clergyman, of high character and conscience and of intellectual leanings, constrained to surrender his own orthodoxy to the influence of the "higher criticism." The character of Elsmere owed much to reminiscences both of T. H. Green, the philosopher, and of J. R. Green, the historian. The book was reviewed by W. E. Gladstone in the *Nineteenth Century* (May 1888, "Robert Elsmere and the Battle of Belief"), and made its author famous.

Mrs. Ward's next novel, *David Grieve,* was published in 1892. In 1895 appeared the short tragedy, the *Story of Bessie Costrell.* Mrs. Ward's next long novel, *Helbeck of Bannisdale* (1898), treated of the clash between the ascetic ideal of Roman Catholicism and modern life. The element of Catholic and humanistic ideals entered also into *Eleanor* (1900), in which, however, the author relied more on the ordinary arts of the novelist. In *Lady Rose's Daughter* (1903)—dramatized as *Agatha* in 1905—and *The Marriage of William Ashe* (1905), modern tales founded on the stories respectively of Mlle. de Lespinasse and Lady Caroline Lamb, she relied entirely and with success upon social portraiture. Later novels were *Fenwick's Career* (1906), *Diana Mallory* (1908), *Daphne* (1909), *Canadian Born* (1910), *The Case of Richard Meynell* (1911), *Delia Blanchflower* (1915), *The War and Elizabeth* (1918), etc. Mrs. Ward died in London on March 24, 1920.

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WARD, SETH (1617–1689), bishop, was educated at Sidney Sussex college, Cambridge, where he became a fellow in 1640. In 1643 he was chosen university mathematical lecturer, but he was deprived of his fellowship next year for opposing the Solemn League and Covenant. In 1649 he became Savilian professor of astronomy at Oxford, and gained a high reputation by his theory of planetary motion, propounded in the works entitled *In Ismaelis Bullialdi astronomiae philolaicae fundamenta inquisitio brevis* (Oxford, 1653), and *Astronomia geometrica* (London, 1656). About this time he was engaged in a philosophical controversy with Thomas Hobbes. He was one of the original members of the Royal Society. In 1659 he was appointed master of Trinity college, Oxford, but not having the statutory qualifications he resigned in 1660. Charles II. gave him numerous preferments, and in 1662 he was consecrated bishop of Exeter. He died at Knightsbridge Jan. 6, 1689.

WARD, WILFRID PHILIP (1856–1916), British man of letters, was born at Ware, Hertfordshire, on Jan. 2, 1856, the second son of William George Ward. In 1906 he became editor of *The Dublin Review.* He died in London on April 8, 1916. His works include: *W. G. Ward and the Oxford Movement* (1889); *W. G. Ward and the Catholic Revival* (1893); *Life and Times of Cardinal Wiseman* (1897); *Life of John Henry Cardinal Newman* (1912) and several volumes of essays.

WARD, WILLIAM GEORGE (1812–1882), English Roman Catholic theologian, was born on March 21, 1812. He was educated at Christ Church and Lincoln College, Oxford, and became a fellow of Balliol in 1834. He was attracted to the Tractarians by his hatred of what he called "respectability." He regarded Newman as a mere antiquary. When he was persuaded to hear Newman preach, he at once became a disciple. He took deacon's orders in 1838 and priest's orders in 1840. From that period Ward and his associates worked for union with the Church of Rome, and in 1844 he published his *Ideal of a Christian Church,* in which he openly contended that the only hope for the Church of England lay in submission to the Church of Rome. This publication brought to a height the storm which had long been gathering. The university of Oxford was invited, on Feb. 13, 1845, to condemn "Tract XC.," to censure the *Ideal,* and to degrade Ward from his degrees. The two latter propositions were carried and "Tract XC." only escaped censure by the *non placet* of the proctors, Guillemard and Church. The condemnation precipitated an exodus to Rome. Ward left the Church of England in Sept. 1845, and was followed by many others, including Newman himself. In 1868 he became editor of the *Dublin Review.* He died on July 6, 1882.

See *William George Ward and the Oxford Movement* (1889) and *William George Ward and the Catholic Revival* (1893), both by his son Wilfrid Philip Ward.

WARD, that which guards or watches, and that which is guarded or watched. In architecture the inner courts of a fortified place are called wards, *e.g.,* the upper and lower wards of Windsor Castle (*see* BAILEY; CASTLE). The "ward" in a lock is the ridge of metal which fits exactly into the corresponding "ward" or slot of the key (*see* LOCK). Boroughs, cities and parishes may be divided into wards, for the conducting of local elections, etc. In the same way, large establishments, such as hospitals, asylums, etc., are divided into wards. In law, "ward" is a term for minors, or persons under guardianship (*see* INFANT; MARRIAGE and ROMAN LAW).

An electoral division in American municipalities is called a ward. Prior to the introduction of the commission and city manager form of government the municipal legislative branch was a city council made up of representatives from the various wards of the city. The wards were supposed to be of about equal population, each ward having either one or two aldermen, chosen by the qualified voters of the ward, in the city council, for terms of one or two years. Many cities are still governed by councils so elected. Each ward is divided into one or more voting precincts or divisions. *See* C. C. Maxey, *An Outline of Municipal Government* (1923).

WAR DEBTS: *see* INTER-ALLIED DEBTS.

WARDEN, a word frequently employed in the ordinary sense of a watchman or guardian, but more usually in England in the sense of a chief or head official. The lords wardens of the marches, for example, were powerful nobles appointed to guard the borders of Scotland and of Wales; they held their lands *per baroniam,* the king's writ not running against them, and they had extensive rights of administrating justice. The chief officer of the ancient stannaries of Cornwall has the title of lord warden (*see* STANNARIES) as has also the governor of Dover castle (*see* CINQUE PORTS).

WAR DEPARTMENT: *see* GOVERNMENT DEPARTMENTS.

WARDHA, a town and district of British India in the Nagpur division of the Central Provinces. They take their name from the Wardha river. The now prosperous town of Wardha was established on a treeless black soil plain at the old village of Palakwari in 1866 at the spot where the branch line to Warora was expected to take off. The population by 1872 had reached 3,560; in 1931 it was 19,571.

The DISTRICT OF WARDHA was carved out of Nagpur in 1862. The population has increased from 355,000 at the census of 1872 to 519,330 in 1941. Area 2,435 sq.mi. There are cotton mills at Hinganghat and Pulgaon. The language is Marathi.

WARDLAW, HENRY (d. 1440), son of Sir Andrew Wardlaw, was educated at Oxford and Paris and nominated by the papal court at Avignon bishop of St. Andrews (consecrated 1403). He was tutor to James I., restored the cathedral, and, on the return of James from England, became one of his principal advisers. He persecuted the Wycliffites. Wardlaw issued the charter of foundation of St. Andrews university, the first in Scotland, in 1411. It was confirmed by a bull of Benedict XIII. on Aug. 28, 1413.

WARDROBE, a portable upright cupboard for storing clothes. The earliest wardrobe was a chest, and it was not until some degree of luxury was attained in regal palaces and the castles of powerful nobles that separate accommodation was provided for the sumptuous apparel of the great. The name of wardrobe was then given to a room in which the wall-space was filled with cupboards and lockers. As a "hanging cupboard" it dates back to the early 17th century. For probably 100 years such pieces, massive, but often with well-carved fronts, were made in fair numbers. During the 18th century the tallboy (*q.v.*) was much used for clothes. Towards its end, however, the wardrobe began to develop into its modern form, with a hanging cupboard at each side, a press in the upper part of the central portion and drawers below. As a rule it was of mahogany, but so soon as satinwood

and other finely grained foreign woods began to be obtainable in considerable quantities, many elaborately and even magnificently inlaid wardrobes were made. The central doors, which had hitherto enclosed merely the upper part, were carried to the floor and were fitted with mirrors.

WARDROBES, THE. Although originally *garderoba* (wardrobe) and *camera* (bedroom) were synonymous, *garderoba* was early distinguished as the small room attached to the bedchamber, where clothes were kept and articles of value stored. Mediaeval kings and emperors, magnates of church and State, all had a wardrobe as well as a bedroom. But no Continental *vestiarium* (wardrobe) experienced such development as that through which the *garderoba* of the kings of England passed. From a place of deposit, a mere adjunct of the king's chamber (*q.v.*), the king's wardrobe in England grew into a third treasury, and, in the 13th century, dispossessing the chamber as the financial and directive agent of the royal household (*q.v.*), became a full administrative department. Not even the wardrobe of the popes, which enjoyed some measure of authority between the 6th and the 11th centuries, can compare with it, while the wardrobe of the kings of France was always a subordinate branch of the chamber, never a separate institution.

The increasing administrative burden of the chamber, relieved only partially by the growth and independent establishment of the exchequer (*q.v.*), imposed further duties upon the *garderoba regis* (king's wardrobe). So ably did it discharge them that, by the end of John's reign, it had developed into a rudimentary office, and before long took over from the chamber the routine work of the household. A clerical keeper or treasurer, and a lay steward, were responsible for its management, their revenue mainly coming from the exchequer, to which the keeper accounted. His statements were attested by the controller, his immediate subordinate, also a clerk, who kept a counter-roll of receipts and expenses. Under Edward I. the controller became the recognized keeper of the privy seal (*see* SEALS), and the cofferer who was the third clerical officer, obtained definite title and position. Beginning as the personal clerk of the keeper, he rose to be chief bookkeeper and cashier, and the usual *locum tenens* of the keeper. By the close of the 13th century, because public matters claimed more and more of the attention of the chancery (*q.v.*), the wardrobe had become the household secretariat; the domestic chancery as well as the domestic exchequer. Nor did it fulfil only domestic and peaceful functions. As the household was the nucleus of the army when the king waged war in person, the wardrobe not unnaturally then undertook the financial administration of the campaigns. The finances of most of Edward I.'s expeditions, of the Scottish offensives of Edward II. and Edward III., and of a number of the campaigns of the Hundred Years' War, were administered in this way. Thus the king's wardrobe, or wardrobe of the household, came to have a wider military and a political importance. The reason lay in its all-round usefulness. Its machinery was adaptable, and its officers, appointed by word of mouth, were directly answerable to the king. Its funds could be augmented or diminished at need, and, although its accounts had to be submitted to the exchequer for audit, it actually spent the money. It also had the use of a seal which, though in the first instance personal to the sovereign, could be and was increasingly employed in State business. These and similar considerations commended the wardrobe to king, aristocracy and ministers alike. Yet the jealous and vigilant barons did not hesitate to attack the wardrobe whenever they felt it was being used as an instrument of prerogative. In the latter part of the reign of Edward I. and again under Edward II., they persistently tried to curtail its activities. It was, for example, a result of the baronial ordinances of 1311, that in 1312 the privy seal was taken away from the controller and given a keeper all to itself. The exchequer equally resented wardrobe encroachments, and its ordinances of 1323–26 were almost as much concerned with defining relations with the wardrobe as with improving internal economy.

The Great Wardrobe.—Differentiation and centralization were as ceaselessly at work within the wardrobe as without. Since both chamber and wardrobe accompanied the household wherever it went, they needed places in which to store their heavier and bulkier commodities. Rooms in the king's manors were set apart for this purpose, the wardrobe being held responsible for the custody and replenishment of the stocks kept in them. A sub-department, the great wardrobe, *magna garderoba regis*, a term in use by 1253, constituted itself to direct the necessary labour. The description "great" referred to the size and quantity of the goods stored, not to the status of the office, which was inferior to the king's wardrobe. The clerk of the great wardrobe was its head, and to begin with, all its officials, excluding the two or three stationed with the more important stores, followed the court. Up to 1324 the clerk was financed by the wardrobe, but from that year he received his revenue from, and accounted to, the exchequer, except for a brief return to former usage between 1351 and 1360. Owing to the nature and variety of the work, it was practically impossible for the clerk or his assistants to reside continually in the household. The great wardrobe was not simply a depository. Besides collecting, safeguarding and distributing goods, it also manufactured and repaired them. Cloth was made into clothes, metal was wrought into armour and weapons, guns and cannon were cast and assembled, and sulphur, saltpetre and other ingredients were combined into gunpowder.

The Tower of London was its first centre, but from the beginning of the 14th century, houses in the city of London were also used. Among them was a house in Bassishaw (Basinghall) ward, near the weekly cloth markets of Weavers' Hall and Bakewell Hall, and the house in Lombard street which had once belonged to the Bardi merchants. Larger and better quarters were bought in 1361, in the parish of St. Andrew's by Baynard's Castle. Here the office and its staff lived until the Great Fire of 1666. They then found accommodation in Buckingham street in the Savoy, but later removed to Great Queen street.

Hardly had the great wardrobe taken shape before the privy wardrobe, *priuata garderoba regis*, made its appearance as a travelling store for chamber, wardrobe and great wardrobe. There had early been in the household a small wardrobe of robes and arms for current use, but only towards the end of the 13th century did it develop even a modest organization. Its officers were as much chamber as wardrobe servants, and such money as they needed was supplied by the wardrobe or the great wardrobe. Although their work was the care and transport of articles wanted from day to day, they soon found it advisable to have a central depository. Between 1323 and 1344 they set up a store in the Tower of London, chiefly of arms and armour. This, used by chamber and great wardrobe as well as by the household, came to be known as the privy wardrobe in the Tower. The keepers of this wardrobe, also clerks of the chamber until 1356, took their revenue from the exchequer, which also audited their accounts. Before 1360 it had separated itself from the household though it left behind a small privy wardrobe, which survived well into the 16th century, to carry on its original work. By 1399 it was as independent of great wardrobe and chamber as it was of the household. It was looted by the revolted peasants in 1381.

In consequence of both internal and external differentiation, and with the adoption of special means for financing war, under parliamentary control the king's wardrobe, from the latter part of the 14th century generally described as "the household," slowly degenerated into a simple office of household accounts. The process was not materially hindered even when the treasurer of war was the treasurer of the household. The privy wardrobe in the Tower lost both name and identity in the 15th century with its transformation into the king's armouries in the Tower. But the great wardrobe, still the storehouse for the household, came to be known as "the wardrobe." The cofferer of the household and the officers of the great wardrobe were suppressed in 1782 by Burke's act for economical reform. Such of their duties as were retained were divided among the lord chamberlain (*q.v.*), the lord steward (*q.v.*), and the surveyor of the buildings.

See T. F. Tout, *The Place of the reign of Edward II. in English History* (1914, bibl.); J. C. Davies, *The Baronial Opposition to Edward II.* (1918, bibl.); T. F. Tout, *Chapters in the Administrative History of Mediaeval England* (vols. i.-ii., 1920; vols. iii.-iv., 1928; vol. v. in preparation: bibl.).

WARD ROOM, officers' living quarters in a war vessel.

WARE, an urban district of Hertfordshire, England, on the Lea, 2 mi. N.E. of Hertford. Pop. (1938) 7,450. Area 2.1 sq.mi. The church of St. Mary has a tower dating from Edward III. The famous "Great Bed of Ware," in Shakespeare's *Twelfth Night,* which formerly was at the Saracen's Head in Ware, was removed to Rye House, 2 mi. distant, the scene of the Rye House plot of 1683 against Charles II, but is now in the Victoria and Albert museum, London. The town's chief trade is in malt.

WARE, a town of Hampshire county, Massachusetts. Pop. (1940) 7,557. Its manufactures include woollen and knit goods, shoes and coated paper. Incorporated, 1775. Liquidation of principal mills in 1938 and 1939 led 1,000 citizens to organize the Ware Industries, Inc., which took over the empty mills and restored and increased employment and industrial activity.

WAREHAM, a municipal borough in the southern parliamentary division of Dorsetshire, England; 121 mi. from London by the S. R. Pop. (1938) 2,496. Area 710 ac.

Owing to its situation as a key of Purbeck, the site of Wareham (*Werham, Warham*) has been occupied from very early times. There are still remains of earthworks around the town which are probably of Romano-British age originally and have been modified on many subsequent occasions. Wareham's British name was *Durngueir.* The early chroniclers declare that St. Aldhelm founded a church near by about 701, and perhaps the priory, which is mentioned as existing in 876. In the following year the Danes made Wareham their headquarters. Beorhtric was buried here. Further incursions made by the Danes in 998 and in 1015 under Canute probably resulted in the destruction of the priory, on the site of which a later house was founded in the 12th century as a cell of the Norman abbey of Lysa, and in the decayed condition of Wareham in 1086. The early castle, which existed before 1086, was important during the civil wars of Stephen's reign. John fortified it against Louis of France in 1216, and during the civil wars of the 17th century it was the scene of much fighting. Wareham was accounted a borough in Domesday. In 1587 Elizabeth granted certain privileges to Wareham, but it was not incorporated until 1703. The town returned two members to parliament from the time of Edward I until 1832 and one member from then until 1885. There are three ancient churches, and the ruins of a priory dedicated to SS. Mary, Peter and Ethelwood. Stoneware pipes is the principal industry.

WAREHAM, a town of Massachusetts, U.S.A. Resident population was 6,364 in 1940 (federal census) and there is a summer population of 15,000. It is a growing and shipping point for cranberries, oysters, clams, scallops and garden truck, and has a horseshoe factory and other manufacturing plants. The town was formed in 1739 from part of Rochester and a plantation of Plymouth called the Agawam Purchase.

WARENNE, EARLS. The Warennes derived their surname from the river of Guarenne or Varenne and the little town of the same name near Arques in Normandy. William de Warenne, who crossed with William I. in 1066, was a distant cousin of the Conqueror, his grandmother having been the sister of Gunnora, wife of Richard I. of Normandy. De Warenne received as his share of English spoil some 300 manors in Yorkshire, Norfolk, Surrey and Sussex, including Lewes Castle. He was wounded at the siege of Pevensey and died in 1089, a year after he had received the title of earl of Surrey. Both he and his successors were more commonly styled Earl Warenne than earl of Surrey.

His son William, 2nd earl (*c.* 1071–1138), was a suitor for the hand of Matilda of Scotland, afterwards queen of Henry I. He was temporarily deprived of his earldom in 1101 for his support of Robert, duke of Normandy, but he commanded at the battle of Tenchebrai (1106), and was governor of Rouen in 1135.

William de Warenne, 3rd earl (d. 1148), was, with his half-brother, Robert de Beaumont, earl of Leicester, present at the battle of Lincoln, where his flight early in the day contributed to Stephen's defeat. He remained faithful to the queen during Stephen's imprisonment, and in 1146 he took the cross, and was killed near Laodicea in January 1148.

His daughter and heiress, Isabel, married in 1153 William de Blois, second son of King Stephen and Matilda of Boulogne, and in 1163 Hamelin Plantagenet, natural son of Geoffrey, count of Anjou. Both Isabel's husbands appear to have borne the title of Earl Warenne. Earl Hamelin was one of those who at the council of Northampton denounced Becket as a traitor; he remained faithful to his half-brother, Henry II., during the trouble with the king's sons, and in Richard I.'s absence on the crusade he supported the government against the intrigues of Prince John.

William de Warenne (d. 1240), son of Isabel and Hamelin, who succeeded to the earldom in 1202, enjoyed the special confidence of King John. In 1212, when a general rebellion was apprehended, John committed to him the custody of the northern shires; and he remained faithful to his master throughout the troubles which preceded the signing of the Charter. In 1216, as the king's situation became desperate, the earl repented of his loyalty, and, shortly before the death of John, made terms with Prince Louis. He returned, however, to his lawful allegiance immediately upon the accession of Henry III., and was, during his minority, a loyal supporter of the crown. He disliked, however, the royal favourites who came into power after 1227, and used his influence to protect Hubert de Burgh when the latter had been removed from office by their efforts (1232). Warenne's relations with the king became strained in course of time. In 1238 he was evidently regarded as a leader of the baronial opposition, for the great council appointed him as one of the treasurers who were to prevent the king from squandering the subsidy voted in that year. His son John de Warenne (*c.* 1231–1304) succeeded in 1240, and at a later date bore the style of earl of Surrey and Sussex. In the battle of Lewes (1264) he fought under Prince Edward, and on the defeat of the royal army fled with the queen to France. His estates were confiscated but were subsequently restored. He served in Edward I.'s Welsh campaigns, and took a still more prominent part in Scottish affairs, being the king's lieutenant in Scotland in 1296–1297. In September 1297 he advanced to Stirling, and, giving way to the clamour of his soldiers, was defeated by William Wallace on the 11th. He invaded Scotland early the next year with a fresh army, and joining Edward in the second expedition of that year, commanded the rear at Falkirk.

John de Warenne (1286–1347) succeeded his grandfather in 1304, and was knighted along with the prince of Wales in 1306 two days after his marriage with the prince's niece, Joanna daughter of Eleanor of England, countess of Bar. From that time onwards he was much engaged in the Scottish wars, in which he had a personal interest, since John Baliol was his cousin and at one time his ward. As there were no children of his marriage, his nephew, Richard Fitzalan II., earl of Arundel (*c.* 1307–1376), became heir to his estates and the earldom of Surrey. His northern estates reverted to the crown, and the southern estates held by Joanna of Bar during her lifetime passed to Fitzalan. The Warrens of Poynton, barons of Stockport, descended from one of Earl Warenne's illegitimate sons by Isabella de Holland.

See G. E. C(okayne), *Complete Peerage,* vol. vii. (1896); and John Watson, *Memoirs of the Ancient Earls of Warren or Surrey* (2 vols., Warrington, 1782).

WAR FINANCE (COST OF WORLD WAR I). Estimates of the direct cost of the World War of 1914–18 vary greatly and even years after the conclusion of the armistice it is difficult to give precise figures. The reason of this lies in the difficulty of clearly determining what part of the national outlays during the war period can be strictly regarded as war expenditure, while there is also difficulty in determining the net, as distinct from the gross, cost. Much of the war expenditure of the various countries constituted in some respects a source of fresh income, and, while national treasuries were heavy losers by war outlays for goods and materials at fabulous war prices, individual nationals made large fortunes, which in due course furnished fresh resources of national wealth for use after the war. The difficulty of determining precise figures is also increased by the task of deciding when war expenditure really terminated. In most cases, increased expenditure from the national exchequers, resulting directly or indirectly from the war, went on for some time after the armistice, in 1918, and it was only some few

years later that anything in the way of statistics was prepared giving the cost of the war, although all kinds of hurried estimates were made during its progress. Thus, in Nov. 1917, the Mechanics and Metals National Bank of the State of New York prepared a statement estimating that at that time the money expended was more than $100,000,000,000, or about £20,000,000,000, the further estimate being made that the expenditure was at the rate of $5,000,000,000 each month, so that, inasmuch as the war persisted for another year, another $60,000,000,000, or £12,000,000,000, would have to be added. In 1924, however, some six years after the war, an exhaustive enquiry into the cost was made by Harvey E. Fisk, of the Bankers' Trust company, in New York, and, according to that authority, the total cost of the war was placed at $80,680,000,000 gold, or about £16,000,000,000. That statement, however, was reached on the basis of endeavouring to calculate the cost of the war on the price-level basis, the inflated currencies which characterized the war years, and especially the latter periods, being adjusted to terms of 1913 prices, which the authority quoted described as "the gold cost of the war."

Bankers' Trust Company Estimate.—Inasmuch, however, as not all the countries formally de-valued their currencies after the war, and while Great Britain, although experiencing, in common with other nations, a decline in commodity prices, preserved intact the exchange value of the £, it is perhaps simpler and more illuminating to give the following estimates, which were put forward in 1924 by the Bankers' Trust company of New York, where the cost to the various nations is set out in sterling, without the further calculations based on an adjustment of price-levels. These figures, as briefly summarized in *Whitaker's Almanack for 1928,* are as follows:

Nation	*Total Expenditure* £
British Empire	13,577,900,000
Great Britain	11,076,000,000
Canada-Newfoundland	762,700,000
Australia	476,700,000
New Zealand	234,400,000
South Africa	159,000,000
India	687,100,000
Other Parts	182,000,000
Belgium	411,800,000
France	7,962,200,000
Greece	115,100,000
Italy	4,432,700,000
Japan	419,100,000
Portugal	235,300,000
Rumania	308,800,000
Russia	5,312,700,000
Serbia	119,000,000
United States	7,500,000,000
Total, Allies	£40,363,600,000
Austria-Hungary	4,068,400,000
Bulgaria	261,000,000
Germany	10,341,100,000
Turkey	451,800,000
Total, Central Powers	£15,122,300,000
Grand Total	£55,486,000,000

The Basis of Calculation.—A striking example of the discrepancies in calculations is afforded by the answer given by the British chancellor of the exchequer to a question in the House of Commons in May 1919, regarding the cost of the war to Great Britain. Sir (then Mr.) Austen Chamberlain said that up to March 31, 1919, the net cost might be estimated, in round figures, at £6,700,000,000. It will be observed, however, that in the table the figure is given as £11,076,000,000. Not only, however, did the chancellor of the exchequer's statement exclude all debts due from dominions and allies, but it is impossible to follow the allowance made for "normal peace expenditure." Broadly speaking, the basis of calculation in the case of the foregoing figures may be said to be (*a*) a calculation based upon the excess of expenditure over the normal figures of the year previous to the war, while the period taken is not 1914–18 but 1914–20, inclusive, war expenditure extending certainly to that date and possibly longer. Thus, in the case of Great Britain alone, expenditure totalled (for one year) £1,666,000,000 more than a year after the war and was over £1,000,000,000 two years after the war. In certain respects, of course, such, for example, as war pensions, war expenditure is still going on, but no attempt has been made to carry the calculation beyond 1920. Nor, as already stated, do the calculations attempt to follow out the American process adopted by the Bankers Trust company of adjusting the currency cost of the war to 1913 levels, although, of course, the point is important. The Bankers' Trust divided the figures for each year by the average wholesale price index number for the year, thus putting the statistics for each country on the 1913 price basis. The adjusted cost figures were then converted into dollars at par of exchange, and on that basis the real cost of the war in 1913 dollars is estimated at 80,681,000,000 dollars, or in sterling a little more than £16,000,000,000, which, of course, is a very different figure to the actual gross currency costs recorded in the foregoing table.

The total expenditure in the case of most of the countries enumerated in the table can be regarded as the outside amount, but the two notable instances where the net cost might be reduced if allowance were made for loans to allies, are the British empire and the United States. British loans are over £100,000,000 to dominions and colonies, while at March 31, 1928, loans due to Great Britain included £706,000,000 from France, £266,000,000 from Italy, £100,000,000 from various smaller European States, and £887,000,000 from Russia, the last item, however, being regarded somewhat in the light of a bad debt.

Indirect Cost of the War.—At this point statistics break down. With the exception, perhaps, of the United States, it may fairly be said that the figures already given do not begin to express the real cost of the war. Great Britain alone sustained 676,442 actual fatalities, with 1,648,014 wounded, while French fatalities totalled 1,400,000 killed, 800,000 maimed, and 3,000,000 wounded. Previous to 1914 Great Britain, by reason of her seniority among the big nations resulting in an accumulation of savings and a prestige in the matter of manufacturing, had the leading place among the nations in financial lending power and control over the exchanges, conditions in their turn contributing to her power as the leading monetary centre of the world. As a consequence of the war, or, rather, as a consequence of the three years of neutrality on the part of the United States during the war, the equipoise of the balance of trade was completely destroyed, and at the end of the conflagration the belligerent countries of Europe became debtors to the United States, first, on account of the colossal trade balance in favour of America, and, second, because of the actual debts incurred by the belligerent nations to the United States Government. All this, so far as Europe is concerned, has to be reckoned amongst the indirect costs of the war, and to express that cost in figures is impossible. Whether, on the other hand, an equivalent of the unknown amount to be debited to the belligerent countries of Europe is to be credited to the United States is not only debatable but a controversial subject, because economists in the United States of America often plead that, as a matter of fact, economic progress in their country was retarded rather than helped by the four years' war.

It may be mentioned that in a lecture delivered before the London Institute of Bankers in June 1920 by Edgar Crammond on "The Real Cost of the War," an attempt was made by that statistician to appraise the real net cost of the war after making all allowances for revenues or territories gained or lost. The result was, naturally, to reduce materially the gross cost. Thus he estimated the net *real* cost of the war to Great Britain at only £3,500,000,000; France at £5,400,000,000; Italy at £2,100,000,000; and so on while for the five years ended 1919 the United States was reckoned to have gained materially in wealth.

Cost of the War to the United States.—More than in the case of any other country, big deductions have to be made in the case of the United States from the gross amount of war expenditure. According to the calculations of the Bankers' Trust company in 1924, the total cost of the war in currency dollars was about $37,500,000,000, or about £7,500,000,000. From that total, however, has obviously to be deducted about $10,000,000,000 or £2,000,000,000, on account of loans to the Allies, while, although

Debts of the Allied and Associated States to the United States as of October 31, 1927

Debtor state	Funded war debt	Unfunded war debt*	Relief given on loan (American Relief Commission and United States Grain Corporation)*	Sales of surplus war supplies*	Total
	£	£	£	£	£
Armenia	..	..	2,457,517	..	2,457,517
Belgium	..	71,344,686	..	6,127,143	77,471,829
Czechoslovakia	..	12,734,392	1,911,232	4,233,761	18,879,385
Estonia	2,841,780	..	..	..	2,841,780
Finland	1,811,096	..	..	..	1,811,096
France	..	600,646,149†	..	83,700,235	684,346,384
Great Britain	925,684,932	..	..	..	925,684,932
Greece	..	3,082,192**	..	..	3,082,192
Italy	417,534,246	..	..	..	417,534,246
Latvia	1,186,644	..	..	..	1,186,644
Lithuania	1,266,285	..	..	..	1,266,285
Nicaragua	..	..	..	59,718	59,718
Poland	36,690,411	..	..	..	36,690,411
Rumania	13,574,088	..	..	..	13,574,088
Russia	..	38,574,606	917,561§	83,441	39,575,608
Yugoslavia	..	5,354,767	..	5,132,470	10,487,237
Totals	1,400,589,482	731,736,792	5,286,310	99,336,768	2,236,949,352
	£2,132,326,274				

*The United States Government holds Bonds of the Debtor Governments in respect of the sums shown in these columns; the amounts stated are exclusive of interest accrued and unpaid. †A funding agreement has been signed but has not yet been ratified. **An agreement between the respective Governments as to this debt was reached in Dec. 1927. §American Relief Administration only.

the point is challenged by many American economists, it would seem that just as to the direct ascertained cost of the war to the European belligerents has to be added a large but unknown total representing indirect cost, so in the case of the United States the argument is of the reverse order. The United States as well as the Allies suffered loss through war casualties and also through war inflation. Nevertheless, just as the cost of the war was increased to the European belligerents by the high prices paid for foodstuffs and war materials, so the United States was the gainer by these same prices. Of still greater moment, however, was the fact that just as the European belligerents lost markets and economic strength by the war, so the United States, by reason of her three years of neutrality, gained in both of these respects. More, however, than any other country, with the exception of Japan, the United States met its war expenditure through taxation, though, equally, and because of its financing of the requirements of the Allies, no country issued within a brief space of time a larger amount in loans, something like $23,000,000,000 being raised after the entry into the war. As the last entrant, however, the United States benefited greatly by the experience gained from the mistakes of other countries, and while a certain measure of inflation was the inevitable accompaniment of such huge and sudden borrowing, economy and sufficient taxation were the watchwords from the moment of America taking a hand in the conflict, and a continuance of that policy has resulted in a greater amount of debt liquidation since the war than any other country has been able to achieve. The above table, taken from *The Stock Exchange Official Intelligence for 1927*, sets out the debts of the Allied and Associated States to the United States of America as of Oct. 31, 1927, the figures being as shown by the *Statement of the Public Debt of the United States* issued by the office of the secretary to the United States Treasury.

How War Expenditure Was Met.—Subject to the difficulties of calculations and estimates already referred to, the statistics prepared by the Bankers' Trust showed that on the basis of currency, not of 1913 values, the entire war expenditure was met as to about 69% in borrowings at home in one form and another, as to a further 10% in loans from Allies, and as to about 1% in loans from foreign neutral countries, the balance being obtained from taxation. In the case of the Continental Central Powers, however, the percentage of borrowing was greater than in the case of Great Britain or the United States. In fact, apart from Japan, the only Governments which had the courage to ask their nationals to pay very heavy taxes during the greater part of the war period were Great Britain and the United States. Even in Great Britain there was a curious reluctance to impose taxation during the earlier stages of the war, the idea apparently prevailing in all countries that the war must be made popular at all costs. In Great Britain, indeed, there was the curious experience of the people actually inviting an increase in taxation, deputations waiting upon the chancellor of the exchequer at quite an early stage of the war requesting that there should be an increase in direct and indirect taxation. Throughout the whole period of six years covered by the calculations concerning the cost of the war, Great Britain was the most heavily taxed country, although she was also during the war itself the largest borrower, having to finance the greater part of the conflict on behalf of herself and her Allies. At one time, the income tax of Great Britain rose to 6s. in the £, while a prolific source of revenue to the exchequer during the war period was the excess profits duty, a tax which was levied from 50 up to 80% on all business profits exceeding the pre-war level. Some idea of the exacting nature of the tax, and incidentally of the profiteering which went on during the war, may be gathered from the fact that from this source alone the British Treasury received within a period of five years no less than well over £1,000,000,000. Indeed, the tax may be said to have yielded not far short of 25% of the total war revenue from taxation. Nevertheless, it is generally believed to have brought some evil consequences in its trail and was among the influences leading to demands for higher wages and to inflation both in credit and in currency. From the outset Great Britain was fortunate in possessing in her income, super tax and death duties, a machine ready to hand which greatly aided the immediate application of war taxation, so that in addition to the revenue from excess profits tax, income and super tax, which had yielded about £47,000,000 in the pre-war year, rose in 1917 to £250,000,000, in 1918 to £291,000,000, in 1919 to £359,000,000, and in the following year to £394,000,000. In Great Britain, however, as in other countries, a large percentage of the war expenditure was met by loans, and at the outset the borrowing method was practically universal with all the belligerent countries. Moreover, as was natural, the first step taken in most of the belligerent countries was in the direction of short-term Treasury bills. In Great Britain these bills, which, beginning in small amounts, rose at one time to over £1,200,000,000, were placed in the London money market with the banks and discount houses through a system of tendering, thus to some extent minimising their inflationary effect, but in other countries the usual procedure was for the bills to be taken by the national or central banks and either held by them or placed gradually in other quarters. In many cases these bills were converted later

into short-term bonds, but the war was not far advanced before long-dated borrowing became necessary, one of the first instances being the flotation in Great Britain in Nov. 1914, of a 15-year loan for £350,000,000 in 3½ per cents at 95. In spite of the stern necessities of the case, the loan was not too well applied for, a part being taken temporarily by the Bank of England, thus involving at the outset a further stimulus to inflation. At the time of the flotation, the loan was the largest ever offered at one time, but it was destined to appear almost a small operation compared with some which followed, the climax being reached in 1917, when, including conversions effected at the same time, the total amount issued was no less than £2,000,000,000. Altogether the extent of Britain's war borrowings may best be expressed by saying that the total amount of funded and unfunded debt, which previous to the war totalled about £650,000,000, had risen by the end of 1920 to £7,830,000,000. To quote figures after that date would be misleading because debt conversions were often carried through on lines involving a saving in the service on the debt but an increase in deadweight debt owing to the loans being issued at a material discount. In considering Great Britain's methods of payment for the war, it must also be mentioned that contemporaneously with the immediate issue of Treasury bills after the commencement of the conflict, currency or Treasury notes were authorized for £1 and 10s. and these notes at one time attained a maximum circulation of over £300,000,000. As against the notes, however, British Treasury bills were issued and must be reckoned amongst the high total attained by those bills.

In considering the payment by the belligerent countries for the war, concealed taxation through the effect of inflation upon prices has to be remembered. It was in the Continental countries that the full effect of inflation, resulting from excessive borrowing and insufficient direct taxation, was most strikingly revealed. Therefore, it is far more difficult in the case of the Continental and Central Powers to assess in terms of currency the cost of the war than in the case of Great Britain and the United States. In most instances, however, the greatest depreciation in currencies occurred after the war was concluded. In Germany this was due to the fact that fully 90% of the war expenditure was met by internal borrowing, Austria also raising about 87% of its war expenditure in loans either at home or from Allies. In France over 76% of the expenditure was raised in loans at home, with fully 17% in loans from Allies and foreign countries, but chiefly from Allies. In the case of France, war expenditure was naturally prolonged for a considerable period after peace owing to the rebuilding of devastated areas, and although Germany was not in a similar position, her supplies of foodstuffs, raw materials, manufactured goods and machinery were so exhausted that heavy borrowings were necessary to meet the situation.

Speaking broadly, and taking for the most part, the calculations of the Bankers' Trust company of New York, Belgium raised practically the whole of her war expenditure in loans from Allies, Italy raised about 51% of the costs in loans at home and 21% in loans from Allies, while Portugal and Russia raised about 75% and 95% respectively in loans.

External Borrowings by the Belligerents.—No feature of war expenditure was more remarkable than the difficulty experienced by the belligerent countries in Europe during the first three years of the war in making payments for goods and services to the United States and other neutral countries. The problem was one of exchange, and no description of the methods of paying for the costs of the war would be complete without a reference to this particular aspect of war finance. In the paragraph dealing with the cost of the war to the United States a table is given showing the indebtedness of various belligerent countries to the United States Government and the United States nationals. It is the origin of those loans which, in the main, may be regarded as one of the concrete expressions of this special difficulty. In the first three years of the war Great Britain and other belligerent countries were largely dependent upon the United States and other neutral countries for foodstuffs and for war materials. Owing to the effectiveness of the naval blockade by Great Britain some of these countries were virtually cut off from outside supplies. The problem of the countries purchasing from abroad, however, was that of making payments in the currencies of the supplying countries. The greater part of the strain—especially during the period of the war—fell upon Great Britain, which was financing its own necessities and a large part of those of its Allies. Out of its own resources, which were supplemented later by amounts taken from the central banks of France and Russia, many millions of gold were shipped from London to the United States to save the strain on the exchange. In spite of such shipments, however, the greatest difficulty was experienced in preventing the American exchange on London from collapsing altogether. At that time the nationals of Great Britain were the holders of about £1,000,000,000 in American securities of various kinds and the greater part of these securities were finally commandeered at the price of the day by the British Government, which then made arrangements with Morgans in New York for the marketing of the securities and for the fixing of the exchange on London. That is to say, the securities were supplied with sufficient rapidity to ensure the necessary amount of dollars being in the hands of Morgans to maintain the exchange. In addition, loans to the extent of at least £200,000,000 for Great Britain and one or more loans for Great Britain and France jointly were placed with American nationals. This was before the entry of the United States into the war. After that date, which was in April 1917, the financing of the requirements of the Allies in the United States was arranged on wholly different lines. America came into the war just when, in spite of the methods described, the sterling exchange appeared again to be on the eve of breaking down. Under the new system, however, the U.S. Government gave dollar credits to the Allies for all goods and services supplied in the United States, and that process went on not only during the war but for some time afterwards when the exchanges were still maintained by America continuing to finance the post-war requirements of the Allies and of France, in particular, by the credits referred to. The net result of these loans is shown in the table giving the debts of the Allied and Associated States to the United States. Thus, in the case of Great Britain, it will be seen that in addition to parting with some hundreds of millions of pounds in gold to meet war expenditure for goods and services supplied from that country, she also remitted nearly £1,000,000,000 of her holding of American railroad securities and incurred a debt of nearly the same amount.

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WARGLA: *see* WARQLA.

WAR GRAVES (WORLD WAR, 1914–18). With a view to ensuring the care and permanence of the graves of British soldiers buried in France, negotiations took place early in the World War between British military authorities and the French Government. On Dec. 29, 1915, the latter passed a law which provided that all Allied graveyards on the soil of France should be acquired by the Government of the republic at its own expense, and that the rights of ownership should be enjoyed in perpetuity by the Allied nations concerned[1].

The result was the establishment in Great Britain (Jan. 1916) of a National Committee for the Care of Soldiers' Graves, the presidency of which was accepted by the Prince of Wales. This committee was succeeded by the Imperial War Graves Commission, chartered May 21, 1917. The commission's deliberations during their first year resulted in the double proposal laid before the Imperial conference on June 17, 1918, that £10 per grave should be taken as the probable cost of the construction of cemeteries, and that the cost of carrying out the decisions of the commission should be borne by the respective governments in proportion to the numbers of the graves of their dead.

Policy.—One of the first acts of the commission was to decide that the graves of all ranks should be treated on a basis of absolute equality. Sir Frederick Kenyon, director of the British

[1]Later on, the governments of Belgium, Italy, Greece, Egypt and Palestine followed the lead of France by passing equally generous measures.

museum, recommended (1) the erection of uniform headstones over all war graves, and (2) the erection of two central monuments in each cemetery where possible. The headstones are 2 ft. 8 in. in height, 1 ft. 3 in. in breadth and 3 in. in thickness. Each stone bears at the top the badge of the regiment or unit. Then follow the military details with the name of the deceased and the date of his death, below which is carved the symbol of his faith, while at the foot of the stone is engraved a personal inscription chosen by the next-of-kin. Of the two central monuments the great altar-like stone of remembrance, designed by Sir Edwin Lutyens, bears the inscription chosen by Rudyard Kipling, "Their name liveth for evermore." The other memorial is the great cross of sacrifice designed by Sir Reginald Blomfield, to the shaft of which is fixed a crusader's sword of bronze.

In addition to the marking and care of the graves, the commission was entrusted with the erection of memorials to record the names—more than 300,000 in number—of those sailors and soldiers who have no known graves.

Among these were the three connected with the navy, which stand on prominent sites at Portsmouth, Chatham and Plymouth, the three ports intimately connected throughout Britain's naval history with the sea service; the Gallipoli memorial at Cape Helles; the Salonika memorial at Lake Doiran; the memorial at Jerusalem in Palestine; the Indian memorials at Neuve Chapelle in France and at Port Tewfik on the Suez canal; the Menin gate at Ypres; and the memorial at Vimy for the Canadians.

The 725,000 known graves for which the Imperial War Graves commission assumed responsibility are scattered all over the world in many different countries with different laws and customs, some of them enemy countries with whom special provisions were made in the treaties of peace to ensure the graves being respected.

Permanent Maintenance.—As a guarantee that the graves and memorials should be forever cared for, the various governments of the empire represented on the commission undertook to provide permanently the income required for maintenance at the accepted standard of upkeep laid down by the commission. After discussion it was agreed that an endowment fund amounting to £5,000,000 should be established for this purpose by the United Kingdom and dominion governments.

French and American Graves.—France, on whose soil lay over 3,000,000 allied and enemy dead, was faced with the problem of honouring her fallen soldiers without clogging the wheels of industry and agriculture, which were beginning to revive under peace conditions, even in the devastated areas where the graves lay thickest. The British helped to solve the difficulty by concentrating all isolated graves into cemeteries which would forever mark the British battle-line. The French adopted the further expedient of giving the next-of-kin the opportunity of having their dead reburied at the state's expense in the churchyard or burial-ground of their native place, while those who were left would rest in great national cemeteries constructed by the state as a lasting monument to the heroism of the soldiers who died for France.

About 50,000 fallen soldiers of the American expeditionary forces were borne back across the Atlantic to rest in their own land. The American authorities would no doubt have hesitated to undertake a task of such difficulty had not a pledge been given before a single American battalion left the United States that no American soldier who died fighting for his country and the liberties of nations should be left to lie on foreign soil except at the express wish of his next-of-kin. There are 30,703 American dead buried in eight American cemeteries in Europe. Six of the cemeteries containing 29,900 graves are situated in France; one, with 366 graves, is situated in Belgium, and one, with 437 graves, is situated in England. The cemeteries are planned on the principle of uniform treatment of the graves, a conception which appears to have been first put into practice by those who laid out Arlington national cemetery, a burial place of many of those who fell in the American Civil and other wars of the United States.

(F. W.; X.)

WARHAM, WILLIAM (*c.* 1450–1532), archbishop of Canterbury, belonged to a Hampshire family, and was educated at Winchester and New college, Oxford. Later he took holy orders, held two livings, and became master of the rolls in 1494, while Henry VII found him a useful and clever diplomatist. He helped to arrange the marriage between Arthur and Catherine of Aragon; and he was partly responsible for negotiating treaties with Flanders, Burgundy and Maximilian I. In 1502 Warham was consecrated bishop of London and became keeper of the great seal, but his tenure of both these offices was short, as in 1504 he became lord chancellor and archbishop of Canterbury. In 1509 the archbishop married and then crowned Henry VIII and Catherine of Aragon, but gradually withdrawing into the background he resigned the office of lord chancellor in 1515, and was succeeded by Wolsey.

This resignation was possibly due to his dislike of Henry's foreign policy. He was present at the Field of the Cloth of Gold in 1520, and assisted Wolsey as assessor during the secret inquiry into the validity of Henry's marriage with Catherine in 1527. Throughout the divorce proceedings Warham's position was essentially that of an old and weary man.

He was named as one of the counsellors to assist the queen, but, fearing to incur the king's displeasure and using his favourite phrase *ira principis mors est,* he gave her very little help; and he signed the letter to Clement VII which urged the pope to assent to Henry's wish. Afterwards it was proposed that the archbishop himself should try the case, but this suggestion came to nothing.

He presided over the convocation of 1531 when the clergy of the province of Canterbury voted £100,000 to the king in order to avoid the penalties of *praemunire,* and accepted Henry as supreme head of the church with the saving clause "so far as the law of Christ allows." In his concluding years, however, the archbishop showed rather more independence.

In February 1532 he protested against all acts concerning the church passed by the parliament which met in 1529, but this did not prevent the important proceedings which secured the complete submission of the church to the state later in the same year.

Against this further compliance with Henry's wishes Warham drew up a protest; he likened the action of Henry VIII to that of Henry II and urged Magna Carta in defense of the liberties of the church.

He died on Aug. 22, 1532, and was buried in Canterbury cathedral. Warham was chancellor of Oxford university from 1506 until his death.

See W. F. Hook, *Lives of the Archbishops of Canterbury,* vol. vi (1860–76); J. Gairdner in *Dict. Nat. Biog.,* vol. lix (1899) and *The English Church in the 16th Century* (1902); J. S. Brewer, *Reign of Henry VIII* (1884); and A. F. Pollard, *Henry VIII* (1905).

WARKWORTH, town of Northumberland, England. Pop. (1931) 713. It is situated on the river Coquet, 1½ mi. above its mouth, where on the south bank is Amble, an urban district (pop. 1938, 4,323), with a harbour. An old bridge crosses the river, with a fortified gateway on the road mounting to the castle. The remains of this Norman stronghold include walls, a gateway and hall, while the Lion tower and the keep are of the 13th and 14th centuries.

Near by are remains of a Benedictine priory of the 13th century, and also the Hermitage of Warkworth, which consists of an outer portion built of stone, and an inner portion comprising a 14th century chapel and a smaller chamber hewn from the steep rock above the river. The church is mainly Norman and has a 12th century tower.

WARLOCK, a word seemingly used in northern English or Scottish for a wizard, sorcerer or magician; in O.Eng. *wóerloga,* literally "a liar against the truth," from *wóer,* truth, cognate with Lat. *verum,* and *loga,* liar, from *léogan,* to lie. It was used for a traitor, deceiver, breaker of a truce.

WARMINSTER, a town and urban district in Wiltshire, England. Pop. (1938) 5,564. Area 8.8 sq.mi. Its white stone houses form a long curve between the uplands of Salisbury plain, which sweep away towards the north and east, and the tract of park and meadow land lying south and west. The cruciform church

of St. Denys has a 14th-century south porch and tower.

Warminster appears in Domesday, and was a royal manor. The meeting of roads from Bath, Frome, Shaftesbury and Salisbury made Warminster a busy coaching centre. Eastward, within 2 mi., there are two large ancient camps: Battlesbury, almost impregnable, and Scratchbury with a citadel.

WARM SPRINGS, a town in western Georgia, U.S.A., with a pop. of 608 in 1940, the site of the Georgia Warm Springs foundation, an institution for paralysis victims. Franklin D. Roosevelt went there after an attack of infantile paralysis and built a home (the "little white house") in 1932, where he died April 12, 1945. After 1933 a number of U.S. cities held balls each year on Roosevelt's birthday to raise funds for the institution.

WARNER, CHARLES DUDLEY (1829–1900), American essayist and novelist, was born of Puritan ancestry, in Plainfield (Mass.), Sept. 12, 1829. His childhood experiences in Charlemont (Mass.), after the death of his father, are pictured in his delightful study *Being a Boy* (1877). The family removed thence to Cazenovia (N.Y.); and Warner graduated in 1851 from Hamilton college, Clinton (N.Y.), through which he had paid his way by his earnings. Because of ill health, he spent some time with a surveying party in Missouri.

When he was 40 years old a series of sketches published in the *Courant* changed him from an editor with a local reputation to a nationally known man of letters. They were published in book form as *My Summer in a Garden* (1870). Thereafter Warner's work appeared frequently in the better class magazines. He travelled widely, and wrote several travel books, the best of which are *My Winter on the Nile* (1876), originally called *Mummies and Moslems,* and its sequel *In the Levant* (1876). With his friend and neighbour, Mark Twain, he collaborated on *The Gilded Age* (1873), an uneven novel which was unsatisfactory to both men. Another story, *Their Pilgrimage* (1886), had as its purpose the description of fashionable American resorts; and the making, fraudulent diversion from its intended object, and final loss of a great fortune were treated in an ambitious trilogy, *A Little Journey in the World* (1889), *The Golden House* (1894) and *That Fortune* (1899). Warner is at his best, however, as an essayist. He also edited the "American Men of Letters" series, which he opened with a biography of Washington Irving (1881). He died in Hartford Oct. 20, 1900.

See the biographical sketch by T. R. Lounsbury in the *Complete Writings of Charles Dudley Warner* (1904) and Annie Fields's *Charles Dudley Warner* (1904).

WARNER, SETH (1743–1784), American Revolutionary soldier, born in Roxbury, Connecticut, May 17, 1743. He removed with his father to the "New Hampshire Grants" in 1763, and became prominent among the young men who forcibly resisted New York's claim to the territory. (*See* VERMONT.) At the outbreak of the War of Independence, he led the detachment of "Green Mountain Boys" which captured Crown Point, May 11, 1775, and took part in the unsuccessful expedition against Quebec later in the year. In July 1776 he became colonel in the Continental Army, and served throughout the war. He retired in 1782, and returned to Roxbury, where he died Dec. 26, 1784.

See Daniel Chipman, *Life of Col. Seth Warner* (1858).

WARNSDORF, a frontier town in north-east Bohemia, with large textile manufactures, chiefly cotton and silks. Pop. (1930) 22,793, most of whom were Germans.

WAR OF 1812, THE. As early as 1806 much friction arose over what President Madison characterized as a "sweeping system of blockades" adopted by British Orders in Council with the object of cutting off essential French supplies by sea. This and similar subsequent war measures greatly hampered lucrative American commerce with France and produced the customary deadlock between the inherent interests of belligerent and neutral.

Hostilities.—The American President represented that British blockade methods widely overstepped legal limits, and constantly opposed them through diplomatic channels. In his message to Congress in June 1812, urging a declaration of war, he stated that "British cruisers have also been in the practice of violating the rights and peace of our coasts. They hover over and harass our entering and departing commerce . . . under pretended blockades without the presence of an adequate force [legally required] . . . our commerce has been plundered in every sea." Ill-feeling had been further aggravated by the forced "impressment" into the British navy of men from the crews of American ships met on the high seas. These practices had led to the encounter between the U.S. frigate "Chesapeake" and H.M.S. "Leopard" in 1807, and to that between the American frigate "President" and H.M.S. "Little Belt" in 1811.

The war, declared by Congress on June 18, 1812, followed three distinct phases. Until the spring of 1813 England was hard pressed in Europe, and endeavoured by diplomatic negotiations to stop the war in America, where she could not afford to send reinforcements to her army nor to concentrate large naval forces. Consequently this was a period when the Americans were free to undertake an invasion of Canada and when their very small navy of 16 vessels was able to cruise extensively against British maritime commerce. The second phase lasted about a year, during which England, though still considerably restrained by affairs in Europe, was able to institute a rigorous commercial blockade of the United States coast, but could not materially increase her troops in Canada. The third and final phase of the war came after the downfall of Napoleon in the spring of 1814, when England could spare considerable army reinforcements for the American theatre, and further strengthen the naval blockade there.

Three days after the declaration of war, the U.S. squadron under Commodore Rodgers sailed from New York with the double object of protecting the great numbers of American merchant ships then due from overseas, and of preying upon British commerce. After chasing the British frigate "Belvidera," which escaped into Halifax through throwing overboard much of her equipment, he made an extensive sweep of the North Atlantic, almost to the English channel, but captured few prizes. In July Commodore Hull sailed from Chesapeake bay in the "Constitution," and reached Boston after a long chase and narrow escape from a British squadron, through towing the ship with her own boats. Within a few days he was again at sea and on August 19 captured the British frigate "Guerrière." In October, Rodgers, Decatur and Bainbridge, sailed from Boston in the "President," "United States" and "Constitution" respectively, and made wide sweeps of the mid-Atlantic. The first named met with little success. On the 25th the "United States" captured the British frigate "Macedonian" in long. 30°, and on December 28 the "Constitution" captured the frigate "Java" off the coast of Brazil.

Operations in Canada.—In view of the great general superiority and prestige of the British navy, the American people were much elated over these results at sea. From a purely military-naval point of view they were of little consequence, since their effects upon British trade and dominating naval power were negligible. But in upbuilding the American national *morale,* notwithstanding distress caused by the blockade, the frigate victories assumed great importance. Meantime the course of the war on land, where American forces had been greatly superior in numbers, was discouraging. The paucity of British military forces in Canada had led the Americans from the outset to undertake an early invasion across their northern frontier. But a mere handful of British regulars, supported by Canadian militia and Indian allies, and utilizing their initial naval control of Lakes Erie and Ontario, were sufficient to defeat the invaders.

General Hull's advance into Canada from Detroit proved so abortive that he soon returned to his base and surrendered it to Gen. Brock in Aug. 1812. A few months later the energetic and skilful Brock repulsed weak American attempts to establish themselves on the Canadian side of the Niagara river. Meantime a force under the American Gen. Dearborn had been mobilizing near Lake Champlain, but its operations were apathetic, in part due to an armistice while fruitless peace negotiations initiated by the British were in progress.

Naval Operations.—The first year's experience on the lake frontier, where roads were extremely primitive, clearly emphasized the importance of naval control thereon if the armies were to be supplied and made mobile. During the succeeding winter

and spring both sides were very active in the construction and equipment of ships. Commodore Chauncey was in general charge of such American preparations on Lakes Ontario and Erie, assisted in the latter case by Commodore O. H. Perry. Comparatively large naval forces came into being on Lake Ontario. Its control was fought for, notably on Aug. 10 and Sept. 28, 1813, but never decisively gained by either side.

In the early spring of 1813, while still in naval control of Lake Erie, the British military forces in occupation of the vicinity of Detroit invaded northern Ohio and during the summer penetrated as far as the Sandusky river. Their fleet under Capt. Barclay was decisively defeated by Commodore Perry on September 10. While the American fleet was somewhat stronger, great credit is due to Perry for his energy in preparing it under much difficulty, and in conducting the battle with marked spirit and determination. After his own flagship "Lawrence" had become disabled, from having borne the brunt of the fighting, and defeat seemed imminent, Perry went by small boat to the "Niagara," took her into close action and turned the tide of victory.

The event strikingly demonstrated the value of the naval control of the lake. The British army, faced with the severance of its line of supplies, was forced to a hasty evacuation of Ohio and Michigan, and a retreat up the Thames river towards Lake Ontario. The American army under Gen. Harrison was taken on board Perry's ships, so soon as repaired, and landed in Canada, where it pursued the British and defeated them at the battle of the Thames, in which Perry led the decisive charge. Thus the Americans had gained all territory west of the Niagara peninsula.

Meantime, with the advent of 1813, the war had entered its second phase at sea. Overwhelming British naval forces instituted such a vigorous commercial blockade of the coast south of New England, as seriously to affect American commerce, both coastwise and foreign. Considerable clandestine exporting was permitted in order to facilitate the supply of British armies in Spain and Canada, and this also furnished a reason for not extending the blockade to include New England. Strong British squadrons occupied Chesapeake and Delaware bays, and closely guarded all ports from Maine to Georgia against the passage of war ships.

Commodore Porter in the frigate "Essex" had been operating in the South Atlantic, and instead of attempting a difficult return to the United States decided upon a voyage into the Pacific to raid the valuable British whaling trade, while at the same time protecting that of the United States. In both objects he was very successful. After refitting at the Marquesas islands, which he annexed to the United States by treaty (not confirmed by his government), he proceeded to Valparaiso to meet a British squadron of whose coming he had received information. Here in March 1814 he was attacked and defeated in Chilean territorial waters by the more powerful "Phoebe" and "Cherub." Meanwhile, during 1813, the "President" and "Congress" had made an all but profitless sweep of the Atlantic, the frigate "Chesapeake" had been captured off Boston by H.M.S. "Shannon," and the U.S. sloop "Argus" taken by the "Pelican" off the coast of Wales.

The Third Phase.—The fall of Napoleon in the spring 1814 brought the war to its final phase by permitting England to augment greatly her military and naval forces in America. At the beginning of the year the Americans still retained the initiative on land, by virtue of superior numbers on the Canadian frontier. Moreover the handicap of poorly disciplined troops had been largely overcome. During a brief campaign against the ill-chosen objective of the Niagara peninsula, Gen. Brown met with considerable success at the battles of Chippewa and Lundy's Lane. But the failure of Commodore Chauncey to deny the use of the lake for carrying supplies and reinforcements to the British army brought the invasion to a close in July. The constant arrival of fresh British regulars, together with increased naval forces which extended and strengthened the blockade and penetrated into all the large coastal bays, enabled them to take the offensive in several quarters. Northern Maine was occupied by light forces and held until the end of the war. In August, Gen. Prevost, at the head of a veteran army of about 12,000 men, based at Montreal, invaded New York via Lake Champlain, bound for the Hudson valley. In the same month a large British squadron ascended the Patuxent river and landed 4,000 regular troops under Gen. Ross who, almost without opposition, marched to Washington and burned the capitol. This raid had little result except to inflame public hatred against the British. The expedition proceeded to Baltimore where its attack was repulsed on September 12. During the attack Francis Scott Key composed "The Star-Spangled Banner." Gen. Ross was killed. The same forces then sailed for the Gulf of Mexico where they undertook the capture of New Orleans in December. Of these operations the advance from Montreal was not only the largest but also threatened the gravest consequences. One of the essential conditions of its success lay in control of water communications on Lake Champlain, in order that the invaders might be readily supplied from the St. Lawrence river. On this account, the victory of the American squadron under Commodore Macdonough, over the British squadron acting in support of the invading army, was of outstanding strategic importance. This occurred off Plattsburg on Sept. 11, 1814, while the American army at that place was about to be assaulted in its works by superior British land forces. The brilliance of Macdonough's triumph is heightened by the fact of his fleet having been somewhat weaker in tactical elements than that of his opponent, and by the immediate reversal of events on shore. On learning the outcome of the naval engagement the British Gen. Prevost abandoned his attack on Plattsburg and retreated.

During 1814 the increasingly effective blockade together with an American embargo virtually put a stop to American sea-borne commerce, domestic and foreign, and consequently brought about widespread economic depression. The price of salt rose to $5 per bu., that of sugar to $26 per cwt., and specie reached a premium of 22%. Exports fell to a total of $7,000,000 as compared with $45,000,000 in 1811—a year of restricted commerce. Most of the American navy was forced to remain in port and the few ships which eluded the blockade found that the British system of convoying trade under naval escort substantially reduced captures. The most notable actions of the year were the previously mentioned loss of the U.S.S. "Essex," the capture of the British brigs "Reindeer" and "Avon" by the "Wasp," and the victory of the American brig "Peacock" over the "Epervier."

The stagnation of American commerce stimulated the employment of large numbers of merchant ships as privateers, and during the last six months of the war their operations constituted the principal American offensive on the sea. Many prizes were taken and the alarm created in British shipping circles increased insurance rates to double those prevailing during the Continental wars. This situation, together with the failure of the projected invasion of the United States through Lake Champlain, and post-war conditions in Europe, were the primary influences towards causing a British desire for peace, the treaty for which was signed at Ghent on Dec. 24, 1814.

Hostilities After Treaty.—The slowness of communications at that period was responsible for the continuation of hostilities for several months thereafter. Early in December the British military-naval expedition bent upon the capture of New Orleans landed on the Gulf coast at Lake Borgne. They advanced to the Mississippi river, where Gen. Jackson had erected entrenchments, which were supported by a naval squadron under Commodore Patterson. By successive stages the British got within three miles of the city; but on Jan. 8 their assault was decisively beaten with a loss of 2,000 troops, including Gens. Pakenham and Gibbs. The victory, though it occurred after the treaty of peace had been signed, had important consequences in further stimulating the American national spirit. In Jan. 1815 the frigate "President" attempted to gain the sea from New York harbour, but was captured by the blockading fleet. A few weeks previously the "Constitution" had succeeded in escaping out of Boston, and in February, while off Madeira, she captured the "Cyane" and "Levant" together. The final action of the war was the capture of the British sloop of war "Penguin" by the "Hornet" on March 23, 1815.

The British invasions of Michigan, Ohio and New York, which might have resulted in important territorial gains, failed by reason of naval defeats on the Lakes, and their threat against the

Louisiana territory was nullified at New Orleans. The issue of "free trade and sailor's rights" which caused the American declaration of war, did not gain recognition in the treaty of peace. It nevertheless became an established political doctrine to which the United States has since firmly adhered. The American attack on British commerce, except for the privateering operations, was on too small a scale to influence the course of the war. The frigate victories, incidental to commerce raiding, had little military effect, but may be regarded as important political successes, in view of their elevation of the national *morale* notwithstanding the widespread economic distress caused by the overpowering British blockade. To America the War of 1812 brought about a much needed national unification.

BIBLIOGRAPHY.—Capt. A. T. Mahan, *Sea Power in its Relations to the War of 1812,* a dispassionate and comprehensive account of the operations ashore and afloat, together with their political relationships. *See* also, T. Roosevelt, *The Naval War of 1812;* Huidekoper, *The Military Unpreparedness of the United States;* and C. P. Lucas, *The Canadian War of 1812* (Oxford, 1906).. (D. W. K.)

WAR OFFICE[1]. (*a*) The building which houses the controlling staff of the army, and (*b*) the controlling staff itself.

(*a*) As regards the local habitation of the staff, in Cromwellian days this was often in the field and was the tent of the secretary to the commander-in-chief whose official title was *Secretary-at-War.* After the Restoration (1660), Monk, as lord general, took up his residence at a house in Whitehall called the Cockpit (which had formerly been used for cock-fighting), and this became the headquarters of the army. Numerous warrants and letters of the early days of the present standing army are dated from "the Cockpit at Whitehall." About 1684 the headquarters were moved to the "Horse Guards," that is, the barracks of the King's Guards at Whitehall, and here it remained until 1856 when it moved to Buckingham House, Pall Mall. In 1907 it moved to its present quarters in Whitehall immediately opposite the Horse Guards.

(*b*) (i)[2] **From the Earliest Times to the Crimean War (1854–56).**—The details of the early administrative history of the army are very obscure. William the Conqueror created the offices of high constable and marshal and their duties appear to have been somewhat analogous to those of the present day adjutant-general and quartermaster-general.

Although the origin of the Board of Ordnance is obscure it was certainly in existence in the early part of the 14th century, and it is the oldest military office with a continuous history. Charles II created the title master-general of ordnance in 1664 and this still survives. The headquarters of the Board were for centuries at the Tower of London. In 1855 the Letters Patent for the Board were revoked and its duties vested in the *Secretary of State for War.* In the 18th century, the office of master-general of the ordnance was held by the chief military leaders and generally carried with it cabinet rank. Marlborough was twice master-general of ordnance.

The office of Secretary of State for War appears to have had its origin in a *Council of War* of Charles I. During the Cromwellian period the army was managed by a *Parliamentary Committee of the Army.* The clerk to Charles' Council was the *Secretary-at-War* and he had a counterpart in the New Model. After the Restoration he became *Secretary-at-War to all the Forces in England and Wales,* and was in fact nothing more than the private secretary of the commander-in-chief. When Monk (duke of Albemarle) died in 1670 the office of *Secretary-at-War* grew in importance, owing to the fact that Charles II did not appoint a successor as commander-in-chief. Gradually the office became separated from that of the commander-in-chief, arriving at complete divorcement in 1704, when the office became a political post. In 1794 was created a new post, the *Secretary of State for War,* and in 1801, because the armies were largely employed in the West Indies, the direction of Colonial affairs was transferred from the Home Office to the Secretary of State for War who became *Secretary of State for War and the Colonies.* In 1855 the office of *Secretary-at-War* was merged into that of the *Secretary of State,* but it was not finally abolished until 1863.

The office of the Deputy Secretary-at-War appears to have been created at least before the 18th century. The holder of the appointment was the senior permanent official in the department of the Secretary-at-War. When the departments of the Secretary of State and Secretary-at-War were amalgamated the post was abolished and in its place that of *Permanent Under Secretary of State* created. In 1904 the title was changed to "Secretary of the War Office," but reverted to "Permanent Under Secretary of State" in 1924.

The office of the Commander-in-Chief dates back to the Restoration. At various times the title has been Captain General, Generalissimo, General on the Staff and Lord General. The first holder of the appointment was the duke of Albemarle whose special charge was the care of men while the Board of Ordnance looked after the material. In the 17th century when the C.-in-C. was on foreign service, many of his duties were usurped by the Secretary-at-War.

The office of Adjutant General to the Forces originated in the Parliamentary Army. After the Restoration the first appointment was made in 1673. From 1685 there has been a continuous line of Adjutants-General.

The Quartermaster General first appeared in 1686. Previous to this his duties had been carried out by the Provost Marshal, Scout Master General and the Harbinger.

An important office in army administration was that of *Commissary-General of Musters.* His chief duty was to keep up the establishment and to issue a certificate to the Paymaster-General for the actual number of men serving. The office was established just after the Restoration and abolished in 1818.

At the outset of the standing army the *medical service* was entirely regimental, but in 1663 was initiated central control which gradually developed into a directorate in the early part of the 19th century. Originally the provision of barracks was the business of the Board of Ordnance, but the need for extensive building in 1793 was responsible for the creation of the office of *Barrack-Master-General.* This office was, however, abolished in 1822 and the Board of Ordnance once more assumed the duty of providing and furnishing barracks.

In 1714 was constituted a *Board of General Officers* whose duty was to settle all financial disputes between colonels, officers and soldiers, and matters of precedence among regiments. With the creation of the Commander-in-Chief's office in 1793, the Board was shorn of much of its power which was now practically confined to matters concerning clothing. The secretary of the Board was the Judge-Advocate-General.

(ii.) **From the Crimean War, 1854, to Aug. 1914.**—Military administration underwent great changes during the period following the outbreak of the Crimean War. The duties of the *Secretary of State for War* were divorced from those of the Colonies: the Commissariat Office was transferred to the War Department; the office of *Secretary-at-War* was merged into that of the Secretary of State; the Board of General Officers and the Medical Department were absorbed by the War Department, and the War Department now became known as the *War Office.*

The military control still remained in the hands of the Commander-in-Chief, while the Secretary of State was responsible to Parliament. However, under the War Office Act (1870) the final welding was effected and the Secretary of State became responsible for every branch of military administration.

The next great change took place in 1904 by the creation of the *Army Council* by Letters Patent, consisting of four military and three civil members and a secretary. The President of the Army Council is the Secretary of State for War; the Chief of the Imperial General Staff is the 1st military member, the Adjutant-General the 2nd, the Quartermaster-General the 3rd and the Master General of Ordnance the 4th. The other civil members are the Parliamentary Under-Secretary of State for War (vice-president of the Council), the Financial Secretary of the War Office (finance member) and the Permanent Under-Secretary of State for War is the secretary of the Council. The creation of the Army Council abolished the office of the Commander-in-Chief.

[1]The permission of the Controller of H.M. Stationery Office has been obtained to the inclusion of this article.

[2]Based on information contained in *The War Office List,* 1927.

The creation of the Territorial Force in 1908 led to the creation of a Director-General of the Territorial Force.

(iii.) **From the Outbreak of World War I, Aug. 1914, to the Armistice, Nov. 11, 1918.**—The rapid expansion of the forces and their requirements and consequential effects of all kinds brought into being four separate ministries, viz., the Ministry of Munitions, Ministry of Pensions, Air Ministry and Ministry of National Service. The latter took over from the Adjutant-General the duty of recruiting for the army.

During the war the Army Council was increased by the following members:—*Military*—Deputy Chief of the Imperial General Staff, Director-General of Military Aeronautics (who ceased to be a member on the creation of the Air Ministry) and the Permanent British Military Representative at the Supreme War Council, Versailles: *Civil*—the Director-General of Movements and Railways and the Surveyor-General of Supply.

(iv.) **After the Armistice.**—The cessation of hostilities and eventual peace, while causing a cessation of activity in certain directions connected with fighting, created activity in matters connected with demobilization, disposal of prisoners of war, issue of medals, repatriation, and everything to do with casualties. To meet the needs of the times the War Office organization was constantly adjusted. The most important change that has taken place is the transfer to the Master-General of Ordnance from the Quartermaster-General all matters connected with research, experiment, design, manufacture, etc., relating to stores, including mechanically propelled vehicles of almost all kinds.

The corresponding government department in the U.S. is the War Department, a description of which will be found under GOVERNMENT DEPARTMENTS, section *United States*.

(T. J. E.)

WAR ORGANIZATIONS, U.S. (WORLD WAR II).

Although the United States had materially increased its expenditures for national defense after the outbreak of World War II (from $1,579,905,000 in the fiscal year 1939–40 to $6,301,043,000 in 1940-41), it was not until after Germany's decisive victories in the Low Countries and France that the danger to the country became apparent. Certain quasi-official agencies such as the short-lived War Resources board had been set up or planned in the fall of 1939 to deal with problems of defense, but they lacked co-ordination and executive power. Not until May 28, 1940, when the British were evacuating Dunkirk, did the first full-dress defense agency come into being—the Council of National Defense, patterned somewhat after President Wilson's council of World War I. To this council President Roosevelt named the secretaries of war, navy, interior, agriculture, commerce and labour. He also established an advisory commission to the council, with the following seven divisions: industrial production, industrial materials, employment, farm products, transportation, price stabilization and consumer protection. William S. Knudsen, who was appointed commissioner of the division of industrial production, was generally considered (in the nation's press at least) as the "head" of the advisory commission.

A great number of defense agencies followed the creation of the Council of National Defense, which itself hardly outlasted the year 1940 before relinquishing most of its powers and duties to the Office of Production Management, which in its turn was succeeded by the War Production board. The present article is concerned with the more important of the various defense agencies created after 1939 and the purposes and activities of each.

OFFICE FOR EMERGENCY MANAGEMENT

The OEM was established by an administrative order issued May 25, 1940, to function within the executive office of the president created under the reorganization act of Sept. 1939. The purpose of the OEM was twofold: (1) to act as a clearing agency for all information relating to national defense; (2) to provide a liaison between the president and the various defense agencies. On Jan. 7, 1941, its status was further defined as an office which was to assist the president in the discharge of all executive duties in connection with the national emergency. On Feb. 28, 1941, all funds of the advisory commission to the Council of National Defense were allocated to the OEM, which became a sort of "holding company" for the most important agencies of national defense. The following agencies were component parts of the OEM in 1942: Office of Civilian Defense; Defense Communications board; National War Labor board; Office of Price Administration; War Production board; Office of Scientific Research and Development; Board of Economic Warfare; Office of Lend-Lease Administration; Office of Defense Health and Welfare Services; Transportation Division; Division of Defense Housing Co-ordination; Office of the Co-ordinator of Inter-American Affairs; Office of Agricultural Defense Relations; Co-ordinator of Information; Office of Export Control; and the Permanent Joint Board on Defense (U.S. and Canada).

W. H. McReynolds, one of the six assistants in the executive office of the president, was the first liaison officer in charge of OEM, but in April 1941, he was succeeded by Wayne Coy.

OFFICE OF PRODUCTION MANAGEMENT

The Office of Production Management was established Jan. 7, 1941, by President Roosevelt as the principal instrumentality for effecting a speedy production of weapons for defense. William S. Knudsen, General Motors executive, was appointed director general, and Sidney Hillman, labour leader, was named associate director general.

Originally organized in three divisions—production, priorities and purchases—the OPM later added a labour division to deal with this aspect of national defense.

As the defense program grew and the need for speed in production became imperative, the OPM was reorganized to centralize and simplify its procedures. Commodity sections were first set up, but with the creation of the Supply Priorities and Allocations board Aug. 28, 1941, industrial branches were substituted. The order that established SPAB also gave OPM broader powers.

The 30 industrial branches thus created were allocated among four of the seven OPM divisions for administrative supervision. These were (1) the production division, (2) the purchases division, (3) the materials division, (4) the priorities division, which really had no branches but assigned specialists to each branch that had priority problems.

Among other OPM divisions, the contract distribution section was set up to spread defense orders and thus help industries affected by priority restrictions; this "subcontracting" was also designed to speed the conversion of such industries to defense work. The labour division was established to handle the many labour problems incident to creation of a wartime economy, and the bureau of industrial conservation worked closely with any or all OPM divisions to turn waste into useful production channels.

When Harry Hopkins returned from a four-week trip to England early in 1941 as President Roosevelt's personal emissary and said that Britain was in desperate need of munitions and supplies, OPM was already under way as a functioning organization. In response to Britain's plea, the lend-lease bill was signed March 11, 1941, and the United States added another huge task to its already great defense effort—that of becoming "the arsenal of democracy." Responsibility for the successful completion of this task resided largely in the OPM. The building of factories, retooling of existing plants for new production uses, the provision of adequate raw materials, the priority listing of scarce metals and materials—all such day-to-day problems were handled by OPM.

This new large-scale manufacture of war weapons created many dislocations in civilian life. Families moved to new industrial centres. The price structure underwent strains as equitable wage levels were sought. Wage earners had to be protected against profiteering at the same time that production was being forced to new highs. Employer-labour disputes had to be held to a minimum and settled swiftly.

Some of the dislocations that the U.S. wartime efforts created showed up in Feb. 1941, when the demand for aluminum for plane production became so great that OPM was compelled to place the metal on the priority list. Subsequently OPM placed priority bans on a host of other metals and materials needed for arms. As

a result, defense production soared. In June 1941 the United States produced 1,476 military planes; two months later this figure jumped to 1,854.

On Oct. 1, 1941, the United States and Britain agreed to back the Russian war against Germany with supplies. The main burden of producing more war weapons fell on the U.S., and OPM had to devise ways and means to squeeze still another notch from the nation's straining economic machine.

After the Pearl Harbor attack drew the United States into the war, congress passed a $10,500,000,000 bill providing funds for new army and navy defenses, and at the same time the navy department asked congress for authorization to build 165 new warships. Prior to the outbreak of war in the Pacific, industrial production in the United States surpassed even 1929 records; and unemployment, except in cases of temporary dislocations caused by conversions of peacetime factories into wartime plants, was becoming a memory of the past. But OPM was now preparing to throw the complete industrial resources of the United States into an all-out war effort. The earlier "business as usual" attitude of U.S. industry went by the boards, and OPM, acting in conjunction with the Office of Price Administration, moved to take over almost complete control of the U.S. economy. On Dec. 26, 1941, the OPA placed new tires under permanent rationing to conserve rubber for military use, and on Jan. 2, 1942, all motor car production for civilian use was halted "for the duration."

Criticism of the OPM was as varied as the many special interest groups from whom it came. Labour charged that OPM exercised too little control over big business interests; capital charged that it exercised too much control; small business groups complained that they were being "squeezed out" of the defense contract picture. But one fact was frequently lost sight of in the welter of complaint and criticism: that the OPM was purely a consultative and administrative body, lacking decisive powers of action. Virtually all the agencies set up by the president to meet U.S. defense needs were organized with the idea in mind of better utilizing already existing agencies within the government. Thus, the OPM, although charged with the responsibility of facilitating and implementing the production of war and defense materials, had no power to place contracts. All contracts were let by the army or navy or similar governmental agencies. This serious hiatus between plan and achievement was a principal point of criticism.

The Office of Production Management was abolished by Donald M. Nelson, chairman of the War Production board, on Jan. 21, 1942. At that time the WPB assumed all its funds, duties and staff. (X.)

SUPPLY PRIORITIES AND ALLOCATIONS BOARD

The Supply Priorities and Allocations board was set up by President Roosevelt Aug. 28, 1941, "in order to assure unity of policy and co-ordinated consideration of all relevant factors involved in the supply and allocation of materials and commodities among the various phases of the defense program and competing civilian demands." In the executive order which called the board into being, the duties of the board were outlined in this manner:

> Consistent with the basic defense policies of the president, the Supply Priorities and Allocations board shall:
> (a) Determine the total requirements of materials and commodities needed respectively for defense, civilian and all other purposes; establish policies for the fulfilment of such requirements, and, where necessary, make recommendations to the president relative thereto.
> (b) Determine policies and make regulations governing allocations and priorities with respect to the procurement, production, transmission or transportation of materials, articles, power, fuel and other commodities among military, economic defense, defense aid, civilian and other major demands of the total defense program.

The executive order named the membership of the board as follows: Vice-President Henry A. Wallace, chairman; William S. Knudsen and Sidney Hillman, respectively director general and associate director general of the Office of Production Management; Secretary of War Henry L. Stimson; Secretary of Navy Frank Knox; Leon Henderson, head of the Office of Price Administration and director of the division of civilian supply in OPM; and Harry L. Hopkins, special assistant to the president. Donald M. Nelson was named executive director of the board.

At its first meeting, SPAB laid down for the national economy a general policy of "cutting off the fat and hardening the muscles," and stated that "production shall be stimulated and organized to the limit of the nation's resources." In subsequent meetings the board adopted a series of policy declarations designed to make the nation's defense effort effective. It ruled, for example, that expansion of productive capacity to meet purely civilian demand could not be undertaken if the expansion would require large quantities of critical defense materials; it called on military and civilian defense authorities for estimates of military and civilian requirements as far in advance as possible; it directed that every effort be made to expand domestic production of all critical materials; it denied priority applications for material to build an oil pipe line from Texas to New York, holding that the materials involved were more greatly needed in other phases of the defense effort; and it undertook to provide the needed equipment to make possible expanded production of dairy products.

On Oct. 9, 1941, SPAB announced one of its broadest policy decisions, ruling that priorities assistance thereafter could not be granted for any public or private building construction project which was neither essential to national defense nor necessary for the public health and safety.

Subsequently, the board approved OPM proposals for a 10,000,000-ton expansion in steel production capacity and directed OPM to develop an allocation system for steel. It followed that action by calling on OPM to obtain detailed production programs, industry by industry, to the end that the most vitally needed materials could be distributed through an allocation program rather than through the system of issuing priority ratings.

At the request of the Economic Defense board (later the Board of Economic Warfare), SPAB on Dec. 2, 1941, agreed to do everything feasible in order to make possible the delivery of 218,600 tons of tin plate to other republics in the western hemisphere. Shortly thereafter it extended the principle set forth in the building construction policy to the fields of public and private electric power, holding in substance that no new projects should be undertaken unless they could be shown to be essential either for national defense or for the public health and safety, and that both public and private power bodies should be treated alike during the national emergency.

Disturbed by increasing reports of inadequate efforts to get the greatest possible production of copper, SPAB early in Dec. 1941 directed OPM to hold an inquiry on the subject and to submit to SPAB a report summarizing all suggestions regarding methods of increasing production.

On the day that the United States declared war on Japan, SPAB called for "a vastly expanded national effort" and laid down the rule that the nation must strive for "the greatest production which is physically possible." It followed this action immediately by making an extensive survey of all critical raw materials coming from the Pacific area, and by setting in motion a program designed to ensure adequate military production even in case further shipments of such materials should be cut off by enemy action. On Dec. 26, 1941, the sale of new tires for pleasure cars was prohibited by the Office of Price Administration, to conserve the nation's supply of rubber.

SPAB was set up as a policy-making body rather than as an administrative agency. In general, its activity took the line of setting broad policies to be followed by OPM and other defense agencies; of charting the course by which actions affecting production and supply were to be taken, and of stating principles to guide the civilian phase of the defense effort.

The board was dissolved by the executive order of Jan. 16, 1942, which set up the War Production board. (D. M. N.)

WAR PRODUCTION BOARD

By executive order of Jan. 16, 1942, President Roosevelt established the War Production board, with Donald M. Nelson as chairman. The order defined the duties and prerogatives of the chair-

man as follows: (1) to "exercise general direction over the war procurement and production program"; (2) to "determine the policies, plans . . . and methods of the several federal departments . . . in respect to war procurement and production . . ."; (3) to take over the functions of the Supply Priorities and Allocations board, which was abolished by the order, and (4) to supervise the OPM. The latter board was abolished by Nelson Jan. 21, and its functions and personnel were incorporated into the new WPB. On the same day Nelson announced the organization and executive personnel of the new board. Serving with the chairman on the general board were Henry A. Wallace, William S. Knudsen, Sidney Hillman, Leon Henderson, Harry L. Hopkins, Jesse H. Jones, Henry L. Stimson and Frank Knox. Six main divisions were set up, as follows: the purchases division, headed by Douglas MacKeachie; the production division, headed by W. H. Harrison; the materials division, headed by William L. Batt, Sr.; the division of industry operations, headed by J. S. Knowlson; the labour division, headed by Sidney Hillman; and the civilian supply division, headed by Leon Henderson. In addition, Nelson provided in his organization for a planning committee, a requirements committee, a progress-reporting committee, a statistics division, a legal division, an administrative division and an information division. Further, he appointed Ernest C. Kanzler to supervise the conversion of the motor car industry into arms production.

President Roosevelt announced that Nelson's decisions on all matters pertaining to production and procurement of U.S. war supplies would be final. An indication that Nelson did in fact receive plenary powers was the decision of the White House to let the new chairman plan his own organization and select its personnel. The greatest criticism of the OPM and the defense agencies generally, prior to the creation of the WPB, was that there was too much division of authority and too much duplication of functions. President Roosevelt recognized and met this criticism by giving Nelson the same control that Bernard Baruch exercised in the War Industries board during World War I. (X.)

OFFICE OF PRICE ADMINISTRATION

The Office of Price Administration (previously called the Office of Price Administration and Civilian Supply) was created by executive order of the president issued April 11, 1941. The agency combined into one organization the activities previously carried out by the commissioners in charge respectively of price stabilization and consumer protection in the advisory commission to the Council of National Defense.

The Office of Price Administration was charged in the executive order creating the agency with the task of taking "all lawful steps necessary or appropriate in order to prevent price spiralling, rising costs of living, profiteering and inflation resulting from market conditions caused by the diversion of large segments of the nation's resources to the defense program, by interruptions to normal sources of supply, or by other influences growing out of the emergency." In addition the OPA was given responsibility, through the consumer division, for seeing that the standard of living was maintained on the highest possible level consistent with military defense requirements.

Leon Henderson was appointed administrator by the president. Under the administrator was placed a deputy administrator. Under the latter was the director of the price division, a deputy director in charge of the consumer division and the general counsel. The price division was composed of 14 commodity sections, each headed by a price executive in charge of price work for the commodities in his section, a research division and a division of accounting, analysis and review. The commodity sections included the following: consumers' durable goods; industrial and agricultural machinery; copper and brass; chemicals, drugs and paints; rubber and rubber products; paper and paper products; automobiles and trucks; textiles, leather goods and apparel; food and food products; fuel; lumber and building materials; zinc, lead and tin; and steel, iron, and steel products. There was also a section which handled rent problems. The consumer division operated through three separate sections dealing respectively with consumer relations, consumer standards and needs and consumer publications.

Price actions by OPA fell into the following general classifications: warnings concerning unjustified price increases, informal agreements with individual concerns regarding prices they charged for their products; letters to individual concerns asking them not to charge prices higher than those prevailing on specified dates; and formal price schedules establishing maximums which might be charged for commodities covered in the schedule. It was the practice of the agency to hold frequent conferences with representatives of companies whose prices were under consideration, and in a number of cases industry panels were created composed of representatives from various concerns in the industry to meet with OPA officials to give advice in working out details of price schedules or other proposed action.

There were 60 price schedules issued as of Dec. 23, 1941, of which two were revoked.

Two orders issued by the OPA after the outbreak of war with Japan had immediate effect upon U.S. consumers. The sale of new automobile tires was stopped Dec. 26, 1941, and rationing of all rubber products began Jan. 4, 1942. Civilian consumption of rubber was cut by an estimated 80% under the rationing plan. On Jan. 2, 1942, the OPA announced that all production of automobiles in the United States would stop after Jan. 31. Sales of new cars were prohibited after Jan. 1. (L. HN.; X.)

OFFICE OF SCIENTIFIC RESEARCH AND DEVELOPMENT

The Office of Scientific Research and Development (OSRD) was created in the Office for Emergency Management by executive order of June 28, 1941. Dr. Vannevar Bush of the Carnegie Institution of Washington was appointed director. The functions of the office were defined as follows:

(1) Advise the president with regard to the status of U.S. scientific and medical research relating to national defense and the measures necessary to assure continued and increasing progress in this field.

(2) Serve as the centre for the mobilization of U.S. scientific personnel and resources in order to assure maximum utilization of such personnel and resources in developing and applying the results to defense purposes.

(3) Co-ordinate, aid and, where desirable, supplement the experimental and other scientific and medical research activities relating to national defense carried on by the departments of war and navy and other departments and agencies of the federal government.

(4) Develop broad and co-ordinated plans for the conduct of scientific research in the defense program, in collaboration with representatives of the war and navy departments; review scientific research programs formulated by the departments of war and navy and other agencies of the government, and advise them with respect to the relationship of their proposed activities to the total research program.

(5) Initiate and support scientific research on the mechanisms and devices of warfare with the objective of creating, developing and improving instrumentalities, methods and materials required for national defense.

(6) Initiate and support scientific research on medical problems affecting national defense.

(7) Initiate and support such scientific and medical research as might be requested by the government of any country whose defense the president deemed vital to the defense of the United States under the terms of the act of March 11, 1941, entitled "An Act to Promote the Defense of the United States"; and serve as the central liaison office for the conduct of such scientific and medical research for such countries.

(8) Perform such other duties relating to scientific and medical research and development as the president might from time to time assign or delegate to it.

Within the OSRD were incorporated the National Defense Research committee (NDRC) and the Committee on Medical Research (CMR), the former to assist the director of the OSRD in the mobilization of the scientific personnel and resources of the U.S. and the latter to advise and assist with special reference to the medical personnel and resources of the U.S. The NDRC operated as a committee of the Council of National Defense from June 27, 1940, until June 28, 1941, during which time it entered into a number of contracts which were assumed by the OSRD.

The OSRD operated through contracts with scientific laboratories in academic and industrial establishments. As of Dec. 31, 1941, the OSRD had concluded 424 contracts, while work was actively under way under approximately 264 additional letters of intention for which covering contracts were in the process

of negotiation. These contracts and authorizations were with a total of 73 academic and 55 industrial establishments. Most of the work of the OSRD was started at the direct request of the armed services. Practically all of it was of a confidential nature. Between June 27, 1940, and Dec. 31, 1941, the OSRD and its predecessor, NDRC, had received a total of $25,702,536 to be used in carrying out its objectives. (I. ST.)

BOARD OF ECONOMIC WARFARE

The Board of Economic Warfare was established under the name of Economic Defense board by President Roosevelt, in an executive order dated July 20, 1941, for the purpose of developing and co-ordinating policies and programs intended to strengthen the international economic relations of the United States.

Vice-President Henry A. Wallace was made chairman of the board, and the secretaries of state, treasury and war, the attorney-general, and the secretaries of the navy, agriculture and commerce were also named in the initial order as members. The chairman was authorized to appoint other members, and each member was authorized to designate an alternate. Other departments and agencies of the government were directed to designate officers to represent the department or agency in its continuing relationships with the board.

As defined in the executive order, the functions and duties of the board were to advise the president on essential economic defense measures; to co-ordinate the policies and actions of the several departments and agencies carrying on activities relating to economic defense; and to develop integrated economic defense plans and programs for co-ordinated action by the departments and agencies concerned. The board also began immediate investigations of the relationship of economic defense measures to postwar economic reconstruction. Soon after being formed, the board named Milo Perkins as executive director.

The first move for expansion of the board's authority came on Sept. 15, 1941, when the president signed an executive order placing the Office of Export Control under the then Economic Defense board. Brigadier General R. L. Maxwell, who had been administrator of export control, was assigned to duty in the war department.

The executive order of Sept. 15 also designated the board as the agency to obtain, develop and determine over-all estimates of materials and commodities required for export purposes in the interest of the economic defense of the United States, exclusive of lend-lease operations.

When the Office of Export Control came under the Economic Defense board, the division of controls of the department of state was also put under the board as the commodity licensing division of the Office of Export Control.

One of the activities carried on by the Office of Export Control had been a clearing service, to which exporters, manufacturers and foreign importers submitted proposals for the export of materials and commodities. This service was reorganized under the board to expedite such clearances through the several federal agencies concerned with the control of exports and related financial transactions.

Another responsibility was given to the board in the executive order of Oct. 28, 1941, which established the Office of Lend-Lease Administration and authorized the administrator to make appropriate arrangements with the then Economic Defense board for the review and clearance of lend-lease transactions which affected the economic defense of the United States.

In recognition of the growing importance of the government's economic program in the western hemisphere, the vice-president announced on Nov. 22, 1941, that, with the approval of the president, he had appointed the co-ordinator of Inter-American Affairs as a member of the then Economic Defense board. At the same time the board began a reorganization of its units into four regional divisions under the direction of a chief of operations, Lieut.-Col. Royal B. Lord. The divisions were: the European and African, of which Morris S. Rosenthal was appointed chief; the far eastern, with Charles B. Rayner, chief; the British empire, with William F. Stone, chief; and the American hemisphere, with Carl B. Spaeth, chief. The combined personnel of the commercial and financial division of the co-ordinator's office and the divisions of the board engaged in western hemisphere matters became the American hemisphere division of the board.

Subsequently, the facilities of the tariff commission and the bureau of foreign and domestic commerce of the department of commerce were placed at the service of the board for the duration of the war.

The title of the board was changed from the Economic Defense board to the Board of Economic Warfare, by executive order, on Dec. 17, 1941.

A total embargo on exports to Japan and its occupied territories, by revoking all licences for the shipment of U.S. goods to those countries and to all Japanese nationals anywhere in the world, was established immediately following the attack on the United States by the Japanese armed forces. Export control was extended, as of Dec. 23, 1941, to cover all articles and materials not previously brought under control. Even before that date, approximately 90% of all U.S.-produced commodities was under licensing regulations.

Continued flow of articles and materials to American republics and other friendly destinations under broad general licences was encouraged under policies of the board. (H. A. WAL.)

OFFICE OF LEND-LEASE ADMINISTRATION

The lend-lease act was enacted by the U.S. congress March 11, 1941, after it had been recognized that the countries resisting aggression were fighting potential enemies of the U.S.A. Thus the lend-lease act established the principle that the United States should be the arsenal of the democracies. From the passage of the bill until May 2, 1941, operations were carried on by the staff of the president's liaison committee, headed by Major General James H. Burns. This committee had been created by the president Dec. 6, 1939, to co-ordinate foreign and domestic military purchases. It was formally dissolved April 15, 1941.

On May 2, 1941, President Roosevelt issued an executive order establishing the Division of Defense Aid Reports within the Office for Emergency Management of the executive office of the president. Major General James H. Burns was designated executive officer of the division, assisted by the former staff of the president's liaison committee. The Division of Defense Aid Reports was set up to provide a single channel for the clearance of actions and reports under the lend-lease act, for the co-ordination of the processing of requests for aid under the act and for maintenance of a system of reports and accounts approved by the bureau of the budget. It was also instructed to serve as a clearing house of information for agencies participating in the lend-lease program, and as a central point to which all representatives of foreign governments requesting lend-lease aid should bring applications.

In due course, the need for broadening of the central administrative office's function and responsibilities became apparent, and, by executive order issued Oct. 28, 1941, the Division of Defense Aid Reports was dissolved, and the Office of Lend-Lease Administration was created, with E. R. Stettinius, Jr., as its head. The lend-lease administrator was formally charged with responsibility for making allocations, transfers and retransfers, and for exercising any power or authority conferred upon the president under the lend-lease act. He was made primarily responsible for co-ordinating and expediting the procurement and delivery of lend-lease goods and services.

Actual purchasing operations under the act were not to be a function of the central administrative office, but rather of the various government agencies best qualified to do each specific job. The Office of Lend-Lease Administration worked very closely with each of the procurement agencies—war, navy, maritime commission, treasury (procurement division) and the department of agriculture—in determining whether items formally requested by foreign governments were lend-leasable. If a requisition for an item was approved as part of a previously agreed-upon program, an allocation of funds was made, and the procurement was then undertaken by the department concerned in accordance with

its normal procurement procedure. The necessary priorities and transportation problems were worked out with the assistance of specialists in these various fields. The transfer and export of any lend-lease material was normally authorized by the lend-lease administrator at the same time as its procurement.

The lend-lease act provided that the president should report to congress every 90 days on operations under the act.

To the end of 1941, two appropriations had been made by congress specifically for lend-lease purposes, the first on March 27, 1941, in the amount of $7,000,000,000, and the second on Oct. 28, 1941, in the amount of $5,985,000,000—a total of $12,985,000,000. As of Nov. 30, out of these appropriations, 61% or $9,186,000,000 had been allocated to the procuring agencies for specific projects. As of the same date, these agencies had obligated 57% of their allocated amounts, or a total of $5,243,000,000. Total aid rendered under the lend-lease act during the same period amounted to approximately $1,202,000,000. This figure included $723,000,000 of defense articles transferred to foreign governments, $140,000,000 of defense articles awaiting such transfer or use by foreign governments, $92,000,000 of articles in process, $79,000,000 for testing and reconditioning of merchant and naval vessels, $75,000,000 for expansion of lend-lease production facilities and $92,000,000 for transportation of defense articles to combat areas.

Countries in the lend-lease area at the end of 1941 included:

Argentina	Egypt	Nicaragua
Bolivia	El Salvador	Norway
Brazil	Free Belgium	Panama
British Empire	Free France	Paraguay
Chile	Greece	Peru
China	Guatemala	Poland
Colombia	Haiti	Russia
Costa Rica	Honduras	Turkey
Cuba	Iceland	Uruguay
Dominican Republic	Mexico	Venezuela
Ecuador	The Netherlands	Yugoslavia

The Office of Lend-Lease Administration also was given the responsibility of using lend-lease machinery in the handling of requisitions of foreign countries for the purchase of specific items on a "cash reimbursement" basis. This procedure provided for the procurement of an item in precisely the same way as that used for other lend-lease operations, with the exception that the foreign government deposited cash with the United States treasury against the value of the goods to be purchased, before delivery. As of Nov. 30, 1941, various foreign governments had made such deposits in a total amount of $8,420,124.

As a third function, the lend-lease office assisted foreign governments in the lend-lease area in making direct cash contracts with U.S. suppliers for the purchase of defense articles and in expediting deliveries.

Funds provided under lend-lease permitted China to make improvements on the Burma road to increase the traffic capacity of that artery appreciably. Many hundred British merchant and naval ships were repaired, refitted and supplied with stores from U.S. shipyards. U.S. armament in the form of aircraft, tanks and guns was shipped in large quantities to the middle east, while shiploads of food went to the British Isles for maintenance of civilian health and morale. Special lend-lease representatives in Great Britain, U.S.S.R., China, Iceland, Iran, North Africa and Egypt maintained close supervision of the disposal and use of lend-lease material. (E. R. Ss.)

DEFENSE COMMUNICATIONS BOARD

The Defense Communications board, created by President Roosevelt in 1940, co-ordinated plans to utilize and safeguard U.S. radio and wire services under any emergency. A planning agency without operating or procurement functions, the board comprised representatives of various federal departments and agencies concerned with electrical communications. Its members included the chairman of the Federal Communications commission, the assistant secretary of the treasury in charge of the coast guard, the chief signal officer of the army, the director of naval communications and the assistant secretary of state in charge of the division of international communications. Advising the board were committees representative of labour, industry, amateurs, aviation, cable, domestic broadcasting, international broadcasting, radio communications, telegraph, telephone and government, state and municipal facilities, with civilian defense and priorities liaison committees.

NATIONAL WAR LABOR BOARD

The National War Labor board was created as the National Defense Mediation board by U.S. executive order March 19, 1941, to adjust labour disputes in defense industries. Three steps were set forth for the board to follow in settling these controversies: (1) collective bargaining between the parties before the board; (2) if that failed, voluntary arbitration; and (3) if both of these failed, findings of fact and recommendations, which might be made public. Disputes were to reach the board only through certification by the secretary of labour, after the United States Conciliation service had been unable to settle them.

The board was originally composed of 11 members—four management, four labour and three public. Labour's representation was equally divided between the American Federation of Labor and the Congress of Industrial Organizations. As the pressure of work increased, alternates from all three groups were added to the board. The first chairman, C. A. Dykstra, was succeeded July 1, 1941, by William H. Davis. Cases were heard by panels of the board, representing the three groups, which had the same authority as the full board.

Starting with a large backlog of unsettled defense strikes, the board gradually acquired the confidence of labour and management in its ability to settle disputes, so that it was able to postpone threatened strikes or bring an end to existing strikes merely by promising the parties a swift and impartial adjustment of the controversy. This voluntary method was working so well by the close of 1941 that during the whole month of December there was not a single stoppage of production in any of the 30-odd cases, involving nearly 350,000 men, still awaiting settlement.

Shortly after the United States declared war on the axis powers in Dec. 1941, a national conference of labour and management, convened by the president Dec. 23, 1941, agreed to settle disputes for the duration without resort to strikes or lock-outs, and recommended the setting up of machinery for peaceful settlement.

The National Defense Mediation board was abolished by President Roosevelt Jan. 12, 1942, and all its duties, records, funds and employees were transferred to the National War Labor board created by executive order on that day with William H. Davis as chairman and with 12 members representing industry, labour and the public. (X.)

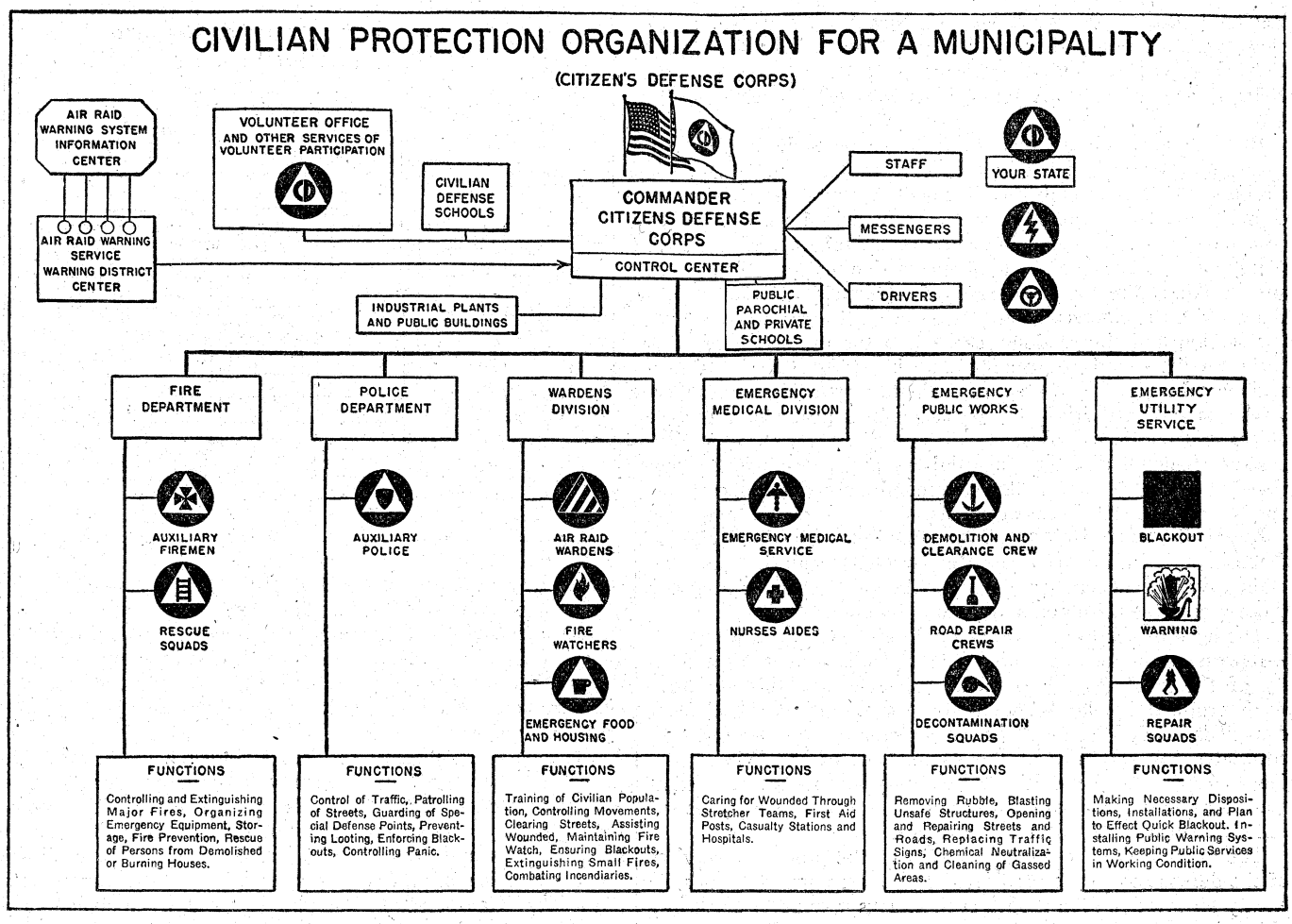
OFFICE OF CIVILIAN DEFENSE

The U.S. Office of Civilian Defense was established by executive order of the president on May 20, 1941 as a part of the Office for Emergency Management of the executive office of the president. The order stated the purpose of the office as follows: "to assure effective co-ordination of federal relations with state and local governments engaged in defense activities, to provide for necessary co-operation with state and local governments in respect to measures for adequate protection of the civilian population in emergency periods, to facilitate constructive civilian participation in the defense program, and to sustain national morale . . ."

Duties and responsibilities of the director were outlined in the order as follows:

(1) Serve as the centre for the co-ordination of federal civilian defense activities which involve relationships between the federal government and state and local governments, territories insular possessions, and the District of Columbia (the term "state and local" shall include territories, insular possessions, and the District of Columbia); establish and maintain contact with state and local governments and their defense agencies; and facilitate relationships between such units of government and the agencies of the federal government in respect to defense problems.

(2) Keep informed of problems which arise from the impact of the industrial and military defense effort upon local communities and take necessary steps to secure the co-operation of appropriate federal departments and agencies in dealing with such problems and in meet-



ing the emergency needs of such communities.

(3) Assist state and local governments in the establishment of state and local defense councils or other agencies designed to co-ordinate civilian defense activities.

(4) With the assistance of the Board for Civilian Protection, study and plan measures designed to afford adequate protection of life and property in the event of emergency; and sponsor and carry out such civil defense programs, including the recruitment and training of civilian auxiliaries, and disseminate to appropriate officials of the federal government and state and local governments such information concerning civil defense measures as may be necessary to meet emergency needs.

(5) With the assistance of the Volunteer Participation committee, consider proposals, suggest plans and promote activities designed to sustain the national morale and to provide opportunities for constructive civilian participation in the defense program; review and approve all civilian defense programs of federal departments and agencies involving the use of volunteer services in order to assure unity and balance in the application of such programs; and assist state and local defense councils or other agencies in the organization of volunteer service units and in the development of their activities.

(6) Maintain a clearing house of information on state and local defense activities in co-operation with appropriate federal departments and agencies.

(7) Review existing or proposed measures relating to or affecting state and local defense activities and recommend such additional measures as may be necessary or desirable to assure adequate civilian defense.

(8) Perform such other duties relating to participation in the defense program by state and local agencies as the president may from time to time prescribe.

Mayor Fiorello H. La Guardia of New York city was appointed first director of the OCD May 22, 1941 On Jan. 9, 1942, Dean James M. Landis of the Harvard Law school, and then regional director of the 1st civilian defense region, was appointed OCD executive. On the resignation of Mayor La Guardia, Feb. 10, 1942, Dean Landis was appointed director by the president.

While the OCD was under civilian direction, its administrative staff had a heavy complement of army and navy officers, and representatives of the U.S. Public Health service. Major divisions of the office included the Civilian Protection program, the Plant Protection program, the Emergency Medical services and the Division of Civilian Mobilization.

Organization of OCD.—Under the executive order establishing the Office of Civilian Defense the office exercises broad advisory and co-ordinating powers but is restricted in its mandatory and administrative functions. At the state and local levels it operates by agreement with officials, agencies and volunteer groups carrying on civilian defense activities within municipal, county or state areas.

Since, however, an enemy does not recognize political boundaries and divisions, it was necessary for the purpose of national security and adequate protection to secure full agreement between the federal government and local agencies on all the essentials of civilian defense. Blackout regulations and alarm signals should vary as little as possible from town to town. Methods of setting up local control centres, warden posts, casualty stations and the like should follow a uniform pattern as recommended by OCD, based on the tests and well considered opinions of its experts.

It should be noted that while the United States learned a great deal from British experience in civil defense, American practice differs in many respects from that of Britain. This is due in part to geographical differences in defense problems, but chiefly to the fact that U.S. local governments are unlike those of the British Isles. Other variations are caused by the equipment and types of motive power available in the U.S. and to techniques developed by experimentation.

From administrative headquarters in Washington, D.C., the Office of Civilian Defense extends its jurisdiction to nine regional offices, corresponding to the nine War Department Corps Areas of the United States. The administrative centres are as follows:

Region I, Boston, Mass.; Region II, New York city, N.Y.; Region III, Baltimore, Md.; Region IV, Atlanta, Ga.; Region V, Columbus, O.; Region VI, Chicago, Ill.; Region VII, Omaha, Neb.; Region VIII, San Antonio, Tex.; Region IX, San Francisco, Calif.

Regional offices were placed in charge of regional directors, with whom are associated in each case the Regional Board for Civilian Protection and the Regional Voluntary Participation committee. The regional office works in liaison with the corps area commander, in connection with protective measures, and with a number of other agencies in nonprotective matters. The assistant regional director in charge of civilian protection guides the work of the emergency medical services, the property-accounting section and the sections devoted to the protection of strategic facilities and to training and inspection. The assistant regional director in charge of voluntary participation supervises women's activities, the physical fitness program, volunteer offices and youth activities.

From regional directors the advisory and co-ordinating functions of OCD extend to the governors' state defense councils, and thence to local defense councils.

Local Civilian Defense Organization.—The local civilian defense organization recommended by OCD comprises the two main divisions of civilian defense—the protective services and those associated with community war programs.

The head of the local governmental unit—city, county or town—represents the local authority from which is derived the authority of the local defense council. The extent of this authority is determined by local conditions and statutes. The defense council is headed by an executive director or co-ordinator, who correlates the activities of the commander of the citizens' defense corps and the chief of voluntary participation. Volunteers for the defense corps and community programs may be enrolled through the local volunteer office.

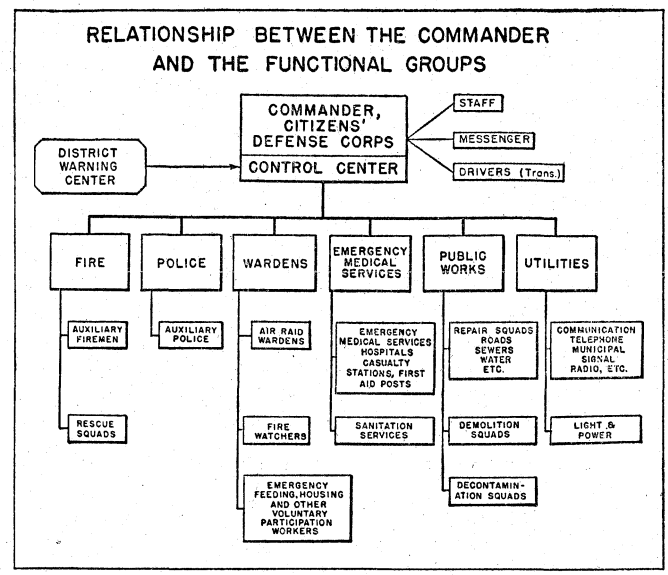
The organization, training and work of the protective services of the defense corps are predicated on the assumption of possible enemy air attacks, even though such attacks may never occur in a given locality. The entire protective program, therefore, is closely tied in with the air-raid precautions system, extending from the army's network to the last air-raid warden post.

Except for the wardens' division, the protective services are based on existing local or municipal services, represented usually by the police and fire departments, public works, utilities and the medical agencies. In smaller communities there may be fewer public services and a simpler procedure in the plan of organization.

The wardens' division received unique duties and responsibilities, and therefore stands as a new type of service, entirely voluntary in its make-up and specially trained for emergency functions. There are district air-raid wardens and zone air-raid wardens, assisting in the organization and instruction of post air-raid wardens, but in any incident caused by enemy action the post warden carries full authority and responsibility; he is required to report directly to the local control centre and remains in charge of operations at the scene of the incident unless relieved by an incident officer dispatched by the commander at the control centre.

The wardens' division also includes fire watchers, and emergency feeding, housing, and other voluntary participation workers. Air-raid wardens, fire watchers and members of the food and housing service must complete a minimum number of specialized courses and hours of training before they are eligible to wear the insignia and arm bands of their service.

The other protective services consist of auxiliary volunteers attached to regular, established departments or of specially trained squads and crews within these departments and agencies. The fire department, with its own rescue squads, and the police department, with its special squads, may be augmented by auxiliary volunteers. Auxiliary police and firemen act as assistants to regular members of the force and receive technical instruction from them. Public works departments supply and train their repair, demolition and decontamination squads, which may be increased by volunteers. The public utilities supply similar crews.



The protection of industrial plants and public buildings raised special technical problems described in a booklet issued by the Office of Civilian Defense. In general, the program prescribes the continuance of operations under all but the most difficult circumstances while affording maximum protection to life, property and equipment.

The emergency medical services embrace a great variety of specialized groups, some of them voluntary, but for the most part professional. Local hospitals are convenient focal points for the organization and equipping of the medical units manning first-aid posts and casualty stations. Emergency medical field units, consisting of two or more squads, are in charge of a physician. Transportation may be supplied by ambulances or emergency vehicles such as station wagons, trucks and passenger cars. Volunteer nurses' aides serve wherever they are needed as a complement to the professional staff. The American Red Cross and other voluntary agencies co-operate in supplying personnel needed in an emergency, and close contact is maintained with the local health department, sanitation services, medical societies, public health nursing and allied groups and services. In some communities canteen, information, evacuation and rehousing services are the responsibility of the local welfare department. All members of the protective services are required to receive training courses appropriate to their service before assuming the official insignia and arm bands of the respective services.

The chief of civilian mobilization heads the large number of community programs that are characteristic of normal health and welfare services, which in wartime undergo great expansion. These include activities connected with the mobilization of local resources involving the use of volunteers, their registration, training and assignment to duty. Added to these are such wartime projects as waste-prevention and salvage campaigns, defense savings drives and the like. Participating groups may be few or numerous, depending on the size and character of the community. Among the most active are the veterans' societies, women's organizations, youth groups, the Boy Scouts of America, and other civic, trade, labour, fraternal, professional, religious and educational organizations.

Members of civilian mobilization groups do not wear arm bands for the reason that it is unnecessary to establish their identity during an emergency as is the case with the protective services. But their work is of immense importance in assuring the health, well-being and high morale of every community in time of war.

The Local Control Centre.—The nerve centre of local civilian defense is the local control centre. It might be called the dispatching terminal of the civilian air-raid warning system, which is fed by the Army's Aircraft Warning service. These two warn-

ing networks, one under strict military control and the other civilian, should not be confused. They complement each other, but their functions and equipment are by no means identical.

The outposts of the Aircraft Warning service are detectors and observation posts manned by volunteer observers under army command. At the approach of hostile or unidentified planes, observers telephone their reports to central points called filter centres, where an expert army officer evaluates the reports from markers placed on a large area map which indicate the probable height, speed, direction and composition of the raiders. These data are then telephoned to a regional information centre, which may be receiving information from several of its filter centres. An operations officer, following the course of the raid on an operations map, orders a particular interceptor squadron to meet the enemy planes. The movements of the pursuit squadron are controlled by an interceptor officer.

Also at the information centre is an air-raid warning officer, whose duty it is to warn communities in the path of the raid to set in motion their air-raid precaution system. The warning is flashed first to the district warning centre in the threatened area, and at this point it becomes a responsibility of the civilian air-raid warning system and of the civilian officials operating it.

At the district warning centre, four coloured bulbs serve as warning signals. The first, or yellow warning signal, is generally known as the "alert" and applies to a large area, any part of which may be threatened. The army flash is transmitted by the district warning centre to its component local control centres, which telephone a confidential warning to all essential industries and transportation on a "yellow list" to be ready to obscure their special lights upon a blue or red warning. With this preliminary caution, members of the control centre staffs are summoned to their stations, and all the civilian protection services are alerted, including of course the post wardens.

The blue warning signal, also confidential, means that raiders are expected to pass over a particular area, and therefore special industrial and transportation lights must be obscured at once. This lights-warning message is telephoned to all on the "blue list," and at the same time all actions taken under the yellow warning are completed. This implies full mobilization of the protection services, messengers, special vehicles and the like.

The third, or red warning signal, is only for those directly in the path of enemy flight and means that an air raid may occur in about five minutes. The red action message calls for informing the public of an impending raid by means of public air-raid alarm devices such as sirens, blacking out the affected district, if it is a night attack, and clearing the control centre for whatever actions or incidents may occur during the raid. Blackouts can be ordered only through the interceptor command. The United States is divided into four such commands, and the decision to black out any area, large or small, during long or short periods, rests with the interceptor commander of the area. Test blackouts are subject to the same restrictions as air-raid precaution blackouts.

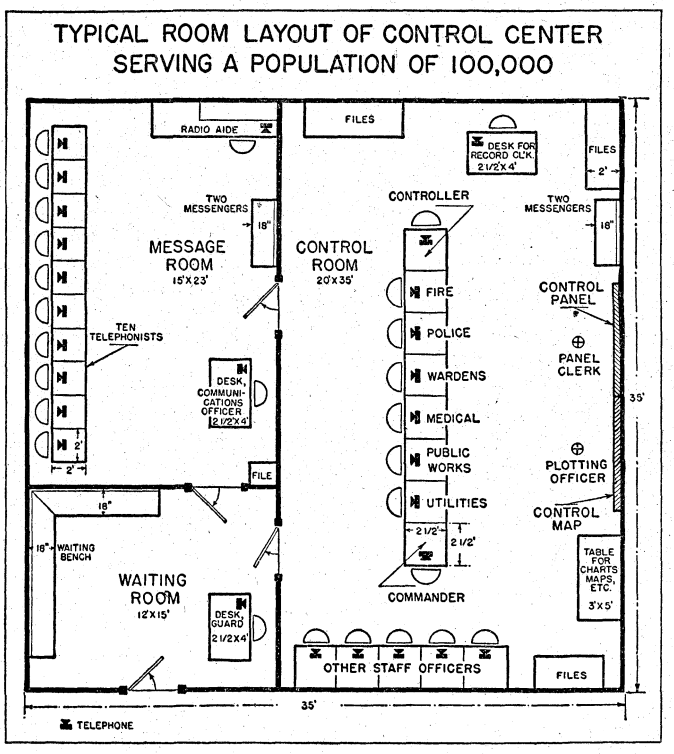
A white signal flashed in a district warning centre indicates the passing of the air-raid danger, and is followed by the "all clear."

Operations During an Air Raid.—The efficient operation of a local control centre, and consequently of local civilian defense, depends on certain basic personnel and equipment. For smaller communities these may be limited, but they should include a number of essentials.

The location of a control centre involves many practical considerations: suitable accommodations and, especially, ease and rapidity of communications; the structural character of the building and its adaptability to air-raid conditions; and the protective features of the rooms which lessen the dangers from fire, gas, flying glass and explosive blasts.

A typical control centre serving a population of 100,000 requires a waiting room, with a guard and desk; a message room, equipped with an ample staff of telephonists, a radio aide, messengers and a communications officer; and a control room of sufficient size to accommodate the commander and his staff, files, a control map and a control panel, and a desk for a records clerk.

The staff consists of the commander, the controller, chiefs of the main protection services or their deputies, a plotting officer in charge of the control map, a panel clerk who operates the control panel, a records clerk and other staff members, including "incident officers."



The control map and control panels are important adjuncts to the control room. As post air-raid wardens report "incidents"—the local damage or effects of bombs in a given sector—they are numbered by the plotting officer and spotted on the control map, a large map of the community. The chiefs of the protection services then advise the controller what equipment in each of their divisions should be sent to the scene of the incident.

The control panel is divided into two main segments. The upper segment contains columns of coloured push pins, identifying the respective equipment, squads and crews of the principal services. As these are dispatched to the various incident locations, they are removed to the lower segment as "services dispatched." A clock set in the panel or near by shows the exact time when the services are sent out. Thus, the commander and controller may see at a glance what equipment and services are on hand at any moment and may dispose or conserve the balance of their "stock" for further use as occasion or emergencies demand. If any service shows dangerous signs of depletion while incidents continue to occur, it may be necessary for the commander to summon assistance from adjacent districts.

If the report of a post air-raid warden indicates that a very serious incident has occurred, involving casualties, damaged buildings, interrupted communications or other extreme hazards, the commander will send one of his incident officers to take charge of the situation Until the incident officer arrives, the post warden must assume responsibility for whatever measures he can take to bring the situation under control.

When all service personnel and equipment have left the bombing incident, the incident may be considered "cleared." All markers covering the incident may be removed from the map, except those showing unrepaired damage. The appropriate entries are made in the log book, and the incident reports may then be placed in a permanent file.

Air-Raid Wardens.—As will be seen from the foregoing, the

position of air-raid warden is one requiring sound judgment, coolness in an emergency, ability to take and give orders, a considerable amount of physical strength and energy and the utmost resourcefulness in handling a number of problems that may occur simultaneously. Quick thinking and instantaneous decisions should characterize this type of protection officer.

Before an air-raid warden becomes fully prepared to face a critical situation arising from a raid, he and his assistants must undertake a great deal of painstaking routine work. He must become thoroughly familiar with the geography of his sector; he must know and plot on a map not only the permanent protective installations—fire hydrants, fire alarm boxes and fire stations, telephone booths, and the like—but also those of an emergency character: first-aid posts, casualty stations, base hospitals, public shelters suitable for protection during an alarm, etc.

First and foremost, however, the post warden must know the people living in his sector, who may number as many as 500. He should know in what families the men will be working at night, and so unavailable for voluntary duty or home protection; the homes where there are small children, infants, invalids, blind, deaf or handicapped persons, or the aged, for any or all of these people may require special care and help if a local incident occurs, a house is set on fire or demolished, or the need of general evacuation becomes apparent. As a part of his clerical duties he will have to keep a record of these matters, and in the event of an actual air-raid incident he will have to make out appropriate reports covering the situation. Since much of the post warden's business will be direct contacts with his own friends and neighbours, he should have tact and understanding of human nature.

In the great army of civilian defense the qualifications and duties of post warden combine those of top sergeant, liaison officer, quartermaster and colonel. He may direct operations and summon assistance, but he must himself know how to perform each separate duty, perhaps alone and unaided, from extinguishing an incendiary bomb to extricating persons from a bombed dwelling. In many wartime circumstances the difference between safety and disaster may be a matter of seconds.

The Citizen During an Alarm.—The final unit in the system of civilian defense is the individual citizen. While the enrolled volunteers of the protection services have specialized technical duties to perform during an air-raid alarm, it is necessary for the citizen and householder and the adult members of each family to look after themselves and take whatever measures are necessary to protect their lives and property. Citizens driving or walking through the streets or congregated in public buildings or places of amusement should know what to do in the emergency, how to control their impulses or a tendency to hysteria and how to follow instructions given them by the authorities.

In England the number of casualties from intensive bombing was less than was generally known at the beginning of 1942, and certainly less than was anticipated before the outbreak of World War II. During 1940–41 fewer people were killed or injured through enemy action than by traffic accidents. Of the total number of casualties, about 90% was suffered by persons *outside* of buildings.

Material damage may be enormous. It may be measured in the destruction of property, interruption of vital community facilities, halting of production in industries and in the incalculable damage to or destruction of works of art, civic and architectural monuments, priceless libraries, museums, foundations, educational institutions and churches, wherein the value lies to a great degree in the cultural heritage of the nation attacked. Modern aggressors strike at the very roots of civilization and propose to obliterate every vestige of democratic culture. Military objectives have ceased to have meaning for them; their primary aim is the conquest and subjugation of entire peoples.

The type of bombs dropped by raiders depends on the enemy's objectives or purpose. If it is to destroy military installations or productive plants, high explosives, combined perhaps with incendiary bombs, may be used. Up to 1942 chemical gas bombs had not been used, so far as reliably reported, except in China by the Japanese. Gas was also said to have been employed by the Italians in their Ethiopian campaign. One reason for the reluctance of the aggressor powers to resort to gas warfare was that the damage and casualties resulting from gas attacks are less than those from other forms of air attack, measured in bomber load. Another deterrent was the fear of reprisals in kind. Nevertheless, it is necessary to consider gas attacks as a distinct possibility for, although the area affected by such attacks may be limited as to size, the effect on morale might be more serious. During World War I gas attacks were effective agents of offense; they were used as a preliminary to attacks in force against ground troops.

The results of high-explosive bombing are serious if directed accurately against military or industrial objectives; they are relatively less so in "indiscriminate bombing." The immediate area affected by the dropping of an explosive bomb is not extensive, and far fewer fires are started by their action than by incendiary bombs. Yet important community facilities may be interrupted or destroyed: water and gas mains, telephone wires and the like.

There is also the question of short-range and long-range bombing attacks, specifically, the greatest amount of damage that may be produced by each bomber load carried. If bombers operate over great distances this factor becomes of special significance in enemy calculations. In general it may be assumed that incendiary bombs wreak the greatest havoc per bomber unit if directed against thickly inhabited areas. Explosive bombs may be mingled with incendiaries in order to create greater hazards in fire fighting and to further the threat to morale in the population attacked.

The normal load of incendiary bombs of a heavy bomber may start 70 or more fires. The remainder fall in vacant spots or prove to be "duds." It is obvious, therefore, that a single load of incendiaries dropped on a large city will set more fires than the fire department can well handle. A bomber squadron would produce correspondingly greater results. To extinguish the greater part of these fires will be the responsibility of the fire watchers, air-raid wardens, auxiliary services, and of citizens in their homes. That this can be successfully accomplished was fully demonstrated in Britain and elsewhere. But in order to achieve an efficient voluntary fire-fighting force it is necessary for the citizen, as well as the civilian protection services, to be thoroughly acquainted with the composition, action, and means of controlling incendiary bombs.

Incendiary Bombs and Their Effect.—The light magnesium bomb is used extensively for incendiary purposes. It weighs slightly more than two pounds. Dropped from an elevation of 5,000 ft. or more, it will penetrate any but the most heavily reinforced roof. Having pierced the roof, it is likely to lodge on the floor beneath, either of the attic or top floor. Without proper attention, it may burn its way fairly rapidly to floors below, starting fires on each.

This bomb has four essential parts: the body, the core, the firing mechanism and the tail or fin. Its over-all length is about 14 in. On impact, the starting mixture fires the core of a compressed thermit mixture, producing a heat of about 4,500° F. The core requires no air for burning, since the thermit supplies its own oxygen, and consequently the bomb cannot be extinguished or safely attacked during the first 40 or 50 seconds.

During this interval the pressure of the liquid iron in the thermit mixture within its confined space causes an explosive scattering of molten iron and hot burning pieces of magnesium from the body of the bomb. When the thermit core has ignited the magnesium body, the latter burns quietly, but with intense heat, for about 15 min. The hot molten magnesium, feeding on oxygen drawn from the air, spatters and runs over the floor and into cracks, spreading the fire to combustible material on contact.

Since burning magnesium requires oxygen, the problem of control is either to shut off its supply of oxygen entirely or to cause the magnesium to burn out more rapidly by supplying a moderate amount of oxygen, such as that contained in a fine spray of

water. A heavy stream of water or the contents of a pail causes a sudden acceleration of oxygen consumption, an action so violent that the effect is that of an explosion. The bomb's contents are scattered widely in every direction, causing a conflagration.

Under a fine spray of water or the spray from an acid-soda type of fire extinguisher, the bomb burns more rapidly and may be consumed within a few minutes. The spray has additional advantages: it blankets the burning bomb with cooling steam, reduces the oxygen content of the air about the bomb and cools the floor, thereby preventing the spread of the fire. Use of the tetrachloride type of extinguisher is extremely dangerous, as the resulting vapours have a toxic effect. Carbon dioxide as an extinguishing agent is equally risky; the foam type of extinguisher is ineffective.

A method recommended by the bureau of mines for extinguishing magnesium fires was developed at the Central Experiment station of the bureau of mines, United States department of the interior, at Pittsburgh, Pa. The extinguishing agent used is a very hard coal-tar pitch (approximately 300° F. softening point), sometimes commercially designated as "fuel pitch." The size of pitch recommended for this use passes a $\frac{1}{8}$-in. mesh sieve and is coarser than 35 mesh; particles finer than 35 mesh should not be used. When spread over a hot magnesium fire the pitch softens and seals the burning magnesium metal with an airtight blanket, thereby smothering the flames. The pitch is nonabrasive, easily available and cheap.

To extinguish a magnesium fire on metal or dry concrete surfaces or on dry ground, the procedure is simply to spread (not throw) with a long-handled scoop or shovel a layer of pitch over the burning metal and then allow the pitch to soften and seal the fire. If, after the first application the pitch tends to burn with a short flame, this can be stopped by applying a second thin layer of pitch over the flaming parts. Smoke will sometimes issue from the hot mass for several minutes, but no reignition will result.

After the fire is extinguished, the mass should be allowed to cool for a reasonable time (5 min. to 10 min. is sufficient for small fires) before the pitch covering is removed from the magnesium. If the fire is discovered early and the pitch is properly applied, most of the magnesium will be recovered before it is consumed. If the pitch is allowed to cool until it is quite hard, it should be chipped off the underlying metal or other surface; on machine beds, bronze or other soft tools should be used for this purpose.

The procedure to be followed in extinguishing magnesium fires on wood floors (or on wet ground) is as follows: Apply a small amount of pitch over the fire to reduce the heat and glare. Then spread a layer of pitch approximately one inch thick on the floor alongside the fire and carefully transfer the burning mass on to the pitch layer with a shovel or hose. Finally, cover the entire surface of the fire with more pitch and also scrape away any burning particles or embers from the floor at the initial location of the fire. If, by the time the fire is discovered, the wood floor is badly scorched or burning, then, after the above steps are taken, apply a fine spray of water (not a strong stream) to the burning wood to prevent the spread of the wood fire. In so far as possible, in shops with wood floors where magnesium is being processed or handled, care should be taken that metal pans be kept under machine beds so that accumulations of magnesium chips or powder collect in the pans and not on the floor.[1]

Objections have been made to the use of pitch on the grounds of heavy smoke produced and its tendency to catch fire from the heat of the magnesium.

Certain dry materials may be used against a magnesium bomb in order to reduce its surface heat and thereby permit the safe handling of it until it can be removed to a place where it can do no further damage. Dry sand is usually available, but commercial fire-resistant powders, talc and a few other materials may be used. No substances, however, should be tried without knowledge of their chemical effect when combined with the elements contained in an incendiary bomb. The effects may be harmful or may actually cause the bomb to burn more fiercely.

[1]Bureau of Mines *Report*.

If dry sand is used, the tools needed should include a long-handled scoop or shovel and a metal pail or container with a four-inch layer of sand on the bottom, in which the burning bomb may be placed to be carried outside. Another container is useful for holding additional sand, and a hoe is convenient for working the sand about the bomb and keeping it off the floor. It should be remembered that even when a bomb seems to smoulder beneath a layer of sand, it continues to eat into the floor if it is in direct contact with that surface. It is advisable, therefore, to prepare a bed of sand, several inches in thickness, close to the bomb, to which the incendiary material can be transferred during the process of handling it. Since the bomb is not only extremely hot but also is likely to throw off burning fragments, it is wise to protect one's self when approaching it, either by crouching behind a chair or table, or holding up some protective material. Keeping the head and body low avoids the smoke and fumes caused by burning materials.

An incendiary bomb will often set fire to inflammable materials in the room where it lodges. It may be necessary to extinguish surrounding fires before turning attention to the bomb itself, and to continue to watch them even while controlling the bomb. Thus, with the hose or extinguisher there may be an alternation of steady stream with fine spray. The decision as to which danger is the greatest requires cool judgment.

When a partly burned-out bomb has been scooped into a container, the mass of it will still emit a great deal of heat, making it difficult to carry the container except by placing the scoop or shovel handle through the pail handle. Two people can then carry out the load more easily than one. When the bomb has been deposited outside, it should be covered to prevent the embers from being visible to enemy aircraft in the vicinity. Having removed the bomb or disposed of it, the fire-fighter should carefully examine the floor to see whether any traces of fire remain below the surface boards. A wise procedure is to cut away the burned portions and drench the under structure.

High Explosives.—Many of the air-raid instructions and precautions have to do with high explosives and their effects. An attack with incendiary bombs is sometimes accompanied or followed by an attack with high-explosive bombs. The immediate results of the latter may be damage to structures or their collapse, imprisoning the occupants or causing hazards from broken water and gas connections and electric wiring. In the streets, broken water mains may produce local floods or gas may escape from broken pipes. Air-raid wardens should know the location of shut-off valves in dwellings and if they are accessible under the conditions. Repair crews from the public utilities will take care of the larger street valves. The danger from water and gas, among other reasons, has made authorities advise against the use of basements as air-raid shelters.

The blast effect of explosive bombs has been carefully studied, and the results are generally known but they vary in detail with each incident. The greatest dangers are: from flying glass and steel splinters or other debris; from direct concussion, producing in extreme cases unconsciousness or death; or from the wave effects of violently disturbed air, which press with great force against walls and windows and then exert an outward pull through air rushing back into the vacuum produced by the explosion. Windows, therefore, may first shatter *inwardly*, and then the walls may bulge and sag *outwardly*, causing them to fall into the street.

A peculiarity of such explosions is that their effect sometimes is slight at close range, where a protective air pocket is formed, and violent at a distance up to 200 ft. or more.

The dangers inherent in bomb explosions make it imperative for citizens to keep away from windows and doorways and to seek whatever protection they can find beneath tables or behind heavier furniture, or in rooms that have no external apertures. Since only 10% of air-raid casualties in Britain have been attributed to persons remaining indoors, there is every reason for all persons except those in the protective services to seek shelter during an alarm. Clearing the streets and sidewalks of drivers and pedestrians also permits the more effective operation of the protective

equipment and personnel.

It cannot be said that any part of a structure is safe in the event of a direct hit, but generally speaking the uppermost and the lower parts of buildings are the least desirable refuges.

Chemical Gas Bombs.—Chemical warfare is a highly technical subject with an extensive literature. Its application in attacks on civilian areas may vary somewhat from its use in armed combat. For example, irritant smokes and tear gas may be employed to cover the advance or retreat of troops. Tear gases are also used in connection with halting mobs or threatened civil insurrection. Their effect is temporary, or nonpersistent. Gas masks are effective against them.

Lung irritants are chemical agents that affect the respiratory tract when breathed. Examples are chlorine, phosgene and chloropicrin. The last two are especially dangerous because their effects are delayed, and in the case of chloropicrin may not be experienced or detected for some hours.

Vesicants, or blister agents, either in liquid or vapour form, produce large watery blisters which require a long time to heal. If breathed, they seriously affect internal tracts. They are dangerous for a number of reasons: first, because they are persistent and so may contaminate affected areas for many days; second, their destructive effect on the skin tissues is not apparent for from one to 24 hours; finally, the gas mask does not afford protection against them because they will penetrate and contaminate clothing, shoes, rubber garments and coverings, and will poison exposed food. Contaminated ground, utensils, walls, furniture and the like spread the infection if they are merely touched. Mustard gas and Lewisite are typical examples. Lewisite, with an arsenical base, is especially deadly, for it may produce arsenical poisoning of the body. Both gas masks and special protective clothing are required in the handling of casualties caused by exposure to the vesicants, and similar protection must be used by decontamination squads. Victims of such exposure to contamination must be sent to decontamination stations and then given proper medical treatment.

In the event of gas attacks, special warning signals are given by air-raid wardens, but only in the sectors actually affected, for a general gas alarm is never contemplated. Chemical gases are heavier than air, and therefore tend to flow with air currents at a rather low level, following the contours of the land toward basements, depressions and any openings near the ground. About 30 ft. above the street level their effect is greatly reduced. It is possible, however, for these agents to be sprayed from planes and fall over a considerable area in liquid drops. Ordinarily, the area affected by the explosion of a gas bomb is not greater than about 40 yd. square, and therefore many bomber loads would be required to produce any considerable results over a large area. For this reason an extensive gas attack at long range is less probable, perhaps, than other forms of attack. The gas mask affords protection against all forms of chemical warfare gases, except the vesicants, and the presence of a gas may be detected by its particular odour. First-aid treatment of gas casualties should be given only by properly qualified medical personnel.

Blackouts and Dimming.—Blackouts may be ordered under two circumstances calling for radically different procedures. Where an entire area is threatened by intermittent or repeated air attacks, it is necessary to institute continuous blackouts every night. This happened in many parts of the world after the outbreak of World War II. Under such conditions the normal activities of civilian life—business, amusement, transportation and the like—are carried on, although they may be considerably curtailed. Traffic continues at reduced speed, but it is not halted.

The problem here is to so reduce the visibility of the area, through appropriate dimming of all lights, that the enemy will be unable to locate vital targets. The reduction of visibility while maintaining a restricted traffic flow and a certain amount of pedestrian movement calls for special and highly technical measures. Vehicles in motion must have their lights hooded; traffic signals must be visible to drivers but invisible from the air, and essential markers to guide foot travellers must be provided, either by fluorescent or white paint, or by lighted signs with their inscriptions dimmed. In Great Britain pedestrians in some cases have taken the extra precaution of wearing white belts, white bands and the like, so that their presence may be detected. Since a flashlight bulb may be plainly seen from the air, it is necessary to carry flashlights of greatly reduced intensity and to hold them downward. Lighted matches and candles also can be seen at a great distance.

In the event of an actual air attack a total blackout of the threatened area will be ordered. Test blackouts are used to determine the effectiveness of such precautions. The Office of Civilian Defense has issued a study of blackouts, prepared by the war department. Under total blackouts, drivers must park their cars at the nearest curb, turn out the lights, and remove the ignition key, but they should not lock the car, for it may have to be moved.

Civil Air Patrol.—The Civil Air Patrol, for voluntary defense mobilization of private planes and airmen throughout the United States, was authorized to organize in OCD in Nov. 1941. Eligibles included 90,000 certificated private pilots, ground personnel totalling 100,000 or more, and specialists such as radio operators; 23,000 private planes were available.

Many thousands of private pilots at once enlisted. Under Major Gen. John F. Curry, national commander, a regional command was established in each of the nine army corps areas with a wing command in each state, divided into groups, squadrons and flights at the local airports. All units began an intensive training program to learn military subjects, advance their aviation skill and work as units on wartime missions and manoeuvres in cooperation with the armed forces and civilian defense services.

By forming a roster of aviation personnel throughout the United States, the Civil Air Patrol was able at once to furnish skilled people for urgent work requested by the armed forces.

Training and Publication.—The technical problems and situations arising from modern warfare require that they be met through scientific research and knowledge, field experimentation and highly specialized training.

Through co-operation with the Chemical Warfare School of Edgewood arsenal, Md., the Office of Civilian Defense conducts a series of courses in civilian defense. The arsenal established branch schools throughout the United States, enlarged its teaching staff through hundreds of instructors in various higher institutions, as well as through training courses conducted by local fire and police departments, industrial establishments, public schools and the like. By Jan. 22, 1942, some 500 graduates had gone from Edgewood to about 300 cities in 40 states.

Supplementing the training of members of the protective services, OCD at the beginning of 1942 had issued more than 40 titles in a series of lectures, training guides and handbooks, with a distribution at the beginning of 1942 of 6,500,000 copies. These publications include a handbook for each of the protective services and such technical studies as "Municipal Signaling Systems," "Report of Bomb Tests on Materials and Structures" and "Glass and Glass Substitutes."

More than 400,000 copies of the full-page, illustrated advertisement, "What to Do in an Air Raid," were distributed as wall posters. Made into an eight-page pamphlet, the first order was for 5,000,000 copies. More than 27,000,000 copies of the leaflet "Meet Your Air Raid Warden" went to readers.

Volunteers.—In Nov. 1941 there were some 5,000 local defense councils. By January of the year following, the number had risen to 7,031, and on Feb. 1 stood at 8,459. Volunteers had risen from 3,516,000 on Jan. 1 to 5,400,000 a month later. The largest single group was air-raid wardens, who numbered close to 1,000,000. (G. W. Cn.)

SELECTIVE SERVICE

The year 1940 witnessed a drastic and significant change in U.S. national life. With the enactment of the Selective Training and Service Act of 1940, the United States implemented and integrated the greatest national defense program in its history. Early in 1940, congress inaugurated a national defense rearma-

ment program involving the expenditure of more than $15,000,000,000.

With the memory of U.S.A.'s unpreparedness in 1917 still fresh in their minds, the members of the 66th congress had passed the National Defense Act of 1920, which provided it was to be the duty ". . . of the war department general staff . . . to prepare plans . . . in conjunction with the naval forces . . . for the mobilization of the manhood of the nation. . ." But in 1919 the selective service laws were allowed to lapse. The selective service organization was disbanded. From 1920 to 1926 the congressional mandate "to prepare plans" was fulfilled by occasional conferences between war and navy department officials. In 1926 these officials recognized the need for the assignment of qualified officers whose responsibility and function it would be to carry out the letter and the spirit of the law.

Joint Army and Navy Selective Service Committee.—After an interchange of letters between the secretary of war and the secretary of the navy, and on their recommendation, the Joint Army and Navy Selective Service committee was created on Jan. 22, 1926. The original committee comprised four officers: one from the marine corps and one from the bureau of navigation for the navy; and two from the army personnel division for the war department. Its first effort was to analyze and study the experiences of selective service during World War I, in order to establish future policies and procedures that were tried and proved successful. It soon became apparent that the committee's greatest need was men; men capable of undertaking a long range program of study, research and planning.

Two major considerations argued that they should not be regular army, navy or marine corps officers.

First, a long-range planning program could not be carried out by regular officers who usually receive a change of assignment every four years. Second, a military education or background was not essential, because the problems of procuring civilians for military service demanded rather a knowledge of civilians and a civilian background.

The secretaries of war and navy made an allotment of 95 reserve officers to assist the committee. These civilian reserve officers were to represent a cross section of U.S. national life. They were to be selected from all parts of the United States and were, in so far as it was possible, to represent varied fields of civilian endeavour.

After establishing broad general policies based on the study and research of previous experience, the committee then outlined a course of further study and research by, and education of, its assigned reserve officers through a series of correspondence courses. When these reserve officers had been indoctrinated in the policies and philosophies established by the committee and educated in the fundamentals of selective service, the committee began to formulate plans and regulations for the organization and operation of a nation-wide man power procurement agency—the selective service system.

By 1935 policies and procedures were established; plans and regulations had been formulated, complete details for the organization, administration and operation of the national headquarters had been worked out. As a first step toward carrying out its planning, the adjutant general of the national guard in each state was asked to co-operate and work out details for the organization, administration and operation of selective service in his state. To assist in this work there were the trained reserve officers who were available for liaison and conference work.

By this time the original four-man committee had been increased by the addition of one reserve officer who had served with the selective service headquarters in World War I, one national guard officer and two industrial advisers; one from the bureau of shore establishments for the navy and one from the office of the assistant secretary of war for the army. With the help of the committee and its assigned reserve officers, the state adjutants general and their staffs undertook the planning of the organization and operation of selective service in the various states, the District of Columbia, Hawaii and Puerto Rico. This work progressed through the years by means of summer training camps, weekly drill instruction periods, extension courses and conferences.

By 1936 over 100 officers, including national guard and naval liaison officers, were attending each of the four annual regional conferences. These conferences were of 14 days' duration and were held in different sections of the country so as to minimize travel time and expense. Nearly 7,000 extension course lessons were being completed annually by officers throughout the country.

When Major Lewis B. Hershey in July 1940 said that the Joint Army and Navy Selective Service committee was "ready," he said it in the full knowledge that the study and analysis of selective service of 1917 and the 14 years of subsequent study, research, planning and training guaranteed the success of any selective service program that was based on the committee's recommendations. The committee had worked out policies and procedures, rules and regulations and details of organization, administration and operation. Its allotment of 95 reserve officers was trained and ready, if called, to function as a national headquarters and as liaison officers with the various states. Each state had an adjutant general and a state staff, trained and ready, if called, to function as a state headquarters. Altogether there were about 350 officers of the army, navy and marine corps, the reserves and the national guard, who were trained specialists in selective service.

The congress of 1920 had told the war and navy departments "to prepare plans." By 1940, the plans had been prepared. The organization, machinery and details of operation outlined in the legislation before congress were identical with the plans of the committee. Said the United States senate: "Aye" by a vote of 47 to 25. Said the house of representatives: "Aye," 232 to 124. On Sept. 16, President Roosevelt signed the Selective Training and Service Act of 1940.

SELECTIVE TRAINING AND SERVICE ACT OF 1940 (CONDENSED)*

The purpose of the act is to provide for the common defense by increasing and training the armed forces under a fair and just system.

Excepting those already in military service, public health service and aliens of certain recognized status, every male citizen and alien between the ages of 21 and 36 residing in the United States on the day or days fixed shall register.

Whether or not a state of war exists, the president may increase the forces from time to time as the national interest requires so long as there are never more than 900,000 men in training and service in any one year under this act. The act will continue in effect for five years. And the president may induct no more men than the congress shall specifically appropriate for from time to time.

Physical examination by the military services shall be given the men upon induction and discharge.

Each man inducted shall serve 12 months, after which he will be placed in a reserve component for 10 years.

The same pay allowances, pensions, disability and death compensation provided for other enlisted men and officers of like grade and length of service are assured inductees under this act.

These inductees shall not be employed beyond the limits of the western hemisphere except in the territories and possessions of the United States, including the Philippine Islands.

Classification, selection and induction under the act shall be made in an impartial manner under such regulations as the president may prescribe.

The number of inductees shall be based on the state's proportion of eligible men compared to the total number of the nation's eligibles, except that credits shall be given for residents of each subdivision who are in the land and naval forces.

The act defers from training and service the following men in the armed forces: those who have served three consecutive years in the regular army; former national guardsmen and former reserve officers, under certain conditions; the vice-president, governors, members of state and federal legislatures, judges of courts of record.

No exception from registration or exemption or deferment from training and service under this act shall continue after the cause therefor ceases to exist.

Inductees leaving nontemporary positions with the federal government or private industry are protected by the act and are to be reinstated with no loss of seniority or privilege and may not be discharged without cause for at least one year after their return. The district courts of the United States are given jurisdiction in cases arising under this provision.

A personnel division is to be organized to secure re-employment and employment for men as they complete the training period.

No vacancy created by induction is to be filled by any member of the Communist party or the German-American bund.

*For subsequent amendments to the act, see p. 365.

The president is authorized to prescribe rules for deferments of: certain men whose occupation, or preparation therefor, is found necessary to national interest and also certain important office holders in the state and federal service; those physically, mentally or morally unfit for service; men with dependents; students entered during 1940 in recognized colleges until graduation or July 1, 1941, whichever occurs first.

Dependent when used in the act means one who is dependent in fact.

Recognized students and ministers of religion are not subject to military training, but must register. Noncombatant and nonmilitary service is provided for conscientious objectors.

The president is empowered to place obligatory orders with any firm or individual for such defense materials as are required and which are of the nature usually produced or capable of being produced by such firm or individual. Upon refusal to comply authority is given to take immediate possession and such failure is deemed a felony which upon conviction carries a penalty of three years' imprisonment and a fine not exceeding $50,000. Just compensation for materials and rent is assured.

The president is authorized: (1) to prescribe the necessary rules and regulations to carry out the provisions of this act; (2) to create and establish a Selective Service system, and shall provide for the classification of registrants and of persons who volunteer for induction under this act on the basis of availability for training and service, and shall establish within the Selective Service system civilian local boards and such other civilian agencies, including appeal boards and agencies of appeal, as may be necessary to carry out the provisions of this act. There shall be created one or more local boards in each county or political subdivision corresponding thereto of each state, territory and the District of Columbia. Each local board shall consist of three or more members to be appointed by the president, upon recommendations made by the respective governors or comparable executive officials. No member of any such local board shall be a member of the land or naval forces of the United States, but each member of any such local board shall be a civilian who is a citizen of the United States residing in the county or political subdivision corresponding thereto in which such local board has jurisdiction under rules and regulations prescribed by the president. Such local boards, under rules and regulations prescribed by the president, shall have power within their respective jurisdictions to hear and determine, subject to the right of appeal to the appeal boards herein authorized, all questions or claims with respect to inclusion for, or exemption or deferment from, training and service under this act of all individuals within the jurisdiction of such local boards. The decisions of such local boards shall be final except where an appeal is authorized in accordance with such rules and regulations as the president may prescribe. Appeal boards and agencies of appeal within the Selective Service system shall be composed of civilians who are citizens of the United States. No person who is an officer, member, agent or employee of the Selective Service system, or of any such local or appeal board or other agency, shall be excepted from registration, or deferred from training and service, as provided for in this act, by reason of his status as such officer, member, agent or employee; (3) to appoint by and with the advice and consent of the senate, and fix the compensation at a rate not in excess of $10,000 per annum, of a director of selective service who shall be directly responsible to him and to appoint and fix the compensation of such other officers, agents and employees as he may deem necessary to carry out the provisions of this act; *provided,* that any officer on the active or retired list of the army, navy, marine corps or coast guard, or of any reserve component thereof or any officer or employee of any department or agency of the United States who may be assigned or detailed to any office or position to carry out the provisions of this act (except to offices or positions on local boards, appeal boards, or agencies of appeal) may serve in and perform the functions of such office or position without loss of or prejudice to his status as such officer in the army, navy, marine corps, or coast guard or reserve component thereof, or as such officer or employee in any department or agency of the United States: *provided further,* that any person so appointed, assigned or detailed to a position the compensation in respect of which is at a rate in excess of $5,000 per annum shall be appointed, assigned or detailed by and with the advice and consent of the senate: *provided further,* that the president may appoint necessary clerical and stenographic employees for local boards and fix their compensation without regard to the Classification Act of 1923, as amended, and without regard to the provisions of civil service laws; (4) to utilize the services of any or all departments and any and all officers or agents of the United States and to accept the services of all officers and agents of the several states, territories and the District of Columbia and subdivisions thereof in the execution of this act; and (5) to purchase such printing, binding and blank-book work from public, commercial or private printing establishments or binderies upon orders placed by the public printer or upon waivers issued in accordance with section 12 of the Printing act approved January 12, 1895, as amended by the Act of July 8, 1935 (49 Stat. 475), and to obtain by purchase, loan or gift such equipment and supplies for the Selective Service system as he may deem necessary to carry out the provisions of this act, with or without advertising or formal contract; and (6) to prescribe eligibility, rules and regulations governing the parole for service in the land or naval forces, or for any other special service established pursuant to this act, of any person convicted of a violation of any of the provisions of this act.

The president is further authorized to delegate any authority vested in him under this act to such officers, agents or persons as he may designate.

Voluntary services may be accepted.

The chief of finance, United States army, is designated as fiscal, disbursing and accounting agent for selective service.

Any person charged with the duty of carrying out any of the provisions of this act, or the rules or regulations made or directions given thereunder, who shall knowingly fail or neglect to perform such duty, and any person charged with such duty, or having and exercising any authority under said act, rules, regulations or directions who shall knowingly make, or be a party to the making of, any false, improper or incorrect registration, classification, physical or mental examination, deferment, induction, enrolment or muster, and any person who shall knowingly make, or be a party to the making of, any false statement or certificate as to the fitness or unfitness or liability or nonliability of himself or any other person for service under the provisions of this act, or rules, regulations or directions made pursuant thereto, or who otherwise evades registration or service in the land or naval forces or any of the requirements of this act, or who knowingly counsels, aids or abets another to evade registration or service in the land or naval forces or any of the requirements of this act, or of said rules, regulations or directions, or who in any manner shall knowingly fail or neglect to perform any duty required of him under or in the execution of this act, or rules or regulations made pursuant to this act, or any person or persons who shall knowingly hinder or interfere in any way by force or violence with the administration of this act or the rules or regulations made pursuant thereto, or conspire to do so, shall, upon conviction in the district court of the United States having jurisdiction thereof, be punished by imprisonment for not more than five years or a fine of not more than $10,000, or by both such fine and imprisonment, or if subject to military or naval law may be tried by court martial, and, on conviction, shall suffer such punishment as a court martial may direct. No person shall be tried by any military or naval court martial in any case arising under this act unless such person has been actually inducted for the training and service prescribed under this act or unless he is subject to trial by court martial under laws in force prior to the enactment of this act. Precedence shall be given by courts to the trial of cases arising under this act.

The monthly base pay of enlisted men of the army and marine corps shall be as follows: enlisted men of the first grade, $126; enlisted men of the second grade, $84; enlisted men of the third grade, $72; enlisted men of the fourth grade, $60; enlisted men of the fifth grade, $54; enlisted men of the sixth grade, $36; enlisted men of the seventh grade, $30; except that the monthly base pay of enlisted men with less than four months' service during their first enlistment period and of enlisted men of the seventh grade whose inefficiency or other unfitness has been determined under regulations prescribed by the secretary of war and the secretary of the navy, respectively, shall be $21. The pay for specialists' ratings, which shall be in addition to monthly base pay, shall be as follows: first class, $30; second class, $25; third class, $20; fourth class, $15; fifth class, $6; sixth class, $3. Enlisted men of the army and the marine corps shall receive, as a permanent addition to their pay, an increase of 10 per centum of their base pay and pay for specialists' ratings upon completion of the first four years of service, and an additional increase of 4 per centum of such base pay and pay for specialists' ratings for each four years of service thereafter, but the total of such increases shall not exceed 25 per centum. Enlisted men of the navy shall be entitled to receive at least the same pay and allowances as are provided for enlisted men in similar grades in the army and marine corps.

When used in this act the United States refers to the several states, the District of Columbia, Alaska, Hawaii and Puerto Rico.

Registration Days for Selective Service.—In accordance with the provisions of the act, President Roosevelt appointed Clarence Addison Dykstra, president of the University of Wisconsin, as the director of Selective Service, at a salary of $10,000 a year (Dykstra resigned April 1, 1941, and was succeeded by Gen. Lewis B. Hershey as acting director). The president proclaimed Oct. 16, 1940, as registration day for the continental United States. Proclamations set registration day on Oct. 26 for Hawaii, Nov. 20 for Puerto Rico and Jan. 22, 1941, for Alaska.

In accordance with the prearranged plan of the Joint Army and Navy Selective Service committee, the governors of the several states and the adjutants general and state staffs immediately undertook to set up the registration machinery. Federal, state and municipal employees—in some cases—city and state-wide organizations, such as police departments and school systems, were called into service. Polling places, schoolhouses, police stations and the like were set up and organized as registration places. Day and evening classes were organized to instruct volun-

teer registrars in their duties and responsibilities.

On Oct. 16, 1940, more than 1,000,000 American men and women voluntarily served as registrars in more than 125,000 registration places throughout the U.S.A. Between 7.00 A.M. and 9.00 P.M. some 16,317,000 men were registered in the continental United States.

The second registration day was July 1, 1941, at which time all men who had reached the age of 21 since Oct. 16, 1941, were required to register. Approximately 752,500 men were registered on that day.

On Feb. 16, 1942, after the Selective Service act had been amended to apply to all men between the ages of 20 and 44 inclusive, the third registration was held. An estimated 9,000,000 registered at that time, bringing the total number of registrations, including those in territories and possessions, to about 26,480,000.

Organization of the Selective Service System.—While the preparations for the first registration day were being made, President Roosevelt issued an executive order which created the Selective Service system. The Joint Army and Navy Selective Service committee and a number of its assigned reserve officers became the nucleus of the national headquarters of the Selective Service system. The adjutants general and their staffs in the various states became the nucleus of the state headquarters. Each governor was asked to nominate a state Selective Service director for appointment by the president. This state director was to be the operating head of the Selective Service organization in each state. The governors were also asked to nominate those who were to be appointed by the president as members of local boards, appeal boards, examining physicians and government appeal agents.

Speedily and efficiently the entire nation-wide Selective Service system was organized and implemented. The outstanding characteristic of the Selective Service system was the almost complete decentralization of its organization and operation. Director Dykstra and a trained and experienced staff comprised the national headquarters. The main function of the national headquarters was to direct and co-ordinate the activities of the various state headquarters.

The state director and a trained and experienced staff comprised each state headquarters. The main function of these state headquarters was to direct and co-ordinate the activities of the local boards, advisory boards, appeal boards, examining physicians, government appeal agents and medical advisory boards in their respective states.

In each state a local board was created for each county, except where there were more than 30,000 people in a county, in which case additional boards were created, so that there was one local board to serve each 30,000 people. These local boards were comprised of not less than three members. Attached to each local board were one or more examining physicians and one government appeal agent. A total of 6,256 local boards were created to serve continental United States, together with 25 for Hawaii and 122 for Puerto Rico. In these local boards rested the real administrative and functional responsibility in the Selective Service system. Each local board was responsible for the classification and resultant deferment or induction of the registered men in its local board area.

The examining physicians made the physical examinations and reported their recommendations to the local board as to the physical fitness of registrants. The government appeal agent assisted registrants and advised them regarding appeals and protected the government by appealing any local board classification not in the best interests of the government.

In each state, boards of appeal were created; one for each 70,000 registrants. These boards of appeal were comprised of not less than five members representative of the various elements and activities in their area. They included one member from labour, one from industry, one physician, one lawyer and where applicable, one member from agriculture. A total of 280 boards of appeal were created to serve the continental United States, together with 1 for Hawaii and 1 for Puerto Rico. These boards of appeal had jurisdiction to review any decision concerning the classification of a registrant by any local board after an appeal had been filed with the local board. They might affirm, modify or reverse the decision of the local board. The decision of the board of appeal was final, unless modified or reversed by the president of the United States.

In each state, the governor created advisory boards for registrants. These boards usually comprised three or more lawyers. Their function was to advise and assist registrants. The governors also created medical advisory boards usually consisting of internists; eye, ear, nose and throat specialists; orthopaedists; surgeons; psychiatrists; clinical pathologists; radiographers; and dentists. These boards assisted the local boards to decide questions of a registrant's physical fitness when the local examining physician was in doubt.

Members of the advisory boards, appeal boards and local boards, together with the examining physicians and government appeal agents were all voluntary workers. They served their country without compensation. They numbered almost 200,000.

After Oct. 16, 1940.—The day following the first registration day, the registrars sent the registration cards which had been entrusted to them to the local board nearest each registrant's home address. Each local board then began the process of sorting and numbering its cards. After examining the cards to ensure that all belonged to men in its local board area, each local board shuffled its cards and then gave each card a serial number. The first card received serial number 1; the second card, serial number 2; the third card, serial number 3 and so on. When the serial numbering process had been completed, each of the more than 16,000,000 men who were registered, had been assigned a serial number.

Each local board then prepared a "List of Registrants." At the top of the list was serial number 1 and the name of the man whose card received serial number 1, next was serial number 2 and the name of the man whose card received serial number 2, and so on. The local board next posted its list of serial numbers and names for public inspection in or near the local board. A copy was sent to state headquarters and copies were made available for the press and radio news agencies.

In each local board area there was a man who held serial number 1; another, serial number 2; and so on up to a serial number equal to the number of men registered in the particular board. A local board with 125 registrants had serial numbers from 1 to 125; one with 6,125 registrants had serial numbers from 1 to 6,125.

National Selective Service Lottery.—While this process of serial numbering was nearing completion, Director Dykstra announced that the National Selective Service lottery would be held on Oct. 29, 1940. There were 9,000 opaque capsules filled with individual cardboard slips, bearing the numbers 1 to 9,000. The goldfish bowl which was used in the draft lottery of 1917 was loaned by Independence Hall, Philadelphia, where it was on display. Secretary of War Henry L. Stimson drew the first number —158.

Secretary of the Treasury Morgenthau drew the second number, which was 192; Attorney-General Jackson, the third, 8,239; Secretary of Navy Knox, the fourth, 6,620; Federal Loan Administrator Jesse Jones, the fifth, 6,685. After Jesse Jones had drawn the fifth number, the president left the auditorium and the drawing continued in a mechanical, routine manner for 17 hr.

Every precaution was taken by Selective Service officials to minimize the chance of error and to assure the U.S.A. that no possible mistake would pass by unnoticed. The capsules were completely opaque and of sufficient length to make it unnecessary to fold the numbered slips. Each number, as it was drawn, was read aloud. The numbered slip was then photographed with a watch which showed the second, minute and hour of the drawing. This photograph also recorded the sequence or order in which the number was drawn. The numbered slip was then mounted with adhesive on a master sheet which held 250 numbers in the order of drawing. As each sheet was filled it was photographed and rushed to the government printing office. There the sheet was reproduced by a photo offset process and the true photographic copy was sent to each local board. By this method, confusion resulting from error in typesetting was completely eliminated.

Drawing and tabulating the 9,000 numbers was an exhausting task. Clerical employees worked in shifts, on duty for two hours, resting for four hours. Army cots were provided in the basement. At last, at 5.47 A.M., Brig. General Lewis B. Hershey, deputy director of Selective Service, drew the last capsule (no. 2,114) from the glass jar. The entire procedure had required 17 hr., 31 min.

After the Lottery.—The 9,000 numbers that had been put into the bowl had, as a result of the lottery, been rearranged in an accidental sequence known as the national master list. This national master list was sent to every state headquarters and local board throughout the country.

Upon receiving the national master list, the local board proceeded to give each registrant an order number. The greatest care was exercised in the assignment of these order numbers, because the order numbers established the order in which registrants were to be selected for service.

The registrant whose serial number appeared at the top or nearest the top of the national master list received order number 1. The registrant whose serial number was next closest to the top, received order number 2. The registrant whose serial number was third closest to the top of the list, received order number 3, etc., until each registrant had an order number.

Order numbers were assigned in sequence; no order numbers were skipped. Serial numbers appearing on the national master list which were not held by any registrant of a particular local board, were simply crossed off the national master list and ignored.

The first step in the process of order numbering was the elimination of those serial numbers on the national master list which did not apply to the particular local board. The remaining serial numbers on the national master list were then paired with the proper order number.

For example, the national master list began:

Serial number 158
serial number 192
serial number 8,239
serial number 6,620
serial number 6,685
serial number 4,779

These were the first 6 serial numbers drawn in the lottery, arranged in the order in which they were drawn. Suppose that a certain local board's largest serial number was 4,780, because only 4,780 men were registered in that particular local board area. Thus: serial number 158 got order number 1; serial number 192 got order number 2; serial number ~~8,239~~ (eliminated); serial number ~~6,620~~ (eliminated); serial number ~~6,685~~ (eliminated); serial number 4,779 got order number 3.

When the local board was sure that its assignment of order numbers was correct, it entered the order numbers on the registration cards in red ink in the place designated. Thus, when this order numbering process had been completed, the more than 16,000,000 registrants in more than 6,400 local boards had been arranged in a new and accidental sequence that determined the order in which each man would be considered for service by his local board.

The second national lottery was held at Washington July 17, 1941; a "trainee" from Ft. Dix, N.J., drew the first capsule—number 196. The list of numbers was integrated into the list of the first lottery. The third lottery was held March 17, 1942, to determine the order numbers of the men between the ages of 20 and 44 who had registered the preceding Feb. 16.

Classification.—Beginning with the man holding order number 1, and following the numerical sequence of order numbers as determined in the first national lottery, the local board began to mail questionnaires to its registrants at the rate of not more than 50 each day. Five days were allowed for the return of this questionnaire to the local board. On the basis of the information contained in the questionnaire, the local board then began to classify each man in one of the following classes:

Class I–A: Available; Fit for general military service. In class I–A are placed registrants who, after physical examination, are found fit for general military service.

Class I–B: Available; Fit only for limited military service. In Class I–B are placed registrants who, after physical examination, are found fit for only limited military service.

Class I–C: Available; Member of land or naval forces of the U.S. In Class I–C are placed registrants who are or who by induction or enlistment became members of U.S. land or naval forces.

Class I–D: Student fit for general military service. Available not later than July 1, 1941. In Class I–D are placed college or university students who, after physical examination, are found fit for general military service.

Class I–E: Student fit for only limited military service. Available after July 1, 1941. In Class I–E are placed college or university students who, after physical examination, are found fit only for limited military service.

Classification in Class I–A, I–B, I–D, or I–E is made only after examination by the local board's examining physician.

Class II–A: Man necessary in his civilian activity. In Class II–A are placed registrants found to be necessary to national defense, in industry, business, employment, agricultural pursuits, government service, etc.

Class III–A: Man with dependents. In Class III–A are placed registrants upon whom one or more dependents rely for support in a reasonable manner.

Class IV–A: Man who has completed service. In Class IV–A are placed registrants who have completed the required military service.

Class IV–B: Official, deferred by law. In Class IV–B are placed registrants who are officials, specifically deferred by law.

Class IV–C: Nondeclarant alien. In Class IV–C are placed registrants who are aliens and who have not declared their intention to become citizens of the United States.

Class IV–D: Minister of religion or divinity student. In Class IV–D are placed registrants who are regular or duly ordained ministers of religion or who are students who are preparing for the ministry in the theological or divinity schools, recognized as such, for more than one year prior to the date of the enactment of the Selective Service act.

Class IV–E: Conscientious objectors. In Class IV–E are placed conscientious objectors who are available only for civilian work.

Class IV–F: Physically, mentally or morally unfit. In Class IV–F are placed registrants who are found to be physically, mentally or morally unfit for military service.

Registrants claiming to be conscientious objectors had to substantiate their claims in a special form of questionnaire.

Induction.—As a result of the classification process after the first registration and lottery, each local board had a pool of men classified in Class I–A (fit for general military service). Early in Nov. 1940 the war department issued its first call for men to be inducted through the Selective Service process. The total number of men inducted in the first call was 19,670. This call was apportioned among the states.

Quotas.—The calls issued to the various states were based on estimates. Subsequent adjustments were to be made in order to conform to that provision of the Selective Training and Service act which provided:

"Quotas of men to be inducted for training and service under this act shall be determined for each state, territory, and the District of Columbia and for subdivisions thereof . . . on the basis of the actual number of men . . . who are liable for such training and service, but who are not deferred after classification, except that credits shall be given in figuring such quotas for residents of such subdivisions who are in the land and naval forces of the United States. . ."

The gross quota represented an estimate of the total number of men who would be in U.S. armed forces on July 1, 1941, from the particular state, based on the number of men available for service from that same state. The credits (national guard) represented the total number of men who would be in the national guard on July 1, 1941, from the particular state to which they were credited. The credits (other) represented an estimate of the total number of men who would be in other branches of the armed

forces on July 1, 1941, from the particular state to which they were credited. The net quota represented gross quota less the credits. This net quota was the estimated number of men to be inducted by Selective Service in order to make up the number of men to be supplied by the particular state. (C. A. Dv.; X.)

Later Legislative Changes in the Selective Service Act.—During 1941, the 77th congress passed several amendments to Public Law 783, passed by the 76th congress, which set up the Selective Service system. The most important of these were as follows:

Public Law 206 (S. 1524) was approved by the president on Aug. 16, 1941. This law in the main provided deferment for registrants above 28 years of age, and for the release of such men already inducted.

Public Law 213 (S.J. Res. 95) was approved by the president on Aug. 18, 1941. The principal provision of this law was to extend the period of training and service to 30 months. It also provided certain rights for National Service Life Insurance, and it provided for release from service of certain men having dependents and provided for an increase of pay of $10 per month after one year of service.

Public Law 338 (S.J. Res. 117) was approved by the president on Dec. 13, 1941. This law removed any territorial restrictions on the use of selectees and extended the period of training and service for the duration and for six months after any war in which the United States might be engaged.

Public Law 360 (H.R. 6125) was approved by the president on Dec. 20, 1941. The main provisions of this law were: (1) provision for the registration of the man power of the United States between the ages of 18 and 65 and (2) provision for liability to service of those between 20 and 45.

WARP AND WEFT. Warp threads are those which run lengthwise of the fabric; weft threads run transversely. In the actual manufacturing of practically all kinds of woven textures, there is a considerable difference between the two: (1) The raw material from which warp is made is almost invariably of a higher grade than that used for weft. (2) The number of turns per inch or the "twist" in warp threads usually exceeds the twist in the weft threads or picks. (3) Multiple-fold or multiple-ply yarns (two or more single threads twisted together) are more often used for warp than for weft. (4) Coloured threads appear in both, but much more frequently in the warp than in the weft. (5) The fibrous material from which warp threads are made may be the same as that used for the weft threads, or the two may be of entirely different kinds. (6) Warp threads are often starched or sized, but weft threads are seldom treated in this way.

With the exception of knitted fabrics or other similar structures in which one series of yarns only is used, the warp and weft threads interweave together, not only to form the structure of the fabric but also to adorn it with more or less complex designs. (*See* WEAVING.)

WAR PENSIONS (GREAT BRITAIN). First Period—Prior to 1592–93. The war pension—which is here taken as covering any grant made in recognition of disablement sustained in the fighting forces—first appears as a purely voluntary grant at the goodwill of the particular war captain or overlord who led a company, or commanded a ship. The commonest form of grant is thus naturally a gratuity on discharge, though the territorial system of the feudal levy obviously provided the means of continued support or assistance in cash or kind where necessary. The monastic houses and charitable endowments of the Church helped substantially in the same direction. The dissolution of these establishments and the dispersal of their endowments, together with the final break up of the feudal system in the 16th century, left the disabled soldier entirely dependent on his former commander. Captains of forces in the Low Countries in Elizabeth's day complained that they were expected to make provision for the sick and wounded "whose charge has laid heavily on them" and the queen "is troubled whensoever she takes the air by these miserable creatures." Accordingly in the last ten years of her reign a series of acts was passed making definite provision by statute for the first time for disabled soldiers and seamen.

Second Period 1592–1681.—The first of these acts recognized the claim of the soldier or seaman maimed "in the service of Her Majesty and of the State" and provided also for those who, though not maimed, had served for 20 years or were incapacitated. The act laid on the locality of the man's enlistment the obligation of providing the pension. The amount of a pension was not to exceed £10 a year for a private soldier, nor £15 for an officer.

This system can never have been altogether satisfactory. Local obligations were unequally fulfilled, payments were irregular and no effective central control existed to make the system work. But, except for a brief interval during the Protectorate, when pensions were made payable from national funds, largely from the sequestrated property of Royalists, the system lasted until some years after the Restoration.

Army Pensions: 1681–1914.—In 1681 Charles II announced his intention to erect a hospital for disabled soldiers and endow it with revenue. Contributions were invited from the public, the king himself heading the list with a substantial grant, but recourse had soon to be had to other means. Funds were found by deduction from the pay of the troops—poundage as it came to be known—both for the cost of construction and maintenance of the hospital and for some part of the cost of pensions, but at a very early date parliament had to supplement these funds, and finally, though not till 1831, when all deductions were finally abolished, it took over the entire cost.

The pension system contemplated was at the outset essentially one of maintenance in a hospital, but in 1685 it was provided that the disabled should receive allowances out of the hospital's funds (out-pensions) until they could be accommodated within it. The disability pensions were at flat rates according to rank, and without regard to the extent of disablement, the awards being made by the commissioners without examination of the men and solely on the strength of certificates from commanding officers. The natural result was in a few years a heavy pension list, and increasing demands on parliament, with the result that in 1713 the commissioners made a complete re-examination of all cases and struck off the pension list all—about one-half the whole number—of whom they were satisfied were wholly able to support themselves. At the same time the pension rate was reduced to a uniform 5d. a day for all ranks. Complaints on the part of the pensioners and ex-pensioners were general, but the principle of a uniform pension rate was adhered to until 1806.

The warrant of 1806 and the act of that year revolutionized the system of pensions. Thereafter disability pensions assumed two permanent characteristics. The pension became a definite reward of service, and it was based at a rate proportionate to the extent of the injury and to the ability of the man to provide for his own livelihood.

On these lines the warrants of the 19th century developed, though, so far as rates of pension are concerned, with extraordinarily little change. The maximum rate for disablement rose only from 14s. a week to 17s. 6d. Not until the South African War were pensions provided for widows out of public funds.

Naval Pensions: 1695–1917.—Provision for disabled seamen was made by William III on the same lines as had been applied by his predecessors to ex-soldiers, namely, on the plan of maintenance in a hospital. The in-pensioner establishment remained popular, and until the middle of the 19th century there were few vacancies. But thereafter the terms of out-pension were improved and the in-pensioners steadily declined in number, until it was thought to be more economical to offer out-pensions to the whole establishment, and in 1869 the hospital was closed to fresh admissions.

The out-pension rates immediately prior to the World War of 1914–18 were for total disablement, from 10s.6d. to 14s.0d. a week; and for partial disablement, which was graduated in three stages, from 3s. 6d. to 10s. 6d. a week. The widow and child were eligible for the same terms as in the army service.

Officers of Both Services.—Pensions for disabled officers have, since their first appearance as a charge upon public funds, been based on the recognition of the professional status and prospects of the officer. Pension is thus based on the half of the pay of

the rank held by the officer at retirement, subject to variation in accordance with the length of his service. An additional consideration for severe wounds received in action, known as "wound pension" (maximum £108 a year), was devised in 1812 and was maintained up till the end of the World War of 1914–18, being permitted to be drawn in addition to half pay. For naval officers a slightly different system obtained. If the disabled officer was under 40 years of age he received the half-pay rate; if over 40, a rate graduated according to age and length of service, but not exceeding the pension due to him on voluntary retirement.

Pension for officers' widows, the provision for which as a public charge goes back to the 18th century, varied according to the circumstances of the husband's death, death in action carrying a higher rate than injury or illness on duty. The rates in operation prior to the World War of 1914–18 were, for the widow of a 2nd lieutenant, £80 a year in the former case and £40 in the latter

World War (1914–18).—The World War changed the whole outlook on pensions. Within a few months of its outbreak the regular forces, even with the addition of the territorial army, were trebled in numbers by voluntary enlistments and, with the enactment of compulsory service in 1916, the army became a national civilian levy of more than 5,000,000 men. At first the Government tried to keep the existing structure of administration. A cabinet committee in the autumn of 1914, followed by a Select Committee, recommended substantially increased rates of disability pensions for both services. The new scale, which subsisted until the end of 1916, raised the widow's pension to 10s. a week (12s.6d. at 35 and 15s. at 45 years of age) and raised her children's allowances; it also provided pensions for other actual dependents, and increased the maximum disability pension to 25s. a week. Pensioners were comparatively few up to 1916, and the central committee was mainly occupied with supplementary family pensions when it was superseded.

The Ministry of Pensions.—This ministry was set up in 1916 to deal with two sources of grievance that had arisen, *viz.*, the practice of determining the amount of pension by reference to a man's capacity to earn a living, and the apparently arbitrary refusal of many pensions on the ground that the disabilities claimed had no connection with military service. The former practice was abandoned by the ministry, which also authorized appeal to a tribunal under a county court judge in cases where doubt as to eligibility existed. At the same time (March 1917) a slight increase in the scales of pensions for all ranks came into effect.

In 1917 the total problem of industrial resettlement for disabled men was transferred from the quasi-charitable Royal Patriotic Fund corporation to the ministry. This work (except for medical care) proceeded without notable difficulties until after the Armistice, when it was multiplied many times by the great volume of demobilization —as many as 50,000 men a day. Aside from the inevitable delay in resettlement and in the adjustment of claims, the pension problem was further complicated by the rising cost of living, which at the time was double the pre-war figure.

The Government met the situation partially by adding a bonus of 20% in Nov. 1918 to the pension rates (bringing the maximum pension for an ex-private to 33s. a week). It also appointed a new Minister of Pensions in Jan. 1919 with a mandate to overhaul the entire machinery of administration. The new ministry was decentralized and disencumbered of its resettlement functions. By the War Pensions Act, 1919, a new series of appeal tribunals, independent of the ministry, was substituted for the informal tribunals. The Government also increased substantially the rates of all classes of pensions by an amount which bore a definite relation to the increase in the cost of living in 1919 over the cost in 1913–14. In 1928 the Government announced that the rates would not be reduced, however much the cost of living might fall, subject to certain conditions for safeguarding both pensioner and State.

The War Pensions Act, 1920, confined the operations of the ministry to disabilities or deaths occurring as a result of World War (1914–18) service terminating Aug. 31, 1921. In 1921 another War Pensions Act declared that every award made up to Aug. 21, 1921, unless stated to be subject to review, would be considered final. The subsequent history of British war pensions, except for amendments in 1924, was one of gradual quiescence. *See* also PENSIONS: NAVY, ARMY AND AIR FORCE; PENSIONS: THE UNITED STATES.

WARQLA (OUARGLA), a town of the Algerian Sahara. Pop. 3,251, the majority of mixed Berber and Negro blood. It is walled and is entered by six gateways, which are fortified. The French fort, barracks, hospital and other buildings are south of the native town. The oasis in which Warqla is situated contains two or three other small fortified *ksurs* or villages, the largest and most picturesque being Ruissat. The population of the oasis is about (1936) 15,000.

WARRANT, in law, indicates an authority in writing empowering a person to do an act or to execute an office. The term is applied to a great variety of documents of very different kinds.

Executive and Administrative.—While the royal prerogative was insufficiently defined and limited, a great many executive acts were authorized by royal warrant (*per speciale mandatum regis*) which now either depend on statute or are dealt with by departments of State without the need of recourse to the personal authority of the sovereign. There is hardly any exercise of the royal will which does not depend on the issue of a warrant attended with the strictest formalities designed to secure the responsibility of some minister for it, in illustration of the great constitutional principle that "the King cannot act alone." (*See* PREROGATIVE; PRIVY COUNCIL.) Under present constitutional practice royal warrants are as a general rule countersigned by a member of the cabinet or other responsible officer of State. By an act of 1435 (18 Hen. VI. c. 1) letters patent under the great seal must bear the date of the royal warrant delivered to the chancellor for their issue. This act still applies to all patents, except for inventions. The form and countersignature of warrants for affixing the great seal is regulated by the Great Seal Act 1884. Pardon, which was granted for centuries only by letters patent under the great seal, has since 1827 in England and 1828 in Ireland been granted in case of felony by warrant under the royal sign manual countersigned by a secretary of State (7 and 8 Geo. IV. c. 28, s. 13; 9 Geo. IV. c. 54, s. 33). The prerogative of the crown with reference to the control of the navy and army is largely exercised by the issue of warrants. In 1871 the purchase of commissions in the army was abolished by royal warrant. The convocation of naval courts-martial and the appointment of judge-advocate and provost-marshal at such court is by warrant of the Admiralty or of the officer on foreign or detached service who by his commission is entitled to convene such a court. (*See* Naval Discipline Act 1866, s. 58; Army Act 1881, s. 179.) A general court-martial for the army is constituted by royal warrant or convened by an officer authorized to convene such court, or his lawful delegate (Army Act 1881, s. 48). Appointments to certain offices under the crown are made by warrant of the king or of the appropriate department of State. In the navy and army the officers called warrant officers are so styled because they are appointed by warrant and do not hold commissions. Certain tradesmen to the court are described as "warrant holders," because of the mode of their appointment. Abuses of claims to this distinction are punishable (Merchandise Marks Act 1887, s. 20; Patents Act 1883, s. 107). The issue of warrants under the hand of a secretary of State, so far as they affect personal liberty, depends in every case on statute, *e.g.*, as to the surrender of fugitive criminals (EXTRADITION), or the deportation of undesirable aliens (*see* ALIEN), or the bringing of prisoners as witnesses in courts of justice. The right of a secretary of State by express warrant in writing to detain or open letters in the post office was recognized by orders in council and proclamations in the 17th century and by various acts, and is retained in the Post Office Act 1836 (s. 25).

Judicial and Quasi-Judicial Warrants.—Unless a statute otherwise provides a judicial warrant must be in writing under the seal, if any, of the court, or under the hand and (or) seal of the functionary who grants it. Committal for breach of privilege of the House of Commons is by warrant of the Speaker. During the Tudor and Stuart reigns frequent attempts were made by the crown and great officers of State to interfere with personal liberty, especially as to offences of State. The legality of these proceedings was challenged by the judges in Elizabeth's reign. On the abolition of the Star Chamber it was enacted (16 Car. I. c. 10) that if any person be imprisoned by warrant of the king in person, of the council board, or any of the privy council, he is entitled to a writ of *habeas corpus,* and the courts may examine into the legality of the cause of detention. This enactment, and the Habeas Corpus Act 1679, put an end to the interference of the executive with matters belonging to the judicature; but until 1763 there survived a practice by which a secretary of State issued warrants to arrest individuals for State offences, and to search or seize the books and papers of the accused. The latter practice was examined and declared illegal in the famous case of *Entick* v. *Carrington* (19 How. St. Tr. 1030) where it was held that a secretary of State is

the king's private secretary and has not, as such, the authority of a magistrate to issue a warrant. Still more important were the cases of *Leach* v. *Money* (19 St. Tr. 1001) and *Willus* v. *Wood* which declared the illegality of "general" or "uncertain" warranty, *i.e.*, warrants which do not testify the name of the person to be arrested. All privy councillors are included in the commission of the peace for every county. The council itself is said to have power to issue warrants of arrest for high treason, but the power, if it exists, is in abeyance in England. As a result of the gradual restriction of the royal prerogative, the term warrant has come in modern times oftenest to be used of documents issuing from courts of justice. Few documents issuing from the superior courts are called warrants. In these courts writs and orders are more generally used. In courts of record which try indictments a "bench warrant" is sometimes used for the arrest of an absent defendant, but the word warrant has for judicial purposes become most closely associated with the jurisdiction of justices of the peace. As a general rule no one can be arrested for a misdemeanour. But to this rule there are many statutory exceptions, as in the case of street offences, gambling, cruelty to animals, offences against the person, profanity and other misdemeanours, also of a breach of the peace actually committed in the presence of a constable. In the case of felonies, no warrant is necessary. At common law a justice of the peace, a sheriff, a coroner, a constable and even a private person, may arrest any one without warrant for a treason, felony or breach of the peace committed, or attempted to be committed, in his presence. A constable (whether a constable at common law or a police constable appointed under the Police Acts) may arrest a person indicted for felony; a constable or a private person may arrest on reasonable suspicion that he who is arrested has committed a felony. But in the latter case he does so at his peril, for he must prove (what the constable need not) that there has been an actual commission of the crime by some one, as well as a reasonable ground for suspecting the particular person. What is a reasonable ground it is of course impossible to define, but, in the case of a constable, a charge by a person not manifestly unworthy of credit is generally regarded as sufficient. An accused person who has been bailed may be arrested by his bail, and the police may assist in the arrest. In neither case is a warrant necessary. Nor is it necessary for the apprehension of one against whom the hue and cry is raised. The king cannot arrest in person or by verbal command, as no action would lie against him for wrongful arrest. In those cases in which arrest without warrant is illegal or is found inexpedient, information in writing or on oath is laid before a justice of the peace setting forth the nature of the offence charged and to some extent the nature of the evidence implicating the accused; and upon this information, if sufficient in the opinion of the justice applied to, he issues his warrant for the arrest of the person incriminated. The warrant, if issued by a competent court as to a matter over which it has jurisdiction, becomes a judicial authority to the person who executes it, and resistance to such a warrant is a criminal offence. The issue of a warrant by a justice of the peace is a judicial act, and provided he is acting within his jurisdiction, he cannot be sued for a "false imprisonment" by the person arrested, even though he has acted unreasonably in issuing it and the prisoner is acquitted. Speaking generally, a constable to whom a warrant is issued is protected from any action at law for executing it if it was apparently legal on the face of it, because he is bound to obey it. But if he arrested the wrong person or arrested without having the warrant in his possession, he is liable in an action for "false imprisonment." Entry upon the land or seizure of property cannot as a rule be justified except under judicial warrant. The only common law warrant of this kind is the search warrant, which may be granted for the purpose of searching for stolen goods. Special powers for issuing such warrants are given by the Army, Merchant Shipping, Customs, Pawnbrokers and Stamp Acts, and for the discovery of explosives or appliances for coining and forgery. The Official Secrets Acts of 1911 to 1920 are remarkable in that they disperse with the necessity of the intervention of a justice of the peace in the case of a search for official documents and enable the constable to make such a search on the order of a superintendent of police if it appears that "immediate action is necessary." The Criminal Law Amendment Act 1885 allows the issue of search warrants where it is suspected that a female is unlawfully detained for immoral purposes. Execution of the decisions of a court of summary jurisdiction is secured by warrants, part of the process of the court, such as warrants of distress or commitment. A warrant may also issue for the apprehension of a witness whose attendance cannot be otherwise assured. The forms of warrants used by justices in indictable cases are scheduled to the Indictable Offences Act 1848. Those used for summary jurisdiction are contained in the Summary Jurisdiction Rules of 1886.

As a general rule, warrants must be executed within the local jurisdiction of the officer who issued them. Warrants, etc., issued by a judge of the High Court run through England, in criminal as well as in civil cases: and the same rule applies as to courts having bankruptcy jurisdiction. The warrants of justices of the peace can be executed on fresh pursuit within 7 m. of the boundary of the jurisdiction, and if properly backed by a local justice or officer in any other part of the British Isles. (*See* SUMMARY JURISDICTION.) There is also a special provision as to executing warrants in the border counties of England and Scotland. Under the Extradition Acts and Fugitive Offenders Act 1881 provision is made for the issue of warrants in aid of foreign and colonial justice; but the foreign and colonial warrants have no force in the United Kingdom. The word is used as to a few judicial or quasi-judicial matters of civil concern, *e.g.*, warrant to arrest a ship in an admiralty action *in rem;* and in the county courts warrants to the bailiffs of the court are used where in the High Court a writ to the sheriff would be issued, *e.g.*, for attachment, execution, possession and delivery.

Financial and Commercial.—Payment out of the Treasury is generally made upon warrant. Treasury warrants are regulated by many of the acts dealing with the national debt.

Payment of dividends by trading corporations and companies is generally made by means of dividend warrants. Mercantile warrants are instruments giving a right to the delivery of goods, generally those deposited at a dock or warehouse, and by mercantile custom regarded as documents of title to goods.

Scotland.—By art. xxiv. of the Articles of Union royal warrants were to continue to be kept as before the union. The Secretary for Scotland Act 1885 enabled the crown by royal warrant to appoint the secretary to be vice-president of the Scotch Education Department. The lord advocate's warrant runs throughout the whole of Scotland. Warrants issued by courts of summary jurisdiction agree in the main with those in use in England, though their names are not the same. (*See* SUMMARY JURISDICTION.) There are many statutory provisions as to other warrants.

(W. F. C.)

UNITED STATES

Judicial warrants can be divided into the two classes of warrants of arrest and warrants of search and seizure. The use of general or John Doe warrants, which did not specify the name of the person to be arrested nor the place to be searched nor the character of the goods to be seized, and the use of writs of assistance having a like effect, a practice condemned in 1763 by Lord Camden in *Entick* v. *Carrington* (19 How. St. Tr. 1030) and one of the abuses complained of by the colonists in the Revolutionary War, led to the prohibition of the issuance of such warrants by constitutional provisions. The 4th amendment to the U.S. Constitution thus provides against unreasonable searches and seizures and prohibits the issuance of any warrant "but upon probable cause, supported by Oath or affirmation, and particularly describing the place to be searched, and the person or things to be seized." Though this amendment is only a limitation upon the powers of the Federal Government, similar restrictions upon the States are to be found in the State Constitutions.

Warrants of arrest, which are necessary where under the common law or under statutory provision no power to arrest without warrant may be exercised, may be issued by those officers designated by the State or Federal statutes. These ordinarily include judges, U.S. commissioners, justices of the peace and judicial or quasi-judicial officers of municipal corporations. A similar power

is conferred upon certain administrative officers in the exercise of their functions, the commonest example being that of warrants issued by the Department of Labor in the deportation of aliens. Under the traditional laws of parliamentary privilege a power to issue warrants of arrest for breach of privilege resides in the speaker of a legislative assembly or the president of a senate. The warrant issues at the behest of the complainant upon a complaint setting forth the facts or information upon which the guilt of the offender is based. Probable cause must be shown in the sense that the complainant must make out a *prima facie* case for concluding that the person accused was guilty of the crime. The complaint must be accompanied by the affidavit of the complainant. The forms and requisites governing the issuance of the warrant must be strictly complied with. The legality of the warrant and the arrest thereunder can be contested by a *habeas corpus* proceeding (*q.v.*) or by an action for false imprisonment. Analogous to the ordinary warrant of arrest is the bench warrant which is issued by the court itself for arrest for contempt or after indictment found or against a recalcitrant witness.

The issuance of search warrants is governed generally by the same limitations surrounding warrants of arrest. The description of the property to be seized must be so particular that the officer charged with the execution of the warrant will be left with no discretion respecting the property to be taken. It may issue for the recovery of stolen property, for the seizure of property used for the commission of a crime or in the possession of a person intending to use it for such a purpose. The warrant should be executed only during the day-time but the officers when resisted may forcibly enter the premises. In its execution its limitations must be strictly observed, and the search confined to the character of goods enumerated in the warrant. Resistance to its execution is punishable. The legality of its issuance is in some instances reviewable by writ of certiorari to a superior tribunal. In all cases the legality of its issuance and execution can be contested by an action of trespass against the officer. In order to make more effective the constitutional prohibition against unreasonable searches and seizures the Federal courts refuse to admit any evidence obtained as a result of a search without a warrant or under an illegal warrant. The majority of the State courts, however, admit such evidence and leave the complainant to his civil action against the offending officer. The enforcement of the constitutional protection against unreasonable searches and seizures has become a matter of intense moment in the prosecution of offenses against the 18th amendment and legislation under it seeking to make effective the constitutional prohibition against the sale, manufacture and transportation of intoxicating liquor. The assertion of these new and penetrating powers of government has, in communities where their assertion is regarded as an infringement upon the liberty of the citizens, precipitated issues akin to those that agitated the citizenry during the controversy over general warrants and writs of assistance.

Other judicial warrants may be briefly adverted to. The escape warrant is issued for the recapture of prisoners who have escaped from custody. The warrant of commitment is the process by which a court directs a ministerial officer to take a person to prison either before or after trial. Orders directing the execution of an offender are known as death warrants, commonly issued by the governor of the State. In some States their issuance is by statute a prerequisite to the execution of the death sentence; in others the pronouncement of the sentence in open court is sufficient authority for its execution. The landlord's warrant is directed by a landlord to a constable to levy upon the goods of his tenant and sell them in order to constrain the latter to pay the rent. Under the Federal Bankruptcy Act of 1898, Section 69, a judge may issue a warrant to a marshal authorizing him to seize the property of a bankrupt upon proof that the latter is neglecting his property or allowing it to deteriorate. A tax warrant is the authority under which a collector is authorized to collect taxes.

Numerous other warrants of a financial or commercial nature are also known to the American law. The term warrant is used to apply to an order or draft for the payment of an indebtedness. School warrants thus issue for the payment of an indebtedness incurred by a school board or district. Like a check or draft it is a conditional payment of the debt. Similarly there are municipal warrants, treasury warrants, State warrants, reclamation warrants, dividend or interest warrants of private corporations. Land warrants are transferable certificates issued by the Government entitling the holder to a specific tract of public land. A warrant of attorney is a writing addressed to one or more attorneys authorizing them to appear in court in behalf of the person who gives the warrant and confess judgment in favour of some particular person named in the warrant. They are commonly used to facilitate the collection of negotiable instruments and such a provision authorizing the confession of judgment on the note is commonly appended to the negotiable instrument. Some States by statute prohibit judgments by such confession. (J. M. La.)

WARRANT OF ATTORNEY. A warrant of attorney to confess judgment is a security for money (now practically obsolete) in the form of an authority to a solicitor named by a creditor, empowering him to sign judgment in an action against the debtor for the sum due, with a clause that the warrant shall not be put into force in case of due payment.

WARRANTY, etymologically, another form of GUARANTEE (*q.v.*). It is used, however, in a rather different sense. The sense common to both words is that of the collateral contract. A "warranty" expresses the collateral responsibility of the principal actor, while "guarantee" expresses that of his surety. It differs from a condition in that a condition forms the basis of the contract and a breach of it discharges from the contract, and from a representation in that the latter does not affect the contract unless made a part of it expressly, or by implication as in contracts of insurance and other contracts *uberrimae fidei,* or unless it be fraudulent. These distinctions are not always maintained. Thus in the Real Property Act 1845, s. 4, condition seems to be used for warranty.

Warranty as it affected the law of real property was, before the passing of the Real Property Limitation Act 1833 and the Fines and Recoveries Act 1833, a matter of the highest importance. A warranty in a conveyance was a covenant real annexed to an estate of freehold, and either expressed in a clause of warranty or implied in cases where a feudal relation might exist between feoffor and feoffee. The warranty, as described by Littleton, s. 364b, 697, was an outgrowth of feudalism, and something very like it is to be found in the *Liber Feudorum.* At the time of Glanvill the heir was bound to warrant the reasonable donations of his ancestor. Warranty was one of the elements in Bracton's definition of homage, 78*b*, "juris vinculum quo quis astringitur ad warrantizandum defendendum et acquietandum tenentem suum in seisina versus omnes." For an express warranty the word *warrantizo* or warrant was necessary. The word "give" implied a warranty, as did an exchange and certain kinds of partition. In order to bind heirs a clause of warranty was required. This was either lineal, collateral or commencing by disseisin. The feoffor or his heirs were bound by voucher to warranty or judgment in a writ of *warrantia chartae* to yield other lands to the feoffee in case of the eviction of the latter. Vouching to warranty was a part of the old fictitious proceedings in a common recovery in use for the purpose of barring an entail before the Fines and Recoveries Act. Warranty is now superseded by covenants for title. The more usual of these are now by the Conveyancing Act 1881 deemed to be implied in conveyances. For the implied warranties of title and quality *see* SALE OF GOODS. Vouching to warranty was at one time important in the law of personalty as well as of realty. Warranty, as it exists at present in the law of personalty, is either express or implied. The principal cases of implied warranty occur in the contracts of sale and insurance. There is also an implied warranty in other kinds of contract, *e.g.,* of seaworthiness by the shipowner in a contract between him and a charterer for the hire of a ship. In all cases of implied warranty the warranty may be excluded by the special terms of the contract. For breach of warranty an action may be brought directly, or the breach may be used as ground for a counter claim or for reduction of damages, but the breach will not in the case of a warranty proper entitle the person suffering by it to a rescission of the contract. Thus in a sale the property passes although the warranty be broken. In some cases warranties

on sale are the subject of statutory enactments, as the Merchandise Marks Acts and the Sale of Food and Drugs Acts.

Scotland.—Warranty is a term imported into Scots law in connection with mercantile law. Differing from the English interpretation it signifies a material condition of the contract, breach of which discharges from the contract in the option of the other party (*see* Sale of Goods Act 1893, ss. 53 [5] and 62 [1]). The term native to Scots law is "warrandice." It occurs in connection with deeds transferring land or discharging obligations, and is in the form of a warranty by the grantor that his title is good. Warrandice is either real or personal. Real warrandice is that whereby warrandice lands are made over, as indemnity for those conveyed, to assure the person to whom they were conveyed from loss by the appearance of a superior title. Real warrandice is implied in excambion or exchange of lands. Its effect is that the excamber, in case of eviction, may recover possession of his original lands. Personal warrandice is either express or implied. There is an implied warrandice in every onerous deed. Express warrandice may be either simple, against the future acts of the grantor; from fact and deed, against the grantor's own acts whether past or future; or absolute, *i.e.*, against acts and deeds whether (a) of the grantor or (b) of a third prior to the date of the deed. A clause of warrandice is the Scottish equivalent of the English covenants for title. By the Titles to Land Consolidation (Scotland) Amendment Act 1869 a clause of warrandice in the form given in the schedule to the act imports absolute warrandice as regards the lands and the title-deeds thereof, and warrandice from fact and deed as regards the rents.

United States.—In the United States the common law warranty accompanying the conveyances of real property seems never to have been known. Personal covenants of title were developed in its place and with greater vigour than in England inasmuch as purchasers were unaccustomed to examine titles with the particularity that is common in England. These covenants of title generally embrace the covenant of seisin or right to convey, the covenant against incumbrances, the covenant for quiet enjoyment and of warranty. This modern covenant of warranty, which is not recognized in England, is quite different from the common law covenant of warranty. Under this covenant the grantor warrants that he will defend the grantee against all lawful claims by third persons. In some States by statute these covenants are implied from the simple terms granting the estate; in other States by statute no such covenants are implied but must be express. The quit-claim conveyance ordinarily imports no covenants but as altered by statute in some States it carries with it a covenant of title. In sales of personal property, warranties are governed by sections 12–16 of the Uniform Sales Act. Any affirmation of fact or promise by the seller relating to the goods and inducing the buyer to purchase them is regarded as an express warranty. In the absence of express warranties the buyer is protected by the implication of warranties of title and quality. In contradistinction to the English law of sale, rescission for breach of warranty is permitted. The buyer may tender back the goods and recover the purchase price. (*See* Sale of Goods.) Sections 65 and 66 of the Uniform Negotiable Instruments Law govern the character of warranties that accompany the transfer of negotiable instruments with or without indorsement. Warranty in insurance law operates to relieve the insurer of liability for breach thereof. Legislation commonly provides that no statements of fact made by the insured shall be regarded as warranties relieving the insurer of liability unless made with the intention to deceive or material to the risk.

WAR RELIEF WORK. Upon the outbreak of the World War in 1914 relief problems far surpassed the capabilities of private charity, involving broad questions of governmental finance, control of production, purchase and transport of huge quantities of supplies from one part of the world to another, intervention of diplomatic agencies, control of shipping and railways, and finally, after the war, general economic rehabilitation and broadly conceived treatment of fundamental social ills. For the first time in history, virtual world control of production and distribution of food was attained (*see* Red Cross).

CIVILIAN RELIEF IN BELGIUM AND FRANCE

During the occupation of Belgium, inhabitants found themselves in desperate straits from interruption of agriculture and the confiscation of stocks by the occupying forces. Belgium's essential food imports were cut off, and hordes of refugees fled before the advancing German armies. Herbert Hoover, an American engineer, with the backing of the U.S. Government persuaded the Allied Govts. to open the blockade and to secure guarantees from Germany against interference and requisitioning of local food products. The Commission for Relief in Belgium (C.R.B.) established by Herbert Hoover as a neutral organization in the midst of war, possessed recognized diplomatic rights and obligations, flew its own flag and issued its own passports.

Food had to be supplied to the 9,000,000 inhabitants of Belgium and northern France. It had to be secured in disorganized markets; supplies had to pass across mine-strewn waters through the naval blockade, and be towed through 133m. of obstructed waterways, passing across the German military line. Relief vessels, 2,313 in number, carried in the neighbourhood of 100,000 tons each month for nearly five years.

The commission formed a committee of Germans, Belgians and Americans which took over harvests of breadstuffs, insuring equitable distribution to the civil population. The world's charity was mobilized through nearly 2,000 committees. Within Belgium and northern France were set up nearly 10,000 communal committees. Purchasing and shipping agencies were organized in the principal world markets and ports. Offices for governmental *liaison* were maintained at Brussels, London, Paris and Washington. Upon America's entry into the war the C.R.B. remained unchanged, except for the necessary withdrawal of American directors from within the German lines. The Spanish-Dutch committee for the protection of the relief in Belgium and northern France took over diplomatic and other functions within the lines. The national committees, one Belgian and one French, administered distribution. These were the Belgian Comité National de Secours et d'Alimentation and the Comité d'Alimentation du Nord de la France under the leadership of Emile Franqui.

During the whole period the commission acquired goods well over $1,300,000,000 in value, including interchange of native products. More than 55,000 volunteers gave their services. Over 5,000,000 tons of supplies were imported. The Belgian Government granted monthly fixed subsidies to the commission from loans advanced by the United States, Great Britain and France. The actual financial resources of the commission amounted to $894,797,150, the expenditure of the benevolent side of the relief organization was $615,237,147 of this total. Of the total funds available to the commission, 47% came from the United States ($421,153,287); 23% from French Treasury loans ($204,862,854); 14% from British empire sources ($125,686,364); and 16% from other sources. The total administrative expenditure of the C.R.B. was kept down to less than one-half of one per cent. The average prices maintained for staple foods in the occupied territory during the entire period of the war were from 15 to 20% less than prices in the Allied countries at the same periods. The Belgian and French Governments in May 1919 took the responsibility of feeding their people.

RELIEF IN CENTRAL EUROPE

When peace came in November 1918 the Allied and associated Governments were confronted with the necessity of extending relief not only to liberated territories in central Europe but also to their enemies. From the Baltic to the Adriatic and Black seas hundreds of millions of people desperately needed food until agricultural production could be brought back and until industries and transportation could be restarted. Herbert Hoover was appointed director-general of Allied Relief, under the Supreme Economic Council. Because America was in a better food position than any of the nations of Europe, the United States was destined to play the principal part, supplemented by a substantial programme of Great Britain. Hoover formed the American Relief Administration (A.R.A.) to carry out the work. The U.S. Grain Corporation handled finances, purchasing and shipping. To

assure the success of the complicated arrangements for the mass feeding of millions of people the director general took temporary control of railways in central and southern Europe, re-established or controlled 10,000m. of telegraph and telephone lines, arranged barge shipments on rivers, initiated food exchanges between States, re-allocated army supplies suitable for civilian needs, established a temporary monetary exchange system, furthered import of raw material, controlled coal production and generally helped struggling Governments to re-establish economic life.

Food from America had to be transported overseas and distributed in 21 countries or States. American deliveries to Allied or neutral countries were financed on credit by the U.S. Treasury. With the exception of Austria, deliveries to ex-enemy countries were paid for in cash. Deliveries to the new States were either as outright gifts or long-term loans. The U.S. Congress also appropriated $100,000,000 as a revolving fund for the operations. Allied and neutral countries supplied by the United States were Italy, Denmark and Holland; ex-enemy countries supplied against cash payments were Germany, Austria, Hungary, Bulgaria and Turkey. The so-called liberated territories supplied were Finland, Estonia, north-west Russia, Latvia, Lithuania, Poland, Belgium, northern France, Czechoslovakia, Rumania, Yugoslavia, south Russia and Armenia.

Notwithstanding its difficult financial position, the British Government was able to appropriate £12,500,000 and to set up other substantial grants. Great Britain agreed to fill the gaps between what the United States could provide and what was required for barest necessities. British assistance was given to Poland, Serbia, Czechoslovakia, Rumania, Estonia and Austria, relief being administered by Sir William Goode.

During the Armistice year relief deliveries to Europe reached about 4,760,000 tons of food valued at over $1,147,600,000. More than two-thirds or $870,000,000 worth, came from the United States. About $120,000,000, or 10%, came from the United Kingdom; from France and Italy about 2% each; about 4% was financed jointly by the United States, France and Italy; and about 5% came from other countries. Inland transportation was paid for by the Governments aided. Local ministries and volunteer committees attended to distribution.

These prompt relief measures undoubtedly saved Europe from great social cataclysm. The relief operation laid down "a wall of food" against militant Russian world revolution.

Privately Organized Relief.—With the signing of peace, all these Allied and American organizations passed out of existence. Certain stocks given by the American Government for charitable purposes were turned over to a new private organization formed by Herbert Hoover, also known as the American Relief Administration. Large numbers were still faced by extreme shortage. Children were the greatest sufferers. The new privately organized A.R.A. carried on mass child feeding in Finland, Estonia, Latvia, Lithuania, Danzig, Poland, northern France, Czechoslovakia, Austria, Hungary, Rumania, Yugoslavia and Armenia. American Quakers co-operated with the A.R.A. in feeding over 1,000,000 children in Germany. The work was carried on until 1923.

During that period about 8,000,000 different children benefited from this charitable relief. Cooked meals were distributed to as many as 4,000,000 children daily at one time, to whom a total of over 1,500 million meals were served. Clothing to the value of over $8,000,000 was distributed to more than 2,000,000 children. These governments also donated some foods and financed some of the foreign imports. National welfare bodies founded and built up by the A.R.A. were perpetuated in many countries. The total amount expended for these post-war charitable operations reached nearly $100,000,000.

Dr. Fridtjof Nansen prevailed upon the League of Nations to help in repatriation of prisoners of war, bringing more than 427,000 war prisoners out of Russia and Siberia back to their homes in a dozen countries. Prominent in post-war relief works were the Save the Children funds of Great Britain and many other countries which, through Dr. Nansen, brought help to eastern European countries; the American Jewish Joint Distribution Committee in Poland, Czechoslovakia, Austria and other places; several Irish relief committees; the American and British Societies of Friends (Quakers). The French war orphans committee brought aid to children in devastated France. The Rockefeller Foundation gave over $22,500,000 for the relief work of the Commission for Relief in Belgium and other charitable purposes.

Russian Famine.—When these post-war relief operations were closing down, famine in Russia faced 25,000,000 people in the Volga valley with starvation. Herbert Hoover revived the A.R.A., secured grants from the U.S. Government, induced the Soviet Russian Government to purchase seed grains, and rushed food, grain and medical supplies. Dilapidated ports, broken-down railways, the general inertia of the broken *morale* of the Russian people, and the dissolution of the productive organism, complicated by suspicions of the Soviet Government against emissaries from "capitalist" America made the task of bringing immediate effective relief to the people in an area of 770,000 sq.m. immense. Every step of operations of transport and distribution had to be supervised amid greatest economic disruption and appalling scenes of misery.

This was accomplished by less than 200 persons supervising a distributing organization of nearly 150,000 Russian workers. More than 10,000,000 people were fed; medical and sanitary supplies valued at $7,600,000 were distributed to 16,500 hospitals and other institutions to combat the spread of typhus, cholera, and other epidemics following in the wake of famine; over 8,000,000 vaccinations or inoculations against smallpox, typhoid and para-typhoid were given to people in epidemic regions; 200,000 tons of seed grain were distributed; and other relief measures brought the total value of American relief to the Russian famine to about $60,000,000. The work was made possible by the contribution of $24,000,000 in cash and medical supplies by the U.S. Government, of $3,600,000 worth of medical supplies by the American Red Cross, about $4,000,000 by the American joint distribution committee, and of $12,000,000 worth of seed grain purchased and transported by the A.R.A. against gold payment by the Soviet Government. Many other American groups co-operated in furnishing means to an extent of nearly $3,000,000. These were the Society of Friends, Mennonite relief, European student relief, Federal Council of Churches of Christ in America, Knights of Columbus, National Catholic welfare council, National Lutheran Council, Volga relief society, Y.M.C.A. and Y.W.C.A. The Russian operations of the American Relief Administration started in September 1921, and were brought to a close in July 1923. Although the sums thrown into Russian famine relief by British agencies and the Nansen relief committee were small in comparison with the American relief, the accomplishment was effective. As High Commissioner for the League of Nations, Dr. Nansen also co-operated with the A.R.A. in care of Russian refugees in the Balkans, arranging for the transport of some 15,000 of these refugees to other localities where they could be supported. (*See* REFUGEES AND THE EXCHANGE OF POPULATIONS; FAMINE.)

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WARREN, SIR CHARLES (1840–1927), English soldier and archaeologist, was born at Bangor, Wales, on Feb. 7, 1840. In 1857 he entered the Royal Engineers. From 1861 to 1865 he was engaged in a survey of Gibraltar, but then went to Palestine where he became interested in archaeology. He conducted excavations at Jerusalem until 1870, and made for the Palestine Exploration Fund the first systematic archaeological survey of the Holy Land. He published *The Recovery of Jerusalem* (1871), and, with C. R. Conder, *The Survey of Western Palestine* (1884). In 1876 he was appointed commissioner to determine the boundary line between Orange Free State and Griqualand West. In 1876, on the outbreak of the Kaffir War, he was given command of the Diamond Fields Horse. He quelled an uprising in Bechuanaland, and in 1879, as administrator of Griqualand West he organized a

force to defend the Transvaal. In 1884 he explored in Arabia Petraea, but before the year was over was again sent to South Africa to restore order in Bechuanaland. He proclaimed the territory south of the Malopo river a crown colony under the name of British Bechuanaland. He served in the Boer War as lieutenant-general in command of the Fifth Division but after the British disaster at the Tugela river was transferred to an administrative post. He died at Weston-supermare, England on Jan. 21, 1927. Among the more notable of his later books was *On the Veldt in the Seventies* (1902).

WARREN, GOUVERNEUR KEMBLE (1830–1882), American soldier, was born at Coldspring (N.Y.), on Jan. 8, 1830, and was graduated from West Point in 1850. He was assigned to the engineers, and was employed in survey work in the West, where he took part in some expeditions against the Indians. In 1859 he was made assistant instructor in mathematics at West Point. At the outbreak of the Civil War he was made lieutenant colonel of volunteers and posted to the newly raised 5th New York volunteer infantry. In August he was promoted to the rank of colonel. He commanded a brigade of the volunteer corps at Gaines's Mill, Second Bull Run and Antietam, and was promoted to the rank of brigadier general of volunteers. During the Fredericksburg campaign he was on the engineer staff of the Army of the Potomac, but after Chancellorsville he was appointed chief of engineers, and in that capacity rendered brilliant services at Gettysburg (*q.v.*), his reward being promotion to major general U.S. volunteers and the brevet of colonel in the Regular Army. When the Army of the Potomac was reorganized in the spring of 1864, Warren returned to the volunteer corps as its commander.

His services in the Wilderness (*q.v.*) and Petersburg (*q.v.*) campaigns proved his fitness for this command, but his lively imagination and the engineer's habit of caution made him a brilliant but somewhat unsafe subordinate. At the critical moment preceding the battle of Five Forks, Sheridan, in charge of the operations, was authorized by Grant to relieve Warren of his command if he thought fit. At first the volunteer corps fell into confusion, which Warren exerted himself to remedy, and the battle was an important Union victory. But after it had ended Sheridan sent for Warren and relieved him of his command. A court of inquiry entirely exonerated Warren from the charges of apathy which Sheridan brought against him. General Warren died Aug. 8, 1882, at Newport (R.I.).

WARREN, JOSEPH (1741–1775), American soldier and patriot, born at Roxbury (Mass.), June 11, 1741. He graduated at Harvard College in 1759, studied medicine at Boston, and soon acquired a high reputation in his profession. The passage of the Stamp Act aroused his patriotic sympathies and brought him in close connection with Samuel Adams, John Adams, and Josiah Quincy, Jr., as a leader of the popular party. He drafted the "Suffolk Resolves," which urged forcible opposition to Great Britain, if such should be necessary, pledged submission to such measures as the Continental Congress might recommend, and favoured the calling of a provincial congress. These "resolves" were unanimously adopted by a convention at Milton (*q.v.*) on Sept. 9, 1774. Warren was a member of the first three provincial congresses (1774–75), president of the third, and an active member of the committee of public safety. On June 14, 1775, he was commissioned a major general, but three days later, and before his commission was made out, he took part as a volunteer, under the orders of Putnam and Prescott, in the battle of Bunker Hill (Breed's Hill), where he was killed.

WARREN, SAMUEL (1807–1877), English lawyer and author, son of Dr. Samuel Warren, rector of All Souls', Ancoats, Manchester, was born near Wrexham in Denbighshire on May 23, 1807. The elder Samuel Warren (1781–1862) was the founder of the "Warrenites," seceders from Wesleyan Methodism, who formed the United Methodist Free Churches.

His son, the younger Samuel Warren, studied medicine but abandoned this and entered the Inner Temple in 1828, took silk in 1851, was made recorder of Hull in 1852, represented Midhurst in parliament for three years (1856–1859) and was rewarded in 1859 with a mastership in lunacy. He was the author of two extraordinarily successful books: *Passages from the Diary of a Late Physician* (1838), and *Ten Thousand a Year* (1841). Warren died on July 29, 1877. He had collected his *Works: Critical and Imaginative* (4 vols., 1854).

WARREN, WHITNEY (1864–1943), American architect, was born in New York city, on Jan. 29, 1864. After studying at the École des Beaux Arts, Paris, under Daumet and Girault (1885–94), he began the practice of architecture in New York, later becoming associated with Charles D. Wetmore in the firm of Warren and Wetmore. They specialized in railway architecture, hotels, business buildings and residences and were architects for the New York Central, Michigan Central, Canadian Northern and Erie railways. Their numerous structures in New York city include the Chelsea docks, the Grand Central terminal and the hotels Belmont (1905), Vanderbilt (1910), Biltmore (1912) and Commodore (1916). He was chosen to reconstruct the library of the University of Louvain, destroyed by the Germans in 1914. He died in New York city, Jan. 24, 1943.

WARREN, a city of Ohio, U.S.A., on the Mahoning river. Pop. (1920) 27,050 (80% native white); in 1940 by federal census it was 42,837. The city occupies 8·6 square miles and was named after Moses Warren, a surveyor of the Connecticut Land company. It was settled in 1799. In 1834 the village was incorporated, and in 1839 it became a port on the new canal from the Ohio river to Lake Erie. In 1869 it was incorporated as a city. Its output of manufactures in 1939 amounted to $86,077,000.

WARREN, a borough of northwestern Pennsylvania, U.S.A., the county seat of Warren county; on the north bank of the Allegheny river. Pop. (1920) 14,272 (85% native white); 1940 federal census 14,891. Warren lies 1,246 ft. above sea level, at the southern foot of a high, sheer ridge, in a beautiful and fertile region, rich in oil and gas. Hydroelectric power from Niagara Falls and the Clarion river is available, in addition to natural gas from the local field. The city's output of manufactures in 1939 was valued at $15,038,200. In the suburbs is a state hospital for the insane (1873) with grounds covering 1,288 acres. Warren was laid out in 1795, and was named for Gen. Joseph Warren, the Revolutionary war officer. The borough was incorporated in 1832.

WARREN, a town of Bristol county, Rhode Island, U.S.A., on the east shore of Narragansett bay, at the mouth of the Warren river, 10 mi. S.E. of Providence. Pop. (1940) 8,158.

WARREN, properly an old term of the English forest law, applied to one of the three lesser franchises, together with "chase" and "park," included under the highest franchise, the "forest," and ranking last in order of importance. The "beasts of warren" were the hare, the coney (*i.e.*, rabbit), the pheasant and the partridge. The word thus became used of a piece of ground preserved for these beasts of warren. It is now applied loosely to any piece of ground, whether preserved or not, where rabbits breed. (*See* FOREST LAWS.)

WARRINGTON, HENRY BOOTH, 1ST EARL (1652–1694). *See* DELAMERE, GEORGE BOOTH, 1ST BARON.

WARRINGTON, a municipal, county and parliamentary borough of Lancashire, England, at the crossing of the river Mersey. Pop. (est. 1938) 78,140. Area, 7.1 sq.mi.

Warrington is supposed to be of British or earlier origin, and the Roman road from Chester to the north passed through it. In Henry I's reign Warrington was the head of a barony created for Pain de Vilars, but both manor and barony passed to the Botelers or Butlers, who first established their residence on the mote hill and before 1280 built Bewsey in Burton wood. The Butlers held both barony and manor till 1586, when the barony lapsed and the manor passed to the Irelands of Bewsey, then to the Booths and in 1769 to the Blackburns. In 1277 Edward I granted a charter for a weekly market on Friday, and an annual fair of eight days from the eve of St. Andrew (Nov. 30), and in 1285 another charter confirmed a change of market day from Friday to Wednesday and extended the summer fair to eight days. The fairs are still held, as well as the Wednesday chartered market, besides a Saturday market which is probably customary During the Civil War the inhabitants were royalists and the earl of Derby made the town for some time his headquarters in order

to secure the passage of the Mersey. In April 1643 the parliamentary forces attacked it but had to raise the siege. Lord Derby left Colonel Edward Norris in command and in May the parliamentarians again attacked the town, which was forced to surrender. In 1648, part of the royal forces under General Baillie rallied temporarily at Warrington. During the Rebellion of 1745, on the approach of Prince Charles Edward from Manchester, the bridge was cut down. A borough was created by William le Boteler about 1230 by a charter (not preserved); but its growing strength alarmed the lord who contrived to repress it before 1300, and for over 500 years Warrington was governed by the lord's manor court. There was a friary of Augustine or Hermit Friars there, founded apparently about 1280.

The fine church of St. Elphin (Decorated style) has a lofty central tower and spire. The crypt of a much earlier church remains beneath the chancel. The town hall, a classical building (18th century) formerly a residence, was purchased by the corporation in 1872, the park being opened to the public. Other buildings are the museum and free library, technical institute and market hall. The educational institutions include a grammar school (1526) and a blue-coat school (1665). A few half-timbered houses of the 17th century remain. The Warrington district is an important centre of the tanning industry. There are also iron bar, hoop and wire works, tool, soap, glass and chemical works, foundries and cotton mills. The Manchester Ship canal is here crossed by five bridges. The town was incorporated in 1847 and was created a county borough in 1900. It returns one member to parliament.

WARRISTON, ARCHIBALD JOHNSTON, LORD (1611–1663), Scottish judge and statesman, son of James Johnston, was baptized on March 28, 1611, educated at Glasgow, and passed advocate at the Scottish bar in 1633. In 1637 he drew up the remonstrances of the Covenanting leaders against Charles I.'s attempt to force the English liturgy upon Scotland, and with Alexander Henderson, was a principal author of the National Covenant of 1638. In June 1639 he took part in the negotiations leading to the Treaty of Berwick, when his firm attitude displeased the king. He was appointed in 1640 to attend the general of the army and the committee and on June 23 wrote to Lord Savile asking for definite support and the acceptance of the National Covenant by the leading opposition peers in England. In October he was a commissioner for negotiating the Treaty of Ripon. In 1641 he led the opposition on the point of control of State appointments during the king's visit to Scotland.

In accordance with the king's short-lived policy of conciliation Johnston was appointed a lord of session Nov. 13, 1641, with the title of Lord Warriston, and was knighted and given a pension. In the same month the parliament appointed him a commissioner at Westminster for settling the affairs of Scotland, and he was later (1643) made a member of the committee of both kingdoms, which directed the military operations. Early in 1644 he took his seat in the Assembly of Divines, where he was strongly opposed to independency and to lay control in ecclesiastical affairs. He was also member for Edinburgh in the Scottish parliament (1643–47) and speaker of the barons.

In Oct. 1646, Johnston was made king's advocate after Charles had surrendered himself to the Scots. In 1648 he became the leader of the "remonstrants," the party opposed to the "engagement" concluded by the predominant party with Charles at Carisbrooke. (*See* ENGLAND: *History*.) In October, after the defeat of the "engagers" at Preston he met Cromwell at Edinburgh, and helped to promote the Act of Classes (Jan. 23, 1649), disqualifying royalists; but after the king's execution good relations with Cromwell were broken off, and Johnston was officially present at the proclamation of Charles II. as king in 1649 at Edinburgh. On March 10, he was appointed lord clerk register; in May he pronounced sentence on Montrose. After the defeat of Dunbar (Sept. 3, 1650) at which Johnston was present, he urged the removal of David Leslie from the command, and on Sept. 21, delivered a violent speech in Charles's presence, attributing all the troubles to the opposition of the Stuarts to the Reformation.

Johnston now committed himself to the faction of the remonstrants, who desired to exclude the king, and whom he represented in London in 1656. On July 9, 1657, he was restored by Cromwell to his office of lord clerk register, and on Nov. 3 was made a commissioner for the administration of justice in Scotland. He sat in the upper chamber of Cromwell's parliament (Jan. 1658) and of Richard Cromwell's parliament; and on the latter's abdication and the restoration of the Rump, he was chosen a member of the council of State, and continued in the administration as a member of the committee of public safety.

At the Restoration he escaped abroad, and was condemned to death in his absence (May 13, 1661). In 1663 he was discovered at Rouen, and with the consent of Louis XIV. was brought over and imprisoned in the Tower. Taken to Edinburgh in June, and confined in the Tolbooth, he was hanged at the Market Cross on July 22. His head was exposed on the Netherbow and afterwards buried with his body in Greyfriars churchyard.

Johnston was a man of energy. His devotion to the Scottish Church amounted to fanaticism. He had by nature no republican leanings. When, however, Presbyterianism was attacked, he desired, like Pym, to restrict the royal prerogative. His acceptance of office under Cromwell hardly deserves the censure it has received. But in his dying speech he condemned the act as a fault which he had committed in order to provide for his numerous family. Johnston was wanting in consideration for his opponents. He was hated by Charles I., whose statecraft was vanquished by his inflexible purpose, and by Charles II., whom he rebuked for his dissolute conduct.

See W. Morison, *Johnston of Warriston* (1901); *Diary of Sir A. J. Warriston*, 1650–54, edit. by D. H. Fleming (Scottish Hist. Soc., 1919).

WARRNAMBOOL, a seaport of Victoria, Australia. It has a good artificial harbour formed by a breakwater, pier, etc. The town (pop. 8,906) is the market centre of a rich agricultural and dairying district (av. an. rainfall 26·18 in.) and farther inland lie the sheep-areas of western Victoria, but the policy of railway concentration upon Melbourne has deprived it of much trade.

WARSAW (Polish *Warszawa*), province of Poland. Area, 11,313 sq.mi. Pop. (1931) without the city of Warsaw, 2,532,528 (est. 1939, 2,531,000), of whom 88.4% were Poles, the rest Jews and Germans. The province of Warsaw, formerly the principality of Mazovia, is situated in the great central plain and drained by the Vistula and its affluents. In the north the Baltic uplands begin; in the south the province includes part of the southern plateau. The plain is sandy and not very fertile, and suffers much from the periodic inundations of the Vistula, particularly near the confluence of the Bug and Narew. But the thrifty Mazovian peasant has prosecuted the cultivation of the soil with considerable success. The principal crops are rye, oats, barley, wheat and potatoes, while beetroot is cultivated for sugar in some parts of the province. Gardening and bee-keeping are also practised. There are large forest areas particularly in the north where there are also wide marshes especially on the Wkra near Mlawa. The shipping of the Vistula is an important occupation, as are the agricultural industries: flour milling, distilleries, breweries and sugar factories. Saw mills and match factories and especially tanneries are important. There is an important industrial area including the metal industries, the manufacture of machinery, locomotives and other goods at Warsaw and the textile manufactures of Zyrardów, forming a link between Warsaw and Lodz.

The chief towns are Warsaw (*q.v.*), Plock (pop. 32,777), Wloclawek (pop. 56,277), Zyrardów, Gostynin, Grojec, Kutno, Nowo-Minsk, Plonsk, Radzymin, Skierniewice, Ciechanów, Lipno, Mlawa, Rypin, Pultusk and Przasnysz.

Mazovia was a semi-independent principality of Poland not finally united to Poland till 1529, when its numerous gentry played a great part in the democratic evolution of the Polish Constitution. The region sent waves of colonists into East Prussia, Lithuania and even the Ukraine. The bishops of Plock originally had all Mazovia as their diocese, but later there was an archbishopric at Warsaw, which in the 16th century succeeded Plock as the capital city. Warsaw became the political centre of Poland when the advance of Germany in the west and Polish

colonization of Lithuania and the Ukraine threw the political centre of the State eastwards. Germany occupied it in 1939.

WARSAW, capital of Poland; chief town of the province of Warsaw (Polish *Warszawa*). Area of the administrative district, 46 sq. miles. Pop. (1939) 1,289,000, of whom 70.7% were Poles, the rest nearly all Jews. It is beautifully situated on the left bank of the Vistula, 387 mi. by rail E. of Berlin, and 695 mi. S.W. of Leningrad. It stands on a terrace 120 to 130 ft. above the river, to which it descends by steep slopes, leaving a broad bench at its base. The suburb of Praga on the right bank of the Vistula, here 450 to 660 yd. broad, is connected with Warsaw by two bridges. Germany occupied Warsaw in 1939.

Situated in a fertile plain, on a great navigable river, below its confluence with the Pilica and Wieprz, which drain the southern area, and above its confluence with the Narew and Bug, which tap a wide region in the east, Warsaw became in mediaeval times the entrepôt for the trade of those fertile and populous valleys with western Europe. Owing to its position in the territory of Mazovia, which was neither Polish nor Lithuanian, and, so to say, remained neutral between the two rival powers which constituted the united kingdom, it became the capital of both, and secured advantages over the purely Polish Cracow and the Lithuanian Vilna. The precise date of the foundation of the town is not known; but it is supposed that Conrad, duke of Mazovia, erected a castle on the present site of Warsaw as early as the 9th century. Casimir the Just is supposed to have fortified it in the 11th century, but Warsaw is not mentioned in annals before 1224. Until 1526 it was the residence of the dukes of Mazovia, but when their dynasty became extinct it was annexed to Poland. When Poland and Lithuania were united, Warsaw was chosen as the royal residence. Sigismund Augustus (Wasa) made it (1550) the real capital of Poland, and from 1572 onwards election of the kings of Poland took place on the field of Wola, on the western outskirts of the city. Charles Gustavus of Sweden took it in 1655 and kept it for a year; the Poles retook it in July 1656. Augustus II. and Augustus III. did much for its embellishment, but it had much to suffer during the war with Charles XII. of Sweden, who captured it in 1702; but in the following year peace was made, and it became free again. The disorders which followed upon the death of Augustus III. in 1763 opened a field for Russian intrigue, and in 1764 the Russians took possession of the town and secured the election of Stanislaus Poniatowski, which led in 1773 to the first partition of Poland. In Nov. 1794 the Russians took it again, after the bloody assault on Praga, but next year, in the third partition of Poland, Warsaw was given to Prussia. In Nov. 1806 the town was occupied by the troops of Napoleon, and after the peace of Tilsit (1807) was made the capital of the independent duchy of Warsaw; but the Austrians seized it on April 21, 1809 and kept possession of it till June 2, when it once more became independent. The Russians finally took it on Feb. 8, 1813. On Nov. 29, 1830, Warsaw gave the signal for the unsuccessful insurrection which lasted nearly one year; the city was captured after great bloodshed by Paskevich on Sept. 7, 1831. Deportations on a large scale, executions, and confiscation of the domains of the nobility followed, and until 1856 Warsaw remained under severe military rule. In 1862 a series of demonstrations began to be made in Warsaw in favour of the independence of Poland, and after a bloody repression a general insurrection followed in Jan. 1863, the Russians remaining, however, masters of the situation. Executions, banishment to the convict prisons of Siberia, and confiscation of estates were carried out on an unheard-of-scale. Scientific societies and high schools were closed; monasteries and nunneries were emptied. Hundreds of Russian officials were called in to fill the administrative posts, and to teach in the schools and the university; the Russian language was made obligatory in all official acts, in all legal proceedings, and even, to a great extent, in trade. The very name of Poland was expunged from official writings, and, while the old institutions were abolished, the Russian tribunals and administrative institutions were introduced. The serfs were liberated. Much rioting and lawless bloodshed took place in the city in 1905–06.

In 1915 Warsaw fell to the Germans; in 1918 the Poles made themselves masters of the city and set up a government. On Sept. 27, 1939 Warsaw again surrendered to German troops after a siege of 20 days and a series of bloody battles in its environs. Much of the city was reduced to ruins by air raids.

The streets of Warsaw are adorned with many fine buildings, partly palaces exhibiting the Polish nobility's love of display, partly churches and cathedrals, and partly public buildings erected by the municipality or by private bodies. Fine public gardens and several monuments further embellish the city. The university was first established in 1816; it was closed in 1832 and was not reopened until 1869, as a Russian institution. It has a remarkable library of more than 500,000 vols., rich natural history collections, a fine botanic garden and an astronomical observatory. The medical school enjoys high repute in the scientific world. The school of arts, the academy of agriculture and forestry, and the conservatory of music are all high-class institutions. The Association of the Friends of Science and the Historical and Agricultural societies of Warsaw were once well known, but were suppressed after the insurrections, though they are revived.

The theatre for Polish drama and the ballet is a fine building, which includes two theatres under the same roof; but the pride of Warsaw is its theatre in the Lazienki gardens, which were laid out (1767–88) in an old bed of the Vistula by King Stanislaus Poniatowski, and have beautiful shady alleys, artificial ponds, an elegant little palace with ceilings painted by Bacciarelli, several imperial villas and a monument (1788) to John Sobieski, king of Poland, who delivered Vienna from the Turks in 1683. Here an artificial ruin on an island makes an open-air theatre. Two other public gardens, with alleys of old chestnut trees, are situated in the centre of the city. One of these, the Saski Ogrod, or Saxon garden (17 acres), which has a summer theatre and fine old trees, is one of the most beautiful in Europe; it is the resort of the Warsaw aristocracy. The Krasinski garden was the promenade of the Jews.

The central point of the life of Warsaw is the former royal castle (Zamek Krolewski) on Sigismund square. It was built by the dukes of Mazovia, enlarged by Sigismund III. (whose memorial stands opposite) and Wladyslaw IV., and embellished by John Sobieski and Stanislaus Poniatowski. Most of its pictures and other art treasures were removed to St. Petersburg and Moscow but have been restored. Four main thoroughfares radiate from it; one, the Krakowskie Przedmiescie, the best street in Warsaw, runs southward. It is continued by the Nowy Swiat and the Ujazdowska Aleja avenue, which leads to the Lazienki gardens. Many fine buildings are found in and near these two streets: the church of St. Anne (1454), which belonged formerly to a Bernardine monastery; the agricultural and industrial museum, with an ethnographical collection; the monument (1898) to the national poet Adam Mickiewicz (1798–1855); the former Saxon palace, once the residence of the Polish kings; the Lutheran church, finished in 1799, one of the most conspicuous in Warsaw; the buildings of the Art Association, erected in 1898–1900; the university (*see* above); the church of the Holy Ghost (1682–96), with the heart and monument of the musician F. F. Chopin; a monument (1830) to the astronomer N. Kopernik (1473–1543); the palaces of the Zamoyski family (now the conservatory of music); the building of the Philharmonic Society (1899–1901); and the church of St. Alexander, built in 1826 and splendidly restored in 1891. The Ujazdowska Aleja avenue, planted with lime-trees and bordered with cafés and places of amusement, is the Champs Elysées of Warsaw. It leads to the Lazienki park and to the Belvedere palace (1822), and farther west to the Mokotowski parade ground, which is surrounded on the south and west by the manufacturing district. Another principal street, the Marszalkowska, runs parallel to the Ujazdowska from the Saxon garden to this parade ground, on the south-east of which are the barracks. The above-mentioned streets are crossed by another series running west and east, the chief of them being the Senators, which begins at Sigismund square and contains the best shops. The palace of the archbishop of Warsaw, the Bank of Poland; the town hall (1725), burned in 1863, but rebuilt in 1870; the small Pod Blacha palace, the theatre (1833); the old mint;

the beautiful Reformed church (1882); the Orthodox Greek cathedral of the Trinity, rebuilt in 1837; the Krasinski palace (1692), burned in 1782 but rebuilt; the church of the Transfiguration, a thank-offering by John Sobieski for his victory of 1683, and containing his heart and that of Stanislaus Poniatowski; and palaces are on or near Senators' Street and Miodowa Street.

To the west Senators' street is continued by Electors' street, where is the very elegant church (1849) of St. Charles Borromeo, and the Chlodna Street leading to the suburb of Wola, with a large field where the kings of Poland used to be elected. In Leszno street, which branches off from Senators' street, are the Zelazna Brama, or Iron Gate; in the market-place the bazaar, the arsenal and the Wielopolski barracks.

To the north of Sigismund square is the old town—Stare Miasto—the Jewish quarter, and farther north still the citadel. The old town very much recalls old Germany by its narrow streets and antique buildings, the cathedral of St. John, the most ancient church in Warsaw, having been built in the 13th century and restored in the 17th. The citadel, erected in 1832–1835 as a punishment for the insurrection of 1831, is of an antiquated type.

The suburb of Praga, on the right bank of the Vistula, is poorly built and often flooded; but the bloody assaults which led to its capture in 1794 by the Russians under Suvorov, and in 1831 by Paskevich, give it a name in history.

In the outskirts of Warsaw are various more or less noteworthy villas, palaces and battlefields. Willanow, the palace of John Sobieski, afterwards belonging to Count X. Branicki, was partly built in 1678–1694 by Turkish prisoners in a fine Italian style, and is now renowned for its historical relics, portraits and pictures. It is situated to the south of Warsaw, together with the pretty pilgrimage church of Czerniakow, built by Prince Stanislaw Lubomirski in 1691, and many other fine villas (Morysinek, Natolin, Krolikarnia, which also has a picture gallery, Wierzbno and Mokotow). Marymont, an old country residence of the wife of John Sobieski, and the Kaskada, much visited by the inhabitants of Warsaw, in the north, the Saska Kempa on the right bank of the Vistula, and the castle of Jablona down the Vistula are among others that deserve mention. The castle and forest of Bielany ($4\frac{1}{2}$ m. N.), on the bank of the Vistula, are a popular holiday resort in the spring.

Among the battlefields in the neighbourhood is that of Grochów where the Polish troops were defeated in 1831, and Wawer in the same quarter (E. of Praga), where Prince Joseph Poniatowski defeated the Austrians in the war of 1809; at Maciejowice, 50 m. up the Vistula, Kosciuszko was wounded and taken by the Russians in 1794; and the whole east bank of the Vistula was the scene of the great Polish victory over the Soviet armies in 1920. Warsaw is connected by six trunk lines with Vienna, Kiev and south-western Russia, Moscow, Leningrad, Danzig and Berlin. The steel industry has developed and the manufactures of plated silver, carriages, boots and shoes (annual turnover £8,457,000), millinery, hosiery, gloves, tobacco, sugar and house decorations are of importance, chiefly owing to the skill of the workers. The city has a trade in corn, leather and coal. The deportations of Warsaw artisans checked industrial progress. The population, nevertheless, grew rapidly from 161,008 in 1860, 276,000 in 1872 and 436,750 in 1887 to 756,426 in 1901; its growth in the period between 1918 and 1939, when World War II broke out, was remarkable. Warsaw is the seat of a Roman Catholic archbishopric and of the Orthodox Metropolitan.

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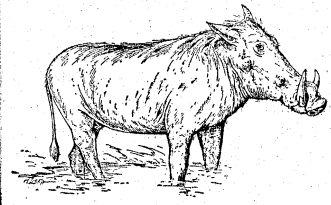
WAR STORE SURPLUSES: *see* DISPOSAL BOARD.

WART, a papillary new-growth of the skin, or mucous membrane. The ordinary flat warts of the skin occur mostly upon the hands of children and young persons; a long pendulous variety occurs about the chin or neck, and on the scalp in adults. Warts are apt to come out in numbers at a time; a crop of them suddenly appears, to disappear after a time with equal suddenness. Hence the supposed efficacy of charms. A single wart will sometimes remain when the general eruption has vanished. In adult life a wart on the hands or fingers is usually brought on by some irritation, often repeated, even if it be slight. Warts often occur on the wrists and knuckles of slaughter-house men and of those much occupied with anatomical dissection; they are often of tuberculous origin (butchers' warts). Chimney-sweeps and workers in coal-tar, petroleum, X-rays, etc., are subject to warts, which often become cancerous. Warts occur singly in later life on the nose or lips or other parts of the face, sometimes on the tongue; they are apt to become malignant especially if subjected to repeated irritation by attempts at their removal. Towards old age broad and flattened patches of warts of a greasy consistence and brownish colour often occur on the back and shoulders. They also are apt to become malignant. Indeed, warts occurring on the lip or tongue, or on any part of the body of a person advanced in life, should be suspected of malignant associations and dealt with accordingly. Venereal warts occur as the result of gonorrhoeal irritation or syphilitic infection.

The treatment of warts needs very careful consideration, and rarely, if ever, should be undertaken by a non-medical person, since, unfortunately, local applications of various kinds to warts have in many instances been accountable for their passage from a mere unsightly excrescence to an indubitable cancer.

WARTA or WARTHE, a river of Poland and Germany, and the chief affluent of the river Oder. It rises in the Carpathian mountains. Its total length is 445 mi. and it is navigable up to Konin in West Poland, a distance of 265 mi. Its banks are mostly low and flat, its lower course especially running through drained and cultivated marshes. It is connected with the Vistula through its tributary the Notec and the Bydgoszcz canal. The area of its drainage basin is 17,400 sq.mi.

WARTBURG, THE, a castle near Eisenach in the grand-duchy of Saxe-Weimar. It is magnificently situated on the top of a precipitous hill, and is remarkable not only for its historical associations but as containing one of the few well-preserved Romanesque palaces in existence. The original castle, of which some parts—including a portion of the above-mentioned palace—still exist, was built by the Landgrave Louis "the Springer" (d. 1123), and from his time until 1440 it remained the seat of the Thuringian landgraves. Under the Landgrave Hermann I., the Wartburg was the home of a boisterous court to which minstrels and "wandering folk" of all descriptions streamed; Walther von der Vogelweide and Wolfram von Eschenbach both refer to the noise and constant crush of crowds passing in and out at the Wartburg "night and day"; and it was here that in 1207 took place the minstrels' contest (*Sängerkrieg*) immortalized in Wagner's *Tannhäuser*. Some years later it became the home of the saintly Elizabeth of Hungary (*q.v.*) on her marriage to Louis the Saint (d. 1227), to whom she was betrothed in 1211 at the age of four. Wagner, with a poet's licence, has placed the *Sängerkrieg* during Elizabeth's residence at the Wartburg. It was to the Wartburg, too, that on May 4, 1521, Luther was brought for safety at the instance of Frederick the Wise, elector of Saxony, and it was during his ten months' residence here that he completed his translation of the New Testament. From this time the castle was allowed gradually to decay. It was restored in the 18th century in the questionable taste of the period; but its subsequent magnificence it owed to the Grand-Duke Charles Alexander of Saxe-Weimar, with whom at certain seasons of the year it was a favourite residence.



WART HOG (PHACOCHOERUS) OF AFRICA

WARTHE: *see* WARTA.

WART HOG, the designation of certain hideous African wild swine (*see* SWINE), characterized by the presence of large warty protuberances on the face and the large size of the tusks in both sexes.

Very frequently the adults have no incisors, and nearly bare skins except for a mane along the back which may be long. Two

forms are recognized, the southern *Phacochoerus ae aethiopicus*, which formerly ranged as far south as the Cape, and the northern *P. ae africanus*, which extends to the mountains of Abyssinia. In south and east Africa wart hogs frequent open country, near water, and dwell in holes. In Abyssinia, they spend the day among bushes, or in ravines, feeding at night. They are active and wary.

WARTON, THOMAS (1728–1790), English poet-laureate was a son of Thomas Warton, vicar of Basingstoke and professor of poetry at Oxford. He was born on Jan. 9, 1728. In a poem written in 1745 he shows the delight in Gothic churches and ruined castles which inspired so much of his subsequent work in romantic revival. Most of Warton's poetry, humorous and serious—and the humorous mock-heroic was better within his powers than serious verse—was written before the age of twenty-three, when he took his M.A. degree and became a fellow of his college (Trinity, Oxford). He did not altogether abandon verse; his sonnets, especially, which are the best of his poems, were written later. But his main energies were given to omnivorous poetical reading and criticism. He was the first to turn to literary account the mediaeval treasures of the Bodleian Library. It was through him, in fact, that the mediaeval spirit which always lingered in Oxford first began to stir after its long inaction, and to claim an influence in the modern world.

Warton, like his brother, entered the church, and held one after another, various livings, but he did not marry. He gave little attention to his clerical duties, and Oxford always remained his home. In 1749 he published an heroic poem in praise of Oxford, *The Triumph of Isis*. He was a very easy and convivial as well as a very learned don, with a taste for pothouses and crowds as well as dim aisles and romances in manuscript and black letter. The first proof that he gave of his extraordinarily wide scholarship was in his *Observations on the Poetry of Spenser* (1754). Three years later he was appointed professor of poetry, and held the office for ten years, sending round, according to the story, at the beginning of term to inquire whether anybody *wished* him to lecture. The first volume of his monumental work, *The History of English Poetry* (3 vols. 1774–1781) is still indispensable to every student of English literature. A work of such labour could proceed but slowly, and it was no wonder that Warton flagged in the execution of it, and stopped to refresh himself with annotating (1785) the minor poems of Milton, pouring out in this delightful work the accumulated suggestions of forty years.

In 1785 he became Camden professor of history, and was made poet-laureate in the same year. His busy and convivial life was ended by a paralytic stroke in May 1790.

Warton's poems were collected in 1777, and he was engaged at the time of his death on a corrected edition, which appeared in 1791, with a memoir by his friend and admirer, Richard Mant. They were edited in 1822 for the *British Poets*, by S. W. Singer. Among his minor works were an edition of Theocritus (1770); a selection of Latin and Greek inscriptions; the humorous Oxford *Companion to the Guide* and *Guide to the Companion* (1762); *The Oxford Sausage* (1764); lives of Sir Thomas Pope and Ralph Bathurst, college benefactors; a *History of the Antiquities of Kiddington Parish*, of which he held the living (1781); and an *Inquiry into the Authenticity of the Poems attributed to Thomas Rowley* (1782).

The History of English Poetry from the close of the 11th to the Commencement of the 18th Century, to which are prefixed two Dissertations: I. On the Origin of Romantic Fiction in Europe; II. On the Introduction of Learning into England (1774–1781) was only brought down to the close of the 16th century. There are later editions, with annotations and corrections, by Richard Price (1824), and again by W. C. Hazlitt (1871). In both these editions other scholars collaborated.

See also W. P. Ker, *Thomas Warton* (1911); E. Gosse, *Two Pioneers of Romanticism; Joseph and Thomas Warton* (1915); C. Rinaker, *Thomas Warton: a biographical and critical study* (Illinois, 1916); *The Three Wartons; A Choice of their Verse* (1928), ed. Eric Partridge; J. Densin, *The Wartons; Studies in English Literature* (1876).

WAR TRADE ADVISORY COMMITTEE, in the World War, a British Government committee which advised it on the blockade. It succeeded and continued the work of the Restriction of Enemy Supplies committee (*q.v.*). It was appointed by the prime minister, H. H. Asquith, in Sept. 1915, with the marquess of Crewe as chairman. On the retirement of Lord Crewe, Sir Francis Hopwood (afterwards Lord Southborough) became chairman on Feb. 25, 1916. It dealt, among other commodities, with coal, cotton, rubber and tin.

The subjects investigated included contraband, and what goods should be placed upon the contraband list; the prohibition of export and re-export from the United Kingdom and the British empire of goods intended for the enemy or likely to reach the enemy through neutral channels; agreements with responsible bodies in neutral countries for the consignment of imported goods under guarantee for the purpose that such supplies should not be re-exported to the enemy, *e.g.*, the Netherlands Oversea Trust in Holland, the Société de Surveillance Economique in Switzerland, and the Danish Merchants Guild in Denmark; recommendations in respect of the purchase in neutral countries adjacent to the enemy of native produce which otherwise would be available for export to the enemy; the surveillance and control of stores of commodities suspected of having been made for the ultimate benefit of the enemy. Difficult and intricate subjects were dealt with by the appointment of sub-committees.

Rationing Neutrals.—One of the most important questions dealt with by the committee was that of the "rationing" of foreign countries contiguous to the enemy to prevent them becoming bases of supply to the Central Powers. This was carried out by arrangements with responsible bodies in the countries affected, and provided for the prevention of the import of supplies in excess of the home requirements of the particular neutral country. The committee was also interested in matters relating to the preparation and administration of the "black list," and in connection with this subject special questions arose involving the abrogation of the Article 57 of the Declaration of London, the definition of "enemy," marine insurance, bills of lading, "to order," the use or abuse of facilities for the purpose of covering transactions of black-listed neutral traders, and consular certificates of origin given in neutral countries.

The contraband sub-committee was appointed on Sept. 6, 1915. In Aug. 1914, the British Government proclaimed that they would abide by the terms of the Declaration of London. It soon, however, became apparent that it would be necessary to enlarge the contraband list. The most important recommendation made was that of adding "gold, silver, paper money, securities, negotiable instruments, cheques, drafts, orders, warrants, coupons, letters of credit delegation or advice, credit or debit notes, or other documents, which in themselves, or if completed or if acted upon by the recipient, authorize, confirm or give effect to the transfer of money, credit or securities." A sub-committee considered oleaginous produce. In due course the Ministry of Blockade in parts superseded the Committee which, however, continued to do useful work. In all, the committee held 68 meetings.

See also BLOCKADE, MINISTRY OF; RATIONING OF NEUTRALS; RESTRICTION OF ENEMY SUPPLIES DEPARTMENT. (L. C. L.)

WAR TRADE DEPARTMENT. This important department of the British Government's economic war operations was formed early in 1915 and directed by the late Lord Emmott. To it were entrusted many matters connected with the blockade of Germany and the care of home supplies. It dealt with all applications for the grant of licences for the export of goods the subject of any official restriction or prohibition. At one and the same time it had oversight of the details of the blockade and the correlative supply of British services.

WARWICK, EARLS OF. The 1st earl of Warwick was HENRY DE NEWBURGH (d. 1123), lord of Newbourg in Normandy and son of Roger de Beaumont. He became constable of Warwick castle in 1068, and, though there is no proof that he actually came over with the Conqueror, his elder brother Robert de Beaumont, comte de Meulan, fought at Hastings. He apparently spent most of his time in Normandy, and was a baron of the Norman exchequer. He was created earl of Warwick early in the reign of William II. receiving a grant of the great estates of the Saxon, Thurkill of Arden, in Warwickshire. He founded the priory of the Austin Canons, and endowed the church of St. Mary. The 6th earl, THOMAS DE NEWBURGH (*c.* 1213–

1297), left no heirs, and was succeeded by his sister Margaret, countess of Warwick in her own right, who was twice married, but left no heirs. Her second husband, John du Plessis, assumed the title of earl of Warwick in 1245, and in 1250 received a grant of his wife's lands for life. He was succeeded in 1263 by Countess Margaret's cousin and heir, SIR WILLIAM MAUDUIT (1220–1268), 8th earl of Warwick.

The Beauchamps.—Mauduit's sister and heiress, Isabel de Beauchamp, had apparently adopted the religious life at the time of her brother's death, and her son WILLIAM DE BEAUCHAMP became 9th earl of Warwick.

His son GUY DE BEAUCHAMP, 10th earl of Warwick (1278–1315), received grants of land in Scotland for his services at Falkirk, and in 1301 was one of the signatories of the letter to the pope denying the papal right to interfere in Scottish affairs. He was one of the lords ordainers of 1310, and was concerned in the capture of Gaveston, though he declined to countenance his execution. He died on Aug. 10, 1315. His son, THOMAS DE BEAUCHAMP, 11th earl (1313–1369), marshal of England in 1344, and of the English army in France in 1346, fought at Crecy and Poitiers, and was one of the original knights of the Garter.

THOMAS DE BEAUCHAMP, 12th earl (*c.* 1345–1401), was about 24 years old when he succeeded his father. He served on the lords' committee of reform in the Good Parliament in 1376, and again in 1377, and was a member of the commission of inquiry in 1379. Appointed governor to Richard II. in Feb. 1381, he joined the nobles who sought to impose their authority on the king, and was one of the lords appellant in 1388. After the overthrow of his party in 1389 Warwick lived in retirement, but although he had for the moment escaped Richard's vengeance he was not forgiven. Being invited with Gloucester and Arundel to a banquet at court on July 10, 1397 he alone of the three was imprudent enough to obey the summons. He was immediately arrested and imprisoned in the Tower of London, in that part of the fortress since known as the Beauchamp Tower. Warwick made a full confession in parliament; his honours were forfeited and he himself banished. He was again in the Tower in 1398, but was liberated and restored to his honours on the accession of Henry IV. His son Richard Beauchamp, 13th earl of Warwick, is separately noticed. HENRY, 14th earl of Warwick (1423–1445), Earl Richard's son, a descendant, through his mother Constance le Despenser, of Edmund, duke of York, fifth son of Edward III., received a patent making him premier earl in 1444. A year later he was created duke of Warwick with precedence next after the duke of Norfolk, a rank disputed by the duke of Buckingham. The assertion that he was crowned king of the Isle of Wight seems to have no foundation in fact. He died in his 22nd year, leaving a daughter Anne, who died in 1449.

On her death the earldom lapsed to the crown. The estates passed to Sir Richard Neville (*see* WARWICK, RICHARD NEVILLE, earl of), in right of his wife Anne, sister of Henry Beauchamp, duke of Warwick. He and his wife were created earl and countess of Warwick each for life in 1450, with remainder to Anne's heirs, and, these failing, to Margaret, countess of Shrewsbury, half-sister of the countess Anne. After the death of her husband, the Kingmaker, at Barnet in 1471, the rights of the countess, heiress of the Beauchamp estates, were set aside "as if the seid countes were nowe naturally dede" (act of 13 Edward IV. 1473) in favour of her daughters, Isabel, wife of George, duke of Clarence, and Anne, who, after the murder of her first husband Edward prince of Wales in 1471, married Richard, duke of Gloucester, afterwards Richard III. Their mother was allowed to resume her estates in 1487, but only to settle them on the crown. She was succeeded in 1493 in the earldom by her grandson Edward Plantagenet, 18th earl of Warwick (1475–1499), son of the duke of Clarence, and therefore the Yorkist heir to the crown. He was imprisoned in 1484, his sole offence being his birth, and was executed in 1499 on a charge of conspiracy with his fellow-prisoner, Perkin Warbeck. He was the last representative of the male line of the Plantagenets. His honours were forfeited, and his estates passed to his sister Margaret, countess of Salisbury in her own right, the unfortunate lady who was executed in 1541.

The next bearer of the title was John Dudley, Viscount Lisle, afterwards duke of Northumberland (*q.v.*), who was created earl of Warwick in 1547, on account of his descent from Margaret, countess of Shrewsbury, daughter of Richard Beauchamp, earl of Warwick. The earldom became extinct with his son John Dudley, 20th earl of Warwick (*c.* 1528–1554), who was condemned to death for having signed the letters patent making his sister-in-law, Lady Jane Grey, heir apparent. He was released from prison in Oct. 1554, but died in the same month. His brother, Ambrose Dudley (*c.* 1528–1590), who fought at St. Quentin in 1557, secured the reversal of the attainder of himself and his brother consequent on the attempt to place Lady Jane Grey on the throne, and in 1561 was created Baron Lisle and earl of Warwick. He was in high favour with Elizabeth, as was his third wife Anne, daughter of Francis Russell, 2nd earl of Bedford. His brother Robert, earl of Leicester, having predeceased him his honours became extinct on his death in 1590.

The earldom was revived in 1618 in favour of Robert Rich, 3rd Baron Rich (*c.* 1560–1619), grandson of Lord Chancellor Rich, who died shortly after his elevation. His wife Penelope, Lady Rich, is separately noticed. He was succeeded in 1619 by his eldest son Robert Rich, 2nd or 23rd earl of Warwick (*q.v.*), whose two sons Robert (1611–1659) and Charles (1619–1673) succeeded him in the earldom and died leaving no male issue. The 5th or 26th earl of Warwick was their cousin Robert Rich (1620–1675), eldest son of Henry, 1st earl of Holland. His grandson, the 7th or 28th earl, left no issue, and the title became extinct on the death, on Sept. 15, 1759, of his kinsman Edward Rich, 8th or 29th earl. It was revived two months later, when Francis Greville, Baron Brooke of Beauchamps Court (1719–1773), who had in 1746 been created Earl Brooke of Warwick Castle, became earl of Warwick. Greville was descended from Robert Greville, the 2nd baron, who was killed at Lichfield during the civil war and he represented a cadet branch of the Beauchamp family. The earldom has remained with his descendants, the present holder (b. 1911) being the 7th. Frances Evelyn, countess of Warwick (1861–1938), widow of the 5th earl (Francis Richard, 1853–1924), inherited the estates of her grandfather, Henry Maynard, 5th and last Viscount Maynard (1788–1865). She became well known in society, and later for her interest in social questions.

See F. R. C. G. G. Warwick, 5th Earl of, *Memories of Sixty Years* (1917); and Countess of Warwick, *A Woman and the War* (1916).

WARWICK, RICHARD BEAUCHAMP, EARL OF (1382–1439), son of Thomas Beauchamp, was born at Salwarp in Worcestershire on Jan. 28, 1382, and succeeded his father in 1401. He had some service in the Welsh War, fought on the king's side at the battle of Shrewsbury (1403) and at the siege of Aberystwyth (1407). In 1408 he started on a pilgrimage to the Holy Land, visiting on his way Paris and Rome, and fighting victoriously in a tournament with Pandolfo Malatesta at Verona. From Venice he took ship to Jaffa, whence he went to Jerusalem, and set up his arms in the temple. On his return he travelled through Lithuania, Prussia and Germany, and reached England in 1410. Two years later he was fighting in command at Calais.

Up to this time Warwick's career had been that of the typical knight errant. During the reign of Henry V. his chief employment was as a trusted counsellor and diplomatist. He was an ambassador to France in September 1413, and the chief English envoy to the coronation of Sigismund at Aix-la-Chapelle, and to the council of Constance in the autumn of 1414. During the campaign of Agincourt he was captain of Calais, where in April 1416 he received Sigismund with such courtly magnificence as to earn from him the title of the "Father of Courtesy."

Warwick's sage experience made it natural that Henry V. should on his death-bed appoint him to be his son's governor. For some years to come he was engaged chiefly as a member of the council in England. In 1428 he received formal charge of the little king's education. He took Henry to France in 1430, and whilst at Rouen had the superintendence of the trial of Joan of Arc. In 1431 he defeated Pothon de Xaintrailles at Savignies. Next year he returned to England. The king's minority came

nominally to an end in 1437. Warwick was then chosen to succeed Richard of York in the government of Normandy. He died at his post there on April 30, 1439. His body was brought home and buried at Warwick. His tomb in St. Mary's church is one of the most splendid specimens of English art in the 15th century. (*See* also WARWICK, EARLS OF.)

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WARWICK, RICHARD NEVILLE, EARL OF (1428–1471), called "the king-maker," was eldest son of Richard Neville, earl of Salisbury, by Alice, only daughter and heiress of Thomas, the last Montacute earl of Salisbury. He was born on Nov. 22, 1428, and was betrothed in childhood to Anne, daughter of Richard Beauchamp, earl of Warwick. In 1449 she brought her husband the title and chief share of the Warwick estates. Richard Neville thus became the premier earl. In 1453 he became a member of the king's council. After the king's recovery in 1455 Warwick and his father took up arms in York's support. Their victory at St. Albans was due to the fierce energy with which Warwick assaulted and broke the Lancastrian centre. He was made captain of Calais; to his position there he owed his strength during the next five years. He distinguished himself in a great fight with Spanish ships off Calais on May 28, and in the autumn captured a German salt-fleet on its way to Lübeck, though England was at war neither with Castile nor with the Hanse. There was pretext enough for recalling him to make his defence. Whilst he was at the court at Westminster a brawl occurred between his retainers and some of the royal household. When a renewal of the war was imminent, Warwick crossed over to England with his trained soldiers from Calais under Sir Andrew Trollope. But at Ludlow on Oct. 12 Trollope and his men deserted, and left the Yorkists helpless. Warwick, with his father, his cousin the young Edward of York, and only three followers, made his way to Barnstaple. There they hired a little fishing vessel. The master pleaded that he did not know the Channel, and Warwick himself steered a successful course to Calais. During the winter Warwick held Calais, and sent out a fleet which seized Sandwich and captured Lord Rivers. In the spring he went to Ireland to concert plans with Richard of York. On his return voyage he encountered a superior Lancastrian fleet in the Channel. But Exeter, the rival commander, could not trust his crews and dared not fight.

From Calais Warwick, Salisbury and Edward of York crossed to Sandwich on June 26. A few days later they entered London, whence Warwick at once marched north. On July 10 he routed the Lancastrians at Northampton, and took the king prisoner. For the order to spare the commons and slay the lords Warwick was responsible, as also for some later executions at London. Yet when Richard of York was disposed to claim the crown, Warwick appears to have decided the discussion in favour of a compromise, perhaps from loyalty to Henry, or perhaps from the wish not to change a weak sovereign for a strong. Warwick was in charge of London at the time when Richard and Salisbury were defeated and slain at Wakefield. The Lancastrians won a second victory at St. Albans on Feb. 17, 1461, possibly through lack of generalship on Warwick's part. He met Edward of York in Oxfordshire, brought him in triumph to London, had him proclaimed king, and within a month of his defeat at St. Albans was marching north in pursuit of the Lancastrians. The good generalship which won the victory of Towton may have been due to Edward rather than to Warwick, but the new king was of the creation of the powerful earl, who now had his reward. For four years the government was centred undisputedly in the hands of Warwick and his friends. The first check to the power of the Nevilles came with the announcement in September 1464 of the king's secret marriage to Elizabeth Woodville, when Warwick had just pledged Edward to a French match. Trouble began in 1466, when Edward first made Rivers, the queen's father, treasurer, and opposed an intended marriage between Warwick's daughter Isabel and George of Clarence, his own next brother. Still in May 1467 Warwick went again with the king's assent to conclude a treaty with France. He returned to find that in his absence Edward, under Woodville's influence, had committed himself definitely to the Burgundian alliance. Warwick began to plot in secret for his revenge. In the summer of 1469 he went over to Calais, where Isabel and Clarence were married without the king's knowledge. Meantime he had stirred up the rebellion of Robin of Redesdale in Yorkshire; and when Edward was drawn north Warwick invaded England in arms. The king, outmarched and outnumbered, had to yield himself prisoner, whilst Rivers and his son John were executed. But in March 1470 a rebellion in Lincolnshire gave Edward an opportunity to gather an army of his own. When the king alleged proof of Warwick's complicity, the earl fled with Clarence to France. There he was reconciled to Margaret of Anjou, and agreed to marry his second daughter to her son. In September Warwick and Clarence, with the Lancastrian lords, landed at Dartmouth. Edward fled oversea, and for six months Warwick ruled England as lieutenant for Henry VI., who was restored from his prison in the Tower to a nominal throne. But the Lancastrian restoration was unwelcome to Clarence, who joined Edward when he landed at Ravenspur in March 1471. Warwick was completely outgeneralled, and at Barnet on April 14 was defeated and slain.

Warwick's only children were his two daughters. Anne, the younger, was married after his death to Richard of Gloucester, the future Richard III.

BIBLIOGRAPHY.—For data *see* especially C. W. Oman's brilliant but enthusiastic *Warwick the King-Maker* (1891); Sir James Ramsay's *Lancaster and York* (1892); and Stubbs's *Constitutional History.*

WARWICK, SIR ROBERT RICH, 2ND EARL OF (1587–1658), colonial administrator and admiral, was the eldest son of Robert Rich, earl of Warwick, and his wife Penelope Rich (*q.v.*), and succeeded to the title in 1619. His interest in colonial ventures involved him in disputes with the East India Company (1617) and with the Virginia Company, which in 1624 was suppressed through his action. In 1627 he commanded an unsuccessful privateering expedition against the Spaniards. His Puritan connections and sympathies, while estranging him from the court, promoted his association with the New England colonies. In 1628 he indirectly procured the patent for the Massachusetts colony, and in 1631 he granted the "Saybrook" patent in Connecticut. Compelled the same year to resign the presidency of the New England Company, he continued to manage the Bermudas Company, and Providence Company which, founded in 1630, administered Old Providence on the Mosquito coast. Meanwhile in England Warwick opposed the forced loan of 1626, the payment of ship-money and Laud's church policy, and with his brother the first Lord Holland (*q.v.*) came to be recognized as one of the heads of the Puritans. In March 1642 the Commons, in spite of the king's veto, appointed him admiral of the fleet, and in July he gained the whole navy for the parliament. He raised forces in Norfolk and Essex on the outbreak of the war, and as lord high admiral (1643–1645) he did good service in intercepting the king's ships and relieving threatened ports. In 1643 he was appointed head of a commission for the government of the colonies, which the next year incorporated Providence Plantations, afterwards Rhode Island, and in this capacity he exerted himself to secure religious liberty. He died on April 19, 1658.

WARWICK, a municipal borough and the county town of Warwickshire, Eng.; on the Avon. Pop. 14,020. Area, 7.9 sq.mi.

Warwick (*Warwic, Warrewici, Warrewyk*) seems to have been an early settlement fortified later by Aethelflaed, against the Danes. At Domesday, Warwick was a royal borough, containing 225 houses, of which 113 were in the king's hands, while 19 belonged to burgesses enjoying the privileges they had had in the time of Edward the Confessor. The Conqueror granted the borough to Henry de Newburgh, who was created earl of Warwick and in all probability built the castle on the site of Aethelflaed's fortification. The Beauchamps, successors of Henry de

Newburgh as earls of Warwick, held the borough of the king in chief. In the vicinity of Warwick is Guy's Cliffe, the hermitage of the first Guy, earl of Warwick. Although the borough owed its early importance to the castle of the earls of Warwick as well as to its position, and received a grant of a fair from John, earl of Warwick, in 1261, it seems to have developed independently of them, and received no charter until it was incorporated in 1546 after it had come into the king's hands by the attainder of Edward, earl of Warwick, in 1499. Other charters were granted in 1553, 1665, 1684 and 1694, of which that of 1553 allowed the appointment of assistant burgesses. This was discontinued in 1698. The charter of 1694 conferred the title of "Mayor, Aldermen and Burgesses" on the corporation.

The castle of the earls of Warwick stands on a rock above the river and includes a residential portion above the river as well as ruined towers of the 14th century and several parts of the ancient walls. There is a famous collection of pictures. The present church of St. Mary is a rebuilding after a fire in 1694. It appears from Domesday that a church existed before the Conquest. It was made collegiate by Roger de Newburgh, the second Norman earl, in 1123. At the Dissolution Henry VIII granted the foundation to the burgesses of the town. The Beauchamp chapel survived the fire; it is of Perpendicular work, built between 1443 and 1464. There are only scanty traces of the old town walls, but the east and west gates remain, with chapels built above them. The priory of St. Sepulchre was founded by Henry de Newburgh and completed in the reign of Henry I, on the site of an ancient church, for a society of canons regular. It is now a private residence. Leicester hospital, established by Robert Dudley, earl of Leicester, is a fine half-timber building. It was originally used as the hall of the united gilds of the Holy Trinity, the Blessed Virgin and St. George the Martyr. The earl of Leicester, by an act of incorporation obtained in 1571, founded the hospital for the reception of twelve poor men. Thomas Cartwright was the first master. St. John's hospital, a foundation of the time of Henry II, is represented by a beautiful Jacobean mansion. There are numerous charities in the town, the principal being those of Henry VIII, Sir Thomas White and Thomas Oken. The first is devoted to ecclesiastical and municipal stipends and to the King's school. By the charity of Sir Thomas White a sum of money is lent to young tradesmen for a period of years. The King's school dates from the reign of Edward the Confessor. Warwick returned two members to parliament from 1295, but in 1885 the number was reduced to one. It has now no independent representation and is in the Warwick and Leamington division of the county.

WARWICK, a town of Kent county, Rhode Island, U.S.A. Pop. (1920) 13,481 (22% foreign-born white) and 28,757 in 1940 federal census. It embraces several manufacturing villages and summer resorts. Warwick was settled in 1643 by Samuel Gorton (*q.v.*). In 1647 the settlement entered into a union with Providence, Newport and Portsmouth under the Warwick (or Williams) charter of 1644. Warwick was the birthplace of Gen. Nathanael Greene.

WARWICKSHIRE, a midland county of England. The area is 982.8 sq.mi. The river Avon, watering a rich valley on a line from northeast to southwest, divides the county into two unequal parts. The greater, lying to the northwest, drains principally to the Trent through the rivers Cole, Blythe, Rea, Anker and minor streams. Between these valleys, and dividing the system from that of the Avon, the land rises in gentle undulations. The land is formed for the most part of Keuper marls and sandstones, the sandstones forming picturesque scarps. The Bunter rocks are represented only between Birmingham and Sutton Coldfield. From this side the Avon receives the Swift, the Sowe and the Alne. An important fault crosses the area from Kenilworth northwards to Tamworth, and brings up the coal measures on the eastern side. The Upper coal measures, with the so-called Permian beds, occupy the larger part of the Warwickshire coalfield, while the productive Middle coal measures crop out in a narrow fringe along the north and east. The estimated reserves of coal were 1,126,981,000,000 tons in 1905. The eastern margin of the field is marked by an inlier of Cambrian and Pre-Cambrian rocks, the Hartshill quartzite (Cambrian) being quarried. The northern district was distinguished by Camden as the Woodland, as opposed to the southern or Feldon, "a plain champain." The woodland embraced the ancient forest of Arden. The finest scenery is found on the banks of the Avon at Guy's Cliffe and Warwick castle. It is not difficult to trace the influence of the scenic characteristics of the county in the writings of its most famous son, William Shakespeare.

Coal, lime and cement are the chief mineral products; manganese ore was formerly got from the Cambrian rocks.

History and Early Settlement.—Warwickshire, the area once largely occupied by the forest of Arden, is poor in prehistoric antiquities though one find, of a palaeolithic implement at Saltley, gave rise to a good deal of discussion some years ago. (*See* Evans, *Ancient Stone Implements,* pp. 522 and 578.) The Fosse way cut across the southeast of the county and Watling street touched it in the north. The earliest English settlers in the district were a tribe of Hwiccas who, pushing up the Severn valley early in the 6th century, made their way by the Avon valley and the Roman Fosse way, the extent of their settlement being indicated by the ancient limits of the diocese of Worcester. Humphreys' recent (*Archaeologia,* 1922–23, vol. lxxiii) discoveries at Bidford-on-Avon have demonstrated these points. The vast forest of Arden, from the Avon to modern Birmingham, barred progress northwards. It was only after the battle of Cirencester in 628 that the whole of the Hwiccan territory was comprised in Mercia. In 675 Cosford was included in the endowment of Peterborough, and in 757 Aethelbald was slain at Seckington in a battle with the West Saxons. The shire of Warwick originated in the 10th century about Aethelflaed's new burgh at Warwick and appears in the *Saxon Chronicle* of 1016.

The shire offered little resistance to the Conqueror, who was at Warwick in 1068. A fortress built by Thurkill, whose family later took the name of Arden, was entrusted by William to Henry, son of Roger de Beaumont, afterwards earl of Warwick, and Robert, count of Meulan, Henry's elder brother. Coventry Minster was richly endowed. The earldom and castle of Warwick subsequently passed to the Beauchamps, and in the reign of Henry VI to the Nevilles.

In the wars of the reign of Henry III, Simon de Montfort placed Kenilworth castle in charge of Sir John Giffard, who in 1264 attacked Warwick castle and took prisoner the earl and countess of Warwick, who had supported the king. During the Wars of the Roses the Nevilles, represented by the earl of Warwick, supported the Yorkist cause, while Coventry was a Lancastrian stronghold. On the outbreak of the Civil War of the 17th century Warwickshire and Staffordshire were associated for the parliament under Lord Brooke. The battle of Edge Hill was fought in 1642, and in 1643 Birmingham was sacked by Prince Rupert. Coventry endured a siege in 1642, and skirmishes took place at Southam and Warwick.

Warwickshire returned two members to the parliament of 1290, and in 1295 Coventry and Warwick were each represented by two members. Tamworth returned two members in 1584. Under the Reform Act of 1832 the county returned four members in two divisions; Birmingham was represented by two members, and Tamworth lost its members. Under the Act of 1868 the representation of Birmingham was increased to three members, and under the Act of 1918 the county returns four members in four divisions (Tamworth, Nuneaton, Rugby and Warwick and Leamington), Birmingham twelve members and Coventry one.

Architecture.—Of pre-Norman architecture some traces appear in the fine church of Wootton Wawen in the Arden (western) district. Saxon remains have been found in several places; *e.g.,* near Bensford bridge on Watling street. For ecclesiastical architecture Coventry with its three spires is famous, and among village churches there are many fine examples. Of those retaining Norman portions may be mentioned: Wolston, Berkswell, Polesworth, Curdworth, Burton Dassett, a very noteworthy building, and Warmington, where there is a remarkable specimen of an anchorite's chamber. There are also fine examples of Decorated work, such as Knowle, Solihull, Temple Balsall and Brailes.

Among the numerous religious houses in the county several have left remains. Such are the Cistercian foundations of Coombe Abbey, Merevale and Stoneleigh. This abbey was a 12th century foundation, but a majestic gatehouse of the 14th century also stands. Maxstoke Priory was a foundation for Augustinian canons of the 14th century. Wroxall Abbey was a Benedictine nunnery of the 12th century. Warwick Castle and Kenilworth Castle, the one still a splendid residence, the other a no less splendid ruin, are described under those towns. At Hartshill there is a fragment of a Norman castle. Among fortified mansions Maxstoke Castle is of the 14th century; Baddesley Clinton Hall is of the 15th; Astley Castle is another good specimen of the period. Compton Wynyates, once fortified, is a beautiful Elizabethan house. Charlecote Park is a modernized Elizabethan hall in an exquisite situation on the Avon above Stratford.

Agriculture and Industries.—The climate is mild and healthy. The soil is on the whole good, and consists of various loams, marls, gravels and clays, well suited for most of the usual crops. It is rich in pasture-land, and dairy-farming is extensive. Of the total of 464,678 ac. under crops and grass in 1939 only 20% was arable land, the principal crops being wheat (26,313 ac.) and oats (15,816 ac.), followed by mangolds (3,390 ac.). It has excellent orchards (2,627 ac. in 1939) and market-gardens and possesses some of the finest woodlands in England. The National Trust owned 181 acres in the county in 1942.

The industrial part of the county is the northern. Warwickshire includes the greatest manufacturing centre of the Midlands —Birmingham, though the suburbs of that city extend into Staffordshire and Worcestershire. Metal-working in all branches is prosecuted here, besides other industries. Coventry is noted for motor cars and cycle-making, and, with Bedworth and Nuneaton and the intervening villages, is a seat of the ribbon- and tape-makers. A rich coalfield occurs in the northeast, extending outside the county northward from Coventry. Clay, limestone and other stone are quarried at various points, and a small amount of iron ore is raised.

Population and Administration.—The area of the geographical county is 982.8 sq.mi., with a population in 1901 of 897,835 and in 1938 of 1,651,600, the chief centres of increase lying naturally in the parts about Birmingham and Coventry. The population of the administrative county (area, 876 sq.mi.) was estimated in 1938 at 397,600. Between Sept. 1939 and Feb. 1941 the population of the county declined by 1%, the exodus of evacuees from the cities probably being the principal cause of the decrease. Warwickshire has one court of quarter sessions, and is divided into 15 petty sessional divisions. There are two county boroughs (Birmingham and Coventry), six municipal boroughs and three urban districts. Birmingham, Coventry and Warwick have separate courts of quarter sessions. The county is mainly in the Birmingham and Coventry dioceses, carved largely out of that of Worcester.

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WASH, THE, a shallow bay of the North sea, Lincolnshire and Norfolk coast of England. Roughly square, it has an area of about 350 sq.m. Through sandbanks which form its bed there are two main channels into deep water; one, Boston Deeps, kept open by the waters of the Witham and Welland; the other, Lynn Deeps, by the Nene and the Great Ouse. The Wash is the remnant of a much larger bay, which covered a large part of the Fens; it is gradually being filled with sediments and from time to time small portions are reclaimed (*see* FENS). The flat bordering lands are protected by sea-walls. The formerly dangerous passage of the marsh-lands, which were liable to irruptions of the tide, is illustrated by the accident to King John in 1216.

WASHBURN, a city of Wisconsin, U.S.A., on the northwest shore of Chequamegon bay, a landlocked arm of Lake Superior, with navigable water close to shore. Pop. (1940) 2,363. It is served by the Chicago, St. Paul, Minneapolis and Omaha railway and is the seat of Bayfield county, Wisconsin's northernmost division. It is the trading centre for a large rural area. The principal industry is the manufacture of dynamite. The coal dock receives coal by lake freighter and ships by truck and rail to points in northern Wisconsin and Michigan. A dairy farming and fruit raising region is adjacent.

Washburn was founded in 1883 (named for Gov. C. C. Washburn) and incorporated in 1904.

WASHBURNE, ELIHU BENJAMIN (1816–1887), American statesman, born in Livermore, Me., Sept. 23, 1816. He was one of seven brothers, of whom four sat in Congress from as many different States. He graduated at the Harvard Law school in 1839, and was soon afterwards admitted to the bar. In 1840 he removed to Galena, Ill. He was elected to Congress in 1852, where, first as a Whig and afterwards as a Republican, he represented his district continuously until 1869, taking a prominent part in debate, and earning the name "watch-dog of the Treasury" by his consistent and vigorous opposition to extravagant and unwise appropriations. He contributed much to aid General Grant during the Civil War, and the latter on becoming president made Washburne secretary of State. On account of ill-health, however, he served only 12 days, and was then appointed minister to France. In 1877 he retired and died in Chicago, Ill., Oct. 22, 1887. He published *Recollections of a Minister to France* (1887), and *The Edwards Papers* (1884).

See Gaillard Hunt, *Israel, Elihu and Cadwallader Washburne* (1925).

WASHING MACHINES. Although household washing machines—mechanical devices for washing clothes—have been used for many years, it was not until the World War that these devices came into general popularity. Mechanical clothes washers trace their origin to the first crude tub with corrugated sides and bottom that revolved on an axis and was propelled by hand and to the stick with a tin pan or cup attached to one end that was plunged up and down in a tub full of clothes. Such mechanical means of washing date back over half a century. Modern mechanical clothes washers are of six general types—agitator or gyrator, cylinder, vacuum cup, oscillator, dolly and flowing or circulating water-type.

The *agitator* or *gyrator washer* employs a rotating and reversing disc, usually made of aluminium with one or more fins mounted on its upper side. This disc is placed in the bottom of the tub, operates from a driving mechanism placed underneath and forces the hot soapy water through the fabric. The agitator washer is generally acknowledged to be the fastest type available and the most popular.

The *cylinder washer* uses a metal or wooden cylinder that rotates in one direction, or rotates in one direction a predetermined number of revolutions varying from one to six, and then reverses. The moving cylinder, which is either perforated or constructed of slats, is contained in an outer shell or tub of metal or wood.

The *vacuum-cup washing machine* utilizes one or more circular or square cups—usually two or three—made of copper or aluminium, which are forced up and down in the water with a radial movement. In this type of machine, washing is accomplished by air pressure and suction.

In the *oscillator type* either a perforated container holding the clothes is rocked back and forth in the tub, or the tub itself is rocked. The oscillator and cylinder types of washing machine are the most gentle in their action.

The *dolly clothes washer,* one of the oldest types, has a rotating and reversing disc equipped on the bottom with fins or pegs. This disc is operated through the top of the tub. The dolly disc catches and holds the clothes while they are being forced through the water.

In the *flowing or circulating water type* washing machine, water is usually introduced into the tub under pressure, and the clothes are stirred around by the movement of the water.

Wood is still employed for the tubs in washing machines, although it has largely given way to copper, tinned copper, copper that is nickel-plated, galvanized iron, galvanized steel, aluminium, zinc and vitreous enamel. The tubs, which are made in a variety of shapes including circular, square and octagon, have a

capacity ranging from five to ten sheets, the average being six sheets or nine pounds of clothes. However, there are a number of small capacity portable washing machines available. There are also clothes washing machines without tubs.

Wringers or Dryers.—There are two general types of clothes wringers or dryers which are used on these clothes washers. Most washers are equipped with a mechanically-driven metal or wooden wringer, with two parallel rubber rolls, that revolve in opposite directions to squeeze the water from the clothes. While most of these wringers have two hard rubber rolls, there is a tendency to use one hard and one soft rubber roll, or two soft rolls. The purpose of the soft rubber roll is to eliminate the breakage of buttons. The wringers usually can be swung around to five or more positions and locked there. The other form of clothes dryer is the centrifugal dryer, spinner or extractor, which is similar to the extractors used in commercial laundry work. These dryers or extractors consist of perforated metal cylinders, driven at high speed so as to throw off the water contained in the clothes. This dryer may be in a separate compartment or the washing may take place in the dryer compartment.

Operation of Machine.—Opinions as to the proper operation of mechanical clothes washers differ among household economists. It is generally agreed, however, that soiled clothes should be sorted into four major groups and each group washed separately. White clothes such as table linen, bed linen, towels and body linen form one group. Clothes with fast colours form the second group. Coloured fabrics with "fugitive" colours or colours of doubtful permanence form the third group and require low temperatures in washing and rinsing and rapid drying. Miscellaneous pieces such as silks, woollens, blankets and rugs also require individual attention. Clothes should be soaked overnight before being placed in the washer or the washer tub should be filled with cold water, the clothes inserted and the machine operated without the use of soap or washing compounds for five minutes.

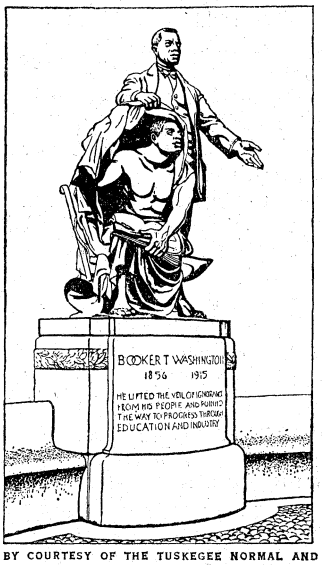
For washing, water of from 135° to 140° F is usually employed with $1\frac{1}{4}$ to 4 ounces of soap. The kind and form of soap used depends upon the condition of the clothes and upon the hardness or softness of the water available. The machine should be operated from ten to fifteen minutes, depending on the type of machine and the condition of the clothes. The washing operation should be followed by two scalding rinses in water 160° to 180° F with the machine operating from ten to fifteen minutes for each rinse. The hot rinses are followed by a cold rinse of ten minutes' duration. Bluing the clothes, if desired, follows the cold rinse.

Later developments in the washing machine field include greater application of safety devices, such as the employment of instant releases on wringers and the enclosure of all accessible moving parts; improved gears, bearings and lubricating means; the use of materials and finishes that are more easily kept clean by the housewife; and the development of machines for permanent installation in stationary laundry tubs. Perhaps the most important development is the two-tub washer, one compartment housing the washing mechanism and the other containing the clothes dryer or extractor which replaces the roll wringer, both mechanisms being operated from the same motor.

In 1939 there were 1,504,704 washing machines produced in the United States alone, with a total value of $54,152,358. This represented an increase over the 1929 figure of more than 370,000 machines, but individual machines declined substantially in price over the ten-year period, as shown by the fact that the total value of the washing machines produced in 1929 was nearly $17,000,000 more than the total value for 1939. Nearly 92% of the washing machines manufactured in 1939 were electric. About 7% were powered by gas or gasoline engines and the remainder were operated by water power or by hand. (A. P. Hr.; X.)

WASHING SODA, the common name for the decahydrate of sodium carbonate ($Na_2CO_3.10H_2O$), also called sal soda and used in household and laundry work. *See* Alkali.

WASHINGTON, BOOKER TALIAFERRO (*c.* 1859–1915), American Negro teacher and reformer, was born on a plantation in Franklin county, Virginia. Soon after the Civil War he went to Malden, W.Va., where he worked in a salt furnace and then in a coal mine. He obtained an elementary education at night school, and became a house servant in a family where his ambition for knowledge was encouraged. In 1872 "by walking, begging rides both in wagons and in the cars" he travelled 500m. to the Hampton (Va.) Normal and Agricultural institute, where he remained three years, working as janitor for his board, and graduated in 1875. For two years he taught at Malden, his former home, and studied for eight months (1878–79) at the Wayland seminary in Washington, D.C. In 1879 he became instructor at the Hampton institute, where he trained about 75 American Indians with whom Gen. S. C. Armstrong was carrying on an educational experiment, and he developed the night school, which became one of the most important features of the institution. In 1881 he was appointed organizer and principal of a Negro normal school at Tuskegee, Ala. (*q.v.*), for which the State legislature had made an annual appropriation of $2,000. Opened in July, 1881, in a little shanty and church, the Tuskegee Normal and Industrial institute became, under Washington's presidency, the foremost exponent of industrial education for the Negro. In the first 19 years of the school's existence 40 buildings were erected, all but four largely by student labour, and student labour also provided other necessities. To promote the interests of the school and to establish better understanding between whites and blacks, Washington delivered many addresses throughout the United States, notably a speech in 1895 at the opening of the Atlanta Cotton States and International Exposition. In 1900 at Boston, Mass., he organized the National Negro Business League. Harvard conferred upon him the honorary degree of A.M. in 1896, and Dartmouth that of LL.D. in 1901. He died at Tuskegee on Nov. 14, 1915, as the result of overwork.



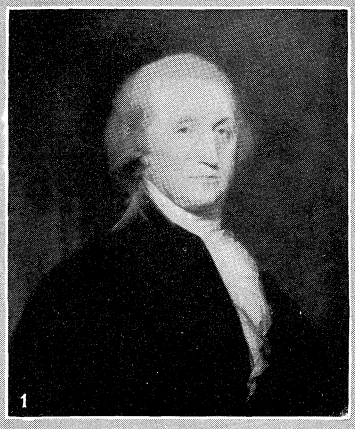
BY COURTESY OF THE TUSKEGEE NORMAL AND INDUSTRIAL INSTITUTE

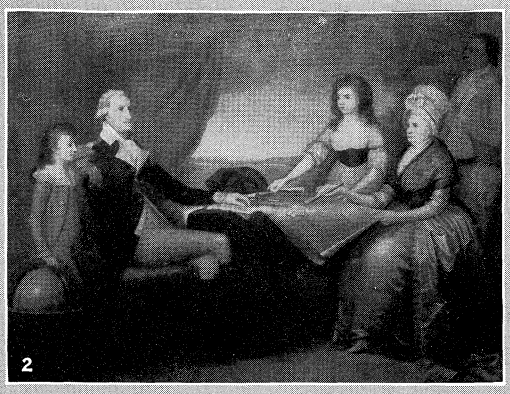
THE BOOKER T. WASHINGTON MEMORIAL AT TUSKEGEE INSTITUTE

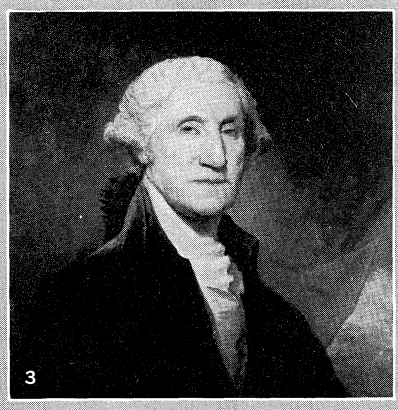
Among his publications are *The Future of the American Negro* (1899); *Sowing and Reaping* (1900); *Up from Slavery* (1901), a strong autobiography; *Character Building* (1902); *Working with the Hands* (1904); *Tuskegee and its People* (1905); *Putting the Most into Life* (1906); *Life of Frederick Douglas* (1907); *The Negro in Business* (1907); *The Story of the Negro* (1909); *My Larger Education* (1911); and *The Man Farthest Down; a Record of Observation and Study in Europe* (1912).

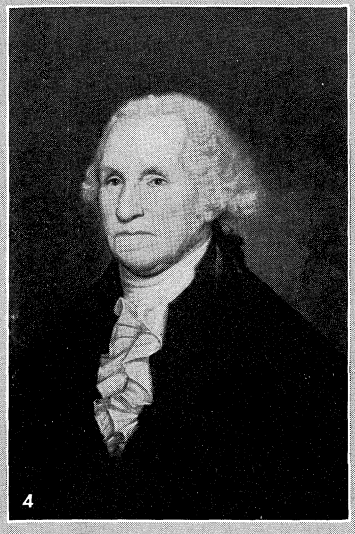
WASHINGTON, BUSHROD (1762–1829), American jurist, nephew of George Washington, was born in Westmoreland county, Va., on June 15, 1762. He graduated in 1778 at the College of William and Mary, where he was an original member of the Phi Beta Kappa Society. He served in the House of Delegates in 1787, and in the following year sat in the convention which ratified for Virginia the Federal Constitution. In 1798 he was appointed an associate justice of the United States Supreme Court by President John Adams. He was George Washington's literary executor, and supervised the preparation of John Marshall's *Life of Washington* (5 vols., 1804–07); and on Mrs. Washington's death in 1802 he inherited Mt. Vernon and a part of the estate. He died in Philadelphia on Nov. 26, 1829.

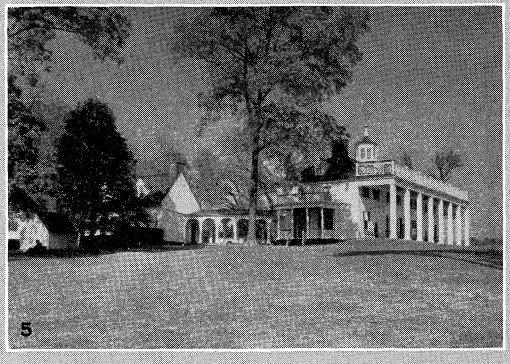
WASHINGTON, GEORGE (1732–1799), general, statesman and first president of the United States, was born at Bridges Creek, near Fredericksburg, in Westmoreland county, Va., on Feb. 22 (old style Feb. 11), 1732. His father was Augustine Washington, who had gone to school in England, had tasted seafaring life, and was now managing his large Virginia estates. On the paternal side the family traced its lineage to Sulgrave, Northamptonshire,

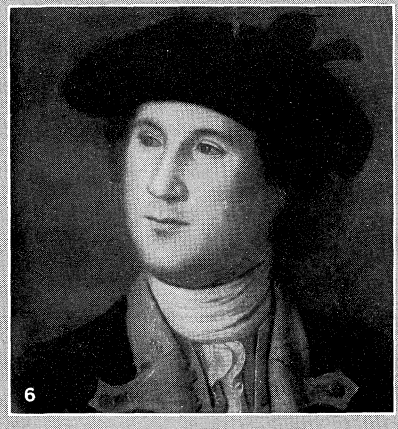


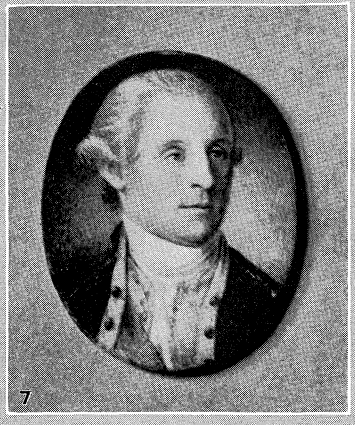


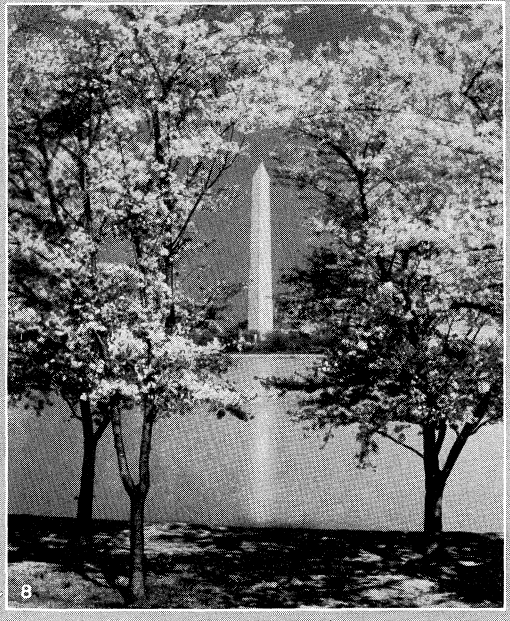


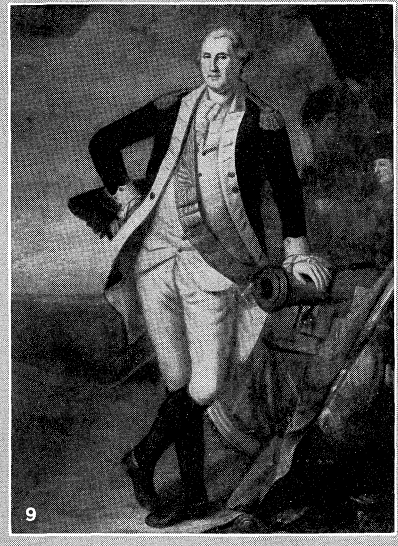












BY COURTESY OF (1) THE GALLERY OF FINE ARTS, YALE UNIVERSITY, SCHOOL OF FINE ARTS, (2, 4) THOMAS B. CLARKE, (3, 7) THE METROPOLITAN MUSEUM OF ART, NEW YORK, (9) THE PENNSYLVANIA ACADEMY OF THE FINE ARTS; PHOTOGRAPHS, (5, 8) CRANDALL, (6) P. B. WALLACE

GEORGE WASHINGTON (1732–1799)

1. George Washington as president. Painted, 1793, in Philadelphia by John Trumbull (1756–1843). In the Gallery of Fine Arts, Yale University
2. "The Washington Family," painted from life in New York and Philadelphia between 1789 and 1796 by Edward Savage (1761–1817). Owned by Thomas B. Clarke and in the Pennsylvania Museum, Fairmount Park, Philadelphia, Pa.
3. The Gibbs-Channing-Avery portrait, 1795, painted in Philadelphia by Gilbert Stuart (1755–1828). In the Metropolitan Museum of Art, New York
4. Portrait, 1795, painted from life by Rembrandt Peale (1778–1860). Owned by Thomas B. Clarke and in the Pennsylvania Museum
5. Mount Vernon, Virginia, the home of Washington on the Potomac River
6. Study for the 1772 portrait by Charles Willson Peale (1741–1827)
7. Washington at 25. Miniature, n.d., attributed to John Singleton Copley (1737–1815). In the Metropolitan Museum of Art
8. The Washington Monument at the national capital
9. Portrait representing Washington on the College Campus at Princeton by Charles Willson Peale. In the Pennsylvania Academy of the Fine Arts, Philadelphia

England, from which Washington's great-grandfather, John Washington, had emigrated in 1657, settling at Bridges Creek and becoming a member of the Virginia house of burgesses. Little is known of any member of the family till the time of Washington's father, Augustine, who was a man of energy, at one time part owner of an iron mine and smelter near Fredericksburg, and active in managing lands both at Hunting Creek (now Mount Vernon) on the Potomac, and on the Rappahannock. Augustine was married twice, first to Jane Butler, who bore him four children, and after her death to Mary Ball, the first of whose six children was George.

Childhood.—Little has been recorded of Washington's childhood in the small four-room farm house on the Rappahannock, a fact which invited Mason L. Weems's absurd fictions regarding the hatchet and cherry tree, and his repugnance to fighting. Till the fall of 1747 he irregularly attended school, first with the local church-sexton, and later with a schoolmaster named Williams. There is evidence that he studied a little Latin; his copy-book, with the moral precepts or *Rules of Civility* which he transcribed at fourteen, was carefully preserved. At a later date he taught himself a good deal of mathematics. His chief education, however, was received from practical men and outdoor occupations, not from books. His father owned six different plantations, of which Washington knew best that at Bridges Creek. Here he rode, watched the slaves at labour, mastered the routine of tobacco-growing and stock-raising. He early learned the elements of surveying, and at the age of 14 was able to plot and measure the fields of his brothers and neighbours.

Early Activities.—Washington's father, dying when the boy was 11, left him under the guardianship of his half-brother Lawrence, who with the other surviving son of the first marriage, Augustine, inherited nearly all of the estate. Thenceforth he lived chiefly with Lawrence at Mount Vernon, though for a time he was at Bridges farm with Augustine. The old story that Admiral Edward Vernon (after whom Mount Vernon was named) offered him the post of midshipman is apocryphal. His half-brother Lawrence, who was a gentleman of fashion and education, married to a daughter of the wealthy and well-born William Fairfax, had served in the attack upon Cartagena in 1741 with Vernon, and doubtless knew that admiral well; but there is no evidence that Vernon interested himself in Washington. The lad turned instead to surveying as a profession. In 1746 Thomas, Lord Fairfax, a middle-aged bachelor who owned more than five million acres in northern Virginia and the Shenandoah valley, came to America to live with his cousin William at Belvoir on the Potomac, adjoining Mount Vernon. He was a man of culture, a former associate of Addison and Steele, and added much to the society of the section. Wishing to protect his lands, on which squatters from Pennsylvania were settling, he sent off to the Shenandoah in March, 1748, a surveying party which Washington accompanied as assistant-surveyor. On this western journey Washington kept a disjointed, ill-spelt diary, which contains some lively touches. He describes the discomfort of sleep under "one thread Bear blanket with double its Weight of Vermin such as Lice Fleas &c"; an encounter with a war party of Indians bearing a scalp; the Pennsylvania-German emigrants, "as ignorant a set of people as the Indians they would never speak English but when spoken to they speak all Dutch"; and the serving of roast wild Turkey on "a Large Chip," while "as for dishes we had none."

After his return, Washington was assisted by Lord Fairfax to obtain the position of public surveyor for Fairfax county, his commission from William and Mary college being dated July, 1749; and for more than two years he was kept almost constantly busy. His surveying trips carried him far beyond the Tidewater region into the western wilderness, taught him resourcefulness and endurance, and toughened his character. In addition, they gave him an interest in western lands, and an appreciation of the importance of western development, which endured throughout his life. He was always disposed to speculate in western holdings, and to view favourably projects for opening and colonizing the west. Lord Fairfax shortly removed into the Shenandoah valley and built there a log mansion called Greenway court, after his English estate; here Washington was frequently entertained, and had access to a large library, including contemporary English novels.

Plantation Life.—The year 1752 marked a turning point in Washington's life, for that summer his half-brother Lawrence died at Mount Vernon of tuberculosis, making George the executor of his will and residuary heir of his estate in the event that his daughter Sarah died—as she did within two months—without issue. At the age of 20 Washington thus became manager of a large plantation. The previous year he had accompanied Lawrence on a trip for his health to the Barbados, and had there contracted smallpox, which left his face permanently pitted. This was the only occasion upon which Washington left the borders of the United States. For the next 20 years the main background of his life was the work and the social life of Mount Vernon. He was fond of riding, of fox-hunting, of dancing, of such theatrical performances as offered themselves and, despite an unconquerable awkwardness with the fair sex, of flirtation. Being now fully 6 ft. tall, and heavily built, with hands and shoulders of unusual size, he excelled in all outdoor pursuits, from wrestling to horse-breaking. In 1752 he was made adjutant of one of Virginia's four military districts, with an annual salary of £100 and not too onerous duties. He rapidly became prominent in community affairs, was an active member and later vestryman of the Episcopal Church, and was known as a strict and sagacious manager of his plantation. As early as 1748 he had begun patenting or buying lands, adding farm after farm to his holdings, till by 1757 he had more than 4,000 ac. to care for with white and slave labour.

Early Military Career.—Washington's entry into military life was not long delayed. In 1753 Gov. Dinwiddie of Virginia found it necessary to warn the French to desist from their encroachments on Ohio valley lands claimed by the British Crown, and after sending one messenger who failed to reach his goal, determined to despatch Washington. On the day he received his commission, Oct. 31, 1753, he set out for the French posts with a party comprising Jacob Van Braam, a Dutch fencing-master, as his interpreter, the scout Christopher Gist as guide, two servants, and two traders. His post of adjutant-general of the colony gave him the rank of major. The party left what is now Cumberland, Md., the middle of November, and despite wintry weather reached Ft. Leboeuf, at what is now Waterford, Pa., 20 m. south of Lake Erie, without delay. The French commander, Legardeur de St. Pierre, received him with courtesy, but "they told me," wrote Washington later, "that it was their absolute Design to take possession of the Ohio, and by God, they would do it"; and they gave Washington a letter to Dinwiddie with the same message. Returning homeward, Washington and Gist met a party of Indians, who fired at them at 15 paces, but missed; and in floating down the Allegheny on a raft, the major was jerked into the ice-filled stream, but "fortunately saved myself by catching hold of one of the Raft Logs." They were at Williamsburg on Jan. 16, 1754, where Washington wrote a report. Dinwiddie, who was labouring to convince the Crown of the seriousness of the French threat, had it printed and sent to London, where it was reprinted, and he appointed Washington lieutenant-colonel of a provincial regiment under Col. Joshua Fry. The governor at once launched into what may be called Dinwiddie's war against the French, and sent Washington and Fry with several hundred men against the enemy on the Ohio.

In this preliminary campaign of the French and Indian war Washington played a brave but by no means brilliant part. He marched with the advance guard to Cumberland, there learning that the French had occupied the fort of the Ohio company on the present site of Pittsburgh, renaming it Ft. Duquesne. Nevertheless he struggled forward hesitantly to within about 40 m. of the French position, and erected a weak fort at Great Meadows, near what is now Confluence, Pa. With this as a base, he made a surprise attack May 28, 1754, upon an advance detachment of 30 French, killing the commander, Coulon de Jumonville, and nine others, and making the rest prisoners. This brought the whole French force upon him. They drove Washington's 350 men into the Great Meadows fort (Ft. Necessity) on July 3, besieged it with 700 men, and after nine hours compelled him to surrender. The construction of the fort was a blunder, for it lay in a water-

logged creek bottom, was commanded on three sides by forested elevations approaching it closely, and was too far from Washington's supports. The French agreed to let the disarmed colonials march back to Virginia with the honours of war, but they compelled Washington to promise that Virginia would not build another fort on the Ohio for a year, and to sign a paper acknowledging responsibility for *"l'assassinat"* of M. de Jumonville; a word which Washington later explained he did not rightly understand. He returned to Virginia, chagrined but proud, to receive the thanks of the house of burgesses, to be made a colonel by Dinwiddie and to find his name mentioned in the London gazettes. His remark in a letter to his brother that "I have heard the bullets whistle; and believe me, there is something charming in the sound," was commented on humorously by Horace Walpole and sarcastically by George II.

An Aide to Braddock.—The arrival of General Edward Braddock and his army in Virginia in Feb. 1755, as part of the triple plan of campaign which called for his advance on Ft. Duquesne, Governor Shirley's capture of Niagara, and William Johnson's capture of Crown Point, brought Washington new opportunities and responsibilities. He had resigned his commission in Oct. 1754, in resentment of the slighting treatment and underpayment of colonial officers, and in especial of an untactful order of the British War Office that provincial officers of whatever rank should be subordinate to any officer holding the king's commission. But he ardently desired a part in the war; "my inclinations," he wrote a friend, "are strongly bent to arms." When Braddock showed appreciation of his merits and invited him to join the expedition as personal aide-de-camp, with the courtesy title of colonel, he therefore accepted. His self-reliance, decision and masterful traits were quickly made as plain as his wilderness experience. At table he had frequent disputes with Braddock, who when contractors failed to deliver their supplies attacked the colonials as supine and dishonest, while Washington defended them with warmth. His freedom of utterance is proof of Braddock's esteem. Braddock also accepted from him the unwise advice that he divide his army, leaving half of it to come up with the slow wagons and cattle-train, and taking the other half forward against Ft. Duquesne at a rapid pace. Washington was ill with fever during June, but joined the advance guard in a covered wagon on July 8, begged to lead the march on Ft. Duquesne with his Virginians and the Indian allies, and was by Braddock's side when on July 9 the army was ambushed and bloodily defeated.

In this defeat Washington displayed the combination of coolness and determination, the alliance of unconquerable energy with complete poise, which was the secret of so many of his successes. So ill that he had to use a pillow instead of a saddle, and that Braddock ordered his body servant to keep special watch over him, he was everywhere at once. At first he followed Braddock as the general bravely tried to rally his men to push either forward or backward, the wisest course the circumstances permitted. Then he rode back to bring up the Virginians from the rear, and rallied them with effect on the flank. To him was largely due the escape of the force. His exposure of his person was as reckless as Braddock's, who was fatally wounded on his fifth horse; Washington had two horses shot under him and his clothes cut by four bullets without being hurt. He was at Braddock's death-bed, helped bring the troops back, and was repaid by being appointed, in Aug. 1755, while still only 23 years old, commander of all the Virginia troops. But no part of his later service was conspicuous. Finding that a Maryland captain who held a royal commission would not obey him, he rode north in Feb. 1756, to Boston, to have the question settled by the commander-in-chief in America, Gov. William Shirley; and bearing a letter from Dinwiddie, had no difficulty in carrying his point. On his return he plunged into a multitude of vexations. He had to protect a weak, thinly settled frontier nearly 400 m. in length with only some 700 ill-disciplined colonial troops, to cope with a legislature unwilling to support him, to meet attacks on the drunkenness and inefficiency of the soldiers, and to endure constant wilderness hardships. It is not strange that in 1757 his health failed, and in the closing weeks of that year he was so ill of a "bloody flux" that his physician ordered him home to Mount Vernon. He recovered sufficiently to command the advance guard of Gen. John Forbes when in 1758 that general marched from Virginia upon Ft. Duquesne, triumphantly captured it, and renamed it Ft. Pitt; but this done, near the end of the year he resigned.

His Marriage.—Immediately after the surrender of his commission occurred his marriage Jan. 6, 1759, to Martha Dandridge, the widow of Col. Daniel Parke Custis. She had been born the same year as himself, was the mother of two children living and two dead, and possessed one of the largest fortunes in Virginia. Washington had met her the previous March, had been attracted by her brown hair, hazel eyes, and plump figure and had asked her hand before his campaign with Forbes. She had the qualities of a good housewife and companion, and the marriage was happy. But she no more represented his first love than he did hers; he had been rejected by a Miss Betsy Fauntleroy; tradition states that he had paid unsuccessful suit to Mary Philipse of New York, and there is clear evidence that he temporarily felt a romantic attachment for Sarah, wife of his friend Geo. William Fairfax. The estimate of John Marshall that Washington's marriage brought him personally an increase of $75,000 in property, and of G. Washington Custis that it brought him $100,000, are excessive; a precise computation shows that the sum was about $66,000, then of course a handsome fortune. The holdings included about 15,000 ac., much of it valuable because placed near Williamsburg, a number of town lots, and 150 slaves, and from this time Washington added to the cares of Mount Vernon those of the Custis estate at the White House on the York river. From his marriage to the eve of the Revolution he devoted himself to the duties and pleasures of a great landowner, varied a few weeks every year by attendance as member of the house of burgesses. He was elected to this body in 1758, after standing treat to the voters a prodigious quantity of rum punch, wine, brandy, beer, and "cider royal."

A Virginia Planter.—In no light does Washington appear more characteristically than as one of the richest and largest of Virginia tobacco-planters. He was industrious, punctual, efficient, and economical. Disliking slavery on economic and social rather than moral grounds, he made the best of it, carefully clothed and fed his hands, and employed a doctor for the sick. He practised crop rotation, diversified his products to raise enough food for all his people and experimented in breeding horses and cattle. He had a peach and apple orchard, grafted many cherry, pear and plum trees, and grew Madeira grapes and the "Mississippi nut" or pecan. Till after the Revolution the Mount Vernon house was a small edifice of eight rooms, but he spent much pains on beautifying the grounds. The health, education and property of his stepchildren Patsy Custis and John Parke Custis were carefully supervised, Washington rendering minute yearly accounts to the court. He engaged a tutor, made special exertions to cure Patsy Custis of the epilepsy to which she succumbed in 1772, and sent John to King's college in New York for a few months. In the social life of the Tidewater, he played a prominent rôle. Mount Vernon was usually full of guests, casual travellers, invited friends and relatives. House-parties were frequent; Washington mentions many expenditures for arrack, wine and punch at neighbourhood clubs; he liked afternoon tea, served in summer on the Mount Vernon verandah; he was fond of picnics, barbecues, and clam-bakes; and throughout his life he enjoyed dancing, frequently going ten miles to Alexandria to attend balls. On the frontier he sighed in a letter for "assembly balls" and "routs," and at the age of 64 in 1796 he still danced. He went regularly to the Williamsburg races, where he sometimes ran horses of his own; and his account books frequently note sums lost at cards, the largest being £9 14s. In bad weather his diary sometimes states "at home all day, over cards." At billiards also he frequently won or lost small sums. At Mount Vernon riding to hounds was a favourite pastime, to which he devoted generous space in his diaries, while he took pains to improve the breed of his favourite hounds. In season he went gunning for ducks, and fished the Potomac for sturgeon and bass. He missed few opportunities to see plays at Alexandria or Williamsburg. He was able to quote

aptly from Shakespeare, Addison and Sterne.

Pre-Revolutionary Politics.—While Washington's associates marked him, in Col. John L. Peyton's words, as "a young man of an extraordinary and exalted character," he gave before 1770 no signs of greatness and few of interest in affairs of State. He played a silent part in the house of burgesses. But he was present when Patrick Henry introduced his resolutions against the Stamp Act in May, 1765, and shortly thereafter gave token of his adherence to the cause of the colonial Whigs against the Tory ministries of England. In 1768 he told George Mason at Mount Vernon that he would take his musket on his shoulder whenever his country called him. The next spring, April 4, 1769 he sent Mason the Philadelphia non-importation resolutions with a letter declaring that it was necessary to resist the strokes of "our lordly masters" in England, that courteous remonstrances to parliament having failed, he wholly endorsed the resort to commercial warfare, and that as a last resort, no man should scruple to use arms in defence of liberty. When, the following May, the royal governor dissolved the house of burgesses, he shared in the gathering at the Raleigh tavern which drew up non-importation resolutions, and he went farther than most of his neighbours in adhering to them. At this time and later he believed with most Americans that peace need not be broken. He had been interested since youth in Western lands, and in 1767 had asked Capt. William Crawford to find for him a fertile tract in western Pennsylvania. Late in 1770 he himself paid a land-hunting visit to Ft. Pitt, where George Croghan was maturing his plans for the proposed 14th colony of Vandalia. Washington directed his agent to locate and survey 10,000 ac. adjoining the Vandalia tract, and at one time he wished to share in certain of Croghan's schemes. But the Boston Tea-party of Dec. 1773, and the bursting at about the same time of the Vandalia bubble, turned his eyes back to the East and the threatening state of Anglo-American relations. He was not a member of the Virginia committee of correspondence formed in 1773 to communicate with other colonies, and when the Virginia legislators, meeting irregularly again at the Raleigh tavern in May, 1774, called for a Continental Congress, he does not seem to have been present. But he was a leading member of the first provincial convention or revolutionary legislature late that summer, and to this body he made a speech which was much praised for its pithy eloquence, declaring that "I will raise one thousand men, subsist them at my own expense, and march myself at their head for the relief of Boston."

The Virginia provincial convention promptly elected Washington one of the seven delegates to the first Continental Congress. He was by this time known as a radical rather than a moderate, and in several letters of the time he opposed a continuance of petitions to the British Crown, declaring that they would inevitably meet with a humiliating rejection. "Shall we after this whine and cry for relief when we have already tried it in vain?" he wrote. When the congress met in Philadelphia on Sept. 5, 1774, he was in his seat in full uniform; and his participation in its councils marks the beginning of his national career. Later Patrick Henry, being asked who was the greatest man in Congress, replied: "If you speak of eloquence, Mr. Rutledge of South Carolina is by far the greatest orator; but if you speak of solid information and sound judgment, Colonel Washington is unquestionably the greatest man on that floor." His letters of the period show that while still utterly opposed to the idea of independence, he was determined never to submit "to the loss of those valuable rights and privileges, which are essential to the happiness of every free State, and without which life, liberty, and property are rendered totally insecure." If the ministry pushed matters to an extremity, he wrote, "more blood will be spilled on this occasion than ever before in American history." Though he served on none of the committees, he was a useful member, his advice being sought on military matters, and weight being attached to his advocacy of a non-exportation as well as non-importation agreement. He also helped to secure congressional approval of the "Suffolk resolves," which looked toward armed resistance as a last resort, and which did much to harden the king's heart against America. Returning to Virginia in November, he took command of the volunteer companies now drilling there, and also served as chairman of the committee of safety in Fairfax county. The unanimity with which the Virginia troops turned to him, though the province contained many experienced officers and Col. William Byrd of Westover had succeeded Washington as commander-in-chief, was a tribute to his reputation and personality; it was understood that Virginia expected him to be her general.

Head of the Colonial Forces.—Washington's choice as commander-in-chief of the military forces of all the colonies followed immediately upon the first fighting, though it was by no means inevitable and was the product of partly artificial forces. The Virginia delegates differed upon his appointment. Washington himself recommended General Andrew Lewis for the place, and Edmund Pendleton was, according to John Adams, "very full and clear against it." It was chiefly the fruit of a political bargain by which New England offered Virginia the chief command as her price for the adoption and support of the New England army. This army had gathered hastily and in force about Boston immediately after the clash of British troops and American minute-men at Lexington and Concord on April 19, 1775. When the second Continental Congress met in Philadelphia on May 10, one of its first tasks was to find a permanent leadership for this force. On June 15 Washington, whose military counsel had already proved invaluable on two committees, was nominated by John Adams, and chosen by unanimous vote. Beyond the considerations noted, he owed his choice to the fact that Virginia stood with Massachusetts as one of the two most powerful colonies; that his appointment would augment the zeal of the Southern people; that he had made an enduring reputation in the Braddock campaign; and that his poise, sense and resolution had impressed all the delegates. The scene of his election, with Washington darting modestly into an adjoining room and John Hancock flushing with jealous mortification, will always impress the historical imagination. So also will the scene of July 3, 1775, when wheeling his horse under an elm in front of the troops paraded on Cambridge common he drew his sword and took command of the army investing Boston. News of Bunker Hill had reached him before he was a day's journey from Philadelphia, and he had expressed confidence of victory when told how the militia had fought. In accepting the command he refused any payment beyond his expenses, and called upon "every gentleman in the room" to bear witness that he disclaimed fitness for it. At once he showed characteristic decision and energy in organizing the raw volunteers, collecting provisions and munitions, and rallying Congress and the colonies to his support.

The first phase of Washington's command covered the period from July, 1775, to the British evacuation of Boston in March 1776. In these eight months he imparted discipline to the army, which at maximum strength slightly exceeded 20,000; he dealt with subordinates who as John Adams says quarrelled "like cats and dogs"; and kept the siege vigorously alive. Having himself planned an invasion of Canada by Lake Champlain, to be entrusted to General Philip Schuyler, he heartily approved of Benedict Arnold's proposal to march north along the Kennebec river and take Montreal and Quebec. Giving Arnold 1,100 men, he instructed him to do everything possible to conciliate the Canadians. He was equally active in encouraging privateers to attack British commerce. As fast as means offered, he strengthened his army with ammunition and siege-guns, bringing heavy artillery from Ticonderoga over the frozen roads early in 1776. His position was at first precarious, for the Charles river pierced the centre of his lines investing the town, and if Howe had moved his 20 veteran regiments boldly up the stream he might have pierced Washington's army and rolled either wing back to destruction. But all the generalship was on Washington's side. Seeing that Dorchester heights, just south of Boston, commanded the city and harbour, and that Howe had unaccountably failed to occupy it, he seized it on the night of March 4, 1776, placing his Ticonderoga guns in position. The British naval commander declared that he could not remain if the Americans were not dislodged, and Howe, after a storm disrupted his plans for an assault, evacuated the city on March 17. He left 200 cannon and invaluable stores

of small arms and munitions. After stamping out the smallpox in Boston and collecting his booty, Washington hurried south by land to take up the defence of New York.

Sources of Military Strength.—Washington had won the first round, but there remained five years of war, during which the American cause was repeatedly near complete disaster. It is unquestionable that Washington's strength of character, his ability to hold the confidence of army and people and to diffuse his own courage among them, his unremitting activity and his strong common sense, constituted the chief factor in achieving American victory. He was not a great tactician; as Jefferson said later, he often "failed in the field," he was sometimes guilty of grave military blunders, the chief being his assumption of a position on Long Island in 1776 which exposed his army to capture entire the moment it was defeated. At the outset he was painfully inexperienced, the wilderness fighting of the French war having done nothing to teach him the strategy of considerable armies. One of his chief faults was his tendency to subordinate his own judgment to that of the generals surrounding him; at every critical juncture, before Boston, before New York, before Philadelphia, in New Jersey, he called a council of war, and in almost every instance accepted its decision. Naturally bold and dashing, as he proved at Trenton, Princeton and Germantown, he repeatedly adopted evasive and delaying tactics on the advice of his associates; however he did succeed in keeping a strong army in existence and maintaining the flame of national spirit, and when the auspicious moment arrived, he planned the rapid movements which ended the war.

One element of Washington's strength was his sternness as a disciplinarian. The army was continually dwindling and refilling; politics largely governed the selection of officers by Congress and the States; and the ill-fed, ill-clothed, ill-paid forces were often half prostrated by sickness and ripe for mutiny. Troops from each of the three sections, New England, the Middle States and the South, showed a deplorable jealousy of the others. Washington was rigorous in breaking cowardly, inefficient and dishonest men, and boasted in front of Boston that he had "made a pretty good sort of slam among such kind of officers." Deserters and plunderers were flogged, and he once erected a gallows 40 ft. high, writing that "I am determined if I can be justified in the proceeding, to hang two or three on it, as an example to others." At the same time the commander-in-chief won the devotion of many of his men by his earnestness in demanding better treatment for them from Congress. He complained of their short rations, declaring once that they were forced to "eat every kind of horse food but hay."

Campaigns in Middle Colonies.—The darkest chapter in Washington's military leadership was opened when, reaching New York on April 23, 1776, he placed half his army, some 9,000 men, under Isaac Putnam, on the perilous position of Brooklyn heights, Long Island, where a British fleet in the East river might cut off their retreat. He spent a fortnight in May with the continental congress in Philadelphia, then discussing the question of independence; and though no record of his utterances exists, there can be no doubt that he advocated complete separation. His return to New York preceded but slightly the arrival of the British army under Howe, which made its main encampment on Staten Island till its whole strength of nearly 30,000 could be mobilized. On Aug. 22, 1776, Howe moved about 20,000 men across to Gravesend bay on Long Island. Four days later, sending the fleet under command of his brother Lord Howe to make a feint against New York city, he thrust a crushing force along feebly protected roads against the American flank. The patriots were out-manoeuvred, defeated, and suffered a total loss of 5,000, of whom 2,000 were captured. Their whole position might have been carried by storm, but fortunately for Washington, Howe delayed. While the enemy lingered, he succeeded under cover of a dense fog in ferrying the remaining force across the East river to Manhattan, where he took up a fortified position. The British, suddenly landing on the lower part of the island, drove back the Americans in a clash marked by disgraceful cowardice on the part of Connecticut and other troops. In a series of actions Washington was forced northward, more than once in danger of capture, till the loss of his two Hudson river forts, one of them with 2,600 men, compelled him to retreat from White Plains across the river into New Jersey. Here he slowly retired toward the Delaware, and as he went his army melted away, till it seemed that armed resistance to the British was about to expire.

It was at this darkest hour of the Revolution that Washington struck his brilliant blows at Trenton and Princeton, reviving the hopes and energies of the nation. Howe, believing the American army would soon totally dissolve, retired to New York, leaving strong forces in Trenton and Burlington. Washington at his camp west of the Delaware planned a simultaneous attack on both posts, using his whole command of 6,000 men. But his subordinates in charge of both wings failed him, and he was left on the night of Christmas day, 1776, to march on Trenton alone with some 2,400 men. He completely surprised the unprepared Hessians, and after confused street fighting killed the commander, Rahl, and captured 1,000 prisoners, with arms and ammunition. The immediate result was that General Cornwallis hastened with 8,000 men to Trenton, where he found Washington strongly posted behind the Assumpink river, skirmished with him, and decided to wait overnight "to bag the old fox." During the night the wind shifted, the roads froze hard, and Washington was enabled to steal away from camp, leaving his fires deceptively burning, march around Cornwallis's rear, and fall at daybreak upon the three British regiments at Princeton. These were put to flight with a loss of 500 men, and Washington escaped with more captured munitions to a strong position at Morristown, N.J. The effect of these victories was threefold; they heartened all Americans, brought recruits flocking to camp with the spring, and encouraged foreign sympathizers with the American cause.

Valley Forge.—Thus far the important successes had been won by Washington; now they fell to others, while he was left to face popular apathy, military cabals, and the disaffection of Congress. The year 1777 was marked by the British capture of Philadelphia and the surrender of Burgoyne's invading army to Gates at Saratoga, followed by intrigues to displace Washington from his command. Howe's main British army of 18,000 left New York by sea on July 23, 1777, and landed on Aug. 25 in Delaware not far below Philadelphia. Washington, despite his inferiority of force, for he had only 11,000 men, mostly militia and in Lafayette's words "badly armed and worse clothed," risked a pitched battle on Sept. 11 at the fords of Brandywine creek, about 13 m. north of Wilmington. While part of the British force held the Americans engaged, Cornwallis with the rest made a secret 17 m. detour and fell with crushing effect on the American right and rear, the result being a complete defeat, from which Washington was fortunate to extricate his army in fairly good order. For a time he hoped to hold the Schuylkill fords, but the British passed them and on Sept. 26 triumphantly marched into Philadelphia. Congress fled to the interior of Pennsylvania, and Washington, after an unsuccessful effort to repeat his stroke at Trenton against the British troops posted at Germantown, had to take up winter quarters at Valley Forge. His army, twice-beaten, ill-housed, and ill-fed, with thousands of men "barefoot and otherwise naked," was at the point of exhaustion; it could not keep the field, for inside of a month it would have disappeared. Under these circumstances, there is nothing which better proves the true fibre of Washington's character and the courage of his soul than the unyielding persistence with which he held his strong position at Valley Forge through a winter of semi-starvation, of justified grumbling by his men, of harsh public criticism, and of captious meddling by a Congress too weak to help him.

Intrigues.—Washington's enemies seized the moment of his greatest weakness to give vent to an antagonism which had been nourished by sectional jealousies of North against South, by the ambition of small rivals, and by baseless accusations that he showed favouritism to such foreigners as Lafayette. The intrigues of Thomas Conway, an Irish adventurer who had served in the French army and had become American inspector-general, enlisted Thomas Mifflin, Charles Lee, Benjamin Rush and others in an attempt to displace Washington. Gen. Horatio Gates appears to

have been a tool of rather than a party to the plot, expecting that the chief command would devolve upon himself. A faction of Congress sympathized with the movement and attempted to paralyze Washington by reorganizing the board of war, a body vested with the general superintendence of operations, of which Gates became president, his chief-of-staff, James Wilkinson, the secretary, and Mifflin and Timothy Pickering members. Washington was well aware of the hostility in Congress, of the slanders spread by Dr. Rush and James Lovell of Massachusetts, and of the effect of forgeries published in the American press by adroit British agents. He realized the intense jealousy of many New Englanders, which made even John Adams write his wife that he was thankful Burgoyne had not been captured by Washington, who would then "have been deified. It is bad enough as it is." But Washington decisively crushed the cabal when, the loose tongue of Wilkinson having disclosed Conway's treachery, he sent the latter officer on Nov. 9, 1777, proof of his knowledge of the whole affair.

With the conclusion of the French alliance in the spring of 1778 the aspect of the war was radically altered; and the British army in Philadelphia, fearing that a French fleet would blockade the Delaware while the militia of New Jersey and Pennsylvania invested the city, hastily retreated upon New York city. Washington hoped to cut off part of the enemy, and by a hurried march with six brigades interposed himself at the end of June between Sir Henry Clinton (who had succeeded Howe) and the Jersey coast. The result was the battle of Monmouth on June 28, where a shrewd strategic plan and vigorous assault were brought to naught by the treachery of Charles Lee. When Lee ruined the attack by a sudden order to retreat, Washington hurried forward, fiercely denounced him, and restored the line, but the golden opportunity had been lost. The British made good their march to Sandy Hook and Washington took up his quarters at New Brunswick. Lee was arrested, court-martialed and convicted on all three of the charges made against him; but instead of being shot, as he deserved, he was sentenced to a suspension from command for one year. The arrival of the French fleet under D'Estaing in July, 1778, completed the isolation of the British and Clinton was thenceforth held to New York city and the surrounding area; Washington making his headquarters in the highlands of the Hudson, and distributing his troops in cantonments around the city and in New Jersey.

Yorktown.—To Washington's vision the final decisive stroke of the war, the capture of Cornwallis at Yorktown, is chiefly to be credited. With the domestic situation intensely gloomy early in 1781, he was hampered by the feebleness of Congress, the popular discouragement, and inability to rely upon prompt and strong support by the French fleet. A French army under Rochambeau having arrived to reinforce him in 1780, he pressed De Grasse to assist in an attack upon either Cornwallis at the South or Clinton in New York. In August the French admiral sent definite word that he preferred the Chesapeake, with its large area and deep water, as the scene of his operations; and within a week, on Aug. 19, 1781, Washington marched south with his army, leaving Heath with 4,000 men to hold West Point. He hurried his troops through New Jersey, embarked them on transports in Delaware bay, and landed them at Williamsburg, Va., where he had himself arrived on Sept. 14. Cornwallis had retreated to Yorktown and entrenched his army of 7,000 British regulars. Their works were completely invested before the end of the month; the siege was pressed with vigour by the allied armies under Washington, consisting of 5,500 Continentals, 3,500 Virginia militia, and 5,000 French regulars; and on Oct. 21, Cornwallis surrendered. By this campaign, probably the finest single display of Washington's generalship, the war was brought to a virtual close.

Washington remained during the winter of 1781–82 with the Continental Congress in Philadelphia, exhorting it to maintain its exertions for liberty and to settle the claims of the army and officers; exhortations which he continued after he joined his command at Newburgh on the Hudson in April, 1782. Suggestions at this time that he found a monarchy were brusquely repelled. When the discontent of his unpaid men came to a head in the circulation of the "Newburgh address" early in 1783, he issued a general order censuring the paper, and at a meeting of officers on March 15 read a speech admonishing the army to obey Congress and promising his best efforts for a redress of grievances. He was present at the entrance of the American army into New York on the day of Clinton's evacuation, Nov. 25, 1783, and on Dec. 4 took leave of his closest officers in an affecting scene at Fraunces' tavern. Travelling south, on Dec. 23, in a solemn ceremonial immortalized by the pen of Thackeray, he resigned his commission to the Continental Congress in the State senate chamber of Maryland in Annapolis, and received the thanks of the nation. His accounts of personal expenditures during his service, kept with minute exactness in his own handwriting, and totalling £14,500, without charge for salary, had been given the controller of the Treasury to be discharged. Leaving Annapolis at sunrise of Dec. 24, before nightfall he was at home in Mount Vernon.

In the next four years Washington found sufficient occupation in his estates, wishing to close his days as a gentleman-farmer and giving to agriculture as much energy and thought as to the army. He enlarged the Mount Vernon house in 1786; he laid out the grounds anew, with sunken walls or ha-has; and he embarked on experiments with mahogany, palmetto, pepper, and other foreign trees, English grasses, and grains. His farm manager during the Revolution, a distant relative named Lund Washington, retired in 1785, and was succeeded by a nephew, Maj. George Augustine Washington, who resided at Mount Vernon till his death in 1792. Washington's losses during the war had been heavy, partly through neglect of his lands, partly through stoppage of exportation, and partly through a depreciation of paper money which cost him hardly less than $30,000. He now successfully attempted to repair his fortunes, his annual receipts from all his estates being from $10,000 to $15,000 a year. In 1784 he made a tour of nearly 700 miles to view the wild lands he owned to the westward, Congress having made him a generous grant. As a national figure, he was constrained to offer hospitality to old army friends, visitors from other States and nations, diplomats, and Indian delegations, and he and his household seldom sat down to dinner alone.

A More Perfect Union.—Viewing the chaotic political condition of the United States after 1783 with frank pessimism, and declaring (May 18, 1786) that "something must be done, or the fabric must fall, for it is certainly tottering," Washington repeatedly wrote his friends urging steps toward "an indissoluble union." At first he believed that the Articles of Confederation might be amended. Later, especially after the shock of Shays's Rebellion, he took the view that a more radical reform was necessary, but doubted as late as the end of 1786 that the time was ripe. He earnestly supported the proposal for a Federal impost, warning the States that their policy must decide "whether the Revolution must ultimately be considered a blessing or a curse." His numerous letters to the leading men of the country assisted greatly to form a sentiment favourable to a more perfect union. Some understanding being necessary between Virginia and Maryland regarding the navigation of the Potomac, commissioners from the two States met at Mount Vernon in the spring of 1785; and from this seed sprang the Federal Convention. Washington approved in advance the call for a gathering of all the States to meet in Philadelphia in May, 1787, to "render the Constitution of the Federal Government adequate to the exigencies of the Union." Though he hoped to be excused, he was chosen one of Virginia's five delegates, arrived in Philadelphia on May 13, the day before its opening, and as soon as a quorum was obtained, was unanimously chosen its president. For four months Washington presided over the Constitutional Convention, breaking his silence only once upon a minor question of Congressional apportionment. But though he said little in debate no one did more outside the hall to insist on stern measures. "My wish is," he wrote, "that the convention may adopt no temporizing expedients, but probe the defects of the Constitution to the bottom, and provide a radical cure." His weight of character did more than any other single force to bring the convention to an agreement and obtain ratification of the instrument afterward. He did not believe it perfect, though his precise criticisms of it are unknown. But his support

gave it victory in Virginia, where he sent copies to Patrick Henry and other leaders with a hint that the alternative to adoption was anarchy; while a letter of his published in a Boston newspaper, declaring that "it or dis-union is before us to chuse from," told powerfully in Massachusetts. He received and personally circulated copies of the *Federalist.* When once ratification was obtained, he wrote leaders in the various States urging that men staunchly favourable to it be elected to Congress. For a time he sincerely believed that, the new framework completed, he would be allowed to retire again to privacy. But all eyes immediately turned to him for the first president. He alone commanded the respect of both the parties engendered by the struggle over ratification, and he alone would be able to give prestige to the republic throughout Europe. In no State was any other name considered. The electors chosen in the first days of 1789 cast a unanimous vote for him, and reluctantly—for his love of peace, his distrust of his own abilities, and his fear that his motives in advocating the new government might be misconstrued all made him unwilling—he accepted. On April 16, after receiving congressional notification of the honour, he set out from Mount Vernon, reaching New York in time to be inaugurated on April 30. This ceremony was performed in Wall Street, near the spot now marked by Ward's statue of Washington, and in the presence of a great crowd which broke into cheers as, standing on the balcony of Federal Hall, he took the oath administered by Chancellor Livingston, and retired indoors to read Congress his inaugural.

President of the United States.—Washington's administration of the government in the next eight years was marked by the caution, the methodical precision and the sober judgment which had always characterized him. He regarded himself as standing aloof from party divisions, and emphasized his position as president of the whole country by a tour first through the Northern States and later through the Southern. A painstaking inquiry into all the problems confronting the new nation laid the basis for a series of judicious recommendations to Congress in his first message. In selecting the four members of his first cabinet, Thomas Jefferson as secretary of State, Alexander Hamilton as secretary of Treasury, Henry Knox as secretary of War and Edmund Randolph as attorney-general, Washington balanced the two parties evenly. But he leaned with especial weight upon Hamilton, supporting his scheme for the assumption of State debts, taking his view that the bill establishing the United States Bank was constitutional and in general strengthening the authority of the Federal Government. Distressed when the inevitable clash between Jefferson and Hamilton arose, he tried to keep harmony, writing frankly to each and refusing to accept their resignations. But when war was declared between France and England in 1793, he again took Hamilton's view that the United States should completely disregard the treaty of alliance with France and pursue a course of strict neutrality, while he acted decisively to stop the improper operations of the French Minister, Genêt. The sequel was the resignation of Jefferson at the close of 1793, the two men parting on good terms and Washington praising Jefferson's "integrity and talents." The suppression of the Whiskey Rebellion in 1794, by Federal troops whom Hamilton led in person, and the despatch of John Jay to conclude a treaty of commerce with Great Britain, tended further to align Washington with the Federalist party. Though the general voice of the people compelled him to acquiesce reluctantly in a second term in 1792, and his election that year was again unanimous, during his last four years in office he suffered from a fierce personal and partisan animosity. This culminated when the publication of the terms of Jay's treaty, which Washington signed on Aug. 18, 1795, provoked a bitter discussion, and the House of Representatives called upon the president for the instructions and correspondence relating to the treaty. These Washington, who had already clashed with the Senate on foreign affairs, refused to deliver, and in the face of an acrimonious debate firmly maintained his position.

Early in his first term Washington, who by education and natural inclination was minutely careful of the proprieties of life, established the rules of a virtual republican court. In both New York and Philadelphia he rented the best houses procurable, refusing to accept the hospitality of George Clinton, for he believed the head of the nation should be no man's guest. He returned no calls and shook hands with no one, acknowledging salutations by a formal bow. He drove in a coach with four or six smart horses, and outriders and lackeys in rich livery. At receptions he came in a black velvet suit with gold buckles, yellow gloves, powdered hair, a cocked hat with an ostrich plume in one hand, and a sword in a white leather scabbard. After being overpowered by callers, he announced that except for a weekly levee open to all, persons desiring to see him must make previous engagements. On Friday afternoons Mrs. Washington held more informal receptions, at which the president appeared and chatted gravely with both ladies and gentlemen. Though the presidents of the Continental Congress had made their tables partly public, Washington, who entertained largely, taking members of Congress in rotation, insisted that his hospitality be entirely private. He served good wines and the menus were elaborate, but such visitors as Senator Maclay complained that the atmosphere was too "solemn." Indeed, his simple ceremony offended many of the more radical anti-federalists, who did not share his sense of its fitness and accused the president of conducting himself like a king. But his cold and reserved manner was due rather to native diffidence than to any excessive sense of dignity.

Retirement.—Earnestly desiring leisure, feeling a decline of his physical powers, and wincing under opposition abuse, Washington refused to yield to the general pressure for a third term. This refusal was blended with a testament of sagacious advice to his country in the *Farewell Address* of Sept. 19, 1796, written largely by Hamilton but remoulded by Washington and expressing his ideas. Retiring in March, 1797, to Mount Vernon, he devoted himself for the last two and a half years of his life to his family, farm operations and care of his slaves. In 1798 his seclusion was briefly threatened when the prospect of war with France caused his appointment as commander-in-chief of the provisional army, and he was much worried by the political quarrels over high commissions; but the war cloud passed away. On Dec. 12, 1799, he exposed himself on horseback for several hours to cold and snow, and returning home exhausted, was attacked late next day with quinsy or acute laryngitis. He was bled heavily four times, given gargles of "molasses, vinegar and butter," and a blister of cantharides was placed on his throat, his strength meanwhile rapidly sinking. The best modern treatment would probably have been unavailing. He faced the end with characteristic serenity, saying "I die hard, but I am not afraid to go," and later: "I feel myself going. I thank you for your attentions; but I pray you to take no more trouble about me. Let me go off quietly. I cannot last long." After giving instructions to his secretary, Tobias Lear, about his burial, he died at 10 P.M. on Dec. 14 without pain or struggle. The news of his death placed the entire United States in mourning, and the sentiment of the country permanently endorsed the famous words of Henry Lee, embodied in resolutions which John Marshall introduced in the House of Representatives, that he was "first in war, first in peace, and first in the hearts of his countrymen." When the intelligence reached Europe the British channel fleet and the armies of Napoleon paid tribute to his memory; and many of the political and intellectual leaders of the time joined in according him a preeminent place among the heroes of history.

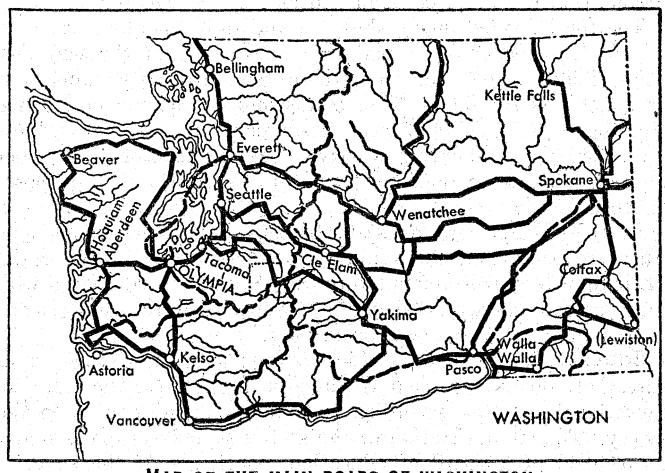
BIBLIOGRAPHY.—The earliest known portrait of Washington is that by Charles Wilson Peale, painted in 1772. A long line of painters and sculptors followed, and their work may be found criticized in Justin Winsor's *Narrative and Critical History of America, vol. VII.* Washington himself thought highly of the likeness by Joseph Wright, painted in 1782. According to Winsor, the favourite profile is Houdon's, while Gilbert Stuart's canvas had been popularly preferred for the full face, and John Trumbull's florid paintings for the whole figure. Stuart's pictures are somewhat idealized, while all the later portraits suffer from the fact that the artificial teeth worn by Washington in later years altered the expression of his face. Houdon's statue hardly does justice to Washington's imposing stature; he was 6 ft. 3 in. tall in his prime, and weighed 220 lb., carrying himself with great dignity and poise.

A full collection of books upon Washington would fill a large library, and the list is being steadily extended. The best edition of his writings is that edited by Worthington C. Ford (1889–93); superseding that by Jared Sparks (1837), the latter contains some papers not found else-

where. Nearly all of the Presidential messages and proclamations are to be found in J. D. Richardson's *Messages and Papers of the Presidents* (1896). The best of the earlier biographies are those by John Marshall (1804–07); Washington Irving (1855–59); Edward Everett Hale (1888); Henry Cabot Lodge (1889); Woodrow Wilson (1897); Worthington C. Ford (1899); and Norman Hapgood (1901). These were supplemented in their time by such special works as G. W. P. Custis, *Recollections and Private Memoirs of Washington* (1860); R. Rush, *Washington in Domestic Life* (1857); H. B. Carrington, *Washington the Soldier* (1899); Paul Leicester Ford, *The True George Washington* (1896); B. T. Johnston, *General Washington* (1894). But in recent years large additions have been made to the store of knowledge of Washington and his times by John C. Fitzpatrick, *The Diaries of George Washington*, 1748–1799 (1925); Paul Leland Haworth, *George Washington, Farmer* (1915); Eugene E. Prussing, *The Estate of George Washington* (1927); Charles Moore, *The Family Life of George Washington* (1926); and Archer B. Hulbert, *Washington and the West* (1911). An iconoclastic short life, often inaccurate, has been written by W. E. Woodward, *George Washington: The Image and the Man* (1926) and a detailed and scholarly record by Rupert Hughes in *George Washington the Human Being and the Hero, 1732–1762*, and *George Washington the Rebel and the Patriot, 1762–1777* (1926, 1927). For a treatment of the military and political background of his times *see* George Otto Trevelyan's history of the American Revolution, the large histories by Bancroft, Winsor, McMaster, Schouler, and Channing, to *William Maclay's Journal*, 1789–91 (1890), and Henry Jones Ford's *Washington and his Colleagues* (1918). *See* also Shelby Little, *George Washington* (1929). The best work on Martha Washington remains Anne Hollingsworth Wharton's *Martha Washington* (1897). (A. N.)

WASHINGTON, the "Evergreen State," is the most northwesterly state of the United States of America. Its extreme length east and west is 360 mi., its extreme width north and south is 240 mi. and its total area is 68,192 sq.mi., of which 1,215 sq.mi. is water surface. In 1853, Columbia was suggested as the name of the prospective territory, but because it resembled that of the federal district, Washington was substituted.

Physical Features.—The Cascade mountain range running north from the Columbia river to the Canadian border divides the state into sections commonly known as eastern Washington and western Washington. The hurrying cascades that have carved deep valleys between the high serrated summits have given the range its name. From a width of 100 mi. at the northern border, it narrows to about 50 mi. where the Columbia river has carved its canyon on its way to the ocean. The summits average about 8,000 ft. in altitude, while few passes less than 6,000 ft. can be found through the chain. Far above the average summits a number of extinct volcanoes rear their glacier-covered sides, chief among them being Mt. Rainier (14,408 ft.), Mt. Adams (12,307 ft.), Mt. Baker (10,730 ft.), Glacier Peak (10,436 ft.), Mt. St. Helens (9,697 ft.), and Mt. Stuart (9,470 ft.). The forests of the Cascades, especially on the western slopes, seem almost to attain as magnificent gestures as the peaks themselves, for cedars, Douglas fir and Douglas spruce often reach 200 ft. in height. The forests in season are painted by the pink petals of the rhododendron, the state flower.



MAP OF THE MAIN ROADS OF WASHINGTON

To the east of the Cascades and bounded on the north by the Okanogan highlands lie the Columbia river plains, a region fast gaining fame as the "Inland Empire," with Spokane as its capital. The plains range in altitude from 500 to slightly over 2,000 ft. with a gentle slope toward the river. Besides the river valleys, some depressions known as "coulees" and some low hills alternate with vast level stretches or undulating country. The soil is mainly a decomposed basalt known as volcanic ash, rich in mineral food elements, and if nitrogen can be worked into it, exceedingly fertile under irrigation. The red-cheeked apples of the Wenatchee have become famous in all the fruit markets of America. The Walla Walla is also a well known grain and fruit raising valley. The centre portion of these plains, known as the Great Bend region, is the driest part of Washington, containing a number of lost rivers and alkaline lakes of which Soap lake, a health resort, and Moses lake are best known. A number of these lakes occupy the bed of the Grand Coulee, a depression from 500 to 1,000 ft. deep, extending for many miles and supposed to be the old bed of the Columbia river. Toward the southeast the plains are interrupted by an extension from Oregon of the Blue mountains, rising over 7,000 feet. To the north, lie the Okanogan highlands, a region of gentler slopes with pine timber and fertile valleys.

West of the Cascades lies the Puget sound basin, and between the basin and the ocean rises another chain of mountains known as the Coast range. This range increases in height and ruggedness toward the northwest, forming the Olympic mountains, a group of wild beauty rising almost immediately from the sea, dominating the whole Olympic peninsula, and culminating in Mt. Olympus, 7,954 ft. in altitude. For nearly the entire year the summits are snow-capped, and seen from Seattle or Tacoma across the sound they form a refreshing and inspiring panorama. In 1909 President Theodore Roosevelt by executive order created 620,000 ac. into Mount Olympus national monument. After its area had been reduced by subsequent withdrawals, congress on June 29, 1938, created it a national park of 648,000 ac. and permitted the president to enlarge it to 898,292 ac.

The Puget sound basin slopes northward gradually from the height of land which divides it from the valley of the Cowlitz river, a tributary of the Columbia. In the north end of the basin the water has conquered and forms Puget sound itself, which is connected with the Pacific by the Strait of Juan de Fuca. Around the shores of the sound are five of Washington's most populous counties, and four of the five largest cities. Branching from the sound and lying close to the steep slopes of the Olympics, is the Hood canal, a narrow fjord penetrating about 60 mi. inland to the southwest, and then bending back upon the Kitsap peninsula. The sound itself is made more interesting by its many islands, large and small. Whidby, the largest, extends about 50 mi. N. and S., and together with several lesser islands forms Island county. The other indentations are Grays Harbor and Willapa bay.

In no part of the generally inhabited regions of Washington are there wide extremes of temperature. The summers are usually cool and the winters mild. This equability is probably caused partly by the warm Japan current, and partly by protection afforded by the mountains. The climate of eastern Washington is considerably drier than that west of the Cascades. The precipitation in the Puget sound district is about the same as that in Chicago, 30–50 in. annually. Irrigation is unnecessary west of the mountains. Little snow falls in the valleys, and a greater part of the rainfall comes in the winter months.

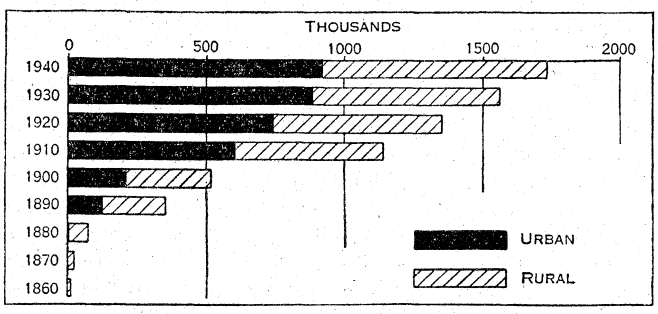
Government.—Washington is governed under its original constitution, adopted on Oct. 1, 1889, and since frequently amended. Except for the powers of initiative and referendum which the people possess by virtue of a constitutional amendment in 1912, the legislative authority of the state is vested in the legislature, consisting of a senate and a house of representatives. Its regular meetings occur in January of odd-numbered years at Olympia, the capital, and are limited by the constitution to 60 days. Special meetings may be called by the governor at his discretion. The senate in 1940 numbered 46 members, each elected for four years (half of the senatorial body retires every two years), and the house of representatives numbered 99 members, elected for two years each. Washington also elects two senators and six representatives (1941) to represent it in congress.

The state legislature is limited in three ways: (1) by the constitution, containing a list of 18 cases in which it is forbidden to enact legislation; (2) by the governor, whose veto of any bill must be overridden by a two-thirds majority in both houses, or the bill dies; and (3) by the people, who have the powers of initiative, referendum and recall. Petitions containing a printed copy of the proposed measure and signed by 10% of all the voters must be filed before any initiated measure can be presented at a general election to be voted upon. To secure a referendum, petitions need contain the signature of but 6% of the voters. Also the legislature itself can, if it wishes, refer any bill it has passed to the people for their approval. Any elective officer, with the exception of judges of county and state courts, is subject to recall. A statutory limitation upon the legislature's power to tax is an act, adopted by the electorate in 1932 and re-enacted by the voters at every biennial election thereafter, which declares that "the aggregate annual rate of levy on real and personal property" for state and local purposes shall not exceed 40 mills.

The executive department consists of a governor, lieutenant-governor, secretary of state, treasurer, auditor, attorney-general, superintendent of public instruction, commissioner of public lands and insurance commissioner, all chosen for a term of four years. In 1921, the legislature passed an act known as the Administrative Code, which abolished some 70 boards and commissions, which had come into existence from time to time, and distributed their duties among ten new departments. In view of new functions and reallocations of duties, these numbered 13 in 1941, namely: agriculture; finance, budget and business; game; highways; licences; public printer; unemployment and compensation; conservation and development; fisheries; health; labour and industries; social security; public service. Each of these departments is in charge of a director appointed by the governor with the consent of the senate. Most departments are subdivided into divisions, each headed by a supervisor. The governor and the directors of the code departments constitute the administrative board.

The judicial department is composed of the supreme court of the state, the superior courts for the counties and courts of justices of the peace for cities, towns or precincts. The last named deal with civil cases involving less than $100, and criminal cases below the rank of felony. While it is intended that ultimately each county shall have a superior court, some of those most sparsely settled are combined under one court and justice as yet. In densely populated counties the superior court is divided into departments with one justice for each. Thus King county has 15 judges, Spokane county five, Pierce county four and several other counties two each. Justices of the superior courts are elected for four years. The jurisdiction of the supreme court is almost entirely appellate.

Population.—The population of Washington in 1860 was 11,594; in 1880, 75,116; in 1910, 1,141,990; and in 1940, 1,736,191. This last figure represents an increase of 11·1% over the population in 1930. The population per square mile was 25·9, as compared with 44·2 for the United States as a whole. Of the 1940 population, 921,969, or 53·1%, lived in urban places, that is, in cities and towns of 2,500 or more. The number of occupied dwelling units returned in the housing census of 1940 was 537,968, which is approximately the same as the number of families. The average population per family (occupied dwelling unit) declined from 3·7 in 1930 to 3·2 in 1940. The white population of Washington formed 97·8% of the total in 1940, as compared with 97·3% in 1930, most of the nonwhite population being Indian and Japanese. The number of males per 100 females in the entire population of the state was 109·1, the sex ratio being 101·4 for the urban population and 118·7 for the rural population. The population of the state and of its principal cities is summarized for recent censuses in the following table:



BY COURTESY OF THE U.S. BUREAU OF THE CENSUS

URBAN AND RURAL POPULATION OF WASHINGTON: 1860–1940

Area	Population			Per cent of increase	
	1940	1930	1920	1930–40	1920–30
The State	1,736,191	1,563,396	1,356,621	11·1	15·2
Urban	921,969	884,539	742,801	4·2	19·1
Rural	814,222	678,857	613,820	19·9	10·6
Per cent urban	53·1	56·6	54·8	..	..
Principal cities:					
Seattle	368,302	365,583	315,312	0·7	15·9
Spokane	122,001	115,514	104,437	5·6	10·6
Tacoma	109,408	106,817	96,965	2·4	10·2
Olympia	13,254	11,733	7,795	13·0	50·5

Finance.—The estimated value of tangible property in the state was $5,122,000,000 in 1922. The assessed value, in 1939, of property subject to tax was $980,260,461. Current state revenues for the year ending March 31, 1940 were $78,805,390.63 and expenditures $77,859,828.34, leaving a $945,562.29 surplus of current revenues over expenditures. Total budget receipts for the same period were $94,327,589.74 and budget expenditures $89,443,604.30. Contributing to the gross revenues were $15,723,376.72 from the gasoline tax, $14,362,556 from the 2% retail sales tax, $6,914,335.53 from liquor licences, taxes and profits, $5,909,335.99 from motor vehicle licences and taxes (other than fuel), $5,475,974.56 from business and occupation taxes, $3,199,418.46 from the state property tax and $2,808,650.12 from public utility taxes and fees. In the form of federal aid the state received $6,929,517.32 for social security, $4,818,133.68 for highways and $1,041,911.54 for other purposes. Insurance and retirement assessments amounted to $6,104,504.59, the sale of securities yielded $4,768,733.77, and other income in trust was $2,728,675.81. Expenditures for highways topped the list with $21,279,614.26, social security followed with $17,901,012.04, state aid to the common schools totalled $17,397,121.47, the state departments received $6,728,853.18 and higher education $4,873,718.88, charitable and penal institutions $3,601,679.84.

The total bonded indebtedness of the state on Sept. 30, 1940 was $11,246,000 or $6.48 per capita. The last of the veterans' bonus bonds being redeemed, there remained outstanding but $3,750,000 of capital building bonds and $7,496,000 emergency relief bonds. The debts of local governments in Washington, however, were high, amounting in 1937 to $220,143,000 or $132.78 per capita against the average per capita of $114.69 for such purposes in the United States.

In 1940 there were 94 state banks, 44 national banks, one trust company, and three mutual savings banks in the state. Their total resources amounted to $657,874,000 as compared with $449,700,000 in 1935. Their total deposits were $598,518,000 as compared with $393,900,000 in 1935.

Education.—In 1926 the chief statistician of the United States bureau of education ranked Washington first among the states in educational standing according to a ten-point scale used in the survey. The administration of the state's school system is under the control of a board of education, consisting of the superintendent of public instruction and seven other members, some ex-officio and some appointed by the governor.

Total enrolment in the public schools during the school year 1939–40 was 331,409. Of these 6,561 were in kindergartens, 134,356 in elementary schools with grades 1 to 8 inclusive, 58,353 in such schools having grades 1 to 6 inclusive, 64,573 in regular high schools, 32,166 in junior high schools with grades 7 to 9 inclusive, and 30,685 in senior high schools including grades 10 to postgraduate. In 1936 18,499 pupils attended private or parochial elementary schools and 4,296 were enrolled in private

high schools. The average daily attendance in the public school system in 1939–40 was 274,565.

Washington has followed the trend of the movement to consolidate school districts; their number was reduced from 1,659 to 1,411 during the quadrennium ending July 1, 1940. A rigid code for the operation of school buses coincides with this program. Schedules must be so arranged that no child be compelled to leave home earlier than 7:45 A.M. nor return home later than 4:30 P.M.

There were in the public school system in 1939–40, 11,478 teachers and administrators, an increase of 338 since 1930, but a decrease of 229 since 1937. The expenditure for their salaries for 1939–40 was $19,133,730.35, or an average of $1,666.99 each, an increase of $160.99 since 1936. Total expenditures for the public and elementary schools by all government agencies in the state in 1939–40 amounted to $30,409,118.64, a decrease from the $33,528,000 expended in 1930 but an increase from $22,036,000 in 1934. Cost per pupil in average daily attendance was $105.89.

The state-supported institutions of higher learning are the University of Washington at Seattle, the State College of Washington at Pullman, and three colleges of education—Western, Central and Eastern—at Bellingham, Ellensburg and Cheney respectively. The enrolment at the university was 13,673 for the fall term of the school year 1939–40, and the teaching staff numbered 650. The state college enrolment was 4,631, and the teaching staff 254. Five experiment stations, distributed throughout the state, are associated with the college. The enrolments at the colleges of education during the fall term of the school year 1939–40 were: Western 1,597; Central 1,158; Eastern 1,413; and their staffs numbered 56 at Western, 50 at Central and 51 at Eastern.

Penal and Charitable Institutions.—The administrative code of 1921 placed the administration of the various state charitable and penal institutions in the hands of what is now the department of finance, budget and business, headed by a director appointed by the governor. These institutions are the Western state hospital for the insane at Ft. Steilacoom, the Northern state hospital for the insane (in conjunction with which is a narcotic farm colony at Sedro Woolley), the Eastern state hospital for the insane at Medical lake, the state soldiers' home at Orting, the veterans' home at Retsil, the veterans' hospital for the treatment of Buerger's disease at Soap lake, the state training school for boys at Chehalis, the state school for girls at Grand Mound, the state reformatory at Monroe, the state school for the deaf and the blind at Vancouver and the state penitentiary at Walla Walla.

Agriculture and Livestock.—In 1940 the farm lands amounted to 15,181,815 ac. (35·5% of the area of the state), of which 7,180,154 ac. were considered crop land. The remainder was classified mainly as pasture and woodland. Farm lands and buildings valued at $773,662,602 in 1930 were worth only $593,366,445 in 1940; whereas the average value per farm dropped from $10,911 in 1930 to $6,527 in 1935, the value recovered to $7,264 in 1940. At the beginning of the decade farms numbered 70,904; in mid-decade 84,381 were listed; but the figure dropped to 81,686 in 1940; the decennial increase, however, was 15·2%. Of the total number of farms in 1930, tenants operated 12,078 (17%); by 1935 the number had increased by 3% to 16,835, but by the end of the decade such farms constituted only 14,462 (17·7%). Since the total number of farms increased and since at the beginning and at the end of the period 70% of the farms were operated by full owners, there was obviously an increase in the actual number of solvent farmers in the state. All figures indicate that although Washington agriculture ten years after 1929 remained somewhat deflated, there had also been substantial recovery and attainment of stability.

Though the depression cut the income from farm crops in Washington from $122,949,000 in 1929 to $80,208,000 in 1939, diversification of the state's agriculture cushioned the blow. Statistics showed some recovery during the last years of the decade and some shifting in crops. Wheat production, which reached a maximum of 45,050,000 bu. in 1923, sank to 37,158,000 bu. in 1934, but climbed back to 43,822,000 in 1939 and 41,808,000 in 1940. The unfavourable apple market, hit by curtailment in consumption of quality foods, rigid spray tolerance, and disappearance of foreign markets, resulted in a reduction from an average annual production of 33,768,000 bu. during 1928–32, to 28,804,000 bu. in 1940. Tame hay ranked third in value in 1939, when production reached 1,891,000 tons worth $15,506,200, but lower yield per acre and a drop in price brought the 1940 crop to $13,152,800. Price factors also explain why the 1940 potato crop of 8,325,000 bu. brought $4,262,500 whereas the 1939 crop, smaller by almost 1,000,000 bu., was worth $4,410,000. Oat production sagged in 1940, but the 8,658,000 bu. figure exceeded the 1929–38 average of 7,791,000 bu. Pears are the crop of hardy fruits which held its own; the production of 6,585,000 bu. in 1940 showed a gain over 1939 and the 1929–38 mean. Hops and barley have become $1,000,000 crops and have left corn, a former runner-up, trailing. Sugar beets for beet sugar made a remarkable comeback in the Yakima valley, where a new variety of beet appears immune to the pest which during the late '20s snuffed out what appeared to be a promising industry. In 1930 only 15,861 tons were grown but in 1940, 210,413 tons were raised. Soft fruits, berries and grapes have received considerable attention.

Owing to severe depression in wool prices the number of sheep grazed in Washington decreased from 1,143,000 head in 1930 to 615,000 in 1939, valued at $4,674,000. The wool production in 1939 was 6,074,000 lb., valued at $1,354,502. From 1920 the state assumed first place in the average weight of fleeces, and in 1939 the average weighed 9·3 lb. as compared with the 7·96 lb. average for the entire United States. Cattle in 1939 numbered 826,000 head valued at $34,361,600.

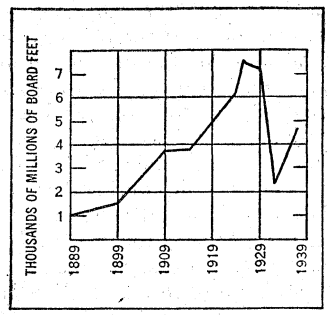
Mining.—The average annual value of mineral production of Washington from 1918 to 1924 inclusive had been $20,943,509. The year 1929 witnessed production of $22,435,000, which had been the top figure before the depression lowered the market so that the value in 1933 was but $9,388,000. With the upswing which began in 1934, however, progress was so rapid that in 1937 a total production of $26,658,257, an all-time high, was reached; the 1938 total was $21,167,004. Coal was the most important mineral produced; production for 1937 was 2,001,449 tons valued at $6,325,000 and for 1938 1,566,973 tons valued at $4,939,000. The coal industry in 1938 employed 2,591 persons for an average of 163 days each. Approximately one-half the output came from Kittitas county, with King, Pierce and Thurston counties next in order. Stone was next to coal in the value of its output—2,329,020 short tons valued at $2,020,445. Of other important non-metallic minerals mined in 1939, sand and gravel production was valued at $6,048,619, lime at $484,667.

Several factors were responsible for an unprecedented boom in the production of metals in the state: the pegging of the price of gold and the purchases of silver by the United States treasury in 1934; the flotation process for reducing low grade ores, and the discovery of remarkably rich veins in Stevens and Ferry counties. Whereas gold production in 1930 was but 4,000 fine oz. worth $82,680, the output of 1935 was 9,739·60 fine oz. worth $340,886, and by 1939 the figure had been catapulted to 90,420 fine oz. worth $3,164,700. A similar impetus was felt in silver, of which 45,000 fine oz. were produced in 1930, 52,338 fine oz. worth $37,618 in 1935, 380,938 fine oz. worth $246,263 in 1938, and 442,003 fine oz. worth $300,067 in 1939. Copper production, however, rose even higher than either gold or silver. In 1934 only 13,900 lb. yielding $1,112 were produced, but in 1939 17,996,000 lb. worth $1,871,584 represented a new high. Lead, weighing 7,436,000 lb. worth $349,492, and zinc, weighing 20,262,000 lb. valued at $1,053,624, figured in the unusually high production of 1939. Research in electrometallurgy gave new significance to the magnesite ores of Stevens county, and the availability of cheap electric power from the Bonneville and Grand Coulee plants promised economical production of magnesium metal and aluminium, the ore of which will be brought by boat to a new plant constructed at Vancouver, Washington, by the Aluminum Company of America.

Forests and Lumbering.—Since 1905 Washington has led all

states in the production of lumber, except in 1914, when Louisiana reported a larger output. The original stand of commercial timber was about 578,000,000,000 bd.ft., of which about 277,000,000,000 remained in 1938. The cut in 1929 amounted to 7,302,000,000 bd.ft.; it declined to 2,255,000,000 in 1932 but reached 4,713,000,000 in 1937. About 75% of the state's timber cut is of the valuable Douglas fir, this amount being nearly two-thirds of the cut of this species in the United States. Hemlock, spruce, western yellow pine and cedar each represents from 4 to 6% of the total cut. Larch, Idaho white pine and white fir are also important.

By far the greater part of the forests lies west of the Cascade range. The eastern section of the state once had a good stand of pine, but it is practically exhausted. There are seven national forests entirely within the state and parts of two others within its boundaries. The acreage so designated comprises 9,003,593 ac., which is 73% of the federal lands in the state and approximately 21% of the state's area. These forests have been made available to the public for purposes of recreation, and the state has developed 55 state parks with a total area in 1939 of 45,000 ac.



LUMBER PRODUCTION, 1889–1939

Fisheries.—Washington, having passed the peak of her development in the salmon and halibut fisheries, relinquished her place as the leader in Pacific coast fisheries to California in 1922. The yield of the fisheries, affected by the economic depression beginning in 1930, fell from a high point of 152,224,000 lb. in 1929 to 94,959,000 lb. in 1932, but by 1934 it had increased to 113,469,000 lb. and in 1937 it attained 155,805,000 lb. The value of the products of the fisheries for the same years were $9,562,800, $3,378,000, $6,305,100 and $7,222,300 respectively. The construction of irrigation and power dams placed the entire salmon industry of the coast, and particularly the Columbia river catch, in serious jeopardy.

Manufacturing, Transport and Commerce.—The growth of manufactures has been gradual but steady, paralleling the steady increase in the production of the raw products upon which it is dependent. In 1929, there were 3,648 factories employing 114,635 workers, paying $160,415,497 in wages and producing goods valued at $789,508,424. Eight years later, though there had been some recovery, there were but 3,057 establishments employing 101,260 wage earners, paying $128,472,000 in wages and manufacturing goods to the value of $675,640,000. The industries leading in value of products in 1937 were: lumbering and saw-mill products, $186,201,508; wood pulp, $48,411,890; flour and grain-mill products, $31,774,606; wholesale meat packing, $28,175,069; canning and preserving of fruits and vegetables, $24,667,198; plywood, $20,018,671; planing-mill products $19,507,717; bread and other bakery products $19,292,065; prepared feeds for poultry and livestock, $18,252,054; printing and publishing of newspapers and periodicals, $15,971,499; butter, $15,384,309; malt liquors, $9,897,869; machinery $7,223,609; canning and curing fishery products, $6,550,710; furniture, $5,519,383; condensed and evaporated milk, $4,967,206; paper boxes and cartons, $4,786,272; job printing and publishing, $4,341,621; and wood preserving, $3,464,582. Shipbuilding, one of the chief industries, with an output valued at $10,829,812 in 1916 and $166,519,787 in 1919, declined by 1935 to $3,324,528 but recovered somewhat by 1937, turning out construction valued at $5,777,576.

The Seattle-Tacoma area, including King and Pierce counties, is the leading manufacturing centre of the state. This area, with a population of 678,945 (1940) had 1,382 industrial establishments in 1937 employing an average of 39,103 wage earners. Total expenditures for wages amounted to $51,292,204; for materials, $191,815,528. Production was valued at $307,401,262.

Puget sound has formed a natural terminus for several transcontinental railways, the cities of Seattle and Tacoma on its shores affording outlets to the commerce of the Pacific for the Northern Pacific, the Great Northern and the Chicago, Milwaukee, St. Paul and Pacific transcontinental lines, which enter these cities over their own tracks. The Union Pacific, the Burlington, the Canadian Pacific and the Grand Trunk lines reach Seattle over the tracks of other roads. The railway mileage in 1937 was 5,280 mi.

The highways of the state are in excellent condition. State and federal funds available for construction during the biennium April 1, 1939 to March 1, 1941 totalled $14,751,000. There are in the state 43,881 mi. of road of all types, of which 16,870 mi. were surfaced in 1930. Concrete roads totalled 1,516.53 mi. in 1940. The state highway system in 1940 included 6,270 mi. of highway, of which 6,089 mi. were surfaced.

The ocean commerce of Washington ports has shown a steady increase. In 1937 the imports were 1,294,012 tons and exports 1,448,000 tons. Seattle was the leading port with a total of 879,000 tons, while Tacoma followed with 789,000 tons. Port Angeles was third with a total of 323,000 tons, largely imports.

History.—Sailing southward after an expedition northward to 55° lat., a Spanish captain, Juan Perez, one day in June 1774, saw a snow-clad peak in lat. 48° 10′ which he named Santa Rosalia, but which today is known as Mt. Olympus. So far as is definitely known, this is the first time that a white man looked upon a part of what is now Washington state. Another Spaniard, Heceta, was in the following year the first man to land on its shores, which he did at the cost of six men, killed by the Indians that they might secure the metal in the white men's boat. In 1778 the great British explorer, Captain Cook, on his third and last voyage, coasted along these shores. Captain John Meares, also an Englishman, in 1788 discovered and named San Juan strait, rechristened Mt. Olympus, and searched the shores for the legendary "river of the west." Though actually within its bay, he failed to perceive the hidden mouth of the Columbia and named the inlet Deception bay and its neighbouring headland Cape Disappointment. In the four years following a number of ships, American, British and Spanish, engaging mostly in the fur trade, reached these coasts, but did not systematically explore them. Then in 1792 came the Englishman, Vancouver, who discovered, named and thoroughly explored Puget sound, doing his work so well that some 70 or 80 of his geographical names remain, among them the Gulf of Georgia, Hood canal, Admiralty inlet, Mt. Baker and Mt. Rainier. In that year also Robert Gray, an American from Boston, not only discovered Grays Harbor, but finally spied the long-sought "river of the west," which he named after his ship, the "Columbia." This discovery gave the United States its first claim to the "Oregon Country," as the land drained by the Columbia was called.

This claim was furthered by the first land exploration, that of Lewis and Clark in 1805–06. They entered Washington from Idaho by the Snake river, which they followed to the Columbia and thence to the sea. Their return the next spring was by the same route. The fur trade, which had proved so profitable by water, was now to be attempted on land almost simultaneously by the British and Americans. David Thompson, the dauntless explorer and geographer of the Northwest company, a British concern, some time in 1810 built Spokane House where the Little Spokane enters the main Spokane river, the first permanent building in Washington. By the end of 1811 Thompson had explored the length of the Columbia valley. In March 1811 an expedition sent out by John J. Astor of New York to develop the fur trade of the region built a fort at the mouth of the Columbia and sent a party up the Columbia to the mouth of the Okanogan where a fort was built in opposition to Spokane House. But the war of 1812 forced the Americans out of the region and the British took over their forts. For the next 35 years the British fur companies ruled the Oregon country. The Hudson's Bay company absorbed its rival, the Northwest company, in 1821 and in 1824 sent John McLoughlin, the "father of Oregon," as its chief factor and governor west of the mountains. McLoughlin governed the region with a firm hand, but with a benevolent purpose for 22 years. On the northern bank of the Columbia in 1824–25 he built Ft. Van-

couver, which became a port for ocean vessels.

In 1818 Great Britain and the United States reached an agreement whereby they were to hold the Oregon territory in "joint occupation" for ten years. This agreement was renewed again in 1827 for an indefinite term, with the proviso that it might be terminated by either party at 12 months' notice. By 1841 a considerable number of American settlers arrived in the region south of the Columbia, and immigration over the Oregon trail was still greater in the years immediately following. But north of the river the Hudson's Bay company discouraged American settlement, believing that the final decision of the Oregon controversy would make the Columbia river the boundary line between the two nations. Certainly north of the river the company seemed to have the prior claim. In 1832 they built Nisqually House on Puget sound. They had large farms near Nisqually and on Cowlitz Prairie. They raised cattle enough to supply their settlers and shipped butter, cheese and beef to Sitka and other places. At the same time there was not a successful American settlement north of the Columbia. Yet in 1846 Great Britain agreed to accept the 49th parallel as the boundary and Washington became part of the United States. The Hudson's Bay company were paid $650,000 for the developments they already had made in the territory.

Hearing that a delegation of Indians from the Pacific Northwest had visited St. Louis in Sept. 1831 and had requested "black robes" and the "Book," the Methodists and the American Board sent missionaries to the region. Dr. Marcus Whitman in 1836 located his station at Waiilatpu, near the present town of Walla Walla. Two Catholic secular priests, Fathers Blanchet and Demers, came in 1838 in response to a call from the Canadian elements among the fur traders. To familiarize the Indians with the history of the church, a chart on a long board, the Catholic ladder, was devised. The immediate needs of the growing white population for spiritual ministrations and samaritan services compelled all the clergy, much against their wishes, to neglect the native. Out of this situation arose complications culminating in the Whitman massacre of Nov. 1847 which spelled disaster for all denominations.

Of their own initiative the Oregon settlers set up a provisional government in 1843. There were not many settlers north of the Columbia to participate in this legislation, but such as there were, were under this government until the United States congress passed the Oregon bill in 1848, providing for the usual territorial administration. Five years later (1853) the Oregon region was divided and Washington acquired its present name and a separate territorial organization. The boundary ran along the Columbia river to the 46th parallel and thence east to the crest of the Rocky mountains. Washington did not assume its present shape until the territory of Idaho was created in 1863. Isaac I. Stevens became the first governor. After his arrival he at once set to work to extinguish by purchase the Indian titles to land, and a series of treaties were held with all the tribes. Delay by the government in ratifying them and failure of goods promised therein to be delivered to the Indians merely added to the irritation caused by the whites' trespassing. Between 1855 and 1859 there were many complicated Indian campaigns and a number of sharp engagements which resulted in the partial subduing of the natives.

The first permanent American settlement was made at Tumwater on Puget sound in 1845. Two miles away a town named Smithfield was begun in 1847. Later the name was changed to Olympia, and the place became the capital of the territory and state. Ft. Steilacoom and Port Townsend were settled in 1850, Seattle in 1851, Bellingham and Tacoma in 1852. The Indian wars prevented settlement in eastern Washington until 1858 when a crowd of homeseekers and miners swarmed into the region, concentrating largely around Colville where the mines attracted attention. Gold discoveries on the Fraser river drew many farther east, and a settlement began to grow up around Ft. Walla Walla. After gold was discovered in the Clearwater region of Idaho (then still Washington territory), Walla Walla became the outfitting point, and the brisk trade soon developed a lively city. In 1872 the first settlement at Spokane Falls was made, the nucleus of the city of Spokane. Supplying the mines in British Columbia, Idaho, Montana, Oregon and California with grain, meat, lumber and other needed articles proved lucrative business for the territory. Rapid growth in wealth and population led to agitation for statehood, and a constitution was adopted in 1878, but congress declined to pass an enabling act. The completion of the Northern Pacific railway in 1883 brought another period of swift increase in population. Statehood was finally granted in 1889. Trade along the Pacific coast became active after the Klondike gold discoveries of 1897. As outfitting and supply points the sound cities especially benefited from this activity, and at this time a period of bitter rivalry began between them for dominance in the trade of the sound. The Alaska-Yukon exposition was held at Seattle in 1909, and its success helped that city and benefited the state as well.

In politics Washington has been Republican in national elections except in 1896 when it was carried by a fusion of Democrats and Populists, in 1912 when it was carried by the Progressives for T. Roosevelt, and in 1916 for Wilson; also in 1932, 1936 and 1940 F. D. Roosevelt and the Democrats swept the state, in the latter elections with the New Deal as the issue. The Democrats also won control of the governorship and the U.S. senate seats in 1932 and 1936, but in 1940 a Republican governor was elected.

BIBLIOGRAPHY.—Consult the *Biennial Reports* of the various state departments and state officers, especially those of the auditor, treasurer and secretary of state, and the departments of education, finance, budget and business, conservation and development and public service; also the *Bulletins* and *Educational Directories* of the department of education state planning council, the *Bulletins* of the geology division of the conservation and development department, the *Bulletins* of the bureau of statistics and immigration, and the *Bulletins* of the agricultural experiment station at Pullman, and the *Publications in Geology*, the *Publications in Anthropology*, and the *Publications in Fisheries* of the University of Washington. *Reports* of U.S. bureau of the census. List of references: C. Smith, *Pacific Northwest Americana* (1921); K. B. Judson, *Subject Index to the History of the Pacific Northwest and Alaska* (1913); *The Pacific Northwest: A Selected Bibliography, 1930–39*, by Northwest Regional Planning Council (1939); C. S. Kingston and J. V. Oliphant, *An Outline of the Pacific Northwest with Special Reference to Washington* (1926). *See* also *Washington: Its People, Products and Resources* (particularly for 1938); *Washington State Government* by Belle Reeves, secretary of state (1940); *Manufacturing Opportunities in the State of Washington* (1918); and *Descriptive and Statistical Information of Washington for the Traveler, Homebuilder and Investor* (1922). For history consult L. Spencer and L. Pollard, *A History of the State of Washington* (1937); C. A. Snowden, *History of Washington* (1909–11); G. W. Fuller, *A History of the Pacific Northwest* (1931); H. H. Bancroft, *History of Washington, Idaho and Montana* (1890); E. S. Meany, *History of the State of Washington* (1909); Washington State Historical Society, *Building a State* (1940); E. Meeker, *Seventy Years of Progress in Washington* (1921); R. L. Neuberger, *Our Promised Land* (1938); W. P. Prosser, *History of Puget Sound* (1903); G. W. Fuller, *The Inland Empire of the Pacific Northwest* (1928); E. S. Meany, *Origin of Washington Geographical Names* (1923); *The Washington Historical Quarterly* (26 vols. 1906–35), now *The Pacific Northwest Quarterly* (1936). (H. J. DE.; X.)

WASHINGTON, a city and the capital of the United States of America, coterminous with the District of Columbia, on the northeast bank of the Potomac river at the head of tide and navigation, 40 mi. S.W. of Baltimore, 135 mi. S.W. of Philadelphia, and 226 mi. S.W. of New York city. Land area, 61 sq.mi. Population in 1800, 14,093; in 1850, 51,687; in 1900, 278,718; in 1930, 486,869; and in 1940, 663,091. Of the 1940 population, 28·6% were nonwhite, mainly Negro. There were only 91·1 males per 100 females.

Climate.—The climate of Washington is characterized by frequent periods of high humidity, occasional periods of oppressive heat in summer and moderately mild winters. The mean winter temperature (December, January and February) is 35° F. and the mean summer temperature (June, July and August) 75°; the mean of the winter minima is 27°, and the mean of the summer maxima 84°.

Extremes range, however, from the absolute maximum of 106° to an absolute minimum of −15°. There is an average annual precipitation of 42·2 in., which is evenly distributed.

Communications.—Five railways enter the city: the Pennsylvania, the Baltimore and Ohio, the Southern, the Chesapeake and Ohio and the Richmond, Fredericksburg and Potomac. Steamboats ply daily from the foot of Seventh street to Alexandria, Mt. Vernon, Old Point Comfort and Norfolk, and at Old Point Comfort there is a connection with boats sailing for New York city.

The street railways, with underground trolley in the urban district, are supplemented by buses. Army, naval and commercial airports provide for planes.

Industries.—The city's manufactures and commerce are of little importance. Only government manufactures and manufactures for local consumption are at all large.

Education.—Washington is one of the leading educational centres of the United States. It is here that the Army War college is situated. The public school system, under the control of a board of education appointed by the supreme court judges of the District of Columbia, embraces kindergartens, primary, grammar, junior high, high, a business high school, manual training, normal and night schools. The Army Medical school is situated here. George Washington university, in the vicinity of the White House, is a nonsectarian institution (chartered by act of congress in 1821 as "The Columbian College in the District of Columbia";

endowed by W. W. Corcoran in 1872, organized as the Columbian university in 1873, organized under its present name in 1904). It comprises a junior college, Columbian college of arts and sciences, graduate council, school of medicine, law school, school of pharmacy, school of engineering, school of education, school of government, the inter-American center studies; division of university students and the summer sessions. Georgetown university (organized 1789) is in Georgetown and comprises a liberal arts college, school of medicine, graduate school, law school, dental school and a school of foreign service. The Catholic University of America (incorporated 1887; opened 1889), with buildings near the soldiers' home, stands at the head of Roman Catholic schools in America. Although designed especially for advanced theological studies, it comprises schools of the sacred sciences, philosophy, letters, physical sciences, biological sciences, social sciences, jurisprudence, law and technological sciences. A Franciscan convent, Dominican, Paulist and Marist houses, and Trinity college for girls are affiliated with the Catholic university. The American university (chartered 1893), under Methodist control, conducts an undergraduate college of arts and sciences on its campus of 90 ac. in the northwest section of the city, and a graduate school and school of public affairs and social sciences in the downtown section. Howard university (1867), for the higher education of Negroes, is situated southwest of the soldiers' home; it was named in honour of Gen. Oliver O. Howard, one of its founders and (in 1869–73) its president; it has a small endowment, and is supported by congressional appropriations which are administered by the secretary of the interior.

The Columbia Institution for the Deaf, on Kendall Green, in the northeastern part of the city, is composed of Kendall school (a secondary school) and of Gallaudet college (called in 1864–93 the National Deaf Mute college; the present name is in honour of Dr. T. H. Gallaudet); it was the first institution to give collegiate courses to the deaf, and it has received congressional appropriations, though it is a private foundation. Washington has also several academies, seminaries and small colleges. Among the latter are St. John's college (Roman Catholic, 1870), Washington Christian college (nonsectarian, 1902), Catholic Sisters' college (1911), National university (1869), Trinity college (1900), U.S. College of Veterinary Surgeons (1894), Washington College of Law (1896), Washington Missionary college (1904). The Washington College of Law (1896) is an evening school especially for women. A school of art is maintained in the Corcoran Gallery of Art. There are also the National School of Fine and Applied Art, Washington School of Art, Arts and Crafts school, Critcher-Hill School of Art, Abbott School of Fine and Commercial Arts, Livingston academy and Columbia School of Draughting.

The Carnegie Institution of Washington, founded by Andrew Carnegie in 1902 and endowed by him with $22,000,000 ($10,000,000 in 1902; $12,000,000 later), is designed "to encourage in the broadest and most liberal manner, investigation, research and discovery, and the application of knowledge to the improvement of mankind; and in particular to conduct, endow and assist investigation in any department of science, literature or art." The main activities of the institution are in the fields of astronomy, terrestrial sciences, biological sciences and historical research. Each division or department is adequately supplied with library and laboratory facilities and equipment.

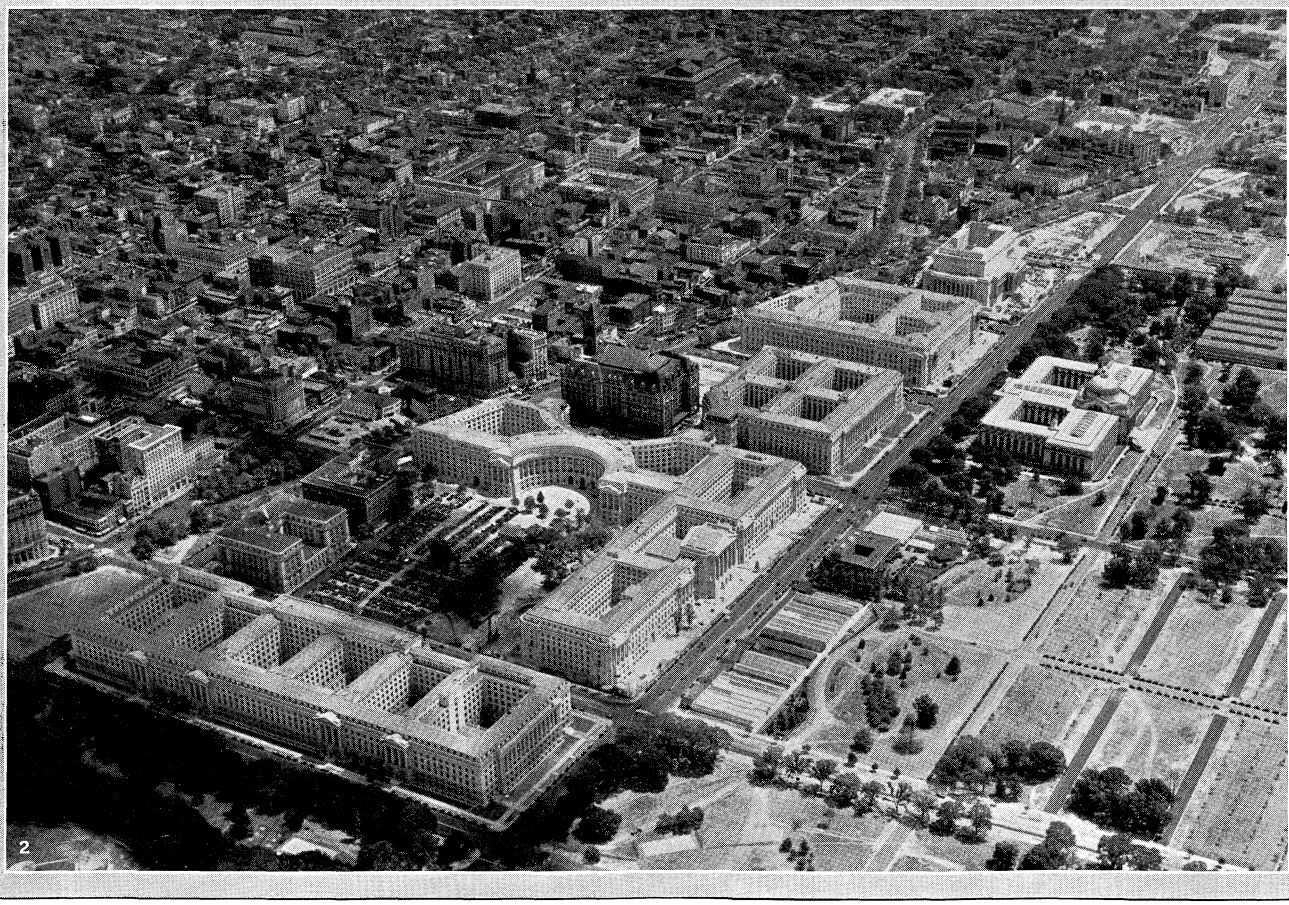
The learned societies of Washington are to a large degree more national than local in their character; among them are: the Washington Academy of Sciences (1898), a "federal head" of most of the societies mentioned below; the Anthropological society (founded 1879; incorporated 1887), which has published *Transactions* (1879 *seq.*, with the co-operation of the Smithsonian institution) and *The American Anthropologist* (1888–98; since 1898 published by the American Anthropological association); the National Geographic society (1888), which since 1903 has occupied the Hubbard Memorial building, which sent scientific expeditions to Alaska, Mt. Pelée and La Souffrière, and which publishes the *National Geographic Magazine* (1888 *seq.*), *National Geographic Monographs* (1895) and various special maps; the Philosophical Society of Washington (1871; incorporated 1901), devoted especially to mathematical and physical sciences; the Biological society (1880), which publishes *Proceedings* (1880 *seq.*); the Botanical Society of Washington (1901); the Geological Society of Washington (1893); the Entomological Society of Washington (1884), which publishes *Proceedings* (1884 *seq.*); the Chemical society (1884); the Records of the Past Exploration society (1901), which publishes *Records of the Past* (1902 *seq.*); the Southern History association (1896), which issues *Publications* (1897 *seq.*); the Society for Philosophical Inquiry (1893), which publishes *Mémoirs* (1893 *seq.*); the Society of American Foresters (1900), which publishes *Proceedings* (1905 *seq.*); the American Institute of Architects, founded in 1857, which has its headquarters in the famous Octagon building; the American Forestry association, founded in 1875, which publishes a magazine; the American Planning and Civic association, organized as The American Civic association in 1904, which publishes a bound annual and issues a magazine; and the Cosmos club. The libraries and scientific collections of the federal government and its various bureaus and institutions afford exceptional opportunities for students and investigators.

The library of congress contains 6,102,259 books and pamphlets, 1,441,719 maps and views, 1,399,357 volumes and pieces of music and 552,514 prints. In the state department library are over 125,000 volumes of documents. The library of the office of the surgeon-general of the army contains 850,000 volumes, and is the largest medical library in the world. Besides these there is a vast amount of material in the collections of the office of education, the bureau of ethnology, the Smithsonian institution, the national museum, the national archives, the war college, the public health service, the patent office, the department of agriculture, the botanic garden, the fish and wildlife service, the naval observatory, the geological survey and the coast and geodetic survey. The public library contains 613,756 volumes in the main and 12 branch libraries.

Government.—Washington is the seat of the U.S. federal government and as such is not self-ruled, but governed by the federal congress. The city was chartered in 1802, with a mayor appointed annually by the president and an elective council of two chambers. The mayor was elected by the council from 1812 to 1820, and by the people (biennially) from 1820 to 1871. In 1871 the federal congress repealed the charters of Washington and Georgetown and established a new government for the entire district, consisting of a governor, secretary, board of public works, board of health and a council appointed by the president with the concurrence of the senate, and a house of delegates and an elected delegate to the national house of representatives.

In 1874 congress substituted a government by three commissioners appointed by the president with the concurrence of the senate, and in 1878 the government by commissioners was made permanent. Two of the commissioners must be residents of the district, and the third must be an officer of the corps of engineers of the U.S. army. The district commissioners are the chief executive officers. The federal congress legislates for the district; the president, the commissioners and the supreme court of the district appoint the administrative officers and boards; and the president appoints the judges of the district courts, viz., a court of appeals, supreme court, municipal court, police, probate court and juvenile court. The United States contributes to the expenses of the district. The revenue of the district, which is derived from real estate, income and personal property taxes and from licences, is paid into the U.S. treasury; appropriations, always specific and based on estimates prepared by the commissioners, are made only by congress; and all accounts are audited by the treasury department. The federal government owns the waterworks, by which an abundant supply of water is taken from the Potomac at the Great falls, conducted for 10 mi. through two aqueducts and filtered through two sand filtration plants.

Early History.—The United States was the first nation in the world to plan a capital exclusively for its seat of government. Before 1800, the congress of the young republic sat in eight cities—Philadelphia, Baltimore, Lancaster, York, Princeton,



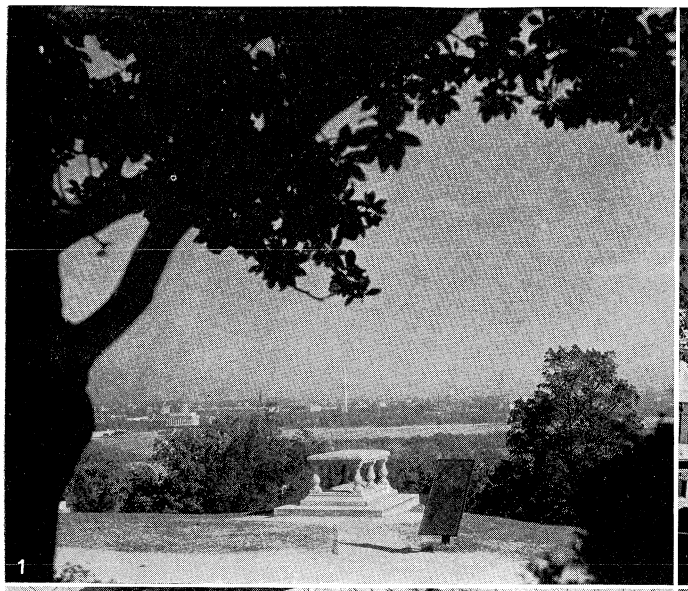
BY COURTESY OF (2) FAIRCHILD AERIAL SURVEYS, INC.; PHOTOGRAPH, (1) EWING GALLOWAY

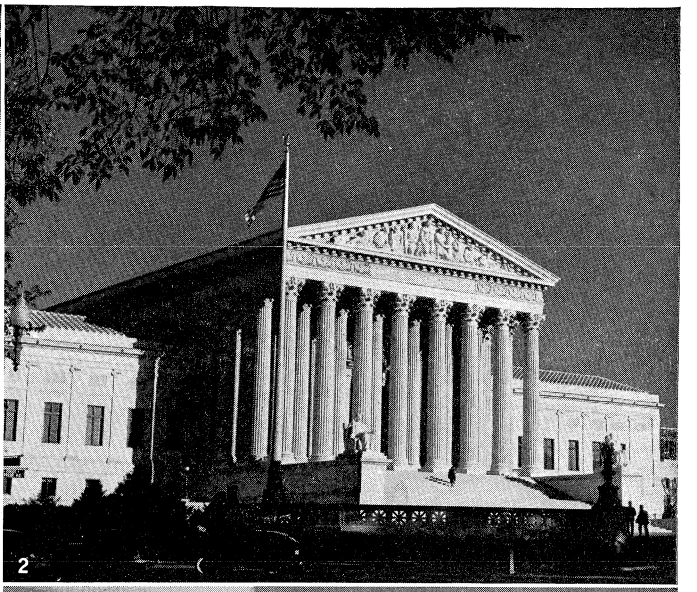
WASHINGTON, D.C.

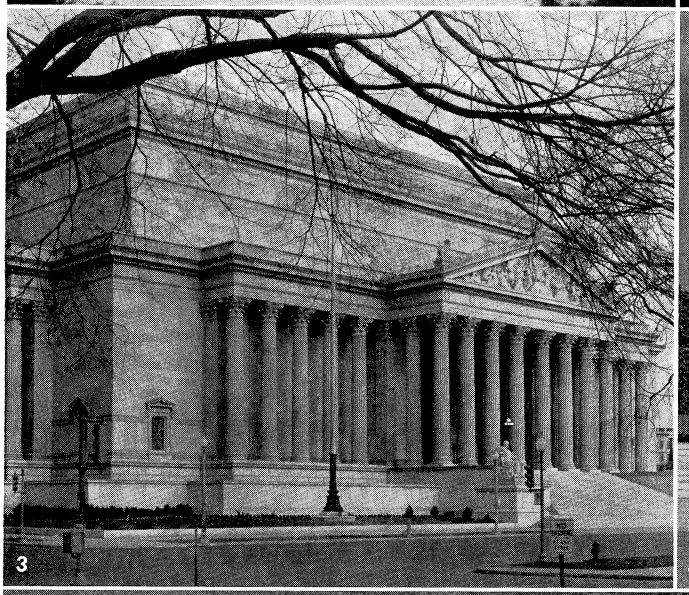
1. Looking toward Lincoln Memorial from Washington Monument

2. The Triangle Buildings taken from over Washington Monument

WASHINGTON







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1. The tomb of L'Enfant in Arlington cemetery, and the city of Washington
2. Supreme Court building, opposite the east front of the Capitol
3. National Archives building
4. The U.S. Capitol and statue of Grant
5. Jefferson Memorial

Annapolis, Trenton and New York. When the statehouse was in Philadelphia after the battle of Yorktown, the army was being disbanded by furloughs as there was no money with which to pay the men. When some of the Pennsylvania troops mutinied and surrounded the building where both Congress and the executive council were in session, neither the State nor the city acted to protect Congress. Madison commented that if the city would not support Congress, it was high time to remove to another place. Congress did, in fact, adjourn to meet three days later in Princeton, New Jersey. Competition was very keen to secure the seat of government. There was "Boston, where the first shot had been fired; Philadelphia, where independence had been proclaimed; Yorktown, where it had been won," commented M. Jusserand. Other competitors were New York, Kingston, Newport, Wilmington, Trenton, Reading, Lancaster, Annapolis, and Williamsburg. During the debate in Congress a question was raised as to the jurisdiction proper for Congress to exercise over the place of the permanent government. The Constitution of the United States quite definitely settled this question. By that document Congress is given power "To exercise exclusive legislation in all cases whatsoever over such district (not exceeding ten miles square) as may, by cession by particular states and the acceptance by Congress, become the seat of government of the United States."

Whether the final vote of Congress would in any case have designated the shores of the Potomac for the permanent seat may always remain a moot question. Probably the account given by Jefferson of the "deal" between himself and Hamilton by which he gave his vote for the assumption of state war debts in return for Hamilton's support of the southern site did influence the action of Congress, which in 1790 definitely directed that a district not exceeding ten miles square should be located on the river Potomac "at some place between the mouths of the Eastern Branch and the Connogocheague," and further stipulated that "the same is hereby accepted for the permanent seat of the government of the United States." The President was authorized to appoint three commissioners who were, under the direction of the President, to survey and define the district, to purchase or accept the necessary lands, and to provide suitable buildings for the public offices of the United States. This was to be accomplished before the first Monday in December, 1800.

According to W. B. Bryan, the first reference of George Washington to the federal seat of government is to be found in his diary under date of July 12, 1790, in the item: "and about noon had two bills presented to me by the joint committee of Congress. The one, an act for establishing the temporary and permanent seat of the Government of the United States." On the 24th of January, 1791, Washington sent a message to Congress stating that "in mature consideration of the advantages and disadvantages of the several positions within the limits prescribed," he had by proclamation of the same date directed commissioners "to survey and limit a part of the territory of the ten mile square on both sides of the river Potomac so as to comprehend Georgetown in Maryland and extend to the Eastern Branch." He suggested that Congress choose whether the area should extend lower in Maryland and include the town of Alexandria in Virginia or reach farther north. Congress acted to extend the limits of the federal district south of the Eastern Branch on the Maryland side and also south on the Virginia side as far as Hunting Creek just south of Alexandria. Bryan states that, after all the debate of the preceding years, the conclusion reached by the President seems to have met with the sanction of public opinion. Even in Congress, where there was ample opportunity for debate, there was no discussion.

As commissioners Washington appointed Thomas Johnson of Frederick, Maryland, Daniel Carroll of Rock Creek, Maryland, and Dr. David Stuart of Hope Park near Fairfax Court House, Virginia. The next step was to find the exact location of the city within the new territory. In addition to the $192,000 granted by Maryland and Virginia it was thought that the sale of lots would provide additional needed income, though this hope brought disappointment and delay. The territory of Columbia, later called the District of Columbia, covered exactly ten miles square, laid obliquely with the compass, sixty-nine and one-quarter square miles within the State of Maryland, at one time by act of Congress known as "The County of Washington," and the remainder of the hundred square miles within the State of Virginia, known as "The County of Alexandria." The latter was in 1846 re-ceded to the State of Virginia by a short-sighted Congress. The actual site of the Federal City, as finally laid out, covered only a little more than one-tenth of the entire original district.

Plan.—Washington entrusted the making of the plan to a young French engineer, Major Pierre Charles L'Enfant, who had served in the Revolutionary war. He was assisted by Andrew Ellicott who had received instructions prior to the appointment of L'Enfant to survey the bounds of the District. Washington finally, but not without considerable difficulty, induced the proprietors of nineteen tracts of land to convey in trust to him the whole of their lands, "in consideration of the great benefit we expect to derive from having the federal city laid off upon our lands," upon condition that "the president shall have the sole power of directing the federal city to be laid off in what manner he pleases." Half the lots were to go to the public and half to the original owners. For the streets the proprietors were to receive no compensation, but for the land taken for public uses, the owners were to be paid at the rate of twenty-five pounds per acre. On March 31, 1791, Jefferson wrote to Washington, "The acquisition of ground is really noble. . . . I think very liberal reserves should be made for the public."

A description written by L'Enfant to accompany the plan, now so well known, declared: "After much menutial search for an eligible situation, prompted, I may say, from a fear of being prejudiced in favour of a first opinion, I could discover no one so advantageously to greet the congressional building as that on the west end of Jenkin's Heights, which stands as a pedestal waiting for a monument." For the presidential palace a ridge west of the Tiber was selected. On the plan the President's House, located on the north-and-south axis from the Washington Monument, mentioned as an equestrian statue, was to be connected with the Congress House by an avenue 160 feet wide—Pennsylvania Avenue—which was later bordered by Jefferson's famous poplars and still later to become a sordid neglected thoroughfare, now being rescued from its dinginess by the extensive public building program. From Congress House the waters of Tiber Creek were to fall in a cascade into a reservoir and then through the gardens into the grand canal which was to be conducted down the north side of "Grand Avenue," 400 feet in breadth, and about a mile in length, bordered with gardens. The irregular rectangular blocks which formed the grille of the basic plan were cut by superimposed diagonal avenues cunningly devised to converge at the Capitol and the Executive Mansion and to form scores of squares, circles and triangles at street intersections, appropriate sites, L'Enfant thought, for monuments and statues.

Later History.—Washington stated in a letter to Mr. Fairfax that the nation "would produce a city, though not as large as London, yet with a magnitude inferior to few others in Europe." Jefferson thought that at the end of a hundred years the Federal City might have 100,000 inhabitants and might possibly hope to attain, ultimately, a population of 200,000. In the year 1800 the entire Federal Government moved to the newly-established headquarters on the Potomac. The Congress House, the President's House and the original Treasury Building were sufficiently near completion to furnish accommodation for part of the offices, and houses were leased for the State, War, Navy, and Post Office departments.

In the succeeding years it was the fashion for those who visited Washington, whether from home or abroad, to ridicule the grandiose plans for a magnificent city, which, it seemed, could never be realized. The rains and snows rendered all but impassable that Pennsylvania Avenue which connected the Executive Mansion and the Capitol. The Centennial Celebration of the establishment of the seat of government which took place in 1900 served to mark the progress of the century which saw a rebuilt and enlarged Capitol, the completion of the Washington Monument in 1884, the erection of many public buildings, and, during the seventies the improvements made possible by the intrepid

Governor Shepherd, who forced upon the luckless property owners of the District an expense which made him the most hated man of his generation, though he is now recognized as the man who "seized the opportunity which others did not see, to begin the long-neglected work of making the city what its founder meant it to be." Lincoln's faith in the Union and its capital was demonstrated by the work on the Capitol dome which proceeded during the Civil War.

But the plan had been forgotten. In 1887, after many years of oblivion, the original manuscript of the "Plan of the City of Washington" which was prepared in 1791 was rediscovered and traced by a nice operation in the offices of the Geodetic Survey. Even within the area of the old Federal City the plan had been frequently violated, though the street and avenue structure remained. The street extensions and the occupation of new lands beyond the old Boundary Street showed little of that planning genius which characterized the original plan. The gridiron and diagonal streets designed for the fairly level site of the old city were extended into the hills regardless of contours.

Senator McMillan, who in 1900 was Chairman of the Senate Committee on the District of Columbia, enlisted the services of four eminent Americans, Daniel H. Burnham, Charles F. McKim, Augustus Saint-Gaudens, and Frederick Law Olmsted, Jr., who constituted a sort of informal Park Commission and whose recommendations were embodied in a report presented by Senator McMillan to the Senate in January of 1902. As a direct result of the McMillan Report of 1901 on the Park System of the District of Columbia and the personal negotiations carried on by Senator McMillan and the Commission, the railroad tracks were removed from the Mall where they had trespassed and the present Union Station was erected as a fitting entrance to the Capital of the Nation. The Commission adapted and developed plans for the Mall, designed a very complete park system which would serve the needs of the capital for a good many years to come; but, unfortunately, in the quarter of a century which followed, and in spite of the fact that the population nearly doubled in that time, out of 53 park areas recommended for early acquisition, but six were actually acquired.

In 1910 President Taft appointed the first Commission of Fine Arts, including on it three who had been identified with the Park Commission of 1901—Daniel H. Burnham, Frederick Law Olmsted, Jr., and Charles Moore. The Commission has exerted a steady influence to bring about the realization of the Mall plan and functions as a continuous agency to pass upon plans for public buildings, monuments and fountains and to give advice on matters of art. In 1920 a Zoning Commission was created to give the District the protection of modern zoning. In areas designated under the Shipstead Act enacted by Congress in 1930, plans for all structures on private property must be approved by the Commission on Fine Arts. Billboards are banned in all residence districts and Shipstead locations. It was not, however, until 1926 that there was established a permanent planning commission for the District of Columbia and its environs through an amendment to a law enacted two years earlier setting up a park-purchase commission. In addition to seven (now six) ex officio members, President Coolidge appointed to serve as first members of the commission Frederic A. Delano, Frederick Law Olmsted, Jr., J. C. Nichols and Milton B. Medary. The commission developed a regional plan and supplemented it by a thoroughfare plan for the district, plans for a complete system of city parks, playgrounds and recreation centres, plans for railroad and terminal facilities and for improvement of streetcar lines, studies of slum conditions, with particular reference to alley dwellings; it also prepared recommendations relating to city-planning elements of the federal building program and on school and municipal centre programs. More than a hundred changes in street plans were made to secure economy and better layouts. The commission became an important agency for the direction and control of the development of the district and surrounding region. A Maryland National Capital Park and Planning commission was created to provide responsible planning and zoning control of the adjacent region in Maryland, and there is a similar Virginia commission.

Parks and Monuments.—Before the passage of the park-purchase bill of 1924 and the creation of the Commission which became in 1926 the National Capital Park and Planning Commission, there were the many little parks and occasional squares in the city covered by the L'Enfant Plan; there was also Rock Creek Park, in Theodore Roosevelt's day a country reserve, but with the years becoming increasingly crowded. There was Potomac Park reclaimed from the flats of the Potomac, supplementing the Mall and the White House Lot back of the White House. But there was no semblance of a comprehensive park system. Since its creation the National Capital Park and Planning commission has not only made plans for an extensive park system; it has seen over 1,890 acres added to the parks of the city. The Anacostia parkway has been reclaimed from the lowlands of the Eastern branch. Much of the land has already been acquired to provide a Fort drive which will connect the defence forts established on the hills surrounding the city during the Civil War. The Mount Vernon Memorial highway gives to the people of the country a beautiful river parkway to connect Washington with Mount Vernon. A George Washington Memorial parkway is projected to continue a river parkway northward to the Great Falls of the Potomac. The ground between the capitol and Union station has been cleared, terraced, planted and embellished by fountains. A waterside parkway now connects Rock Creek and Potomac parks and Rock Creek park has been extended into Maryland. The National Zoological park adjoining Rock Creek has been developed and improved.

The parks of the District of Columbia, comprising 6,231 acres, are administered by the National Park service in the department of the interior. Playgrounds are supervised by a division under the commissioners of the district. School grounds and recreation activities are supervised by an agency of the board of education. The recreational activities of these three agencies were unified in 1935 under a single co-ordinator.

The public grounds around the capitol, the White House and other public buildings, the Mall and the park, parkway and playground system of Washington all combine to form a fine setting for the buildings and monuments of the city. The federal city probably has the most beautiful street and park trees of any city in the United States. Its streets are lined with ancient elms, with spreading ginkgo trees, with oriental planes, pin oaks, red oaks, maples and scores of others.

In the parks are beeches of many varieties, elms, magnolias, dogwoods, oaks and maples, which provide a welcome shade during the southern summers and present brilliant hues in autumn. A national arboretum adjoins Anacostia park.

The Washington monument, located near the spot designated by L'Enfant at the cross axis running south from the White House and west from the capitol, dominates the skyline of the city. Originally designed by Robert Mills, the obelisk now stands, devoid of embellishment, a dignified shaft a little over 555 feet in height. The monument was many years in course of construction and was not complete until 1884.

While the cascades envisioned by L'Enfant may be classed among the lost opportunities, the rescue of the Mall from the encroaching railway tracks, the realignment of the axis running west from the Capitol to take in the Washington Monument, placed slightly off centre to secure firmer foundations, and the development of a design for the whole are lasting contributions. The Grant Memorial, at the foot of Capitol Hill, facing the Mall, a most impressive monument designed by Henry M. Shrady, is on the new axis. The chaste Lincoln Memorial designed by Henry Bacon, with its imposing figure of Lincoln designed by Daniel Chester French, is also on the axis and forms a part of the composition by which the Lincoln Monument is connected by the beautiful Arlington Memorial Bridge with Arlington, the National Cemetery. Here is the Tomb of the Unknown Soldier, a classical amphitheatre, and the pillared mansion which was built by George Washington Parke Custis, grandson of Martha Washington, and before the Civil War was the home of Robert E. Lee.

Among the notable monuments in Washington are the five in Lafayette Square of General Andrew Jackson, Lafayette, Rochambeau, Von Steuben, and Kosciuszko; the statue of John Paul

Jones and the Jefferson memorial near the Tidal basin; the statues of Washington, McPherson, Farragut, Scott, Logan and Sheridan in the squares and circles of those names; the statue of Chief Justice Marshall on the west terrace of the capitol; the figure of Hamilton on the south steps of the treasury, the Sherman monument south of that; the Meade memorial in the Mall; the statues of Dante and Jeanne D'Arc in Meridian park, and the Peace monument at the head of Pennsylvania avenue. Special attention should be called to the Adams memorial, designed by Augustus Saint-Gaudens, in Rock Creek cemetery; the Butt-Millet fountain, designed by Daniel Chester French; the Titanic memorial, designed by Gertrude Payne Whitney; the Columbus monument, designed by Lorado Taft, in front of Union station; and the Zero Milestone, designed by Horace Peaslee, south of the White House, as a monument from which to measure all distances, an idea proposed by L'Enfant.

Buildings.—The capitol and White House today occupy the sites indicated in the original L'Enfant plan, but many of the public buildings erected in the 19th century were placed in unrelated locations. The Treasury building, in itself an excellent structure, designed by Robert Mills, blocks the Pennsylvania avenue approach to the White House. With the Park Plan of 1901, interest in the L'Enfant plan was revived and most of the public buildings erected since that time have conformed to the spirit of the plan. For the Triangle bounded by Pennsylvania avenue, the Mall and 15th street, a unified plan has been prepared and most of the buildings have been erected, though several nonconforming buildings still survive from a previous era.

In a dignified landscape setting on the brow of a hill 88 ft. above the Potomac stands the capitol (built 1793–1827; architect William Thornton, later superintendent of the patent office, whose designs were modified by B. H. Latrobe and Charles Bulfinch; the wings and dome added 1851–65). It consists of a central building of Virginia sandstone, painted, and two wings added to the original building of white Massachusetts marble. The cornerstone of the original building was laid on Sept. 18, 1793, by President Washington, with Masonic ceremonies. On Aug. 24, 1814 (during the War of 1812), the interior of both wings of this building was destroyed by fire, started by the British forces. The cornerstone of the extension wings (senate and house) was laid on July 4, 1851, by President Fillmore, Daniel Webster officiating as orator (architect Thomas U. Walter). The length of the capitol building over all is 751 ft. 4 in., and its breadth ranges in different parts from 121 ft. to 350 feet. The main building is surmounted with an iron dome, designed by Thomas U. Walter, which rises to the height of 287 ft. 5 in., and on the dome is a statue of Freedom (1863; 19½ ft. high) by Thomas Crawford.

The executive mansion, more commonly called the White House, the official residence of the president, is a two-story building of Virginia freestone, painted white since 1814 to hide the marks of fire—only the walls were left standing after the capture of the city by the British in that year. It is 170 ft. long and 86 ft. deep. It is simple but dignified; the principal exterior ornaments are an Ionic portico and a balustrade. The White House was built in 1792–99 from designs by James Hoban, who closely followed the plans of the seats of the dukes of Leinster, near Dublin, and remodelled in 1902–03, when the president's office was moved out of the White House itself into new quarters near by and the interior brought back more nearly into accord with the original mansion of Hoban.

In the capitol group we have the senate office building, recently enlarged and the old house office building, designed by Carrere & Hastings as rim buildings in keeping with the architecture of the capitol. The new house office building, designed by the Allied Architects of Washington, is in the type of architecture known as "Early Federal." East of the capitol is the new supreme court building, designed by Cass Gilbert in the grand manner. The portico containing eight Corinthian columns supporting an entablature and a sculptured pediment is the largest in scale of any in the city. Also east of the capitol is the library of congress, an "Italian Renaissance" building quite different from other structures in the capitol group, now supplemented by a modern building, designed by Pierson and Wilson. Back of the library of congress is the severely simple marble building, designed by Paul Cret, with Alexander B. Trowbridge as consultant, which houses the Elizabethan halls of the Folger Shakespeare library.

Within the Mall are located the Smithsonian institution, with its tessellated towers, the new National museum, the latter recently enlarged, the lovely Freer gallery, designed by Charles A. Platt, the completed Agriculture building and the National Gallery of Art, designed by John Russell Pope (1874–1937), which houses the Mellon, Widener and Kress collections.

In the Triangle bounded by the Mall, 15th street and Pennsylvania avenue there is a unified design. The Commerce building, designed by York and Sawyer, 1,053 feet long, occupies one end of the triangle, between 14th and 15th streets. The architecture is an adaptation of the Italian Renaissance. An open triangular park will be maintained between the end of the Commerce building and Pennsylvania avenue at 15th street. From the District building on 14th, which may be replaced or remodelled, there will be a fairly uniform façade along the south side of Pennsylvania avenue until the point of the triangle is reached. Constitution avenue, formerly B street, separates the Triangle buildings from the Mall. The prospect looking down the wide thoroughfare which runs from the Lincoln memorial grounds to the capitol grounds, is most impressive. The Post Office Department building, designed by Delano & Aldrich, faces Pennsylvania avenue at 12th street and in the rear forms part of a rectangular court with rounded end, looking out on the Commerce building, one of the interesting architectural features of the plans for the Triangle. An inner plaza, reminiscent of the Place Vendome, breaks the interior of the Triangle group. The Department of Labour and Interstate Commerce Commission buildings, designed by Arthur Brown, face Constitution avenue, as does the Department of Justice building, designed by Zantzinger, Borie & Medary. The Archives building, designed by John Russell Pope, and the Federal Trade Commission building, designed by Bennett, Parsons and Frost, occupy the apex of the Triangle.

Pending plans for the municipal centre place the new police, municipal court and juvenile court buildings in old Judiciary square where the early Republic architecture of the beautiful old courthouse now in use will dominate. Two adjacent southern squares will be the future site of the District Administration buildings.

A number of public and semi-public buildings have been erected in a triangle formed by Constitution avenue, 17th street and New York avenue. The beautiful Pan-American building, designed by Kelsey and Cret, stands in well planted grounds at the corner of Constitution avenue and 17th street. Between the main building and the annex with its arched loggia of Aztec tiling there is an Aztec garden and pool. In the main building is a patio filled with tropical plants and birds flying about a splashing fountain. Running north on 17th street, opposite the White House lot are the group of buildings erected by the Daughters of the American Revolution, consisting of Continental Hall, designed by Edward P. Casey, Constitution Hall and an administration building designed by John Russell Pope; the group of buildings, simple in design, erected by the American National Red Cross; and the Corcoran Art gallery designed by Ernest Flagg. Along Constitution avenue, opposite the temporary Navy and War buildings are the National Academy of Sciences and National Research Council building, of Greek Alexandrian design, planned by Bertram G. Goodhue; the U.S. Public Health Service building and the charming American Pharmaceutical building, designed by John Russell Pope.

The new Department of Interior building, designed by Waddy Wood, and the Federal Reserve building, designed by Paul Cret, face Constitution avenue.

Among the churches in Washington which add to the architectural beauty of the city may be counted the National Episcopal cathedral, now in course of construction, set on a high hill in an extensive Close; the Brookland monastery which crowns another eminence and affords fine vistas from the picturesque cloisters;

the National Shrine of the Immaculate Conception in connection with the Catholic University of America; the church of the Disciples of Christ which dominates Thomas circle; the Church of the Pilgrims, of old English design, which the Southern Presbyterians have erected overlooking Rock Creek parkway; the severely plain meeting house of the Friends, and the building reminiscent of Christopher Wren of the Unitarians. On 16th street the Scottish Rite temple is housed in notable buildings.

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WASHINGTON, a city of southwestern Indiana, U.S.A., on federal highways 50 and 57, near the White river; county seat of Daviess county. Population (1920) 8,743 (97% native white); in 1940, 9,312 by the federal census. The city was founded in 1816 and chartered in 1870.

WASHINGTON, a city of southwestern Pennsylvania. Pop. (1930) 24,545 (83% native white; the remaining 17% about equally divided between Negroes and foreign-born white); 1940 federal census, 26,166, with 8,000 more in contiguous suburbs. Washington lies among beautiful surroundings, at an altitude of 1,156 ft., in a fertile region, rich in bituminous coal (still largely unmined) and producing oil and gas wells. The manufacturing output in 1939 was valued at $23,400,000. Among leading products are glass food containers of all types, table glassware, steel for high speed tools, ferroalloys, tungsten, molybdenum, annealing boxes, tin and terne plate and corrugated shipping cases. It is the seat of Washington and Jefferson college and of Washington seminary for girls (1836). The college is a consolidation (1865) of Washington college, founded in 1787, as an academy formed by the union of three schools established within 10 mi. of Washington in 1780, 1781 and 1785, by three Presbyterian ministers, and Jefferson college, founded as an academy at Canonsburg in 1794. On South Main street stands a house built in 1788, which was the headquarters of David Bradford, leader of the Whiskey Insurrection, in 1794. The site of Washington was part of a tract bought in 1771 by David Hoge, and was at first called Catfishes Camp, then for brief periods Dandrige Town and Bassett Town. In 1781 Hoge laid out a town, and gave lots (now part of the college campus and the site of the First Presbyterian church) to George and Martha Washington. The National road (first proposed by George Washington and urged by him throughout his life) was authorized by Congress in 1806, and the right of way was given in 1807 by Pennsylvania on condition that it should pass through the town of Washington, along the route of George Washington's first expedition into the west. The first crematory in the United States was established in Washington in 1876 by Francis Julius Le Moyne (1798–1879), the son of a French refugee.

Through his ardent sympathy for the abolition movement he was influential in making Washington an important "station" on the "underground railroad."

The town of Washington was incorporated in 1810 and became a city in 1924.

WASHINGTON, MOUNT, a peak of the White mountains in New Hampshire, alt. 6,293 ft. The Presidential range is about 20 m. in length, and contains nine other peaks exceeding 5,000 ft. in height. The sides of Mt. Washington are cut deep with ravines which offer some of its wildest scenery. Above the ravines (5,000–5,500 ft.) are comparatively level areas called "lawns"; from these rises the rounded bare-rock summit. The tree-line, which extends up its sides to an elevation of about 3,850 ft., gives way for the next 1,000 ft. of altitude to dwarf spruce, balsam and birch. This is followed by the real Alpine zone which extends to the summit. The flora of this region is chiefly Alpine flowers, sedges and lichens. The winter weather is very severe. Official weather records show temperatures as low as 60° below zero and storm winds exceeding 100 m. per hour. The region is plentifully supplied with water which finds its way into three rivers, the Androscoggin, the Connecticut and the Saco. Near the summit are two rock-rimmed and clear bodies of water known as the "Lakes of the Clouds."

The peak was first sighted from the ocean in 1605, and was first ascended in 1642 by Darby Field accompanied by two Indian guides. The mountain was given its present name by the Rev. Manasseh Cutler, who, with several companions, made a scientific trip to the summit in 1784. The Crawford path, which approaches from the south-west, was finished in 1821, and a few years later was made a bridle path to the summit. The carriage road, which was constructed during the years 1855–61, follows the prominent north-east ridge from Glen House to the summit. This makes it possible to climb the peak by automobile. The cog railway, which follows the westerly spur, was started in 1866 and completed in 1869. It operates between the Base station and the Summit house. Numerous trails and shelters are maintained, chiefly by the Appalachian mountain club.

See W. C. O'Kane, *Trails and Summits of the White Mountains* (1925) and *Guide to Paths in the White Mountains* (6 ed., 1925) published by the Appalachian mountain club.

WASHINGTON CONFERENCE. Preliminary invitations to a Conference at Washington on the limitation of national armament "in connection with which Pacific and Far Eastern questions could also be discussed" were issued by President Harding in July 1921, to Great Britain, France, Italy and Japan. On Aug. 11, formal invitations were sent to these Powers, to China and later to Belgium, the Netherlands and Portugal, President Harding having been authorised by Congress on July 11, 1921, to arrange for the Conference. As American delegates Mr. Harding designated Secretary of State Hughes, Elihu Root, Senators Lodge and Underwood; the British Empire was represented by Mr. Balfour (as he then was), Lord Lee of Fareham, Sir Auckland Geddes and Sir Robert L. Borden, as principal delegates; France by M. Briand, M. Viviani, M. Sarraut and M. Jusserand; Italy by Senator Schanzer and Ambassador Rolandi-Ricci; Japan by Prince Tokugawa, Admiral Kato and Ambassador Shidehara; China by Wellington Koo and Sao-Ke Sze. The conference assembled on Nov. 12, 1921, and elected Mr. Hughes as its chairman. The latter at once placed the American proposals on naval disarmament before the gathering. Mr. Hughes proposed that there should be a naval "holiday": "for a period of not less than 10 years there shall be no further construction of capital ships." He then presented a definite plan for the scrapping of certain of the older capital ships and of capital ships under construction, and the restriction of capital ship replacements by an agreed maximum of tonnage.

In the plenary session of Nov. 21 the subject of military armament was introduced by Mr. Hughes, but the attitude of France established the impracticability of discussing any definite plan for the limitation of armies. A sub-committee was appointed, however, to consider the question of aircraft, poison gases and the rules for the conduct of war.

The agenda of the conference were dealt with by two committees of the whole, one composed of the delegates of the five principal Powers to deal with limitation of armament, the other composed of delegates of all nine Powers to deal with matters affecting the Pacific and the Far East.

Meetings of these committees and their sub-committees were not open to the public; their results were reported formally at the

open plenary sessions, of which six were held. The decisions reached were in regard to navies, including submarines; poison gases; the Pacific Ocean and its islands; and Chinese affairs.

The Question of Capital Ships.—The committee on armament discussed fully the maximum tonnage and ratio of capital ships to which each Power should restrict itself; and on Dec. 20 a provisional agreement was reached. Japan maintained (Dec. 20) that 60% of the quota proposed for the United States and Great Britain was insufficient for her defensive needs, and asked that it be increased to 70%; her delegates were especially unwilling to sacrifice the "Mutu," a new capital ship (in large measure paid for by popular subscription), which, under the Hughes plan, would have to be scrapped. This obstacle was overcome by permitting Japan to retain the "Mutu," on condition that an older ship, the "Setsu," should be scrapped. This change gave Japan two post-Jutland ships and an increased capital ship tonnage, to offset which it was agreed that the United States should complete two ships still in process of construction, and that Great Britain should construct two new vessels not to exceed 35,000 tons each. In replacement tonnage the ratio was to stand thus: United States and Great Britain 525,000 tons each and Japan 315,000 tons—a ratio of 5–5–3. This agreement was stated to be contingent upon a suitable arrangement for France and Italy, who had been offered a replacement tonnage of 175,000 each. But M. Sarraut, representing France, held out for an aggregate of 350,000 tons, to be constructed on a replacement basis from 1925 onwards. The controversy was finally laid before M. Briand, who had returned to France; he agreed to accept for France the maximum of 175,000 for capital ships, but made his consent conditional on the obtaining of a larger proportion of auxiliary craft and submarines, which were regarded by France as purely defensive weapons.

The Question of Submarines.—The French reply settled the problem of capital ships, but a warm controversy was provoked over submarines. Mr. Balfour proposed their complete abolition. Mr. Hughes proposed a reduction of submarine tonnage for the United States and Great Britain to 60,000 apiece, and approximately the *status quo* for France, Japan and Italy (31,500 for the first two, 21,000 tons for the last). But the French delegates refused to accept less than 90,000 tons for submarines and 330,000 for cruisers and auxiliary craft. Mr. Balfour then made it plain that, failing action against the submarine itself, Great Britain could accept no limitation for anti-submarine craft.

As a result, the treaty, as finally agreed upon by the five major Powers, did not include limitation of total tonnage of submarine or auxiliary craft. Limits, however, were placed upon the total tonnage of aircraft carriers and upon individual tonnage of capital ships and cruisers, as well as upon the calibre of guns carried.

The failure of the British attempt to abolish the submarine was mitigated by the passage of a series of resolutions presented by Mr. Root and later embodied in a treaty. As accepted, they stated the rules of international law as to "visit and search" on the high seas, and declared that belligerent submarines are not exempt from these rules. They invited the adherence of all civilised Powers to this statement. In the third place, they recognised that the use of submarines as commerce destroyers was practically impossible without violation of these rules, and that prohibition of such use should be accepted as a law of nations; they declared the assent of the contracting Powers to such prohibition, and invited that of all other nations. No definition of a merchant ship was adopted. In the fourth place, they declared that commanders of all ships transgressing international rules should be subject to punishment for piracy. Aircraft limitation was rejected by the conference, after a technical report of the subcommittee had declared limitation to be impracticable, but an inquiry commission was appointed. The abolition of the use of poison gas in international warfare, on the other hand, was advocated by the Naval Committee Jan. 7 1922, on the motion of Mr. Hughes, and prohibition of poison gas was embodied in a treaty.

Problems of the Pacific.—In respect of the problems of the Pacific a new treaty was drafted and presented at the plenary session, Dec. 10 1921, between the United States, Great Britain, France and Japan. It pledged each to respect the rights of the others in relation to their insular possessions and insular dominions in the Pacific, to accept mediation in case of controversy over these possessions and to open frank discussions if their rights were threatened by any other Power. The treaty was to remain in force for 10 years, and upon its ratification the Anglo-Japanese Alliance was automatically to be terminated. A reservation accompanied the treaty embodying provisions to the effect that it should not be deemed an assent on the part of the United States to "mandates" granted in the Pacific under the Peace Treaty of Versailles, and should not preclude agreements relative to mandated islands. (*See* SINGAPORE.)

The reservation also excepted from arbitrable controversies questions lying within domestic jurisdiction of the contracting Powers. To the treaty was later appended a second agreement, defining the phrase "insular possessions and insular dominions" in such a way as to exclude Japan proper from its scope. The representatives of the United States and Japan also signed a treaty regarding Yap, according to which the United States was to have free access there on a footing of entire equality with Japan in all that related to cable and radio service, and received certain privileges and exemptions in relation to electrical communications. Subject to various conditions the United States consented to the administration by Japan of the mandated islands in the Pacific north of the equator.

Attitude Towards China.—Chinese problems were presented (Nov. 16 1921), by Mr. Sze in the form of 10 points, which the conference was asked to adopt. (*See* CHINA.) They called for recognition of the territorial integrity and political and administrative independence of China, the "open door" neutrality and the complete removal of all political, jurisdictional and administrative restrictions upon the Chinese Republic. The general attitude of the conference towards China was crystallised (Nov. 21) when four resolutions presented by Mr. Root were adopted. They declared the intention of the Powers to respect the sovereignty, the independence and the territorial and administrative integrity of China, their desire to maintain the principle of equal opportunity for the commerce and industry of all nations and their agreement not to seek special rights or privileges. Details of specific arrangements to be enforced led to long discussions. A resolution was adopted (Dec. 24) providing for the voluntary withdrawal of foreign post-offices from China Jan. 1 1923, on condition that China should maintain efficient service and continue the supervision of the foreign co-director-general. The problem of extraterritorial rights could not be settled definitely, but it was referred to an international committee for intensive study and report within a year. The demand for the withdrawal of foreign troops from China was referred to a sub-committee, and finally it was agreed that, while the principle of withdrawal was accepted, the issues raised should be made the subject of inquiry, in order to determine the conditions upon which withdrawal must depend.

On the other hand, the Powers passed a resolution urging China to reduce the large military forces maintained by the military governors. The relinquishment of foreign leaseholds in China was not actually secured (though Great Britain announced her readiness in this respect if other countries would join her); but China's fight for "open diplomacy" was virtually won when a resolution was passed (Dec. 8) pledging the nine Powers not to enter into any agreement that might impair the force of the four Root resolutions. As regards the customs tariffs, the demand of China for complete autonomy was not granted, nor the request made, in view of the nation's financial necessities, that her quota be raised from 5% to 12½%. It was decided, however, that China's customs revenue should be increased by $46,000,000 silver annually, through an advance to 5% effective, a surtax of 2½% and a surtax not exceeding 5% on luxuries. The treaty provided for the convening of a Tariff Revision Commission at Shanghai, the opening of which was delayed until Oct. 1925, owing to the internal troubles of China. Other resolutions included agreements that foreign radio stations should transmit

only Government messages, that there should be no unfair discrimination in railway rates, an expression of hope that the railway system might be unified under Chinese Government control, and an agreement for the establishment of a board of reference for Far Eastern questions.

Shantung.—The question of the Japanese occupation of Shantung entailed long negotiations which at times seemed to reach a dead-lock, especially those relating to the Tsingtao-Tsinan-fu Railway. Largely through the mediation of Mr. Hughes and Mr. Balfour, a separate agreement was finally reached between Japan and China and signed Feb. 4. It provided for the return to China of the former German leasehold and 50-km. zone in Shantung, and the withdrawal of Japanese troops and gendarmes; China was to purchase the Tsinan-fu Railway for $30,000,000, but, before complete redemption, there were to be appointed a Japanese traffic manager subject to the direction of the Chinese managing director, a Japanese accountant and a Chinese accountant of equal rank. Japan renounced all rights to foreign assistance stipulated in the Chinese-German Treaty of 1898, and relinquished the maritime customs at Tsingtao and former German public properties. As to Siberian problems, Baron Shidehara made a full statement to the effect that it was "the fixed and settled policy" of Japan to respect the territorial integrity of Russia.

The Treaties.—The decisions taken by the conference were embodied in seven treaties and various supplementary resolutions. For particulars regarding the terms of the *Five-Power Treaty Limiting Naval Armaments see* WASHINGTON TREATY

By June 9 1923, all the signatory Powers except France had ratified the Five-Power Treaty in relation to the use of Submarines and Noxious Gases in Warfare, the Nine-Power Treaty relating to Principles and Policies to be followed in Matters concerning China, and the Nine-Power Treaty relating to Chinese Customs Tariff. France ratified the last two on July 20 1925, but had not, up to Apr. 1929, ratified the treaty in relation to the use of Submarines and Noxious Gases, apparently because of its objection to the provision on the use of submarines and not because of the restrictions upon the use of poison gases. The French Government ratified the Geneva Poison Gas Protocol of June 1925. By July 28, 1923, all the signatory Powers had ratified the Five-Power Treaty limiting Naval Armaments; also the Four-Power Treaty relating to Insular Possessions and Insular Dominions in the Pacific Ocean, the Declaration accompanying this treaty, and the treaty supplementary thereto.

Norway adhered on Sept. 23 1925, to the treaty relating to Chinese Customs Tariff; and on Nov. 13 1925, to the treaty relating to Principles and Policies concerning China. Denmark and Sweden signified their adherence to the treaty relating to Chinese Customs Tariff on Aug. 27 1925 and Sept. 11 1925.

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WASHINGTON COURT HOUSE, a city of Ohio, U.S.A., the county seat of Fayette county; 40 mi. S.W. of Columbus, at an altitude of 975 feet. Pop. (1940) 9,402. The city was laid out in 1810 and chartered in 1888.

WASHINGTONIA, a genus of the palm family (Palmae), named in honour of George Washington, comprising three handsome species, natives of southern California, Arizona and adjacent Mexico.

WASHINGTON TREATY (LIMITATION OF NAVAL ARMAMENTS). A treaty for the limitation of naval armaments was concluded at Washington, U.S.A., on Feb. 6, 1922. The contracting parties were the United States of America, the British empire, France, Italy and Japan.

Provisions of the Treaty.—The following are the essentials of the agreement come to under the treaty.

(1.) The Contracting Powers agree to limit their respective naval armament as provided in the treaty.

(2.) The Contracting Powers may retain respectively the capital ships specified in the treaty; all other capital ships, built or building, of the United States, the British empire and Japan to be disposed of.

(3.) Subject to the foregoing, the Contracting Powers abandon their respective capital ship building programmes, and no new capital ships shall be constructed or acquired by any of them except replacement tonnage as specified below. Ships replaced shall be disposed of.

(4.) The total capital ship replacement tonnage of each of the Contracting Powers shall not exceed in standard displacement, for the United States, 525,000 tons; for the British empire, 525,000 tons; for France, 175,000 tons; for Italy, 175,000 tons; for Japan, 315,000 tons.

(5.) No capital ship exceeding 35,000 tons' standard displacement shall be acquired by, or constructed by, for, or within the jurisdiction of, any of the Contracting Powers.

(6.) No capital ship of any of the Contracting Powers shall carry a gun with a calibre in excess of 16 inches.

(7.) The total tonnage for aircraft carriers of each of the Contracting Powers shall not exceed in standard displacement, for the United States, 135,000 tons; for the British empire, 135,000 tons; for France, 60,000 tons; for Italy, 60,000 tons; for Japan, 81,000 tons.

(8.) The replacement of aircraft carriers shall be effected only as prescribed below, provided, however, that all aircraft carrier tonnage in existence or building on Nov. 12, 1921, shall be considered experimental, and may be replaced, within the total tonnage limit prescribed above without regard to its age.

(9.) No aircraft carrier exceeding 27,000 tons' standard displacement shall be acquired by, or constructed by, for or within the jurisdiction of, any of the Contracting Powers. However, any of the Contracting Powers may, provided that its total tonnage allowance of aircraft carriers is not thereby exceeded, build not more than two aircraft carriers, each of a tonnage of not more than 33,000 tons' standard displacement, and in order to effect economy any of the Contracting Powers may use for this purpose any two of their ships, whether constructed or in course of construction, which would otherwise be scrapped. The armament of any aircraft carriers exceeding 27,000 tons' standard displacement shall be in accordance with the requirements stated below, except that the total number of guns to be carried in case any of such guns be of a calibre exceeding 6 in., except anti-aircraft guns and guns not exceeding 5 in., shall not exceed eight.

(10.) No aircraft carrier of any of the Contracting Powers shall carry a gun with a calibre in excess of 8 inches. Without prejudice to the foregoing provisions, if the armament carried includes guns exceeding 6 in. in calibre the total number of guns carried, except anti-aircraft guns and guns not exceeding 5 in., shall not exceed 10. If alternatively the armament contains no guns exceeding 6 in. in calibre, the number of guns is not limited. In either case the number of anti-aircraft guns and of guns not exceeding 5 in. is not limited.

(11.) No vessel of war exceeding 10,000 tons' standard displacement, other than a capital ship or aircraft carrier, shall be acquired by, or constructed by, for, or within the jurisdiction of, any of the Contracting Powers. Vessels not specifically built as fighting ships nor taken in time of peace under Government control for fighting purposes, which are employed on fleet duties or as troop transports or in some other way for the purpose of assisting in the prosecution of hostilities otherwise than as fighting ships, shall not be subject to this limitation.

(12.) No vessel of war of any of the Contracting Powers, hereafter laid down, other than a capital ship, shall carry a gun with a calibre in excess of 8 inches.

(13.) Except as provided in Article IX., no ship designated in the treaty to be scrapped may be reconverted into a vessel of war.

(14.) No preparations shall be made in merchant ships in time of peace for the installation of warlike armaments for the purpose of converting such ships into vessels of war, other than the necessary stiffening of decks for the mounting of guns not exceeding 6-in. calibre.

(15.) No vessel of war constructed within the jurisdiction of any of the Contracting Powers for a non-Contracting Power shall exceed the limitations as to displacement and armament prescribed by the treaty for vessels of a similar type which may be constructed by or for any of the Contracting Powers; provided, however, that the displacement for aircraft carriers constructed for a non-Contracting Power shall in no case exceed 27,000 tons' standard displacement.

(16.) If the construction of any vessel of war for a non-Contracting Power is undertaken within the jurisdiction of any of the Contracting Powers, such Power shall promptly inform the other Contracting Powers of the date of the signing of the contract and the date on which the keel of the ship is laid; and shall also communicate to them particulars of the ship.

(17.) In the event of a Contracting Power being engaged in war, such Power shall not use as a vessel of war any vessel of war which may be under construction within its jurisdiction for any other Power, or which may have been constructed within its jurisdiction for another Power and not delivered.

(18.) Each of the Contracting Powers undertakes not to dispose by gift, sale or any mode of transfer of any vessel of war in such a manner that such vessel may become a vessel of war in the navy of any foreign Power.

(19.) The United States, the British empire and Japan agree that the *status quo* at the time of the signing of the treaty, with regard to fortifications and naval bases, shall be maintained in their respective territories and possessions specified hereunder:—

1. The insular possessions which the United States now holds or may hereafter acquire in the Pacific ocean, except (*a*) those adjacent to the coast of the United States, Alaska and the Panama Canal Zone, not including the Aleutian islands, and (*b*) the Hawaiian islands;

2. Hong Kong and the insular possessions which the British empire now holds or may hereafter acquire in the Pacific ocean, east of the meridian of 110° east longitude, except (*a*) those adjacent to the coast of Canada, (*b*) the Commonwealth of Australia and its territories and (*c*) New Zealand;

3. The following insular territories and possessions of Japan in the Pacific ocean, to wit: the Kurile islands, the Bonin islands, Amami-Oshima, the Loochoo islands, Formosa and the Pescadores, and any insular territories or possessions in the Pacific ocean which Japan may hereafter acquire.

The maintenance of the *status quo* under the foregoing provisions implies that no new fortifications or naval bases shall be established in the territories and possessions specified; that no measures shall be taken to increase the existing naval facilities for the repair and maintenance of naval forces, and that no increase shall be made in the coast defences of the territories and possessions above specified. This restriction, however, does not preclude such repair and replacement of worn-out weapons and equipment as is customary in time of peace.

Replacement.—The replacement of capital ships and aircraft carriers shall take place according to the following rules.

(1.) Capital ships and aircraft carriers 20 years after the date of their completion may, except as otherwise provided, be replaced by new construction, but within the limits prescribed in Article IV. and Article VII. The keels of such new construction may, except as otherwise provided, be laid down not earlier than 17 years from the date of completion of the tonnage to be replaced, provided, however, that no capital ship tonnage, with the exception of ships specified in the treaty, shall be laid down until ten years from Nov. 12, 1921.

(2.) Each of the Contracting Powers shall communicate promptly to the others the following information:

(*a*) The names of the capital ships and aircraft carriers to be replaced by new construction; (*b*) the date of governmental authorization of replacement tonnage; (*c*) the date of laying the keels of replacement tonnage; (*d*) the standard displacement in tons and metric tons of each new ship to be laid down, and the principal dimensions, namely, length at waterline, extreme beam at or below waterline, mean draft at standard displacement; (*e*) the date of completion of each new ship and its standard displacement in tons and metric tons, and the principal dimensions.

(3.) In the case of loss or accidental destruction of capital ships or aircraft carriers, they may immediately be replaced by new construction subject to the tonnage limits prescribed in Articles IV. and VII. and in conformity with the other provisions of the treaty, the regular replacement programme being deemed to be advanced to that extent.

(4.) No retained capital ships or aircraft carriers shall be reconstructed except for the purpose of providing means of defence against air and submarine attack, and subject to the following rules: The Contracting Powers may, for that purpose, equip existing tonnage with bulge or blister or anti-air-attack deck protection, providing the increase of displacement thus effected does not exceed 3,000 tons' displacement for each ship. No alterations in side armour, in calibre, number or general type of mounting of main armament shall be permitted except: (*a*) In the case of France and Italy, which countries within the limits allowed for bulge may increase their armour protection and the calibre of the guns carried on their existing capital ships so as not to exceed 16 in. and (*b*) the British empire shall be permitted to complete, in the case of the "Renown," the alterations to armour that have already been commenced but temporarily suspended.

Definitions.—For the purpose of the treaty, a capital ship, in the case of ships hereafter built, is defined as a vessel of war, not an aircraft carrier, whose displacement exceeds 10,000 tons' standard displacement, or which carries a gun with a calibre exceeding 8 inches.

An aircraft carrier is defined as a vessel of war with a displacement in excess of 10,000 tons' standard displacement, designed for the specific and exclusive purpose of carrying aircraft. It must be so constructed that aircraft can be launched therefrom and landed thereon, and not designed and constructed for carrying a more powerful armament than that allowed to it under Article IX. or Article X. as the case may be.

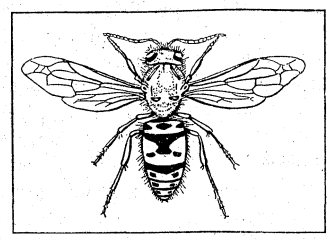
The standard displacement of a ship is the displacement of the ship complete, fully manned, engined, and equipped ready for sea, including all armament and ammunition, equipment, outfit, provisions and fresh water for crew, miscellaneous stores and implements of every description that are intended to be carried in war, but without fuel or reserve feed water on board.

Miscellaneous Provisions.—If during the term of the treaty the requirements of the national security of any Contracting Power in respect of naval defence are, in the opinion of that Power, materially affected by any change of circumstances, the Contracting Powers will, at the request of such Power, meet in conference with a view to the reconsideration of the provisions of the treaty and its amendment by mutual agreement.

In view of possible technical and scientific developments, the United States, after consultation with the other Contracting Powers, shall arrange for a conference of all the Contracting Powers which shall convene as soon as possible after the expiration of eight years from the coming into force of the present treaty to consider what changes, if any, in the treaty may be necessary

to meet such developments.

Whenever any Contracting Power shall become engaged in a war which in its opinion affects the naval defence of its national security, such Power may after notice to the other Contracting Powers suspend for the period of hostilities its obligations under the present treaty other than those under Articles XIII. and XVII., provided that such Power shall notify the other Contracting Powers that the emergency is of such a character as to require such suspension. The remaining Contracting Powers shall in such case consult together with a view to agreement as to what temporary modifications, if any, should be made in the treaty as between themselves. Should such consultation not produce agreement, duly made in accordance with the constitutional methods of the respective Powers, any one of the said Contracting Powers may, by giving notice to the other Contracting Powers, suspend for the period of hostilities its obligations under the present treaty, other than those under Articles XIII. and XVII. On the cessation of hostilities the Contracting Powers will meet in conference to consider what modifications, if any, should be made in the provisions of the present treaty.



BY COURTESY OF H.M. STATIONERY OFFICE AND THE MINISTRY OF AGRICULTURE AND FISHERIES

FIG. 1.—WASP (VESPA RUFA), ONE OF THE SEVEN SPECIES MET WITH IN BRITAIN

The present treaty shall remain in force until Dec. 31, 1936, and in case none of the Contracting Powers shall have given notice two years before that date of its intention to terminate the treaty, it shall continue in force until the expiration of two years from the date on which notice of termination shall be given by one of the Contracting Powers, whereupon the treaty shall terminate as regards all the Contracting Powers. Within one year of the date on which a notice of termination by any Power has taken effect, all the Contracting Powers shall meet in conference.

The present treaty remains deposited in the archives of the Government of the United States, and duly certified copies thereof have been transmitted to the other Contracting Powers.

WASP, the ordinary name for a well-known kind of stinging insect belonging to the order Hymenoptera (*q.v.*). At least 10,000 species of wasps are known and unlike the bees, they are primarily predacious in habit, feeding their young upon other insects. They form two great groups, Sphecoidea and Vespoidea, with the vast majority of the species solitary in habit. Most of these solitary kinds are known as fossorial or digging wasps, from the fact that so many of them make receptacles for their young by excavating burrows in the ground or tunneling in wood or in stems of plants. The true wasps form a separate section of the Vespoidea and were formerly grouped into a single division—the Diploptera, in allusion to the fact that the fore wings are longitudinally folded when at rest. They are further distinguished from other wasps by the posterior lateral angles of the pronotum, which extend to the tegulae. They include three families, one of which, the Vespidae, consists of social species and includes the wasps most familiar to the ordinary observer: for these *see* SOCIAL INSECTS. The Eumenidae are solitary wasps and the best-known genera are *Eumenes* and *Odynerus*. These insects have the curious habit of suspending their eggs by slender threads from the roofs of the cells in which they are laid. Each cell is commonly provisioned with several caterpillars previously paralyzed by stinging. In *Eumenes* the abdomen is joined to the thorax by a slender petiole or stalk: they are potter wasps making neat vaselike cells attached to stems or other objects. In *Odynerus* the petiole is wanting and the cells are made on walls, in wood, or in the ground; some species utilize key holes or even deserted cells of other wasps. Both genera occur in Great Britain and North America. The third family, or Masaridae, is chiefly tropical and remarkable because its cells are provisioned with a paste of honey and pollen. The species are all solitary and have the wings either incapable of being folded or imperfectly plicate.

FIG. 2.—NEST OF THE TREE WASP (VESPA SILVESTRIS)

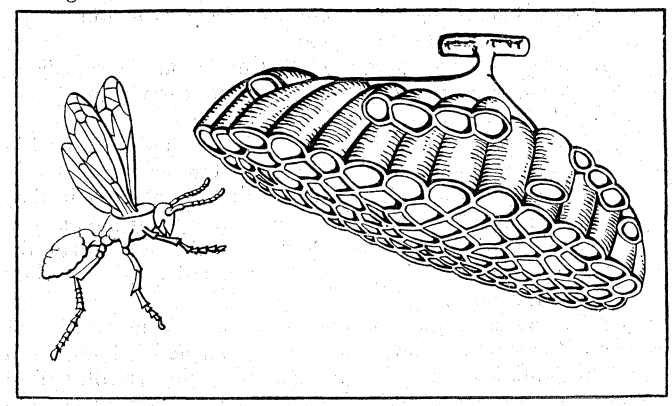


FIG. 3.—NEST OF THE MEDITERRANEAN WASP (POLISTES GALLICUS)

See E. Saunders, *Hymenoptera Aculeata of the British Islands* (1896); P. and N. Rau, *Wasp Studies Afield* (Princeton, N.J., 1918); G. W. and E. G. Peckham, *Wasps, Solitary and Social* (Boston and New York, 1905); E. Berland, "Hymenoptères Vespiformes," *Faune de France,* vol. x. (1925). (A. D. I.)

WASSAIL, the ancient form of "toasting" (O.E. *waes hál,* "be whole"), the term being applied later to the Christmas feasting and revelries and particularly to the bowl of spiced ale or wine which was a feature of the mediaeval Christmas. At the reception of King Vortigern by Hengist, Rowena "came into the king's presence, with a cup of gold filled with wine in her hand, and making a low reverence unto the king said, 'Waes hael hlaford Cyning,' which is 'Be of health, Lord King.'" In Henry VII.'s reign the steward on Twelfth Night cried "wassail" three times on entering with the bowl. Wassailing was as much a custom in the monasteries as in laymen's houses, the bowl being known as *poculum Caritatis.*

WASSERMANN, AUGUST VON (1866–1925), German professor of medicine, was born Feb. 21, 1866, at Bamberg, in Bavaria. He studied in Erlangen, Munich, Strasbourg and Vienna, and in 1888 began to practise as a physician in Strasbourg. He was then engaged as an assistant to the Robert Koch institute for Infectious Diseases, Berlin, where, from 1906, he directed the department of experimental therapy and serum research. In 1913 he became director of the Kaiser Wilhelm institute in Berlin-Dahlem. Wassermann achieved international fame by his discovery (1907) of sero-diagnosis in syphilis—the so-called Wassermann Reaction—which enables both past infection and the activity of the process of the disease to be ascertained. He died in Berlin on March 15, 1925.

His works include "Allgemeine Einleitung zur Lehre von den Infektionskrankheiten" in Ebstein and Schwalbe's *Handbuch der praktischen medegia: Influenza, Immunität und Serumtherapie* and *Hämolysine, Zytotoxine und Präzipitine* (1910).

WASSERMANN REACTION. The Wassermann, or, perhaps more correctly, the Bordet-Wassermann test of the blood serum and of the spinal fluid for active syphilis was elaborated in 1906 by Wassermann, Neisser and Bruck. It depends on the fact well-known to bacteriologists that foreign organic substances, *e.g.,* disease germs in the body, stimulate the formation of compounds (which appear in the blood) designed to destroy the foreign organic substances or germs (*see* IMMUNITY). These anti-bodies effect their purpose with the aid of a substance present in practically all blood sera and known as complement. Bordet and Gengou, by devising a simple test for complement, showed that,

in the process, complement was put out of action.

Wassermann, Neisser and Bruck adapted the Bordet-Gengou phenomenon to the purpose of detecting anti-syphilitic substance in the blood serum. They found that, in a mixture of (a) extract of liver of an infant dead of syphilis (which they regarded as extract of the germs of syphilis—*Spirochaeta pallida*—with which the liver was stuffed), (b) fresh serum of a guinea-pig—complement—, and (c) serum (previously heated to destroy its natural complement) of a syphilitic person, the complement was put out of action, and that this did not occur when serum of a normal person was substituted for that of a syphilitic. Thus they demonstrated, as they thought, anti-spirochaeta-pallida substance in the blood of the syphilitic person and inferred from this that a similar phenomenon in any serum would prove syphilitic infection.

Later discoveries showed that extract of such an organ as normal heart of any animal would serve in the test as well as syphilitic liver, and it is now believed that the test does not discover anti-spirochaeta-pallida substances, but anti-bodies to tissue cells which have degenerated in consequence of the action of *Sp. pallida* and act as foreign organic substances. The reliability of the test can best be described in the words of a committee of the Medical Research Council as follows:

> There is no process of biochemical diagnosis that gives more trustworthy information or is liable to a smaller margin of error than the Wassermann test when it is performed with completeness and with proper skill and care.

The percentages of cases of syphilis which give positive reactions to the Wassermann test vary with different pathologists, who have modified the original technique considerably—in the preparation of the extract, the proportions of the different reagents to one another and the periods during which they are allowed to interact, but broadly the reaction is negative for the first fortnight after appearance of the primary syphilitic lesion, and is positive in almost 100 per cent of cases by the end of a month or six weeks. In older cases with outward signs of active syphilis the percentage is almost as high, but in those with no obvious signs (latent syphilis) it is rather lower. Treatment in the early stages usually converts the reaction to negative in a few weeks, but in later stages a persistently positive reaction is very common. A negative reaction does not prove cure or absence of the disease, and suspension of treatment when the reaction first disappears is commonly followed by relapse, a fact which the general public often does not realise. The reaction may be negative in the blood serum but positive in the spinal fluid, and vice versa.

Other Serum Tests for Syphilis.—The great complexity of the Wassermann test has stimulated research to discover a simpler, and there are now a number, of which the chief are the Sachs-Georgi, the Meinicke, the Sigma, the Vernes and the Kahn. They differ considerably in technique and quality, but all depend on the fact that, when a syphilitic serum is brought into contact with an extract of heart, flocculi appear sooner or later in the mixture, or it becomes more turbid. The reliability of these flocculation tests and their value in comparison with one another are not yet decided, but the better of them are practically as reliable as the Wassermann and give higher percentages of positive reactions in syphilis. Since, however, a syphilitic serum may give a positive reaction to the Wassermann but negative to a flocculation test, and vice versa, it is now a common practice to test every specimen of serum by the Wassermann and by one or more of the flocculation methods. (L. W. H.)

WASTE, a term used in English law in several senses, of which four are the most important. (1) "Waste of a manor" is that part of a manor subject to rights of common, as distinguished from the lord's demesne (*see* COMMONS, MANOR). (2) "Year, day, and waste" was a part of the royal prerogative, acknowledged by a statute of Edward II., *De Praerogativa Regis.* The king had the profits of freehold lands of those attainted of felony and petit treason, and of fugitives, for a year and a day with a right of committing waste in sense (3) thereon. After the expiration of a year and a day the lands returned to the lord of the fee. This species of waste was abolished by the Corruption of Blood Act 1814 (*see* FELONY, TREASON). (3) The most usual signification of the word is "any unauthorized act of a tenant, for a freehold estate not of inheritance, or for any lesser interest, which substantially alters the permanent character of the thing demised (i.) by diminishing its value, (ii.) by increasing the burden on it, (iii.) by impairing the evidence of title and thereby injuring the "inheritance" (*West Ham Charity Board* v. *East London W.W.*, 1900, 1 Ch. 624, 637; *cf.* Pollock on *Torts*, 357).

Waste in sense (3) is either *voluntary* or *permissive.* Voluntary waste is by act of commission, as by pulling down a house, wrongfully removing fixtures (*q.v.*), cutting down timber trees, *i.e.*, oak, ash, elm, 20 years old, and such other trees, *e.g.*, beech, as by special custom are counted timber in the district, opening new quarries or mines (but not continuing the working of existing ones), or doing anything which may—for this is the modern test—alter the nature of the thing demised, such as conversion of arable into meadow land. Although an act may technically be waste, it will not as a rule constitute actionable waste, or be restrained by injunction, in the absence of some prohibitive stipulation if it is "ameliorating," *i.e.*, if it improves the value of the land demised (see *Meux* v. *Cobley*, 1892, 2 Ch. 253, 263). In the case of "timber estates" upon which trees of various kinds are cultivated solely for their produce and the profit gained from their periodical felling and cutting, the timber is not considered as part of the inheritance but as the annual fruits of the estate, and an exception arises in favour of the tenant for life (see *Dashwood* v. *Magniac*, 1891, 3 Ch. 306). Under the Settled Land Act 1925, a tenant for life may grant building, mining, forestry and other leases for the prescribed terms "for any purpose whatever, whether involving waste or not" (s. 41) and is also protected as regards waste, in the execution and repair of improvements (s. 89). *Permissive* waste is by act of omission, such as allowing buildings to fall out of repair. A "fermor"—a term which here includes "all who held by lease for life or lives, or for years by deed or without deed" by the statute of Marlborough (1267)—may not commit waste without licence in writing from the reversioner.

Acts of equitable waste were, before 1875, not cognizable in courts of common law. However, by the provisions of the Law of Property Act 1925 (s. 135) an equitable interest for life without impeachment of waste does not confer upon the tenant for life any right to commit equitable waste, unless an intention to confer such right expressly appears in the instrument creating the equitable interest. A copy-holder may not commit waste unless allowed to do so by the custom of the manor. The penalty for waste is forfeiture of the copyhold; *Galbraith* v. *Poynton*, 1905, 2 K.B. 258 (*see* COPYHOLD). The Agricultural Holdings Act 1923, by reason of provisions giving compensation for improvement as regards the holdings to which it applies, overrides some of the old common law doctrines as to waste.

(4) "Waste of assets" or *"devastavit"* is a squandering and misapplication of the estate and effects of a deceased person by his executors or administrators (*see* EXECUTORS AND ADMINISTRATORS, and Administration of Estates Act 1925, s. 29). Executors and administrators may now be sued in the county court for waste of assets (County Courts Act 1888, s. 95).

Remedies for Waste.—The landlord is entitled to compensation for deterioration in the value of a holding by the failure of the tenant to cultivate according to the rules of good husbandry or the contract of tenancy (s. 10). *See* also Landlord and Tenant Act 1927 (s. 11). Proceedings may be taken either by action for damages, or by application for an injunction, or by both combined, and either in the king's bench or in the chancery divisions. *See* Supreme Court of Judicature (Consolidation) Act 1925, s. 45.

The law of waste as it affects ecclesiastical benefices will be found under DILAPIDATION.

Scotland.—In Scots law "waste" is not used as a technical term, but the respective rights of fiar and life-renter are much the same as in England. As a general rule, a life-renter has no right to cut timber, even though planted by himself. An exception is admitted in the case of coppice wood, which is cut at regular intervals and allowed to grow again from the roots. Grown timber is also available to the life-renter for the purpose of keeping up the estate or repairing buildings. Before making use of mature

timber for estate purposes, the life-renter should give notice to the fiar. He is also entitled to the benefit of ordinary windfalls. Extraordinary windfalls are treated as grown timber. Life-renters by "constitution" (*i.e.*, by grant from the proprietor) as opposed to life-renters by "reservation" (where the proprietor has reserved the life-rent to himself in conveying the fee to another) have, as a rule, no right to coals or minerals underground if they are not expressed in the grant or appear to have been intended by a testator to pass by his settlement, for they are *partes soli.* Where coals or minerals are expressed in the grant, and also in cases of life-rent by "reservation," the life-renter may work any mine which had been opened before the beginning of his right, provided he does not employ a greater number of miners, or bring up a greater quantity of minerals, than the unburdened proprietor did. All life-renters are entitled to such minerals as are required for domestic use and estate purposes.

British Possessions.—French law (u. i.) is in force in Mauritius, and has been followed in substance in the civil codes of Quebec (art. 455) and St. Lucia (art. 406). In most of the other colonies the rules of English law are followed, and in many of them there has been legislation on the lines of the English Settled Land Acts. In India the law as to waste is included to some extent in the Transfer of Property Act (No. IV. of 1882) and its amendments. Section 108 deals with the liabilities of lessees for waste, which may be varied by the terms of the lease or by local usage. The liabilities for waste of persons having under Hindu or Mohammedan law limited interests in reality depend in the main upon those laws, not on Indian statutes.

United States.—Following the general principle that the common law was applicable only in so far as it served American needs, American courts adapted the common law doctrine of waste to the requirements of a continuously expanding country. The application of the English law of waste was thus restricted to stimulate the development of the land by the tenant in possession. Good husbandry upon his part was the criterion by which the character of his acts as waste was determined. The conversion of meadow and wood land into arable land was thus permissible. In view of the quantity of land available for use by simply clearing away the timber, cutting timber for the purpose of cultivating the soil was not regarded as waste. With the disappearance of pioneer conditions, except in the far western States, a tendency toward greater stringency in the application of the doctrine of waste is apparent. This is particularly noticeable in such highly industrialized States as those of the northern Atlantic seaboard. The difference, however, lies largely in a change in the character of what good husbandry demands, rather than a change in the legal principle. The remedy for waste lies either by an action at law for damages due to waste or by an injunction to restrain further waste and to compel an accounting for the waste done. Few cases in which the old common law action for forfeiture of the tenancy because of waste are to be found in the American reports.

Europe.—The French Civil Code provides (art. 591) that the usufructuary may cut timber in plantations that are laid out for cutting, and are cut at regular intervals, although he is bound to follow the example of former proprietors as to quantity and times. This provision is in force in Belgium (Civil Code, art. 591). Analogous provisions are to be found in the civil codes of Holland (art. 814), Spain (art. 485), Italy (art. 486), and *cf.* the German Civil Code, art. 1036.

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(A. W. R.)

WATCHES. The word watch by derivation means that which keeps observation. It is thus the term for the body of persons who patrolled the streets, called the hours, and performed the duties of the modern police. The application of the term to a period of time is due to the military division of the night by the Greeks and Romans into watches marked by the change of sentries; similarly, on shipboard, time is also reckoned by watches, and the crew is divided into two portions, the starboard and port watches, taking duty alternately.

The invention of portable timepieces dates from the end of the 15th century, and the earliest manufacture of them was in Germany. They were originally small clocks with mainsprings enclosed in boxes; sometimes they were of a globular form and were often called "Nuremberg eggs." Being too large for the pocket they were frequently hung from the girdle. The difficulty with these early watches was the inequality of action of the mainspring. An attempt to remedy this was provided by a contrivance called the stack-freed, which was little more than a sort of rude auxiliary spring. The problem was solved about the years 1525–40 by the invention of the fusee. By this contrivance the mainspring is made to turn a barrel on which is wound a piece of catgut, which in the latter part of the 16th century was replaced by a chain. The other end of the catgut band is wound upon a spiral drum, so contrived that as the spring runs down and becomes weaker, the leverage on the axis of the spiral increases, and thus gives a stronger impulse to the works (fig. 1).

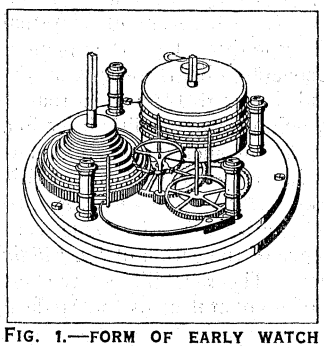

FIG. 1.—FORM OF EARLY WATCH FROM 16TH CENTURY ONWARDS, SHOWING GOING BARREL AND FUSEE

In early watches the escapement was the same as in early clocks, namely, a crown wheel and pallets with a balance ending in small weights. Such an escapement was, of course, very imperfect, for since the angular force acting on the balance does not vary with the displacement, the time of oscillation varies with the arc, and this again varies with every variation of the driving force. An immense improvement was therefore effected when the hair-spring was added to the balance, which was replaced by a wheel. This was done about the end of the 17th century. During the 18th century a series of escapements were invented to replace the old crown wheel, ending in the chronometer escapement, and though great improvements in detail have since been made, yet the watch, even as it is to-day, may be called an 18th-century invention.

The watches of the 16th century were usually enclosed in cases ornamented with the beautiful art of that period. Sometimes the case was fashioned like a skull, and the watches were made in the form of octagonal jewels, crosses, purses, little books, dogs, seashells, etc., in almost every instance being finely engraved. Queen Elizabeth was very fond of receiving presents, and a number of the gifts presented to her were jewelled watches.

The man to whom watch-making owes perhaps the most was Thomas Tompion (1639–1713), who invented the first dead-beat escapement for watches. But a defect remained, namely, the influence of temperature upon the hair-spring of the balance-wheel. Many attempts were made to provide a remedy. But the best solution of the problem was ultimately proposed by Pierre le Roy (1717–85) and perfected by Thomas Earnshaw (1749–1829). This was to diminish the inertia of the balance-wheel in proportion to the increase of temperature, by means of the unequal expansion of the metals composing the rim.

Invention in watches was greatly stimulated by the need of a good timepiece for finding longitudes at sea, and many successive rewards were offered by the Government for watches which would keep accurate time and yet be able to bear the rocking motion of a ship. The difficulty ended by the invention of the chronometer, which was so perfected towards the early part of the 19th century as to have even now undergone but little change of form. In fact the only great triumph of later years has been the invention of watch-making machinery, whereby the price is so lowered that an excellent watch (in a brass case) can now be purchased for about £2, and a really accurate timekeeper for about £18.

THE MODERN WATCH

A modern watch consists of a case and framework containing the four essential parts of every timepiece, namely, a mainspring and apparatus for winding it up, a train of wheels with hands and a face, an escapement and a balance-wheel and hair-spring.

The Mainspring.—As has been said, the mainspring of an old-fashioned watch was provided with a drum and fusee so as to equalize its action on the train. An arrangement was provided to prevent over-winding, consisting of a hook which, when the chain was nearly wound up, was pushed aside so as to engage a pin, and thus prevent further winding (*see* fig. 1). Another arrangement for watches without a fusee, called a Geneva stop, consists of a wheel with one tooth affixed to the barrel arbour, working into another with only four or five teeth. This allows the barrel arbour only to be turned round four or five times.

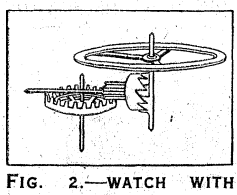

FIG. 2.—WATCH WITH EARLY CROWN WHEEL ESCAPEMENT

The going barrel, which is fitted to most modern watches, contains no fusee, but the spring is delicately made to diminish in size from one end to the other, and it is wound up for only a few turns, so that the force derived from it does not vary very substantially. The unevenness of drive is sought to be counteracted by the construction of the escapement and balance-wheel.

Watch Escapements.—The escapements that have come into practical use are—(1) the old vertical escapement, now disused; (2) the lever, very much the most common in English watches; (3) the horizontal or cylinder, which is equally common in foreign watches, though it was of English invention; (4) the duplex, which used to be more in fashion for first-rate watches than it is now; and (5) the detached or chronometer escapement, so-called because it is always used in marine chronometers.

The vertical escapement is simply the old verge adapted to the position of the wheels in a watch and the balance, in the manner exhibited in fig. 2. As it requires considerable thickness in the watch, is inferior in going to all the others and is no cheaper than the level escapement, it has gone out of use.

The lever escapement, as it is now universally made, was adopted late in the 18th century by Thomas Mudge. (Fig. 3.)

Figure 4 is a plan of the horizontal or cylinder escapement, cutting through the cylinder, which is on the verge of the balance, at the level of the tops of the teeth of the escape-wheel; the triangular pieces, A, B, are not flat projections in the same plane as the teeth, but are raised on short stems above the plane of the wheel; and still more of the cylinder than the portion shown at ACD is cut away where the wheel itself has to pass. The author of this escapement was G. Graham. The Swiss watches have almost universally the horizontal escapement. It is found that—for some reason which is apparently unknown, as the rule certainly does not hold in cases seemingly analogous—a steel scape-wheel acts better in this escapement than a brass one, although in some other cases steel upon steel, or even upon a ruby, very soon throws off a film of rust, unless they are kept well oiled, while brass and steel or stone, will act with scarcely any oil at all, or none.

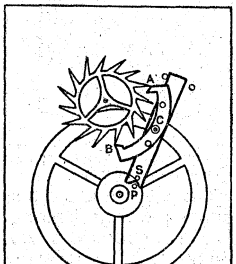

FIG. 3.—THE LEVER ESCAPEMENT

The chronometer or detached escapement is shown in fig. 5 in the form to which it was brought by Earnshaw, and in which it has remained ever since. The early history of escapements on this principle does not seem to be very clear. They appear to have originated in France; but there is no doubt that they were considerably improved by the first Arnold (John), who died in 1799. Earnshaw's watches, however, generally beat his in trials.

In fig. 5 the small tooth or cam V, on the verge of the balance, is just on the point of unlocking the detent D T from the tooth T of the scape-wheel; and the tooth A will immediately begin to give the impulse on the pallet P, which in good chronometers, is always a jewel set in the cylinder; the tooth V is also a jewel. This part of the action is so evident as to require no further notice. When the balance returns, the tooth V has to get past the end of the detent, without disturbing it; for, as soon as it has been unlocked, it falls against the banking-pin E, and is ready to receive the next tooth B, and must stay there until it is again unlocked. It ends, or rather begins, in a stiffish spring, which is screwed to the block D on the watch frame, so that it moves without any friction of pivots, like a pendulum. The passing is done by means of another spring V T, called the passing spring, which can be pushed away from the body of the detent towards the left, but not the other way without carrying the detent with it.

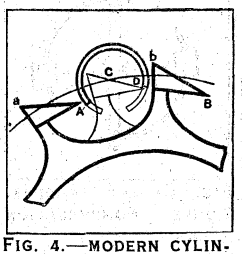

FIG. 4.—MODERN CYLINDER ESCAPEMENT

The Balance-wheel and Hair-spring.—This consists of a small wheel, usually of brass, to which is affixed a spiral, or in chronometers a helical spring. This wheel swings through an angle of from 180° to 270° and its motions are approximately isochronous. The time of the watch can be regulated by an arm to which is attached a pair of pins which embrace the hair-spring at a point near its outer end, and by the movement of which the spring can be lengthened or shortened. The first essential in a balance-wheel is that its centre of gravity should be exactly in the axis, and that the centre of gravity of the hair-spring should also be in the axis of the balance-wheel. True isochronism is disturbed by variations in the driving force of the train or by variations in temperature, and also by variations in barometric pressure. Isochronism is produced in the first place by a proper shape of the spring and its overcoil. It is usual to time the watch's going when the mainspring is partly wound up, as well as when it is fully wound up, and then by removing parts of the hair-spring to get such an adjustment that the rate is not influenced by the lesser or greater extent to which the watch has been wound. The variations in length and still more in elasticity caused in a hair-spring by changes of temperature were for long not only a trouble to watchmakers but a bar to the progress of the art. A pendulum requires scarcely any compensation except for its own elongation by heat; but a balance requires compensation, not only for its own expansion, which increases its moment of inertia just like the pendulum, but far more on account of the decrease in the strength of the spring under increased heat. E. G. Dent, in a pamphlet on compensation balances, gave the following results of some experiments with a glass balance, which he used for the purpose on account of its less expansibility than a metal one: at 32° F, 3,606 vibrations in an hour; at 66°, 3,598·5; and at 100°, 3,599. If, therefore, it had been adjusted to go right (or 3,600 times in an hour) at 32° it would have lost 7½ and 8 seconds an hour, or more than three minutes a day, for each successive increase of 34°, which is about 15 times as much as a common wire pendulum would lose under the same increase of heat; and if a metal balance had been used instead of a glass one the difference would have been still greater.

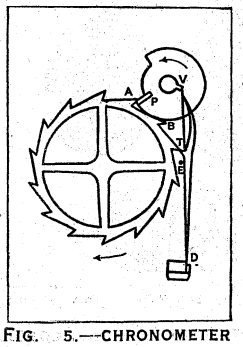

FIG. 5.—CHRONOMETER ESCAPEMENT

The necessity for this large amount of compensation having arisen from the variation of the elasticity of the spring, the first attempts at correcting it were by acting on the spring itself in the manner of a common regulator. Harrison's compensation consisted of a compound bar of brass and steel soldered together, having one end fixed to the watch-frame and the other carrying two curb pins which embraced the spring. As the brass expands more than the steel, any increase of heat made the bar bend; and so, if it was set the right way, it carried the pins along the spring, so as to shorten it. This contrivance is called a compensation curb; and it has often been reinvented, or applied in a modified form. But there are two objections to it: the motion of the curb pins does not correspond accurately enough to the variations

in the force of the spring, and it disturbs the isochronism, which only subsists at certain definite lengths of the spring.

Compensation Balance.—The compensation which was next invented left the spring untouched, and provided for the variations of temperature by the construction of the balance itself. Fig. 6 shows the plan of the ordinary compensation balance. Each portion of the rim of the balance is composed of an inner bar of steel with an outer one of brass soldered, or rather melted, upon it, and carrying the weights *b*, *b*, which are screwed to it. As the temperature increases, the brass expanding must bend the steel inwards, and so carries the weights farther in, and diminishes the moment of inertia of the balance, the decrease of rate being inversely as the diameter of the balance-wheel. The metals are generally soldered together by pouring melted brass round a solid steel disk, and the whole is afterwards turned and filed away till it leaves only the crossbar in the middle lying flat and the two portions of the rim standing edgeways. The first person to practise this method of uniting them appears to have been either Thomas Earnshaw or Pierre le Roy.

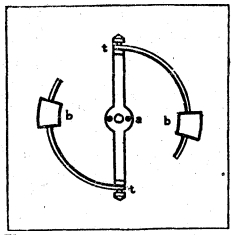

FIG. 6.—THE TEMPERATURE COMPENSATION BALANCE

The adjustment of a balance for temperature compensation can only be done by trial, and requires a good deal of time. It must be done independently of the compensation for time. It is effected by shifting the weights, because the nearer they are to the crossbar the less distance they will move over as the rim bends with them. The timing is done by screws with heavy heads (*t*,*t*, fig. 6), which are just opposite to the ends of the crossbar, and consequently not affected by the bending of the rim; other screws are also provided round the rim for adjusting the moment of inertia and centre of gravity of the balance-wheel. The compensation may be done approximately by the known results of previous experience with similar balances; and many watches are sold with compensation balances which have never been tried or adjusted, and even with a sham compensation balance, not cut through.

A few chronometers have been made with glass balance-springs, which have the advantage of requiring very little primary and no secondary compensation, on account of the very small variation in their elasticity, compared with steel or other metal.

Use of Invar.—One of the most important and interesting attempts to correct the temperature errors of a hair-spring by a series of corresponding temperature changes in the moment of inertia of the balance-wheel has been made by means of the use of the nickel-steel compound called invar, which, on account of its very small coefficient of expansion, has been of great use for pendulum rods. In a memoir published in 1904 at Geneva, Dr. Charles Guillaume, the inventor of invar, showed that in order to get a true secondary compensation what is wanted is a material having the property of causing the curve of the rim of the wheel to change at an increasing rate as compared with changes in the temperature. This is found in those specimens of invar in which the second coefficient of expansion is negative, *i.e.*, which are less dilatable at higher temperatures than at lower ones. It is satisfactory to add that such balance-wheels have been tried successfully on chronometers, and notably in a deck watch by Paul Ditisheim of Neuchâtel, who has made a chronometer with a tourbillon escapement and an invar balance-wheel, which when made held the highest record ever obtained by a watch of its class.

BY COURTESY OF THE METROPOLITAN MUSEUM OF ART

FIG. 7.—THE WATCH WHICH LOUIS XIII OF FRANCE PRESENTED TO CHARLES I OF ENGLAND, SHOWING OBVERSE, REVERSE AND SIDE APPEARANCE

It is obvious that in order that a watch may keep good time the centre of gravity of the balance-wheel and hair-spring must be exactly in the axis; for if this were not the case, then the wheel would act partly like a pendulum, so that the time would vary according as the watch was placed in different positions. It is exceedingly difficult to adjust a watch so that these "position errors" are eliminated. Accordingly it has been proposed to neutralize their effect by mounting the balance-wheel and hair-spring upon a revolving carriage which shall slowly rotate, so that in succession every possible position of the balance-wheel and spring is assumed, and thus errors are averaged and mutually destroy one another. This is called the tourbillon escapement. There are several forms of it, often contributing to excellent time.

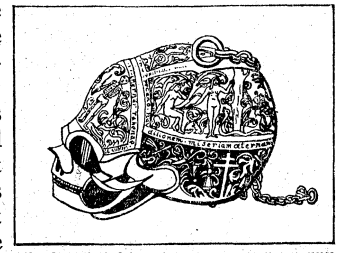
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FIG. 8.—THE SILVER GILT SKULL WATCH OF MARY QUEEN OF SCOTS

Stop Watches.—Stop watches or chronographs are of several kinds. In the usual and simplest form there is a centre seconds hand which normally remains at rest, but which, when the winding handle is pressed in, is linked on to the train of the watch and begins to count seconds, usually by fifths. A second pressure arrests its path, enabling the time to be taken since the start. A third pressure almost instantaneously brings the seconds hand back to zero, this result being effected by means of a heart-shaped cam which when a lever presses on it instantaneously flies round to zero position. The number of complete revolutions of the seconds hand, *i.e.*, minutes, is recorded on a separate dial.

Calendar work on watches is, of course, fatal to great accuracy of time-keeping, and is very complicated. A watch is made to record days of the week and month, and to take account of leap years usually by the aid of star-wheels with suitable pauls and stops. The type of this mechanism is to be found in the calendar motion of an ordinary grandfather's clock.

Watches have also been made containing small musical boxes and arranged with performing figures on the dials. Repeaters are striking watches which can be made at will to strike the hours and either the quarters or the minutes, by pressing a handle which winds up a striking mechanism. They were much in vogue as a means of discovering the time in the dark before the invention of lucifer matches, when to obtain a light by means of flint and steel was a troublesome affair. A very beautiful watch of this type is shown in the plate. It contains a minute barrel fitted with pins which as the barrel rotates strike or rather flip across the teeth of a minute comb. The whole thing is a marvellous specimen of hand skill. Minute work of this sort is now not much in use. It used to be thought that it ruined the eyes of the workmen. But it appears that fine work of all sorts can be done without injury to the eyes, if only proper magnifying glasses are used.

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FIG. 9.—THE BOOK-SHAPED WATCH BELONGING TO BOGISLAUS XIV, DUKE OF POMERANIA BEARING THE DATE, 1627

A watch shown in the plate is an example of early 18th-century work. It has only one hand but two dials on the face. It is enclosed in a separate case as was usual with early watches. It has a crown escapement. These crown escape wheels were abandoned and replaced by the more accurate "lever." On the same plate is also shown a clock with an enamelled painted dial and a windmill with movable arms.

MODERN WATCH MAKING

From what has been said it will be seen that for many years the form of escapements and balance-wheels has not greatly altered. The great improvements which modern science has been able to effect in watches are chiefly in the use of new metals and in the employment of machinery, which, though they have altered the form but little, have effected an enormous revolution in the price. The cases of modern watches are made sometimes of steel, artificially blackened, sometimes of compounds of aluminium and

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WATCHES, 16TH–18TH CENTURIES

1. Table watch of gilt metal, Nuremberg, Germany, 16th century, one of the earliest watches in existence. 2. Silver dome-shaped clock watch, made by Bartholomew Nusam, *c.* 1560, England. 3. Cross-shaped watch of rock crystal, black and blue enamel and gilt metal, by Conrad Kreizer, *c.* 1610, Strasbourg. 4. Oval watch, Limoges enamel panels and gilt metal, movement signed by David Ramsey, *c.* 1610–25, England. 5. Hourglass-shaped watch of gold, enamel and crystal, to be set on head of walking-stick; movement signed by Jean Hubert, *c.* 1645–70, Rouen, France. 6. Engraved silver watch with original fob; movement signed by Edward East, 1640–60, London. 7. Clock watch belonging to a knight of the Order of St. Stephen. 8. Italian leather case for (7), with crimson cord and tassel

copper, known as aluminium gold. Silver is at present being less employed than formerly. The hair-springs are often of palladium in order to render the watch non-magnetizable. An ordinary watch, if the wearer goes near a dynamo, will probably become magnetized and quite useless for time-keeping. One of the simplest cures for this accident is to twirl it rapidly round while retreating from the dynamo and to continue the motion till at a considerable distance. The use of invar has been already noticed.

The forms given to watches have exercised the ingenuity of the most splendid artists. They have been enclosed in fanciful cases representing deaths' heads and all sorts of sacred emblems. They have been ornamented by movable figures and in some of them little chimes have been inserted, but the tendency of modern days is rather in favour of utility than beauty. One of the most interesting centres of watch-making is to be found at Neuchâtel in Switzerland. There on a ridge of mountains overlooking the valley is a row of watch-making factories. Formerly, until about 1900, the majority of Swiss watchmakers pursued their trade in their homes. According to the official census of 1905, however, three-quarters of the labourers were employed in factories, and by 1940 the number of home workers was insignificant. But watch-making remains an hereditary art, and the labourers have been in the trade for generations. There are ten important Swiss horological schools where the engineering of watch-making is thoroughly taught and inspection of the factories will show how effectively scientific engineering can be made applicable to factory work.

The use of jewelled bearings for watch pivots was introduced by Nicholas Facio about the beginning of the 18th century. Diamonds and sapphires are usually employed and pierced either by diamond drills or by drills covered with diamond dust. Rubies are not a very favourite stone for jewels, but as they and sapphires can now be made artificially for about two shillings a carat the difficulty of obtaining material for watch jewelling is met.

Watches have also been fitted with machinery whereby electric contacts are made by them at intervals, so that if wires are led to and away from them, they can be made to give electric signals and thus mark dots at regular intervals on a moving strip of paper.

Watch Testing.—As in the case of clocks, the accuracy of going of a watch is estimated by observation of the variations of its mean daily rate. In Great Britain, this is officially done at The National Physical Laboratory, Teddington, and also for admiralty purposes at Greenwich. Watches are divided into two classes, A and B. For an A certificate the trials last for 45 days, and include tests in temperatures varying from 40° to 90° F, going in every position with dial vertical, face up and face down. The average daily departure from the mean daily rate, that is the average error due to irregular departures from the average going rate, must not exceed 2 seconds a day except where due to position, when it may amount to 5 seconds. The error should not increase more than 0·3 second a day for each 1° F. The trial for the B certificate is somewhat similar but less severe. Chronometers are put through trials lasting 55 days, and their average error from mean rate is expected not to exceed 0·5 second per diem. The fees for these tests are various sums from two guineas downwards. In estimating the timekeeping qualities of a watch or clock, the error or rate is of secondary consequence. It is due to the time-keeper going too fast or too slow, and this can easily be corrected. What is wanted for a good watch is that the rate, whatever it is, shall be constant. The daily error is of less account provided it is a uniform daily error and not an irregular one. Hence the object of the trials is to determine not merely the daily rate but the variations of the daily rate, and on the smallness of these the value of the watch as a time-keeper depends.

Machine-made Watches.—Briefly that every part is stamped out of metal. The stamped pieces are then finished by cutters and with milling machinery. Each machine as a rule only does one operation, so that a factory will contain many hundreds of different sorts of machines. The modern watchmaker, therefore, is not so much of an art craftsman as an engineer. The effect of making all the parts of a watch by machinery is that each is interchangeable, so that one part will fit any watch. It is not an easy thing to secure this result, for as the machines are used the cutting edges wear down and require regrinding and resetting. Hence a tool is not allowed to make more than a given quantity of parts without being examined and readjusted, and from time to time the pieces being put out are tested with callipers. The parts thus made are put in groups and sorted into boxes, which are then given over to the watch-adjusters, who put the parts together and make the watch go. The work of adjustment for common watches is a simple matter. But expert adjusters select their pieces, measure them and correct errors with their tools. The finest watches are thus largely machine-made, but hand-finished. The prejudice against machine-made watches has been very strong in England, but has largely died out. In Switzerland the industry, first established about 1587, flourishes in Geneva, the canton of Neuchâtel, and the Bernese Jura. A watch in a stamped steel case can now be made for about five shillings.

When one considers that watch and clock-making is capable of affording employment to thousands of artisans, that it is healthy, and above all that a considerable part of the work can be done by girls without any interruption to their home life, and again when one thinks of the millions of labourers over the world who have not got watches but who now can afford to purchase them, it seems very desirable that every effort should be made to encourage this industry. Switzerland should be forever grateful to the men of the 16th century who introduced watch-making, for a nation in which there are men and women trained to dexterity with the fingers, possesses an asset that may be very valuable in view of the increasing demand for delicate mechanisms.

Watch Imports Into United Kingdom.—The importation of watches into the United Kingdom is very large, although it has been severely hit by large import duties. In 1927 the value of watches, clocks, and parts imported was £1,878,777. In 1928 it was £2,278,733; 1929, £2,234,352; 1931, £2,251,677; 1933, £1,847,698; 1935, £2,177,209; 1937, £2,592,107. Export of British-made watches is negligible.

(H. H. C.; X.)

MASS PRODUCTION OF WATCHES

The use of duplicating machinery for watchmaking began in the U.S. with Henry Pitkin of Hartford, Conn., in 1838, but with no stress on interchangeability. The American Waltham Watch company early in 1853, in Boston, produced watches in quantity. This was the parent organization of about 30-odd American factories, of which, in 1939, only the Waltham, Elgin and Hamilton factories existed, producing from about 100 to 4,000 watches each, or a total of 8,000 to 10,000 per day, more than 3,000,000 per year. The present-day automatic machinery has been developed by many inventors and designers among whom are Sherwood, Webster, Marsh, Stratton, Moseley, Woerd, Hart, Church, Ohlson and Gabriel.

Modern Methods.—There have been two rather different routes to mass production of watches: (1) following the making of the conventional watch; and (2) making little clocks smaller and smaller, but essentially along lines developed in mass production of clocks (*q.v.*). The pioneer unit of mass production in cheap watches was the Waterbury watch (about 1890), but it had a short-lived popularity because of the greater amount of time required in winding its 8 ft. mainspring. The production of these watches exceeded 500,000 per year.

The New Haven Clock company then began making a clock wound from the back, small enough to be carried in the pocket, and this was followed by a smaller one by the Waterbury Clock company. It was due, however, to the merchandising genius of Robert H. Ingersoll that enormous production has come into being. His business passed in 1922 to the Waterbury Clock company. Other companies followed and of those in the U.S. continuing in 1939 the Western Clock Manufacturing company, the Ingraham company, the New Haven Clock company and the Ingersoll Watch company, each produce daily from 5000 to 14,000 watches or a total of about 10,000,000 per year. The size of the cheap watch has been reduced from an 18 to a 12 and even to a 6 size. (The sizes of movements are designated by 30ths of an inch over the 0 size which is $1\frac{5}{30}$ inches.) The various companies making stamped watches have brought out wrist watches.

Recent Improvements.—Many improvements have been made in the design of cases, by chromium plating and luminous dials. While each factory has its own processes in detail, the example of one factory in which there are 117 pieces is described here as being fairly typical. Forty of these pieces are made on screw machines, 38 in presses and 39 on forming or heading machines. The frame plates are blanked from sheet brass at the rate of 25,000 to 50,000 per day per machine, pierced 15,000 to 16,000, reamed 2,000 to 3,500 and finished 12,000 to 14,000. The wheels stamped finished from sheet brass by compound sub press dies come through at a rate of 50,000 to 100,000 per day. In this press the holes are pressed downward and the wheel upward simultaneously, the severed parts coming back in original position so that the sheet may be pushed onward for duplications.

The small toothed wheels (pinions), are produced in three ways: (1) by milling the teeth from a solid blank in a screw machine; (2) by turning down for arbor and pivots from pinion rod (which has been produced by a drawing process giving the proper shape of teeth); and (3) the lantern pinion, in which two brass collets on the arbor carry into proper holes short steel wires as teeth.

A screw machine will produce from 800 to 1,500, and a pinion milling machine from 500 to 3,000 per day. In the lantern pinions the arbor of wire of proper size has pivots turned on it by an automatic screw machine at a rate of 2,000 to 3,000 per day. The collets will then produce from 3,000 to 5,000 partly finished pinions. These go from a hopper to an automatic drilling machine which drills through one collet and partially through another the circle of holes for the short wires at 3,000 to 5,000 per day.

Dials are punched from sheet brass, buffed, plated, wire-brushed and lacquered. The numerals are applied by a rubber roller taking ink from multiple electros and with this press two operators will produce from 5,000 to 8,000 dials per day. Hands made from steel or from nickel silver for holding luminous material, are progressively pierced for the centre hole, swaged for the socket and blanked in a press capable of producing more than 100,000 per day. The blueing is done in an appropriate furnace.

Time of Manufacture.—Taking another example to give a more concrete conception of rapidity with which operations are performed, the following outline, covering nearly all the steps in the making of "a mass production watch," gives the equivalent time of manufacture of one individual watch in seconds:

The back plate, involving 17 operations by 25 hands for 103 seconds; front plate, 12 operations by 7 hands, 29; barrel, 10 operations, boring, levelling, turning, sizing, punching hook for spring, assembling spring, fitting arbor and testing, 69; centre pinion pivoted, 29; other pinions pivoted, each 40; wheels stamped, 0.3; staking centre wheel on pinion, 4; staking third and fourth wheels on pinion, each 7; fitting centre arbor, 4; staking escape wheel on pinion, 7; making brass screws, 1.25; making steel screws, 2.5; making winding stem, 15; grinding balance staff, 3.6; fitting balance and pinning hairspring, 51.4; drilling for impulse pin, 4.1; staking impulse pin, 4.5.

Putting in balance staff, 4.8; truing wheel in press, 4.1; lining up, 4.5; putting on roller, 5.5; general inspection, 4; spinning, 4.3; poising balance, 18.9; assembling movement, 72; washing movement, 4; oiling train parts, 20.5; fitting stem and winding wheel, winding with lever not in, 4; lever put in, inspection for end shake and winding, 45; putting on hairspring 4.5; truing hairspring, 17; vibrating hairspring, 91.1; setting balance to beat, 7.2; putting hour hand on hour wheel, 2.4; putting on dial and hour wheel, 17; putting on minute and seconds hands, 17; putting in case, shaping hands, driving three screws and putting on temporary back, 117; oiling and winding, 42.3; timing, comprising four 24 hour runs with dial down for interference of hands, pendant up with two-minute tolerance and another run with permanent back and bezel on, 170; putting on permanent back and bezel, 14.4; inspection and packing, 18.2. The making of the case involves 16 operations, ranging from four-tenths seconds to nine and seven-tenths seconds; total, 36 seconds. (P. M. C.)

WATER, a chemical compound having the formula H_2O, is one of the most abundant and widely distributed substances on the surface of the earth. It occurs in nature in the solid, liquid and gaseous states of aggregation known as ice or snow, water and steam or water vapour, respectively. Water is a necessary constituent in the cells of all animal and vegetable tissues and in the crystals of many minerals.

Sea water, the direct or indirect source of most water, contains on the average about 3.5% by weight of dissolved substances, principally NaCl 2.7%, $MgCl_2$ 0.4%, $MgSO_4$ 0.2%, $CaSO_4$ 0.15% and KCl 0.05%; but traces, at least, of all chemical elements are present. Snow is probably the purest natural source of water and rain the next purest, although the latter contains dissolved gases of the air as well as traces of carbon dioxide, chlorides, sulphates, nitrates and ammonia, with organic and inorganic dust held in suspension. Water from streams and lakes in mountainous districts is relatively free from organic impurities but may contain dissolved inorganic salts, while that from lowland rivers and lakes may be highly polluted. Water from springs and wells has filtered through the ground and has been more or less purified from organic contamination but may contain large amounts of inorganic salts.

Water is essential in all animal and plant nutrition. It finds extensive use in science and industry as a solvent, a catalyst, a standard for the concrete representation of certain physical units (*e.g.*, litre, calorie), a standard of comparison for certain physical properties (*e.g.*, specific gravity, relative viscosity), a conveying medium for the transport of materials and disposal of wastes, a diluant or dispersive medium, a cooling agent, a cleansing medium and in the production and distribution of heat and power. Water is the source of industrial hydrogen which is obtained by electrolysis or by passing steam through a bed of hot coal.

Inorganic salts in small amounts are not objectionable in potable waters, indeed they increase the palatability but harmful bacteria thrive on the organic content. Drinking water is subjected to microscopic, bacteriological and chemical examination. In the interpretation of the chemical analysis the source and history of the water must be taken into account. Abnormally high chloride content usually means sewage pollution. The amount and condition of nitrogenous solutes is an indication of the extent and present state of the contamination. Certain bacteria in water convert albuminoid ammonia to free ammonia which is then oxidized to nitrites and later to nitrates. A high albuminoid or free ammonia content indicates recent contamination while a high nitrate content is evidence of past contamination from which the water may have been purified. For purification of potable water *see* article on WATER PURIFICATION.

"Hard" waters contain soluble salts of calcium and magnesium, principally as bicarbonates (from the action of water containing carbon dioxide on the carbonates), chlorides and sulphates. Ferrous iron may also be present. Hardness caused by calcium bicarbonate is known as "temporary" since boiling expels carbon dioxide and converts the bicarbonate to the insoluble carbonate; hardness from the other salts is called "permanent." Calcium and magnesium ions react with the higher fatty acids of soap (*q.v.*) to form an insoluble gelatinous curd difficult to remove from the material being washed and thereby cause a waste of soap, since a lather will not form until these ions have been removed from solution. The iron oxidizes to the ferric form and appears as a reddish-brown stain on the material. The hardness of water is determined by the amount of a standard soap solution (made by dissolving castile soap in an alcohol solution) required to produce a lather that remains unbroken for five minutes in a definite volume of the water. The soap solution is standardized so that the volume used gives directly the hardness (as calcium carbonate) in parts per million of water or in grains per gallon. Water is "softened" on a small scale by the addition of ammonia, borax, or trisodium phosphate together with sodium carbonate (washing soda) which precipitates the calcium as carbonate and the magnesium as hydroxide. Certain phosphates, as $Na_4P_2O_7$ and $Na_6P_6O_{18}$, form a complex with calcium in the negative ion, *e.g.* $Ca_2P_6O_{18}^{-}$, and prevent reaction with the soap. Water is softened on a large scale by the addition of just sufficient lime to precipitate the calcium bicarbonate as carbonate and the magnesium as hydroxide followed by the addition of sufficient sodium carbonate to remove the remaining calcium salts. In the "permutite" process the water is filtered through a natural or artificial zeolite (*q.v.*) which replaces the calcium, magnesium and ferrous ions by sodium ions. The zeolite is regenerated by treatment with a strong brine solution.

In the boilers of power plants, the calcium and magnesium salts in hard waters form a hard, adherent scale on the plates. Due to the poor heat conductivity of the scale, fuel consumption is increased and the boiler deteriorates rapidly through overheating of the plates. Sodium carbonate if present in the water hydrolyzes to give free alkali that causes caustic embrittlement and failure of the boiler plates. In some localities sulphuric acid is added to boiler feed water after softening to increase the ratio of sulphate to carbonate.

"Ion-free" water comparable in saline content with ordinary laboratory distilled water is produced by percolating the water through a granular bed of a polyhydric phenol formaldehyde resin then through an amine formaldehyde resin. The phenol groups of the former replace the positive ions in solution by hydrogen ions and the amino groups of the latter absorb the acids so formed.

Water as a Standard.—Water exhibits the strange anomaly of having a greater density at 3.98° C. than at any temperature above or below. The litre is the volume of one kilogram of air-free water at this temperature and one atmosphere pressure. The prototype kilogram was designed to have the mass of 1000 cubic centimeters of water under these conditions but because of a slight error one litre actually contains 1000.028 cubic centimeters. The specific gravity of a substance at a temperature t is the ratio of the mass of a certain volume to the mass of an equal volume of water at the same temperature (S_t^t) or at the temperature of maximum density (S_4^t). 0° C. (32° F.) is defined as

the temperature of equilibrium between ice and air-saturated water under a pressure of one normal atmosphere; 100° C. (212° F.) is the temperature of equilibrium between water and steam at the same pressure. The 15°– calorie is the quantity of heat required to raise the temperature of 1 gram of liquid water from 14.5° to 15.5° under an air pressure of one atmosphere; the 20°– calorie, from 19.5° to 20.5° C. and the mean calorie 1/100 of the quantity of heat to increase the temperature from 0° to 100° C. These calories are equivalent to 4.185, 4.181 and 4.188 joules, respectively. Water is used as a standard in the calibration of viscosimeters (*see* VISCOSITY).

TABLE I.—*Some Physical Constants for Water (calories are 15°-calories)*

	At Melting Point (0°C.)		At Boiling Point (100°C.)
Heat of fusion	79.7 cal./g.		
Heat of vaporization	597.2 cal./g.		539.0 cal./g.
Specific volume of ice	1.091 m./g.		
Specific volume of water	1.000132 m./g.		1.0434 m./g.
Specific volume of steam			1673 m./g.
Critical constants	374.1°C.	218.4 atm.	3.1 m./g.

Properties of Liquid Water at 25°C. and 1 atm.

Specific volume	1.002934 m./g.	ΔH^*	−68,320 cal.
Coef. of thermal expansion	2.57×10^{-4} °C.$^{-1}$	$\Delta F^{\circ *}$	−56,690 cal.
Coef. of compressibility	4.51×10^{-5} atm.$^{-1}$	Entropy	16.72 e.u./mol.
Const. press. heat cap.	4.179 joules/g.	Heat of ionization**	13,360 cal.
Heat of vaporization	583.2 cal./g.	Ion product	1.0×10^{-14}
Dielectric constant	78.5 cgse.	Viscosity	8.95 millipoise
Elect. conductance	5.51×10^{-8}(ohm-cm.)$^{-1}$	Surface tension	72.0 dyne/cm.

* For H_2 (gas, 1 atm.)$+\frac{1}{2}$ O_2 (gas, 1 atm.) $=H_2O$ (liquid, 1 atm.) at 25°C.
** For H_2O (liquid) $=H^+$ (aq.)$+OH^-$ (aq.) at 25°C, 1 atm.

Physical Properties of Water.—The water molecule is in the form of an isosceles triangle with an apex angle of 105° and a dipole moment of 1.83×10^{-18} cgse (cgs electrostatic units) (in the gas), the oxygen being negatively and the hydrogens positively charged. Other properties are given in the tables. Abnormalities in the properties of water are the high dielectric constant which accounts for its solvent action and ionizing power, high melting and boiling points for its low molecular weight, high critical temperature and pressure, large heat capacity, expansion below 3.98° C. and expansion on freezing (only bismuth and gallium behave in a similar manner). Since ordinary ice (Ice I) is less dense than water, increasing pressure decreases the temperature of melting; the other crystalline forms of ice given in the table are all heavier than water so that pressure increases their melting points. P. W. Bridgman followed the melting curve of Ice VII to 192° C. and 39,000 atmospheres. The freezing point of water (0° C.) is 273.16° on the Kelvin or thermodynamic scale of temperature.

TABLE II.—*Triple Points Along the Melting Curve*

Phases at Equilibrium	Temperature (°C)	Pressure (atm.)
Steam Ice I Water	+0.0098	0.00603
Ice I Ice III Water	−22.0	2,000
Ice III Ice V Water	−17.0	3,400
Ice V Ice VI Water	+0.2	6,200
Ice VI Ice VII Water	+81.6	21,700

Chemical Properties of Water.—Water is a relatively stable compound, dissociating into hydrogen and oxygen only to the extent of 2% at 2,000° C. and one atmosphere. Metals and some nonmetals are oxidized by water or steam to the oxides with the liberation of hydrogen ($3Fe+4H_2O=Fe_3O_4+4H_2$, $C+2H_2O=CO_2+2H_2$). Steam reduces the halogens with the liberation of oxygen ($2Cl_2+2H_2O=4HCl+O_2$). With some elements disproportion takes place ($3S+2H_2O=SO_2+2H_2S$). Oxides or hydrated oxides react with water to form hydroxides which are basic, acidic or amphoteric depending on the position of the positive element in the periodic table—*see* PERIODIC LAW—($CaO+H_2O=Ca^{++}+2OH^-$; $P_2O_5+3H_2O=2H_3PO_4, H_3PO_4=H^++H_2PO_4^-$; $Al_2O_3.H_2O+2H_2O=2Al(OH)_3$. $Al(OH)_3=Al(OH)_2^++OH^-$ and $Al(OH)_3=H^++H_2AlC_3^-$). Neutralization is the reaction of base with an acid to form a salt and water ($Na^+OH^-+H^+Cl^-=Na^+Cl^-+H_2O$). Since water itself ionizes to a small extent into H^+ (or H_3O^+) and OH^-, hydrolysis (*q.v.*) takes place when the salt of a weak base or a weak acid, or both is dissolved in water. The chlorides and sulphides of many of the elements that are not strongly metallic are often completely hydrolyzed ($PCl_3+3H_2O=H_3PO_3+3HCl$, $Al_2S_3+6H_2O=2Al(OH)_3+3H_2S$). Metallic nitrides and hydrides are decomposed by water to give NH_3 and H_2 respectively and the hydroxide of the metal. Metallic carbides yield hydrocarbons ($CaC_2+2H_2O=Ca(OH)_2+C_2H_2$). Organic esters, *e.g.* fats, are hydrolyzed by water to yield the alcohol and the acid. Because of its small size the water molecule can fit into many ionic crystal lattices, yielding hydrates ($Na_2HPO_4.2H_2O$, $Na_2HPO_4.7H_2O$, $Na_2HPO_4.12H_2O$).

Heavy Water.—"Ordinary water" as obtained from fresh water lakes contains isotopes of hydrogen in the ratio of 1 atom deuterium (q.v.) to 6,900 of hydrogen. The oxygen isotope ratio is $O^{16}:O^{18}=506:1$ with perhaps one fifth as much O^{17} as O^{18}. When water is electrolyzed the gas produced at the cathode is poorer in deuterium than the water, which is thus enriched in deuterium content. Practically pure D_2O has been obtained by the electrical decomposition of hundreds of gallons of water until only a few millilitres remain. The oxygen isotope ratio in the water seems to remain substantially unchanged during the electrolysis. Heavy water has a density at 25° C. 1.1079 times that of ordinary water. It freezes at 3.82° C., boils at 101.42° C. and has a maximum density at 11.6° C. D_2O solid phases corresponding to Ices I, III, V and VI have been found; all triple points are at higher temperatures and pressures than for ordinary water. The dielectric constant of the liquid is 80.7, viscosity 10.99 and surface tension same as that of ordinary water. The ion product is about 0.2×10^{-14}. In general, salts are less soluble in D_2O than in H_2O and the rates of chemical reactions in solution are less. Heavy water is used to slow the speed of neutrons in nuclear investigations. When deuterium is used as a tracer in physiological studies, the amount present in tissue is usually determined by oxidation to water and measurement of the density.

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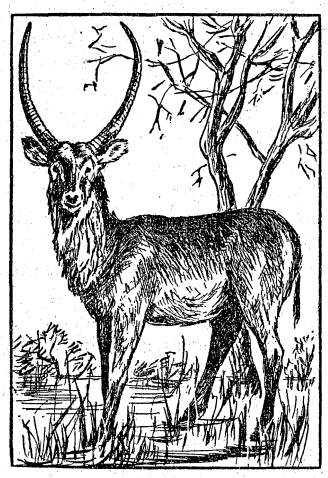
(J. A. B.)

WATER BOATMAN, an aquatic hemipterous insect belonging either to the family Notonectidae or to the family Corixidae. In England it is a Notonectid of which the best known species (*Notonecta glauca*) is common in the ponds. This insect feeds upon other aquatic insects and can inflict a severe "sting" with its beak. In the United States the Notonectidae are called "backswimmers" because they swim on their backs, while "water boatman" refers to the Corixidae which often occur in large numbers and include more species than any other family of aquatic Hemiptera. They live on the bottom of the pool where they feed upon the organic ooze containing both plants and minute animals or consume quantities of filamentous algae or the chlorophyll therefrom. Their eggs are gathered for food in Mexico.

(H. B. HD.)

WATERBUCK, a large South African antelope (*Kobus ellipsiprymnus*) of the tribe Reduncini, characterized by the white elliptical ring on the buttocks and the general reddish gray colour of the long coarse hair. They have heavily fringed necks and tufted tails; long sublyrate, ringed horns are carried by the bucks only. The name is extended to include the sing-sing (*K. defassa*), a widespread species, without the white ring. Both species equal the red deer in size. (*See* ANTELOPE.)



WATERBUCK (KOBUS ELLIPSIPRYMNUS)

WATERBURY, a city of western Connecticut, U.S.A., one of the county seats of New Haven county; on the Naugatuck river, 21 mi. N.N.W. of New Haven. Pop. (1940) 99,314. It is the centre of the brass industry of the country. Other products are clocks and watches, recording instruments, machinery, chemicals and acids. The city's assessed valuation in 1940 was $167,199,550. Waterbury (settled in 1677) was set off from Farmington and incorporated in 1686. The city was chartered in 1853, and in 1901 city and town were consolidated. The brass industry dates from 1802. Sheet brass was first made in 1830.

Tall wooden clocks were made here in the latter part of the 18th century. The manufacture of cheap watches was begun in 1879; these were long distinctive of Waterbury, and were often called "Waterbury watches."

WATER CHINQUAPIN (*Nelumbo luteum*), a beautiful North American aquatic plant of the water-lily family (Nymphaeaceae), called also American nelumbo or lotus, rare and local in ponds and slow streams from Conn. to Mich. and southward to Fla. and La. It is a stout plant, rising from a horizontal tuber-bearing rootstock, with large shield-shaped leaves, 1 to 2 ft. across, some floating but mostly rising high out of the water, and solitary pale-yellow flowers, 4 to 10 in. broad, borne on long stalks usually higher than the leaves. The edible tubers and farinaceous seeds were used for food by the Indians, who probably introduced it into the eastern States. It is sometimes grown in water-gardens for its ornate foliage. (*See* WATER-LILY.)

WATER-COLOUR PAINTING. The art of water-colour has passed through a renaissance since about 1890 and has again assumed a recognized place among the mediums of artistic expression. For many years the medium had been looked down upon and considered unimportant, and of use only in young ladies' "finishing schools." The 20th century has seen this most spontaneous of all mediums regain its eminence and vital beauty. A small group in England, the United States and France kept the use of water-colour alive until the present awakening, and great water-colour societies have now grown up and become of national and international importance.

HISTORY

Ancient Chinese Art.—Water-colour in its various forms constitutes one of the finest and most permanent records of art that has come down to us, reaching back into the 3rd century of Chinese art, and it was also used both by the Japanese and the East Indian artists in various forms. We find in the Chinese art a great use of clear water-colour and some use of tempera (*q.v.*). Brushes for the very fine work were as a rule made of sable hair; selected pig bristles were used for coarse textures. An elaborate and adroit handling of the brush was cultivated, the result being a delicate and exquisite line; design was ranked above colour in most of the early work. It is interesting to note that water-colour was always used in the East to a much greater degree than oil, being more delicate and of greater flexibility.

Paper and silk were the surfaces used. Paper of wood bark came first, and then silk was made into a kind of paper but it was found too glossy; then came a tough rice-paper. Silk was mounted on paper and glued down to hold the colour intact and keep it from spreading. The backing was built up by placing layers of paper on successively, and it is said that the silk was moistened and stretched, which seems reasonable since we stretch our fine rag papers to-day. The ink, of course, went through, onto the backing, making two pictures. Black ink was frequently the only colour used, though dark brown, or sepia, appears. The most interesting impressions were done in ink by the masters of the Sung dynasty and by the Japanese of the 15th century. (*See* ART: *Far Eastern Methods;* CHINESE PAINTING; JAPANESE PAINTING AND PRINTS.)

Rich colour and much use of gold dominate the Buddhist pictures. The masterpieces of the religious painters contain a fine rhythm of design, which gives them a fundamental character, exquisite subdued colour, and is also found in the flower designs and birdpieces. Poetic suggestion, and not representation, was the most important part of the Ming art, and helped to explain the great use of water-colour. In the Sung dynasty, lampblack began to be used, mixed with a glue made from donkey hides boiled in water. The glue obtained is the colour of amber, glossy and odourless, and is mixed with black made from soot which is obtained from imperfect combustion in the burning of dry pine or fir. This was used to the end of the Yuan dynasty, notably by Tung Chi-Chang, Wu Wei and Fu Shan. This depth of colour and glossiness was lacking in the Ming ink as used by Shên Chau, T'ang Yin, Weu Cheng-Ming and Ch'in Ying. In the Sung work no attempt was made at modelling; consequently there was no trace of light and shade. The figures stand in a flat light. Of course, this enhances the decorative effect greatly. The following artists of the Sung dynasty (A.D. 960–1279) are the outstanding ones as far as known: Wen Tung, Tung Chi-Ch'ang, Wu Wei, Fu Shan, Shen Chan, T'ang Yin, Wen Chêng-Ming, Ch'in Ying, and Kuo Chung-Shu.

Japanese Art.—From the 6th century the development of painting may be shown as follows: (1) middle of 6th to middle of 9th century: naturalization of Chinese and Chino-Buddhist Art; (2) middle of 9th to middle of 15th century: establishment of great native schools under Kose no Kanaoka and descendants—pure Chinese school falling into neglect; (3) 15th to latter part of 17th century: revival of Chinese style; (4) latter part of 17th to latter part of 18th century: popular school; (5) 18th to 19th century: introduction of European influence—naturalistic school—acme and decline of popular school; (6) 1875 to present: a period of transition.

Painting began in the 5th century, brought by Nawrin from China. By the middle of the 6th century a real art of painting, of which Buddhism was the main theme, had begun. The art was thereafter carried out under Korean and Chinese immigrants. Toward the end of the 9th century, two exotic styles of painting flourished, and on these a native style had been founded which featured landscape of a romantic kind, animal life, trees, flowers and designs representing legends of olden times. The exotic Buddhist style brought a change. Of Indian origin or influence, it was brilliant and decorative, with a lavish use of gold, and confined to representations of sacred personages and places. The principal painters of this period, extending into the succeeding centuries, were of the Kose, Takuma and Kasuga lines, descending from Kanaoka, Takuma Tameuji, and Fujiwara respectively. Last and greatest was Meicho, or Chō Densu, who died in 1427.

The beginning of the 11th century shows adaptations of Chinese canons to motives selected from poetry, court life, and legends of Old Japan. This art was characterized by a lightly touched outline and tinted with flat and bright body-colour. Verdigris-green dominated the schemes. Important names are Fujiwara no Motomitsu (11th century), Nobuzane and Tsunetaka (13th century), Mitsunobu (15th and 16th centuries), Sishu (1421–1509), Shūbun and Kano Masanobu (1424–1520), Mitsushige and Mitsuōki (17th century).

A popular period began with the establishment of a school of art by Hishigawa Moronobu (1646–1713). He created a progressive and trustworthy life about him, expanding his followers' artistic natures. After this came a development of realistic art, which compares in time with the European style. This manner has its importance in the great harm it did to Japanese art. It attempted to reproduce nature and all forms exactly, combining European chiaroscuro and linear perspective with the Japanese style. Glass, tapestry and furniture suffered as well as pictures. Except for the existence of water-colour painting, the loss would have been still greater.

Persian Artists.—During the 8th century, Turkistan princes sent into China for their artists and in the conventionalization of certain forms and flat treatment of figures, a trace of Chinese influence is discernible. The few surviving paintings of the Mongol period are in the Persian manuscripts of the "History of Ghenghis Khan and Family," and are the most important, dating back to A.D. 1314. Here the Mongol types and fashion of drapery are manifested. At Herat, the most famous of the Persian masters, Bihzad, who founded a National School of Painting, changed the course of the native art. Bihzad illustrated manuscripts of the two most famous poets, Sadi and Nizami. The Sultan, Mahmed, worked in Mirak's studio and Mirak, who was born A.D. 1500, was a pupil of Bihzad.

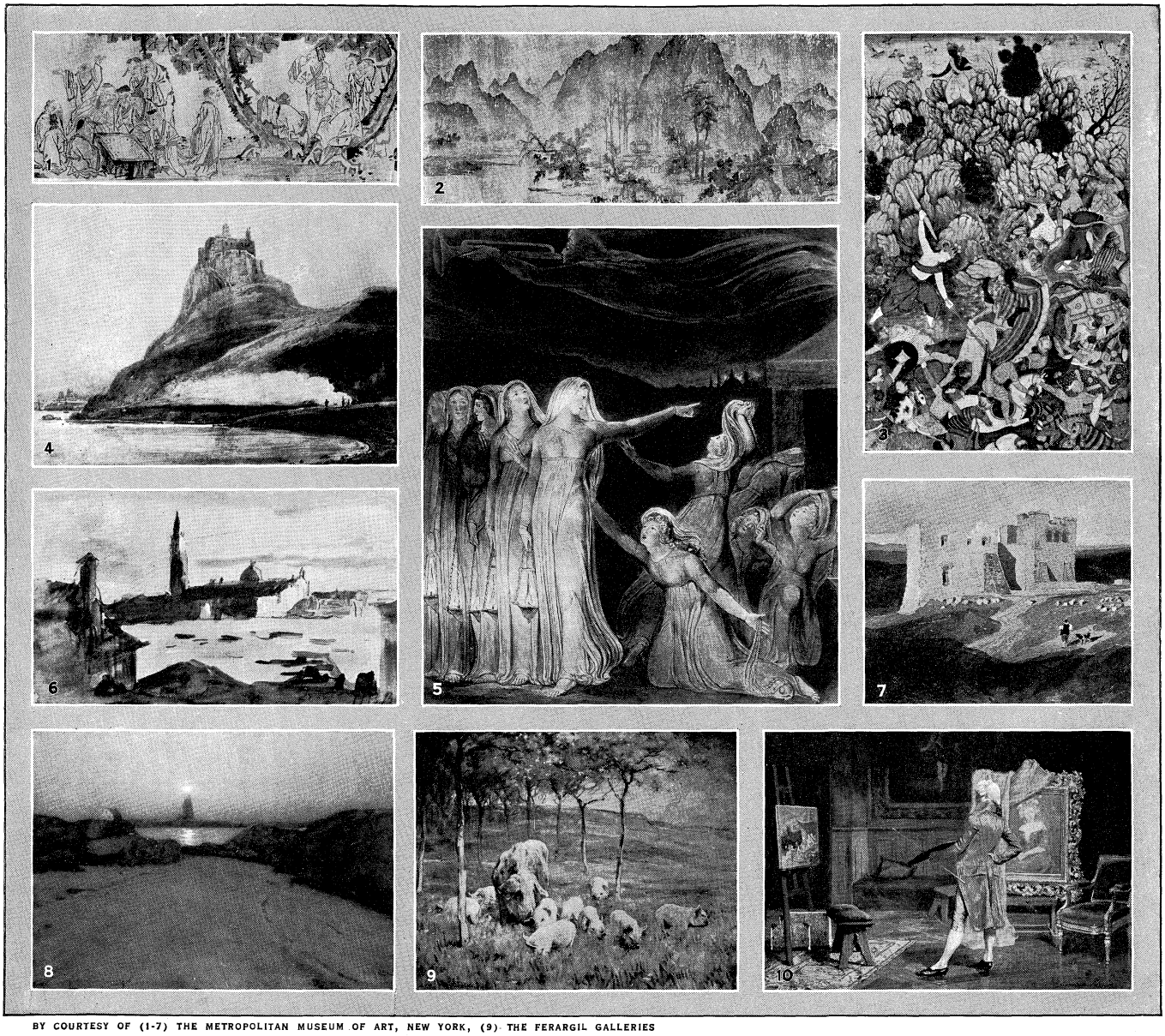
The most important contribution of Persian art, and to it the Indian is closely allied, is its charm of colour. As the school matures, it shows a weakening of design, becomes less coherent, and conventions become dominant; vitality is lost and expressiveness of drawing is smothered. But the gem-like colour and refined luxury give a marvellous atmosphere of sensuousness and beauty. Figure work was not done from living models. The painters recreated the entire scene in their mind and in putting colour on material suggested such detail only as was essential to the depicting of the tale. This lack of realism gave a splendid feeling of all-over pattern.

Chiaroscuro and modelling were not important in painting, and third dimension was sedulously avoided; decorative effects in two dimensional space were aimed at. (*See* PERSIAN ART, PAINTING AND CALLIGRAPHY.)

Indian Technique and Materials.—The earliest material used in painting was a red haematite which was mixed with an animal fat. The outlines were made with a pointed stick, brushes being of such poor quality that it was not possible to bring them to a point; they were probably made of vegetable fibre at first. White was obtained from an earth substance, possibly a clay or lime; black was obtained from dried astringent prune-like fruit.

Frescoes.—The Buddhist frescoes were painted over a roughly

WATER-COLOUR PAINTING

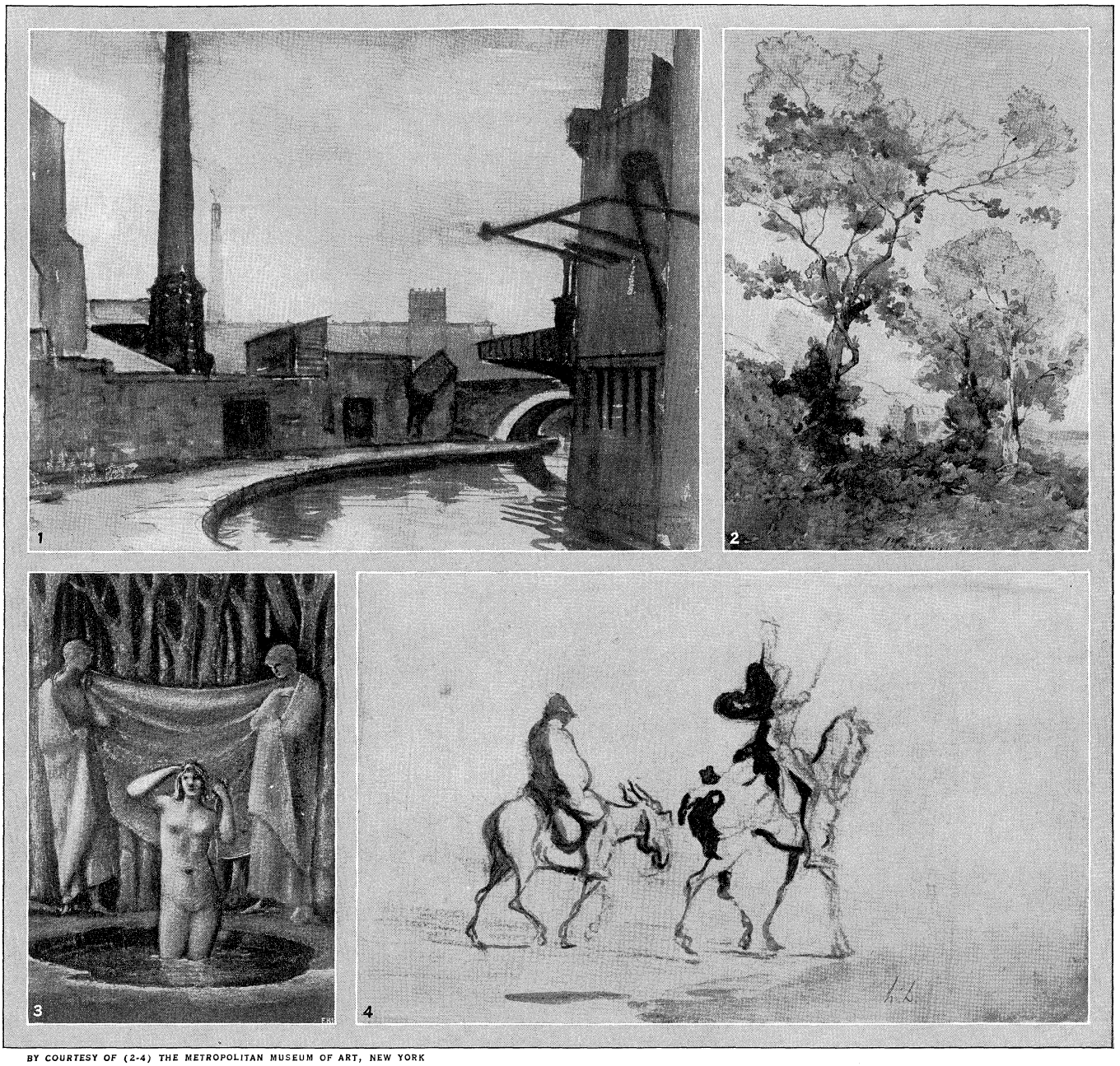


BY COURTESY OF (1-7) THE METROPOLITAN MUSEUM OF ART, NEW YORK, (9) THE FERARGIL GALLERIES

ORIENTAL, EUROPEAN AND AMERICAN WATER COLOURS

1. "Gathering of Philosophers" by Kung Kai. Sung Dynasty (960–1279). Metropolitan Museum of Art. Chinese
2. "Landscape, Late Autumn," part of a long "Makimono" by Wen-Tung (also called Yu-K'o). Sung Dynasty. Metropolitan Museum of Art. Chinese
3. Miniature, "Arjuna Fighting the Kauravas," by Mughal, Indian School of the 16th century. Metropolitan Museum of Art
4. "Saint Michael's Mount" by Thomas Girtin (1775–1802). Metropolitan Museum of Art. English
5. "The Wise and Foolish Virgins," water colour with pen and ink, by William Blake (1757–1827). Metropolitan Museum of Art. English
6. "San Giorgio Maggiore, Venice," by Hercules Brabazon (1821–1906). Metropolitan Museum of Art. English
7. "The Ruined Castle" by John Sell Cotman (1782–1842). Metropolitan Museum of Art. English
8. "The Lighthouse" by Henry B. Snell (1858–1943), American
9. "Spring," by Horatio Walker (1858–1938), American
10. "A Perplexing Point" by John Ward Dunsmore (1856–1945). American

WATER-COLOUR PAINTING



BY COURTESY OF (2-4) THE METROPOLITAN MUSEUM OF ART, NEW YORK

NINETEENTH-CENTURY WATER COLOURS OF EUROPEAN MASTERS

1. Water colour view of Blackburn canal, by Sir Charles John Holmes (1868–1936); showing interesting structure and composition acquired directly. English
2. "French Landscape," water colour by Henri Harpignies (1819–1916); a delicate and effective treatment involving a certain amount of drawing with the brush. French
3. "Bath of Venus" by Sir Edward Burne-Jones (1833–98); a treatment inappropriate for water-colours. Its necessarily careful modelling loses its spontaneity. English
4. "Don Quixote and Sancho Panza" by Honoré Daumier (1808–79). Masterful example of direct powerful modelling. French

excavated wall, first prepared with a coating made of a mixture of clay, camel dung, and trap rock, to the thickness of $\frac{1}{8}$ to $\frac{3}{4}$ inches. This surface was then coated with a thin layer of white plaster and the painter was ready to paint frescoes in water-colour. The method used is open to difference of opinion. True fresco was done on wet plaster. If a part of the design did not suit the artist, he had to cut out that section and apply a fresh coat of wet plaster. The other method (*fresco secco*) is a combination of fresco and tempera. The plaster ground is allowed to dry before painting. True fresco is favoured but much more difficult because a design cannot be changed except as mentioned above.

The *Rajput* painting was a mural in design but done on a small scale. Paper was used instead of a wall surface. The Mogul miniatures were painted on a paper composed of bamboo, jute and cotton. The surface was carefully rubbed smooth with a rounded agate. Later English painters took rough paper, painted their figures on it, but rubbed the surface smooth where the heads were to be. A fine texture was acquired in this way.

These various processes of clear colour, fresco, tempera and combined methods of water-colour and inks, paved the way for the development in southern and western Europe. Italy took what was best suited for its climate, tempera; fresco for wall-surfaces, and the mixed methods of tempera and ink for book illumination scrolls, and later for studies to be developed in larger oil painting, as oil became better understood during the Middle Ages. Water-colour slipped lower down the scale of artistic and popular appreciation. The return to active use of water-colour now heralds a real awakening of art and promises tremendous progress in the near future. Beauty of colour and dignity of design will strip the old ugliness of things from our every-day lives and prevent the return of naturalistic abominations. (*See* INDIAN AND SINHALESE ART AND ARCHAEOLOGY.)

DEVELOPMENT OF WATER-COLOUR PAINTING

The use of water colour has been an all important factor in the development of the technique of oil painting. That heavy medium, slow and cumbersome as it is, required an experimental companion, so water colour has its being in the fact that studies and colour schemes can be made in it with great ease and rapidity. Oil painting owes much of its life and vitality to the example of this so called lighter medium. Water colour is by far the older. It was used both in clear wash and in tempera form centuries before oil painting was discovered. The decorations in the caves of Altamira and Perigord date perhaps 20,000 years ago, a form of fresco done on a lime surface. Egyptian wall paintings were all executed in some form of tempera, as far as can be judged from fragments of coloured plasters. Analysis shows some form of gum or glue, proving a water colour medium. Pliny says that fresco was known to the Greeks. The paintings in the porch and corridor of the Minoan Palace of Cnossus were executed in true fresco, twenty-five centuries ago. The illuminated manuscripts of the Middle Ages were all executed in water colour, tempera and opaque, or body colour, the pigment being ground in gum or glue and dissolved in water. Nearly all of the illustrations and decorations of manuscripts were done on parchment, which was used instead of the rice and silk papers employed by the Chinese, thus bringing about a change from the earlier method of clear water colour to the late development of opaque or semi-transparent colours.

Water colour for centuries has been the universal medium of expression both in wall decorations and in miniature. The fact that this form of transcription gave a quick and brilliant result and enabled the artist to place his impressions permanently on paper or parchment in a fresh and glowing manner endeared the medium to every true artist and formed the basis of the monumental work in oil which was done during the Middle Ages and in our time. Water-colour drawing and painting show the true ability and genius of each generation.

The medium may be divided into a number of classes:—clear water colour (done directly on paper or silk), encaustic, fresco, true fresco and tempera. Gum arabic, glue, wax, the white or yolk of eggs are the usual binders that are mixed and ground with dry colour and dissolved in water to produce the various mediums used in water-colour painting. Sometimes water colour is covered or sealed with wax or shellac.

Water colour is the basic or fundamental medium of expression which has served to preserve the great advance of the art as developed during the past ages.

GREAT BRITAIN

Renaissance of Water Colour Painting.—Water colour painting was a forgotten art until about the year 1700, when English artists began using this medium. Previous to this period, water colour was used only to tint pen and pencil sketches. Pen and ink, both black and brown, with superimposed tints of sepia and blue were first used. These tints of colour suggested the warm and cool masses. Monochrome also came into general use at this period. Monochrome lacked range and sequence and was soon superseded by the above-mentioned addition of colour.

During those early years three forms of water colour painting came into use in England:

First, colour and water were mixed and used on white paper, often with the addition of fine pen lines to strengthen the drawing. Rubbing or scrubbing the colour after it had been laid on the paper darkened and dimmed the lustre just as it does in the modern day method of painting in water colour.

Second, the employment of opaque, gouache, or body colour. This form comprised opaque colour mixed with solid opaque white. This method is rather harsh and raw. The mixture often would clot up and become unmanageable, creating ridges of colour. It was used mostly on soft gray or tinted papers. Interesting textures were obtained with this form.

Third, a combination of transparent colour and opaque white. This is a most interesting form to use. Shadows are kept transparent and the light masses loaded. Clever handling and the accidental quality of clear water colour is present in this method.

These three methods are in active use to-day. Clear water colour painting seems capable of expressing more in the way of sheer beauty, atmosphere and power than the other forms.

Figure studies and decorative motives by Albrecht Dürer (1471–1528), Rembrandt, and Claude are important landmarks in the development of the early periods of water colour; also Peter Paul Rubens (1577–1640); Cornelius Dusart (1660–1704); Francis Barlow (1626–1702); and Honoré Daumier (1808–1879).

This type of drawing formed the basis and beginning of the great art of water colour painting in England, both by nature and climate adapted to this form of artistic expression.

First Period—(1725–1780).—The early period of British water colour development can be dated from 1725–1780. Within this time progress was made and many artists destined to become great were born. The work done during these years was carefully topographical and painstaking. Pen and tint drawings represented their range. Landscape was beginning to be used as a theme in pictorial art, though in a tentative and monochromatic form. Real colour was not understood or used. Colour makers had not appeared on the scene and artists using this medium were obliged to grind and prepare their own colour. When one considers the modern artist and his absolute lack of knowledge of what his colour is made, and how it is prepared, all praise must be accorded to the artists of that time who made almost every kind of material for themselves.

Paul Sandby (1725–1809) laid the foundations of landscape painting in England. His early drawings carried a fine, closely drawn line around the objects used in his compositions. Then an India tint was imposed over parts of this picture. As he gained in knowledge, varied colour was used and the outlines were softened to effect a chiaroscuro. He gradually began to add more and more colour through superimposing hue upon hue, timidly perhaps at first, but building solidly and in advance of his time.

When water colour first emerged from the early monochromatic state, artists of this period sensed its possibilities and began a series of experiments that was destined to restore this medium to its rightful place as a great means of art expression. Samuel Scott (1710–1772), Michael Angelo Rooker (1743–1801) and Thomas

Malton (1748–1804) were eminent exponents of water colour. Malton painted architectural subjects with great distinction. John Alexander Gresse (1741–1794), William Pars (1742–1782) and Francis Wheatley (1748–1801) are representative of the fine art of this time.

Second Period—(1780–1850).—This second stage of development brought forth the real force of water colour and cemented the foundations laid by the earlier painters, developing from pen and wash or tinted drawings into water colour painting of great quality and power. In the beginning of this period a number of colours were already being made by a rapidly growing gild of colour makers.

John Robert Cozens (1752–1797) produced work of a high order, romantic and imaginative, possibly influenced by Claude, but striking boldly into an undeveloped realm of landscape composition and showing the way to many young artists of this period.

William Blake, Thomas Girtin and J. M. W. Turner were outstanding painters of this period. Blake and Turner were romantic and highly imaginative, leaving the common highway to delve into unexplored phases of painting. In each existed the impulse to subordinate reality and seek romance in colour and design. Blake delved farthest into that unknown world, while Turner roamed in a world of colour, making colour his servant and slave. Girtin painted landscape with a splendid feeling for scale, mass, and atmosphere, holding that simplicity was great art. He was friendly with and undoubtedly influenced many of his younger contemporaries. Turner and Cotman both profited by their association with Girtin.

These painters, each in his way and manner, left a great impress on the art in England, not only on water colour painting, but on the medium of oil. Girtin's impress extends over this entire period and helped to create the modern school of water colour painting. Cotman excelled in clear, limpid, flowing colour.

Peter De Wint (1784–1849) used a rich palette, saturated his paper and while it was wet brushed the colour into it. In this manner he maintained, or avoided disturbing, the bloom which is one of the beauties of water colour, and which accounts for the transparency of his tones. Superimposed colour almost always deadens brilliancy and makes it look sodden.

De Wint, and also Cox, obtained a beautiful quality in their sketches. De Wint obtained fine colour effects in his broad rough way, using the brush vigorously and with interesting suggestiveness, not bothering with, nor caring for the naturalistic, but creating an impression of air and wind, and solid things. Cox's sketches took the form of notes, design not playing much of a part, but his loose handling and reminiscent colour imparted a great charm to his work.

Dayes used water colour in an architectural manner, choosing subjects possessing great detail and handling these compositions in a large way. While he was inclined toward colour and experimented freely with that method of expression, yet he never fully accepted it. Dayes' influence on Turner's early work was unquestioned.

Girtin profited also to a large extent through Dayes' experiments in warm and cool colour. By the last years of the 18th century Turner and Girtin had surpassed Dayes in quality and colour. Turner may be classed as the most important colourist of this period. Another note of interest is that Turner's water colour practice exerted a very strong influence upon his oil painting. He was able to experiment quickly and easily in this medium and to obtain the effect of clarity and richness. He realized that the transparency and fluidity of the lighter medium would tend to lift oil out of its heavy dull manner, as it was practised at that time. This was a matter of evolution, of one medium flowing into another. Water colour has a verve and spirit all its own and the painters of this period realized its value both as an individual art, and as a helpmate in reclaiming oil from its sloth of dullness.

Lustreless blues and browns gave way rapidly to Turner's swift and fresh sense of colour. It is an extremely noteworthy fact that sketches, tinted drawings and water colour paintings reveal the spontaneous artistic soul of an artist. He seems freer and less bound by convention and an academic view of Art. Turner, through the use of water colour, vitalized his oil painting and developed its brilliancy.

John Sell Cotman used water colour with great freedom and simplicity. His pattern and form show a fine judgment in selection. He did not clutter up his composition by useless detail. He held the masses of his picture clear and strong.

The Society of Water Colour Painters was formed in London in 1804 and its first exhibition was held in Brook Street on April 22, 1805. Most of the distinguished water colour painters exhibited their work in this society excepting Turner, who was never a member. Among the noted water colourists of this period were William Blake (1757–1827); E. Dayes (1763–1804); Thomas Walmsley (1763–1806); Francis Towne (1740–1816); John White Abbott (1763–1851); J. M. W. Turner (1775–1851); John Constable (1776–1837); Thomas Girtin (1775–1802); John Varley (1778–1842); Cornelius Varley (1781–1873); William Fleetwood Varley; John Sell Cotman (1782–1842) and David Cox (1783–1859); A. V. Copley Fielding (1787–1855); Peter De Wint (1784–1849); G. F. Robson (1790–1833); William Hunt (1790–1864).

Third Period—(1850–).—By this time a number of exhibitions were being held and the painters were afforded the opportunity of showing their work to advantage. For many years past the water colour exhibitions have been important artistic and social events in England. In addition to these advantages the finest paper and colour is now preferred and sold by colour makers. The only difficulty is that too many hues and tints are made to-day. The beginner in this interesting form of art becomes confused and is liable to select a complicated and impossible palette. Simplicity still rules the world of art.

Among the many outstanding water colour painters of this period may be mentioned Sir Edward Burne-Jones (1833–1898), and Dante Gabriel Rossetti (1828–1882). They had a great deal in common. Their work was decorative and colourful. Burne-Jones used water colour in designing many stained glass windows.

More recent was the rich and dramatic art of J. D. Innes (1887–1914). Among others who in the first quarter of the 20th century produced excellent work were Sir W. Orpen, A. M. McEvoy, J. Holland, S. Palmer, J. F. Lewis, W. Callow, T. Shotter Boys, B. Foster, A. W. Hunt, E. M. Wimperis, T. Collier, E. B. Lintott, A. J. Munnings, Arminell Morshead, P. W. Steer, W. Tryon and Frank Brangwyn.

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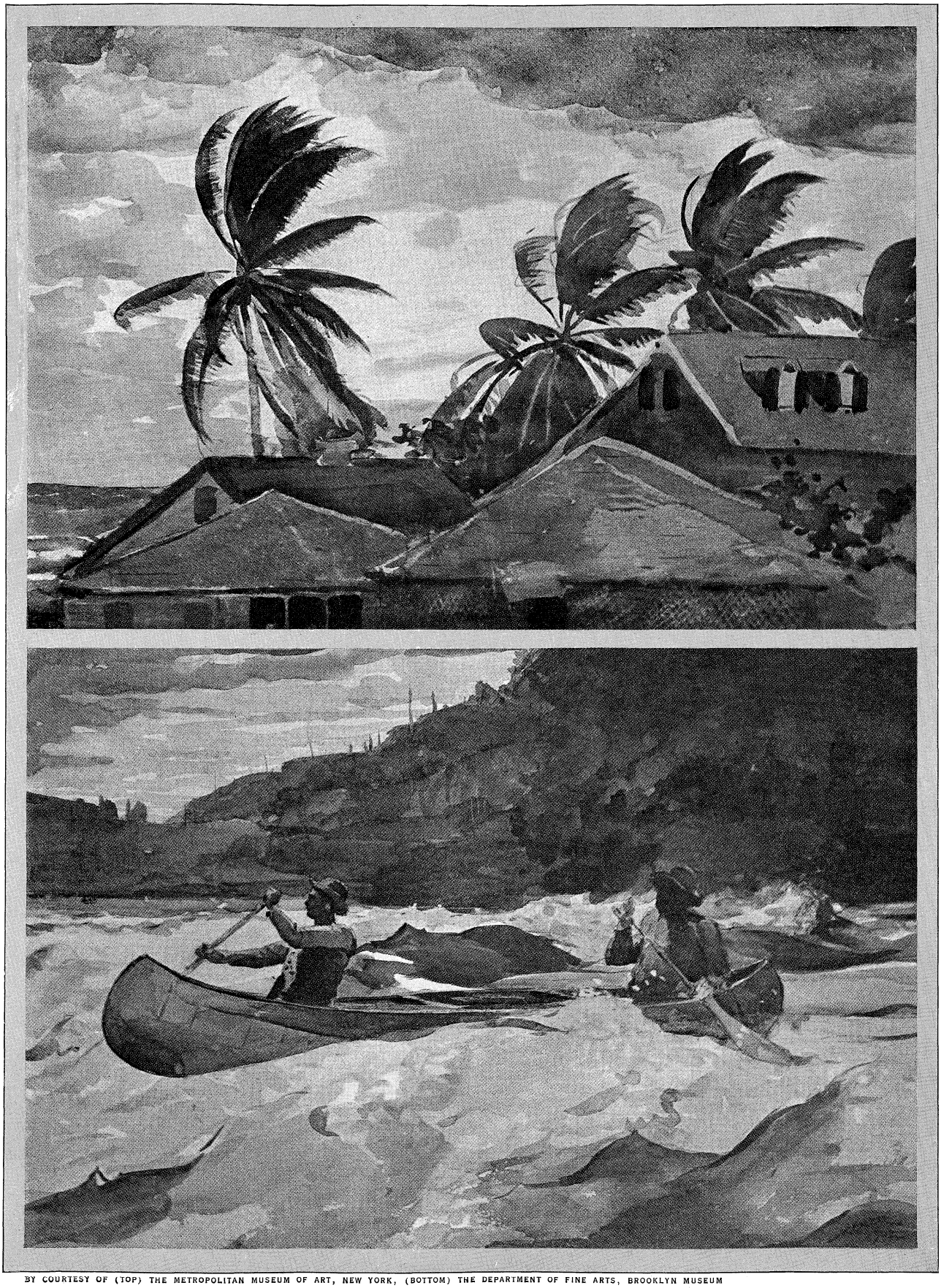
THE UNITED STATES

The first water-colour societies in America were formed by small coteries of workers who appreciated the need for this medium. Then came the formation of the American Water Color Society in New York on December 5th, 1866. Some years later, Philadelphia and Boston formed groups and in 1890 the New York Water Color Club was organized. These societies endeavoured to foster and develop the art of water-colour painting early in the 19th century. Most American artists worked in oil, and water-colour was not a part of their general training. It was thought necessary to study in Paris and water-colour has never assumed a very important niche in French art. This practice of study continued until about 1890. There were exceptions to this, as Winslow Homer, George Inness and a few other painters developed their art in their own country and are called self-taught by many writers on art. Painters who have used this medium successfully find it of great value in advancing their oils; experiments may be made easily, and colour values established.

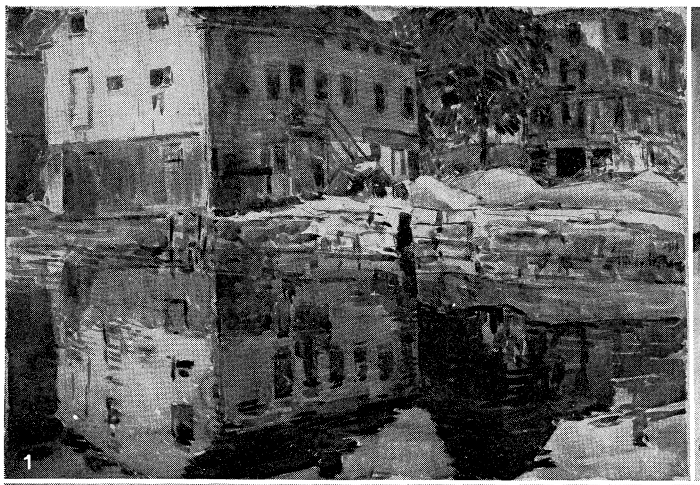
Three Stages.—The first stage of development resulted in a meticulous kind of workmanship, rather dry and not rich in

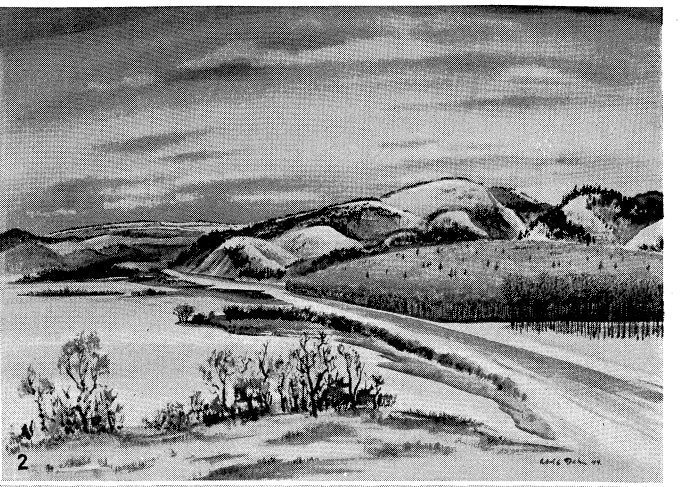


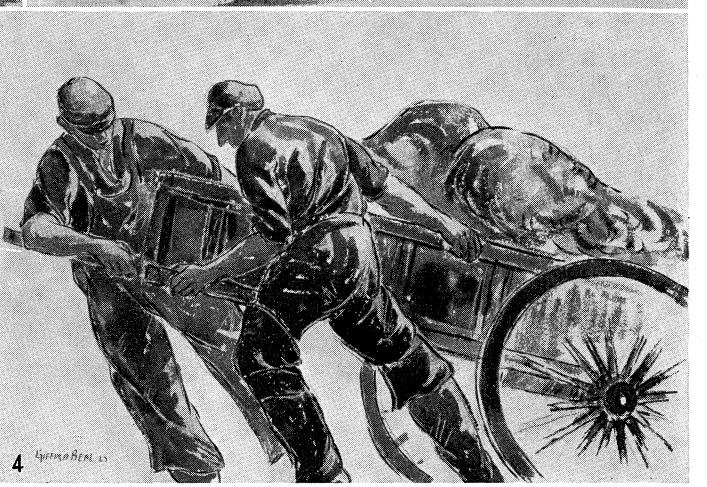
BY COURTESY OF (TOP) THE METROPOLITAN MUSEUM OF ART, NEW YORK, (BOTTOM) THE DEPARTMENT OF FINE ARTS, BROOKLYN MUSEUM

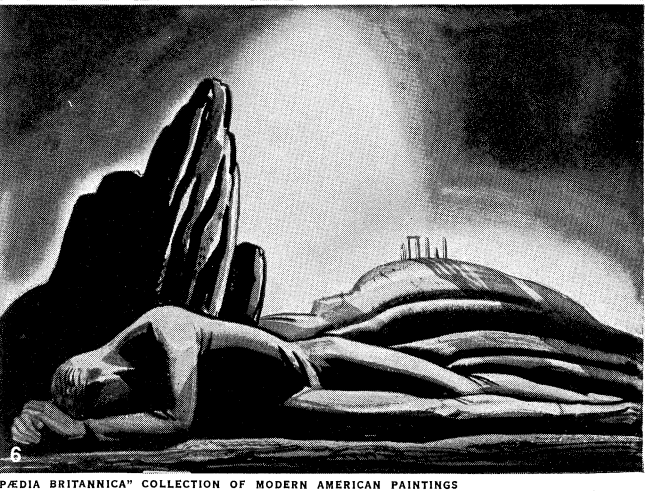
WATER COLOURS BY WINSLOW HOMER

Top. "Tornado—Bahamas." Bottom. "Shooting the Rapids." Winslow Homer (1836–1910), an American artist well known as a painter of landscape and genre pictures in oil, was equally distinguished for his water colours, of which two are here reproduced. They are good examples of his sure, vigorous brush work, and the directness and economy of his method







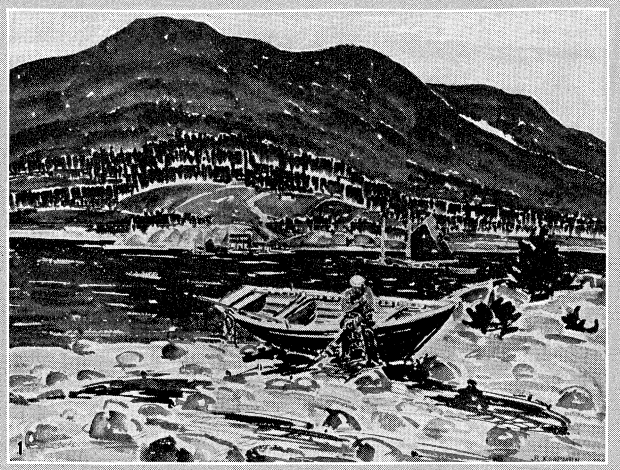


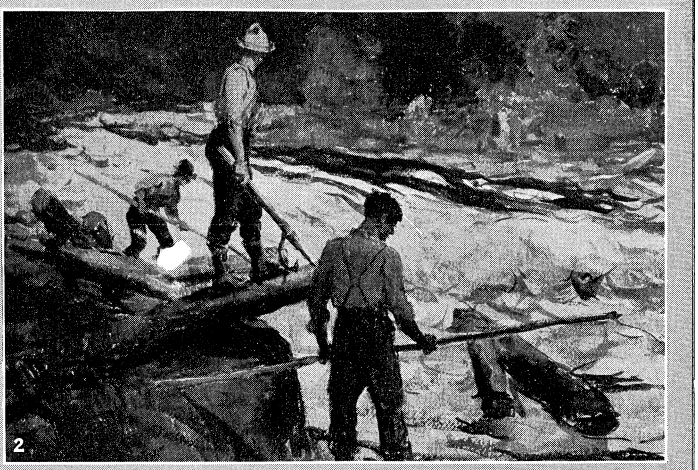
BY COURTESY OF (4) THE KRAUSHAAR GALLERIES, (6) THE WEYHE GALLERY; (2) FROM THE "ENCYCLOPÆDIA BRITANNICA" COLLECTION OF MODERN AMERICAN PAINTINGS

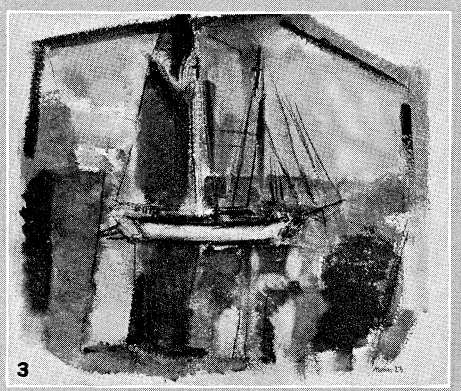
WATER COLOURS BY CONTEMPORARY AMERICAN ARTISTS

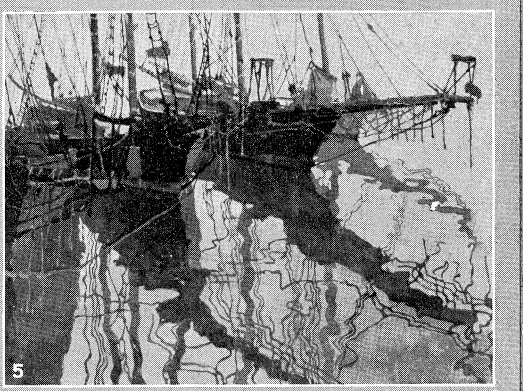
1. "The Mirror, Cos Cob" by Childe Hassam (1859–1935)
2. "Winter in Minnesota" by Adolf Dehn (1895–)
3. "Landscape" by Arthur B. Davies (1862–1928)
4. "Fishermen with Nets" by Gifford Beal (1879–)
5. "Sheep at the Gate" by John E. Costigan (1888–)
6. "Twilight of Man" by Rockwell Kent (1882–)

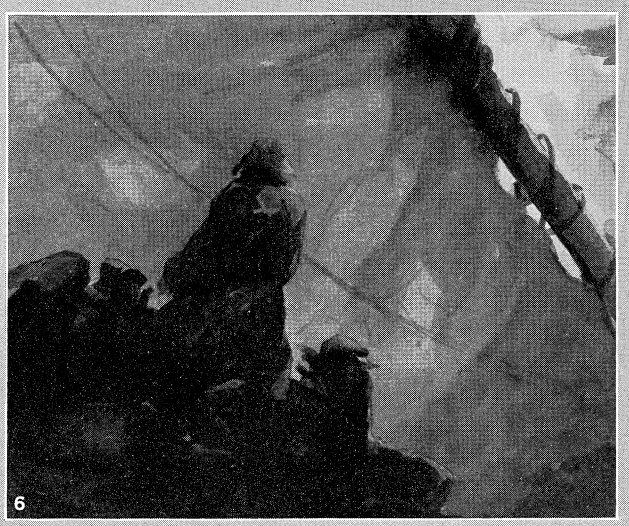
WATER-COLOUR PAINTING

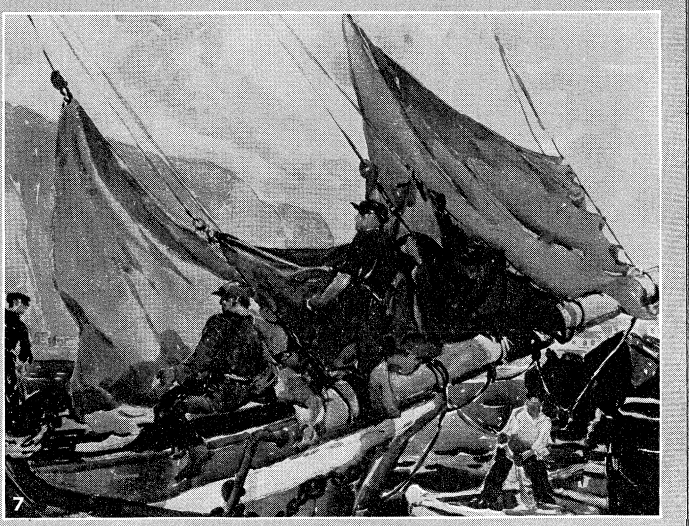












BY COURTESY OF (3) ALFRED STIEGLITZ, (7) THE BABCOCK GALLERIES

REALISTIC AND IMPRESSIONISTIC WATER COLOURS BY AMERICAN ARTISTS

1. "Mending the Net" by John R. Koopman (1881–)
2. "The Log Drive," showing lumberjacks at work, by Frank W. Benson (1862–)
3. "Becalmed," impressionistic water colour by John Marin (1875–). Modernist
4. "Voyage of Leif Ericson to America," decorative mural by Ezra Winter (1886–). In the Great Hall of the Cunard Building in New York city
5. "A Quiet Morning," tempera water colour by Félicie Waldo Howell (1897–)
6. "Broadside On" by Armin Hansen (1886–)
7. "The Free Wind" by George Pearse Ennis (1884–1936)

colour, following closely the English school and showing small promise of what it was destined to become a half-century later. Free water-colour painting did not develop until after the 60's.

The second stage began about 1850 and extended to 1890. It saw the rise of a number of great water-colourists who were destined to save the medium from death by dry rot, and encourage the present generation to renewed activity and progress.

The third and last stage (1890–1929) shows a combination of knowledge acquired from the preceding schools of painting and a keen analysis of what the art of water-colour is capable of giving the student in this medium. Over-modeled forms are being eliminated and design is valued at its proper worth. Colour takes a great place in rhythmic masses and naturalistic interpretation and meticulous workmanship is giving place to a finer conception of emotional feeling, and painters are becoming sensitized to the horrors of unintelligent imitation.

Such men as E. Leutze (1816–1868), T. P. Rossiter (1817–1871), John F. Kensett (1818–1873), S. R. Gifford (1823–1880), J. O. Eaton (1829–1875) and Thomas Hicks (1823–1890), represented a few of the well-known workers of this period. From 1850 a strongly marked development began. The artists of America saw the need of a fluent, rapid medium which could be used to gather material and as a means of study. This period saw a great development, with highlights here and there among the artists; Wordsworth Thompson (1840–1896), J. H. Dolph (1835–1903), Robert C. Minor (1840–1904), Eastman Johnson (1824–1906), Daniel Huntington (1816–1906), Thomas B. Craig (1849–1924).

1850–1890.—The period of 1850 can be called the dividing line between the older or representative form of water-colour drawing and the beginning of water-colour painting. Accurate drawing was the important quality to be obtained and this was accomplished much in the manner of the contemporary English school prior to 1850. The period between 1850 and 1890 records the birth and development of many painters of genius, with a decided flair for clear water-colour painting. This method of laying on colour directly and achieving deep, rich tones at the first stroke sadly upset the older and more conservative manner of building up contrasts by stages. The direct handling of flashing contrasts forced the opaque water-colour from the important exhibitions. The use of Chinese-white lowered the brilliance and purity of water-colour, giving it a chalky dull effect.

John La Farge (*q.v.*), famous for his decorative work, used water-colour to make his designs for stained glass, mosaic and mural painting. His drawings and water-colour paintings done in the South Seas enriched the art of the United States. Other painters who have left their impression on the art of America and whose work is appreciated were Edwin A. Abbey (1852–1911), who used the medium in planning many large decorations; Robert Blum (1857–1903), Carleton T. Chapman (1860–1925), Harry Chase (1853–1890), Wm. M. Chase (1849–1916), William Hart (1823–1894), Francis C. Jones (1857–1932), Arthur I. Keller (1867–1924), George H. McCord (1849–1909), F. D. Millet (1846–1912), J. Francis Murphy (1853–1921), who painted beautiful water-colours, mostly landscapes, subtle and atmospheric; Edward H. Potthast (1857–1927), whose work was clear and fresh, won many prizes during his lifetime and took a great interest in water-colour; Walter Shirlaw (1838–1909), noted in his day; William T. Smedley (1858–1920); F. Hopkinson Smith (1838–1915), who was an engineer, artist and author, self-taught in the art of water-colour painting. Besides being an artist of note, he built the foundations for the "Statue of Liberty" and many other engineering works of importance. H. Vance Swope (1879–1925), used a mixed medium, almost opaque water-colour. His work had power and design. George H. Hallowell (1871–1927) used a scrub method and achieved delightful texture and colour. His life and work were centred around Boston.

Winslow Homer (1836–1910). In tracing the work of Homer (*q.v.*) through his early drawings and sketches, one is impressed with his steady advance from drawing in water-colour into the finer art of painting in this medium. Masses became more simple and colour cleaner. His water-colours were always well in advance of his oils, which makes it clear that water-colour is the most distinguished of all mediums and requires the most complete knowledge of the master artist.

John Singer Sargent (1856–1925) was born at Florence, Italy, of American parentage, and while he was educated in Europe and lived a good part of his life there, his work, and especially his water-colours, has exerted a great influence on the art of this generation in America. His clear and brilliant quality of painting offered encouragement to other painters and helped keep the medium alive. He is quoted as saying that water-colour was his best medium and capable of greater artistic expression than oil. (*See* Sargent, John Singer.)

Horatio Walker (1858–1938), born at Listowel, Ont., Canada, was a strong and vigorous painter who used water-colour with fine distinction. His work shows atmosphere and quality and he used the every-day life of farm and countryside for his subjects and understood its character, investing this life with a quaint and romantic air. While he worked largely in Canada, most of his work was exhibited in the United States and especially in New York.

John Ward Dunsmore (1856–1945), was born near Cincinnati, Ohio. The work of this artist, while careful in detail, shows a rich quality of tone and colour. It is largely historical, with much material used from the American Revolution; he produced large groups of figures, well composed and fine in spirit. He held his way undisturbed, reflecting little of the modern day manner. Dunsmore received his training in France and returned to America to organize the Detroit Art Museum and School. As president of the American Water Color society for many years, he gave much of his time to bring the society to its high plane.

Henry B. Snell (1858–1943) contributed largely to water-colour painting. His work is beautiful in tone and composition. He most always used a scrub method for which he was largely responsible, being its leading exponent both in England and in America. His work has great depth of colour and reflects a luminous feeling of light; edges are softened, thereby regaining the decorative sense of paint which was lost in a hard rendering of things. Snell was born in Richmond, Surrey, England, in 1858. He taught painting for many years and had a great influence on other artists. He was one of a younger group of painters who broke away from the American Water Color society to form the New York Water Color club.

Arthur B. Davies (1862–1928), and Frank W. Benson were born in the same year; Davies in Utica, N.Y., and Benson in Salem, Mass. Both of these painters impressed a fine and spontaneous art on their country. Davies' work carries a mystery and romance, not realistic, but filled with atmosphere and beauty of design. Both his landscape and figure groups are noteworthy. He used nude figures set in a romantic landscape, decorative and with rich, fine colour. Frank W. Benson uses most mediums, but his water-colours have a direct charm and a spontaneity of handling, crisp and rich, and luscious in colour, which is direct water-colour painting at its best.

Childe Hassam (1859–1935) was a painter of many moods and mediums. Water-colour was his vehicle of spontaneous expression from the beginning of his artistic career, covering a period of forty years. Breadth of colour and an impressionistic manner, broken colour closely tied together and washes beautifully spotted in, tend to give a fine sparkle to his pictures. He was the first president of the New York Water Color club, organized in 1890, serving six years.

Dodge MacKnight (1860–) is noted for his broad treatment and brilliant colouring. He had a strong influence over Boston painters, tending to loosen the tightness of the Boston school of water-colourists. Reds and violet blues were dominant notes in his work, running sometimes almost to monochrome, but always saved by a complement, giving his pictures a brilliant quality.

William Ritschel (1864–), born in Nuremberg, Germany, worked through many phases from the older methods of superimposed tone on tone to get depth, to a direct and sparkling wash of broken colour.

Maurice Prendergast (1861–1924) belongs to the same period but his work has been developed and relates to the Persian rather than the Chinese manner, direct in handling but highly imaginative patterns backed by high colour suggesting mosaic glass.

Sigurd Skou (1877–1929), Gifford Beal (1879–), Rockwell Kent (1882–), John E. Costigan (1888–), and John R. Koopman (1881–) use a fast and direct method and are interested in design first and colour second. Possibly Beal thinks more of tonality than the others. George Elmer Browne enters this same group, but with a broader handling of swift, wet colour used simply. Browne has taught painting for many years and has had a decided influence on young American painters. He was educated in Paris. Kent has the most striking sense of design in this group, while Koopman, subjecting colour to a decorative treatment rhythm, plays a strong part in creating this feeling. He paints and draws in water-colour and treats of broken pattern and colour, design translated to pattern, fresh and rich in handling. Costigan achieves beautiful water-colour handling daringly on smooth paper.

John Marin (1875–) started from a conservative form of painting and steadily developed a swift and subjective manner in his late work. Objective things have little place in his scheme. This intense effort to throw off the representative type so dominant for many years and work inward, not outward, causes one to wonder what the ultimate answer will be.

Chauncey Ryder presents another phase, not exactly realistic but rather decorative and free, treating mountains and trees in an extremely simple manner.

Other water-colourists who are enriching the art of the present time are Emerton Heitland, a modern painter in water-colour, brilliant in style; Frank Hazell, who used tempera with force and freedom; J. Scott Williams, who uses clear water-colour with effect; and John Alonzo Williams, who illustrates and paints in a rich manner. John Goss, Emil J. Bistran, Paul Gill and Edward Hopper work in a direct and characteristic way, putting down their impressions with power, keenly observing the salient points of interest and never becoming commonplace. Harley Perkins achieves pattern and colour in an extremely modern way. William J. Aylward, Arthur Beaumont, Roy Brown, Julius Delbos, Sir Lloyd C. Griscom and Frank Tenney Johnson present work of distinction. Charles W. Hawthorne (1872–1930) used water-colour with liquid flowing effects.

George (Pop) Hart (1868–1933) and Eugene Higgins search out the heavy, gloomy feeling in life, both painting in a dark, strong manner. Walter Farndon views water-colour as a helper to his oils, sketchy and rather light in colour. Oscar Julius, Wayman Adams, Charles S. Chapman, Alpheous P. Cole, E. Irving Conse, Frederick K. Detwiller, Jonas Lie, George Laurence Nelson, G. Glenn Newell, Raymond Perry, Arthur E. Powell, Ernest D. Roth, W. Granville-Smith, Stanley W. Woodward, Cullen Yates, Frank N. Wilcox, J. Lars Hoftrup and Howard Giles, Gordon Grant and Herbert B. Tschudy represent a few of the many water-colourists of note. Armin Hansen (b. 1886) paints the sea with fine feeling. Ezra Winter uses water-colour to plan and design the decorations which he finally paints in oil or fresco. His work has excellent mural quality; formal design holds a strong place in his field. He uses one of the methods employed by the Pompeians.

William J. Whittemore is a landscape and figure painter who has for many years been a devotee of this medium. His recent work is free and colourful, and has a fine quality. William Starkweather, a vigorous painter, spares no trouble in finding interesting motives, unusual and rich in colour. He is a personage in this field. Harry Vincent (1864–1931), another water-colourist, used the sea and boats to create luscious and fluid combinations of colour. George Walter Dawson, professor of drawing at University of Pennsylvania, is widely known as a water-colourist. J. Olaf Olson and Felicie Waldo Howell (1897–) are younger artists who have shown the great possibilities of water-colour.

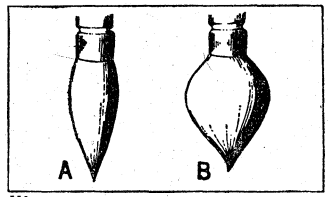
TECHNIQUE

The materials used in painting in water-colour become of prime importance if the richness and purity of colour is to be achieved. This calls for a short but brilliant palette. Seven or eight colours suffice to give the greatest range and flexibility of handling, making it possible for the painter to force the key at any desired area on his paper. The medium must be liquid and free to gain beauty and texture. The artists of the Sung dynasty carried much of the same fresh directness that is being achieved to-day, and they took great care and trouble in the making of their materials. The artist of the present time uses a much more brilliant palette; consequently his troubles increase, as it is doubly important to have all materials of the best.

To begin with, a box to hold the colour is an important matter. It should be convenient, not too large to handle, and be both palette and colour container; it should be a folding box, having preferably two lids, one flat which folds over the first, and then the outer cover which should contain three or four wells or sinks where one can mix colour or gather a pool if there is a large surface to cover.

It is wise to procure a separate holder for the brushes and pencil, and to carry the tubes of paint separately. Tube colour is better than pans of colour, because it can be squeezed out as needed and the colour is always fresh, one of the most important factors in this difficult art. With the exception of vermilion, which must have time to set, otherwise it runs throughout the box, the various colours used can be put out when ready to work. So-called pan colour is of little use and is almost always dried out when bought. Tube colour is much more economical, keeps better, and if the cap is put on tight, will not dry out.

The Use and Care of Brushes.—One large brush, red sable, will do the work of five small ones. One No. 10 or No. 12 brush will do the finest or broadest kind of work. It is well to wash the sable in warm water and soap at various times, as the paint rots the hairs. Dip the brush in water and see if it tapers to a fine point, wedge-shaped, almost straight from tin to point, and not curved (*see* figure). A fat, curved brush seldom acts well in handling, and does not last. It becomes a club after the point wears down. Some water-colour artists use three or four different-sized brushes, but the mastery of one brush means considerable progress. The wedge-shaped brush will spread as well as the curved brush, and can be controlled much better. The curved brush kicks up edges and sometimes needlessly separates. The mere matter of holding a brush is very important to the novice in water-colour painting.



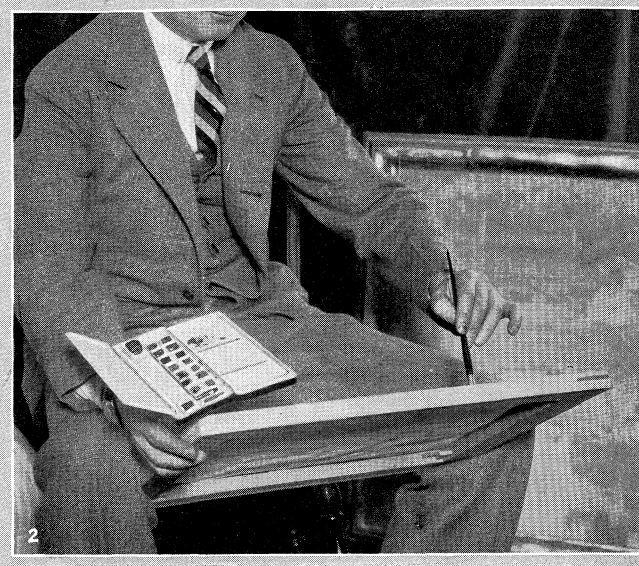
WATER-COLOUR BRUSHES; (A) CORRECT SHAPE, (B) INCORRECT SHAPE

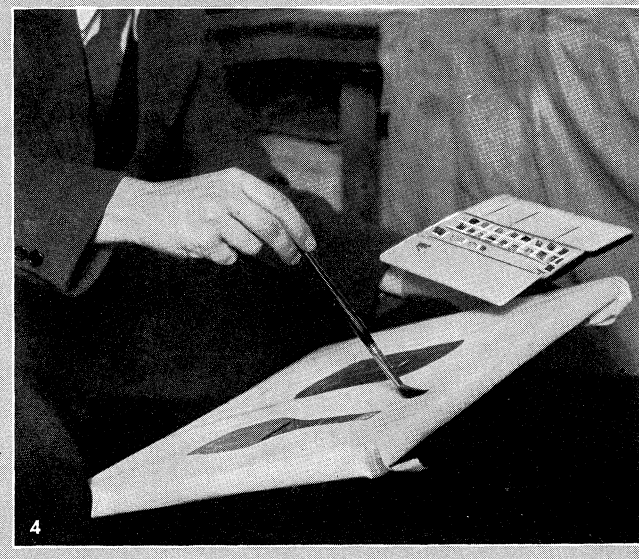
The Chinese spent years in cultivating the use of their brushes, how to hold them, acquiring a dexterity of handling far beyond that of many of our modern artists. They wrote with the brush and also painted with it, painting with the greatest breadth or with the most exacting minuteness. (*See* ART: *Far Eastern Methods.*)

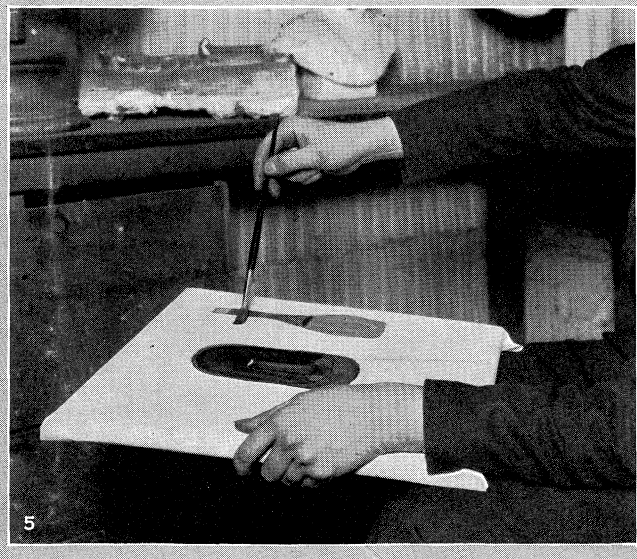
In holding the brush, it is necessary to use not only the fingers but the entire arm and wrist, taking care not to choke the brush by grasping it down close to the tin. When it is held in such a manner, only the fingers operate; the rigid arm means a loss in freedom. The brush should be held as far from the hair as possible, and kept as nearly at a right angle to the paper as possible. This makes for great variety, flexibility, and carries the colour to the paper with dexterity. In taking up colour from the box a charged brush is of supreme importance, whether the colour be pale or of the deepest intensity. A full brush means depth; a thin brush means a tint, and tinting is not, in the fullest meaning of the term, water-colour painting.

A flooded colour, light or dark, has a much greater beauty and vibration. Dark detail can be struck over a lighter mass with a charged brush, without wiping up the colour underneath or disturbing it; when colour is used thinly it loses lustre. The paper should not be held flat, as colour will puddle and not flow as it does when held at a 45° angle; flood-colour helps to give variation and texture, and also better represents light. Just as will be observed in fine stained-glass, the upper edge will be light in colour and the lower edge rich and glowing. The colour should really flow from the brush onto the paper and be luminous, not thin and pasty.

Selection of Colours.—This subject is extensive and full of pitfalls. Naturally, the dealer desires to sell as many different







RELATIVE POSITIONS OF PAPER, PAINT BOX AND BRUSH IN WATER COLOUR WORK

1. In applying a wash as is illustrated here, and in fact throughout water-colour painting, the brush should be full of colour which flows easily, and the arm should have a free movement in any direction. 2. In the painting in of detail a brush perpendicular to the painted surface permits movement in any direction. If the brush is slanted and the painter attempts to do a curve such as a circle, it will stutter when it is pushed forward and draw more finely when it is pulled back. 3, 4. The proper method of holding the paint-box and the paper, showing a slight canting of the brush in the direction of the stroke. 5. Some painters prefer the paper to be nearly horizontal, which permits an even freer use of the perpendicular brush. Note that the hand is some distance from the ferrule. 6. Showing method of stretching water colour paper on frame

shades and hues of colour as possible. The artist's task is to select exactly the smallest number of colours which will give complete range and effect.

Three primary colours are the first necessity: red, yellow and blue. Three secondary colours complete the range: orange, violet, green. The warm colour scale is comprised in the red, yellow and orange. The complements represent the cool scale. This is the theory of warm and cool colour. If we select a rose madder for our red, an ultramarine blue and a cadmium yellow, this set of three calls for supplementary assistants. The rose madder needs a yellow red, so vermilion is added, as it helps to reach the yellow spectrum. Cobalt blue assists French ultramarine blue and a pale yellow forms the link between yellow and green. The cadmium yellow can be omitted and cadmium pale substituted in its place. Adding green deep, the artist has a complete range of colour, from deep to light and from warm to cool. Cerulean blue will also be found useful.

Water-Colour Palette

Rose Madder	*French Ultramarine Blue*
Vermilion	*Cobalt Blue*
Cadmium Pale	*Hookers Green Deep II.*
Cadmium Yellow	*Cerulean Blue* (a cold blue green)

This palette will be found clear and brilliant and will enable one to paint in a very deep, full-toned manner or in a very pale and high-keyed pitch; it also has the value of being short and easily handled. The three primary colours "carry" the picture, and the remaining colours complete the tone scale and envelop the picture.

Hooker's green, No. 2, has many advantages over other greens, since it is deep, clear, cool, and mixes readily with the other colours of this palette. It will mix with yellows without turning into mud, as most greens do. Cerulean blue melts into ultramarine and cobalt blue, and cools them. When used with vermilion it makes a beautiful grey. It is interesting to put down vermilion and then carry the cerulean to it directly from the box and mix on the paper. This gives a better variety. It also helps to make transparency in the gray, for while vermilion is inclined toward opacity, it clears when the brush is charged and flushed directly into blues. When it is desired to make rose madder flash, cerulean blue can be charged into it in the above manner, but not if the madder has dried.

Of the eight colours above mentioned, six or seven will always be in active use. The water-colourist should resist as much as possible the impulse to work over a tone. If its depth at first is questioned, he should charge the surface again, thereby increasing its weight. It is a wise practice to establish the contrast or deepest notes at the beginning of the picture, saving all light masses, as white paper, until near the finish. This makes optional the matter of holding the contrasting masses or pressing them down with tone or warm light, as the subject may require. Save or spare the whites. Do not dull them. At the finish they can be tinted.

The picture must be carefully planned, drawn as simply as possible, not modelled in pencil or shade, and designed as one would design a pattern, giving due thought to the rhythm of line and mass. When the enveloping process begins, as mentioned earlier, the main masses should be preserved, since this maintains the carrying power. Light or dark masses should not be cut up too much, as this results in chaos and gives the feeling of over-abundance in the picture. When a colour occurs in a mass, say red or blue, let the clear colour flash to the surface somewhere, as that produces light and brilliance. If a red appears in a mass, repeat it again elsewhere in a minor chord. Other colours should reach in like manner. Do not try to over-model clear tones; simply maintain them.

(*See* PAINTING.)

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WATER-CRESS (*Nasturtium officinale*), an aquatic salad-plant of the family Cruciferae, native to Europe and Asia, common in Great Britain, widely naturalized in the United States and Canada and introduced also into the West Indies and South America. It is a creeping or floating perennial, rooting in clear, cold running water, with leaves composed of few to several small rounded leaflets and elongated clusters of small white flowers. Its slightly pungent flavour is due to an oil containing sulphur. Water-cress is cultivated for the market in shallow streams or pools prepared in wet, low-lying meadows, provision being made for flooding at will. It can be propagated either from seeds or by planting stem cuttings. Its use as a garnish or a green salad is widespread but only small quantities are grown commercially.

WATER DEER, *Hydropotes inermis,* a small, harsh-haired deer from eastern China and Korea, differing from all other Cervidae except the musk deer (with which it has no special affinity) by the absence of antlers in both sexes. Instead the males are armed with long, daggerlike upper tusks (*see* DEER). Four to seven young are born at a time, a unique condition for the Ungulata. Water deer frequent the neighbourhood of the large Chinese rivers, where they crouch amid the reeds and grass. When running, they arch their backs and scurry away in a series of short leaps. This is one of the few deer in which there are glands neither on the hock nor on the skin covering the cannon-bone. These glands probably enable deer to ascertain the whereabouts of their fellows by the scent they leave; but the subaquatic habits of the present species render such a function impossible. The tail is a mere stump. (J. E. HL.)

WATERFALL, a point in a watercourse where descent is perpendicular or nearly so. The beauty of a waterfall is dependent on its height rather than on the volume of water. Small but immensely deep falls are common, for a small stream has insufficient power to erode a steady slope, and thus any considerable irregularity of level in its course is marked by a fall. In mountainous districts a stream may descend into the main valley as a "hanging tributary" by way of a fall, its own valley having suffered less erosion than the main valley. The chief cause of a waterfall is a sudden and marked change in geological structure. For example, if a stream crosses a harder stratum it will be able to grade its course through the upstream or downstream soft strata more rapidly than through the intermediate hard stratum, over a ledge of which it will subsequently fall. Such barriers may be produced by the ordinary rock sequence or by an intrusive dyke of basalt, or by glacial deposits. Where a river falls over a shelf of hard rock overlying softer material there is a rapid erosion of the soft rock, with undercutting and consequent collapse of the edge of the hard shelf. In this way, the fall gradually moves upstream and a gorge occurs below it; the Niagara Falls provide an excellent illustration of this process.

WATER FLEA, a name given by the earlier microscopists (Swammerdam, 1669) to minute aquatic Crustacea (*q.v.*) of the order of Cladocera, but applied also to the smaller members of other groups. The Cladocera are abundant everywhere in fresh water. One of the commonest species, *Daphnia pulex,* found in ponds and ditches, is less than one-tenth of an inch in length and has the body enclosed in a transparent bivalved shell. The head, projecting in front of the shell, bears a pair of branched feathery antennae which are the chief swimming organs and propel the animal, in a succession of rapid bounds, through the water. There is a single large black eye. In the living animal five pairs of leaf-like limbs acting as gills can be observed in constant motion between the valves of the shell, and the pulsating heart may be seen near the dorsal surface, a little way behind the head. The body ends behind in a kind of tail with a double curved claw which can be protruded from the shell. The female carries the eggs in a brood-chamber between the back of the body and the shell until hatching takes place. Throughout the greater part of the year only females occur and the eggs develop "parthenogenetically," without fertilization. When the small males appear, generally in the autumn, fertilized "winter" or "resting eggs" are produced which are cast adrift in a case (ephippium) formed by a specially modified part of the shell. Resting eggs enable the race to survive droughts and freezing. (*See* BRANCHIOPODA). (W. T. C.)

WATERFORD, a county of Eire in the province of Munster. The area of Waterford is 454,278 acres, or about 710 sq.mi.

Pop. (1936), exclusive of Waterford City, 49,646 (total 77,614). The coast line is in some parts rocky and is indented by many bays and inlets, the principal being Waterford Harbour; Tramore Bay, with picturesque cliffs and extensive caves, and noted for its shipwrecks on account of the rocky character of its bed, Dungarvan Harbour, much frequented for refuge in stormy weather, and Youghal Harbour, partly separating Co. Waterford from Co. Cork. The surface of the country is to a large extent mountainous, providing beautiful inland scenery, especially toward the west and northwest. The Knockmealdown Mountains, which attain a height of 2,609 ft., form the northern boundary with Tipperary. A wide extent of country between Clonmel and Dungarvan is occupied by the two ranges of the Comeragh and Monavallagh Mountains, reaching a height of 2,504 ft.

To the south of Dungarvan there is a lower but very rugged range, called the Drum Hills. The south-eastern division of the county is for the most part level. Though Waterford benefits in its communications by the important rivers in its vicinity, the only large river it can properly claim as belonging to it is the Blackwater. This river is famous for salmon fishing, and, particularly in the stretch between Cappoquin and Lismore, flows between high, well-wooded banks, contrasting beautifully with the background of the mountains. It enters the county east of Fermoy, and flows eastward to Cappoquin, the head of navigation, where it turns abruptly southward, to enter the sea at Youghal Harbour. Waterford Harbour may be called the estuary of three important rivers, the Suir, the Nore and the Barrow, but neither of the last two touches the county. The Suir reaches it about 8 m. from Clonmel, and thence forms its northern boundary with Tipperary and Kilkenny. It is navigable to Clonmel, but the traffic lies mainly on the left bank, outside the county.

Geology.—The Knockmealdown Mountains are an anticline of Old Red Sandstone, cut away at the eastern end to expose Silurian strata, which are associated with an extensive series of volcanic and intrusive rocks, often crushed by earth-movement. The impressive scarp formed by the Old Red Sandstone conglomerate above this lower ground is called the Comeragh Mountains. The moraine-dammed cirque of Lough Coumshingaun lies in these, with a precipice 1,000 ft. in height. The unconformity of the Old Red Sandstone on the greenish and yellowish Silurian shales is excellently seen on the north bank of the Suir at Waterford. Carboniferous Limestone is found in the floor of the synclinals on either side of the great anticline, that is, in the Suir valley on the north, and in the green and richly-wooded hollow of the Blackwater on the south. Rapidly repeated anticlinal and synclinal folds continue this structure across the country between Dungarvan and Youghal. Rich copper-mines were worked, mainly in the 19th century, in the Silurian area near Bonmahon, and the region remains full of mineral promise.

History.—In the 9th century the Danes landed, and afterwards made a permanent settlement. Waterford was one of the twelve counties into which King John is stated to have divided that part of Ireland which he nominally annexed to the English crown. On account of the convenience of the city as a landing place, many subsequent expeditions passed through the county. In 1444 the greater part of it was granted to James, earl of Desmond, and in 1447 it was bestowed on John Talbot, earl of Shrewsbury, who was created earl of Waterford. The county suffered severely during the Desmond rebellion, in the reign of Elizabeth, as well as in the rebellion of 1641 and during the Cromwellian period. At Ardmore, overlooking the sea from Ram Head, there is a round tower 95 ft. in height, and near it a huge rath and a large number of circular entrenchments. Lismore castle, originally erected in 1185, is in great part comparatively modern. The chief ecclesiastical remains are those of the chancel and nave of the cathedral of Ardmore, where a monastery and oratory were founded by St. Declan in the 7th century. The see of Ardmore was abolished in the 12th century. Here are also remains of a church and oratory, and a holy well. Mention should be made of the existing monastery of Mount Melleray, a convent of Trappists founded near Cappoquin in 1830, on the expulsion of the foreign members of this order from France. Schools, both free and boarding, are maintained; and there is a branch of the order at Roscrea (co. Tipperary).

Agriculture and Industries.—The land is generally better for pasturage than for tillage, although there are considerable tracts of rich soil in the southeastern districts. In 1939 there were 44,576 ac. in crops, 27,337 ac. in hay and 229,001 ac. in pasture. Of the crop acreage well over half was planted to corn crops, mostly oats (17,563 ac.), and less than half to root and green crops. Of the latter, potatoes, turnips and mangels were the most important.

The size of farm holdings in the county average larger than for Ireland in general. The county ranked second among Irish counties in 1926 in the number of its cattle, but by 1939 Waterford's position had fallen considerably. The woollen manufacture, except for home use, is practically extinct, but the cotton manufacture is still of some importance. There are a number of breweries and distilleries and also a large number of flour-mills. The deep sea and coast fisheries have their headquarters at Waterford, and the salmon fisheries of the Suir and Blackwater have theirs at Waterford and Lismore respectively. Railway communication is provided by the Great Southern railway. Waterford returns 4 members to Dáil Eireann.

WATERFORD, the chief town of County Waterford, Eire. Pop. (1936) 27,968. It is situated on the Suir 4 mi. above its junction with the Barrow at the head of the tidal estuary called Waterford Harbour. The Suir is crossed by a wooden bridge of 39 arches, and 832 ft. long, connecting Waterford with the suburb of Ferrybank. Waterford is governed by an elected council and a manager who is appointed by the central government. The manager's extensive powers are limited by the council's authority over rates, by-laws and loans.

Anciently Waterford was called *Cuan-na-groith,* the haven of the sun. By early writers it was named Menapia. It first acquired importance under the Danes, of whom it remained one of the principal strongholds until its capture by Strongbow in 1171. In 1172 Henry II. landed near Waterford, and received here the hostages of the people of Munster. It became a cathedral city in 1096. The Protestant dioceses of Cashel, Emly, Waterford and Lismore were united in 1833. John landed at Waterford in 1185. After ascending the English throne he granted it a fair in 1204, and in 1206 a charter of incorporation. He landed at Waterford in 1210, in order to establish within his nominal territories in Ireland a more distinct form of government. The city received a new charter from Henry III. in 1232. Richard II. landed at Waterford in Oct. 1394 and again in 1399. In 1447 it was granted by Henry VI. to John Talbot, earl of Shrewsbury, who was created earl of Waterford. In 1497 it successfully resisted an attempt of Perkin Warbeck to capture it, in recognition of which it received various privileges from Henry VII.

In 1603, after the accession of James I. to the English crown, the city, along with Cork, took a prominent part in opposition to the Government and to the Protestant religion, but on the approach of Mountjoy it formally submitted. From this time, however, the magistrates whom it elected refused to take the oath of supremacy, and, as by its charter it possessed the right to refuse admission to the king's judges, and therefore to dispense with the right of holding assizes, a rule was obtained in the Irish chancery for the seizure of its charter, which was carried into effect in 1618. In 1619 an unsuccessful attempt was made to induce Bristol merchants to settle in the city and undertake its government, and in 1626 the charter was restored. The city resisted Cromwell in 1649, but surrendered to Ireton in 1650. After the battle of the Boyne James II. embarked at it for France (July 1690). Shortly afterwards it surrendered to William, who sailed from it to England. It sent two members to parliament from 1374 to 1885, when the number was reduced to one. In 1898 it was constituted one of the six county boroughs having separate county councils.

The city is built chiefly along the banks of the river, occupying for the most part low and level ground except at its western extremity. The modern Protestant cathedral of the Holy Trinity,

generally called Christ Church, occupies the site of the church built by the Danes in 1096, in the Mall. Near it are the episcopal palace and deanery. There is a Roman Catholic cathedral, and St. John's college, a training seminary for priests. The principal secular buildings are the town-hall, the county and city courts and prisons, the custom-house and the barracks. At the extremity of the quay is a large circular tower, called Reginald's tower, forming at one time a portion of the city walls, and occupying the site of the tower built by Reginald the Dane in 1003. Other remains of the fortifications, consisting of towers and bastions, are to be seen as in the Tramore railway sidings and in Castle street. The leper house, founded in the reign of King John, is now used practically as an infirmary. The town possesses breweries, salt-houses, foundries and flour mills; and there is a large export trade in cattle, sheep and pigs, and in agricultural produce. It is the headquarters of extensive salmon and sea fisheries. Waterford is second in importance to Cork among the ports of the south coast of Ireland. There is regular communication by steamer with Cork, with Dublin and Belfast, with Fishguard and with many English ports.

Waterford harbour is a winding and well-sheltered bay formed by the estuary of the river Suir, and afterwards by the joint estuary of the Nore and Barrow. Its length to the sea is about 15 miles. Its entrance is 3 m. wide, and is lighted by a fixed light on the ancient donjon of Hook Tower (139 ft. in height) and others. The natural harbour is formed by the Suir from Waterford to its confluence with the Barrow and thence to the sea, a distance of 18 miles. The entrance is 3 m. wide. The Suir is navigable to Waterford for vessels drawing 22 ft. The shores of the harbour are studded with country residences and waterside villages, of which Passage and Duncannon are popular resorts of the citizens of Waterford.

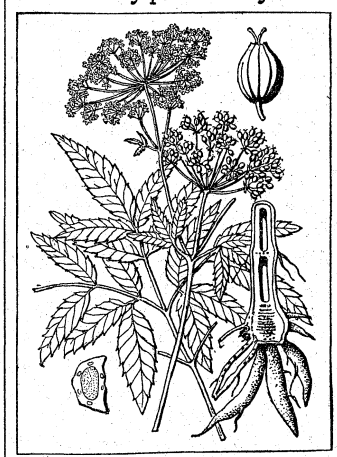
See C. Smith's *Antient and Present State of the County and City of Waterford* (1746); R. H. Ryland, *Topography and Antiquities of the County and City of Waterford* (1824); P. M. Egan, *Guide to Waterford* (1896); Power, *Parochial History of the Diocese of Waterford and Lismore* (1912); E. Downey, *The Story of Waterford* (1914).

WATERFORD, a village of Saratoga county, New York, U.S.A., on the west bank of the Hudson river, near the mouth of the Mohawk river, and about 10 miles north of Albany. The population was 2,637 in 1920, 2,921 in 1930, 2,903 in 1940. Waterford is served by the Delaware and Hudson railway, and is at the junction of the Erie and the Champlain divisions of the great barge canal connecting Lake Erie and Lake Champlain with the Hudson river. There was a settlement here probably as early as 1630, and Waterford was laid out in 1784, and was incorporated as a village in 1794.

WATER GAS. When steam is passed over red-hot anthracite or coke it is decomposed, and the resultant gas, consisting of a mixture of hydrogen and carbon monoxide, is termed water gas. Enriched with gas from cracked oil, it is termed carburetted water gas and is largely employed in industrial operations. It is also used mixed with coal gas for town purposes; when so employed it increases the poisonous character of the gas supply owing to the peculiarly dangerous qualities of carbon monoxide. For full details *see* GAS MANUFACTURE and FUEL.

WATER-GLASS. A common name for sodium silicate, made by fusing together in a furnace soda ash and clean sand. The name water-glass (or soluble glass) is derived from the fact that while the substance resembles glass it can be dissolved in water by prolonged exposure. The proportions of soda and silica in water-glass may be considerably varied, according to the purpose for which it is required. (*See* ALKALI.)

WATER HEMLOCK, also known as cowbane, is botanically *Cicuta virosa,* of the parsley family, Umbelliferae, a poisonous weed growing at the edges of ponds, ditches and rivers in Great Britain. It is a perennial with clusters of fleshy roots, and has large compound leaves and small white flowers appearing from July to August. It has been mistaken by human beings for celery, with fatal results, and is responsible for the death of cattle. In North America there are several native species of *Cicuta* common in marshes and wet meadows, all similarly poisonous, especially the spotted cowbane or musquashroot (*C. maculata*) of the eastern states and Canada, and the western water hemlock (*C. douglasi*) of the Pacific coast. Before its virulence became known to cattle raisers the western species caused serious losses of livestock in the Pacific northwest. Humans are sometimes fatally poisoned by mistaking the roots for other plants.



THE WATER HEMLOCK (CICUTA MACULATA), A HERB FOUND IN SWAMPS AND LOW LANDS

The closely allied poison hemlock (*Conium maculatum*) is a biennial plant of the family Umbelliferae, found wild in many parts of Europe, where it occurs in waste places on hedge banks, and by the borders of fields. It is also widely spread over temperate Asia and is naturalized in the cultivated districts of North and South America. It is an erect branching plant, growing from 3 to 6 ft. high, from a large tap root. The stems are hollow, smooth, somewhat glaucous green, spotted with dull dark purple. The root leaves have long furrowed footstalks, sheathing the stem at the base, and are large, triangular in outline, and repeatedly divided or compound, the ultimate and very numerous segments being small, ovate and deeply incised at the edge. These leaves generally perish after the growth of the flowering stem, which takes place in the second year, while the leaves produced on the stem become gradually smaller upwards. The branches are all terminated by compound many-rayed umbels of small white flowers, the general involucres consisting of several, the partial ones of about three short lanceolate bracts. The flowers are succeeded by broadly ovate fruits, the mericarps (half-fruits) having five ribs which, when mature, are waved or crenated; and when cut across the albumen is seen to be deeply furrowed on the inner face, so as to exhibit in section a reniform outline. Humans have been poisoned by mistaking the roots for parsnips or the seeds for caraway. (W. C. M.)

WATERHOUSE, ALFRED (1830–1905), English architect, was born at Liverpool on July 19, 1830, and died on Aug. 22, 1905. He was a pupil of Richard Lane in Manchester. His earliest commissions were of a domestic nature, but his position as a designer of public buildings was assured as early as 1859 when he won the open competition for the Manchester assize courts. This work marked him not only as an adept in the planning of a complicated building on a large scale, but also as a champion of the Gothic cause. In 1868 he won the competition for the Manchester town-hall, where he showed a firmer and perhaps more original handling of the Gothic manner. The same year brought him the rebuilding of part of Caius College, Cambridge, not his first university work, for Balliol, Oxford, had been put into his hands in 1867. At Caius, out of deference to the Renaissance treatment of the older parts of the college, the Gothic element was intentionally mingled with classic detail, while Balliol and Pembroke, Cambridge, which followed in 1871, may be looked upon as typical specimens of the style of his mid career —Gothic tradition (European rather than British) tempered by individual taste and by adaptation to modern needs. Girton College, Cambridge, a building of simpler type, dates originally from the same period (1870), but has been periodically enlarged by further buildings. Two important domestic works were undertaken in 1870 and 1871 respectively—Eaton Hall for the duke, then marquis, of Westminster, and Heythrop Hall, Oxfordshire, the latter, a restoration, being of a fairly strict classic type. Iwerne Minster for Lord Wolverton was begun in 1877. In 1865 Waterhouse had removed his practice from Manchester to London, and he was one of the architects selected to compete for the Royal Courts of Justice. He received from the government, without competition, the commission to build the Natural History Museum, South Kensington, a design which marks an epoch in the modern use of terra-cotta. The new University Club—a

Gothic design—was undertaken in 1866, to be followed nearly twenty years later by the National Liberal Club, a study in Renaissance composition. Waterhouse's series of works for Victoria University, of which he was made LL.D. in 1895, date from 1870, when he was first engaged on Owens College, Manchester. Yorkshire College, Leeds, was begun in 1878; and Liverpool University College in 1885. St. Paul's School, Hammersmith, was begun in 1881, and in the same year the Central Technical College in Exhibition Road, London. Waterhouse's chief remaining works in London are the new Prudential Assurance Company's offices in Holborn; the new University College Hospital; the National Provincial Bank, Piccadilly, 1892; the Surveyors' Institution, Great George Street, 1896; and the Jenner Institute of Preventive Medicine, Chelsea, 1895. For the Prudential Company he designed many provincial branch offices, while for the National Provincial Bank he also designed premises at Manchester. The Liverpool Infirmary is Waterhouse's largest hospital; and St. Mary's Hospital, Manchester, the Alexandra Hospital, Rhyl, and extensive additions at the general hospital, Nottingham, also engaged him. Among works not already mentioned are the Salford gaol; St. Margaret's School, Bushey; the Metropole Hotel, Brighton; Hove town-hall; Alloa town-hall; St. Elizabeth's church, Reddish; the Weigh House chapel, Mayfair; and Hutton Hall, Yorks.

Waterhouse became a fellow of the Royal Institute of British Architects in 1861, and president from 1888 to 1891. In 1878 he received the royal gold medal of the institute, and was made an associate of the Royal Academy, becoming a full member in 1885 and treasurer in 1898. He became a member of the academies of Vienna (1869), Brussels (1886), Antwerp (1887), Milan (1888) and Berlin (1889), and a corresponding member of the Institut de France (1893). After 1886 he was constantly called upon to act as assessor in architectural competitions, and was a member of the international jury appointed to adjudicate on the designs for the west front of Milan Cathedral in 1887. In 1890 he served as architectural member of the Royal Commission on the proposed enlargement of Westminster Abbey as a place of burial. From 1891 to 1902, when he retired, his work was conducted in partnership with his son, Paul Waterhouse.

See Memoir in *The Builder,* Aug. 1905.

WATERHOUSE, GEORGE ROBERT (1810–1888), English naturalist, was born at Somer's Town on Mar. 6, 1810. He was educated as an architect and for a time followed his profession with great success. His real taste, however, was for entomology. In 1833 he and Frederick W. Hope founded the Entomological Society of London and Waterhouse was made honorary curator and later president. He wrote the natural history articles for Knight's *Penny Cyclopaedia.* In 1835 he became curator of the museum of the Royal Institution at Liverpool, giving this up in 1836 for the curatorship of the Zoological Society of London. He made a catalogue of the mammals in the society's museum which was published in 1838 and followed by a supplement in 1839. He declined an invitation to accompany Darwin on the famous voyage of the "Beagle," but on its return Darwin placed the mammals and the coleoptera collected on the voyage with Waterhouse for description. In 1843 he was appointed an assistant in the mineralogical branch of the department of natural history of the British Museum. Of this branch he became keeper in 1851, but in 1857 was transferred to keeper of the department of geology, which post he held until his retirement in 1880. He died at Putney on Jan. 21, 1888.

His special studies were on coleoptera and on the group Heteromera. He began in 1844 a *Natural History of the Mammalia* of which two volumes (1846–1848), treating of the Marsupialia and Rodentia, were published when the publisher found himself unable to continue the work. Waterhouse published also a *Catalogue of British Coleoptera* (1858), and contributed some 120 papers to various scientific journals. He was an indefatigable collector and greatly enriched the museums of which he was curator.

WATERHOUSE, JOHN WILLIAM (1847–1917), English painter, was the son of an artist, by whom he was mainly trained. As a figure-painter he shows in his work much imaginative power and a very personal style, and his pictures are for the most part illustrations of classic myths treated with attractive fantasy. He was an able draughtsman and a fine colourist. He was elected an A.R.A. in 1885 and R.A. in 1895. Four of his paintings. "Consulting the Oracle," "St. Eulalia," "The Lady of Shalott" and "The Magic Circle," are in the National Gallery of British Art. He died in London on Feb. 10, 1917.

See A. L. Baldry, "J. W. Waterhouse and his Work," *Studio,* vol. iv. (1894).

WATER-HYACINTH (*Eichhornia crassipes*), an aquatic herb of the pickerel-weed family (Pontederiaceae), native to tropical America and widely naturalized in warm regions. It is an emersed or floating somewhat fleshy plant, bearing smooth, nearly round, erect leaves, ½ in. to 6 in. broad, and loose clusters of pale violet, orchid-like flowers, marked with blue and yellow. The bladder-like bases of the leaf-stalks serve as floats which keep the plant high in the water. Escaping from cultivation, it has become a troublesome weed, impeding navigation in the inland waters of many warm countries, as Florida, Panamá, India, Java, Argentina and Australia. Large expenditures of labour and money on mechanical and chemical control have resulted in only temporary relief. In India water-hyacinth plants have been utilized for making paper and pressed boards. See *Science and Culture* 6:656–661 (1941).

WATERLAND, DANIEL (1683–1740), English theologian, was born at Walesby on Feb. 14, 1683. He was educated at Magdalene college, Cambridge. On Nov. 14, 1715 he became vice-chancellor of the university and in the following year was appointed chaplain in ordinary to the king. In 1720 he published *Eight Sermons in Defence of the Divinity of our Lord Jesus Christ,* preached by him in St. Paul's cathedral. In 1722 he was appointed chancellor of the diocese of York, and in 1723 appeared his *Critical History of the Athanasian Creed.* In 1730 he became archdeacon of Middlesex and vicar of Twickenham. His other major works were *Scripture Vindicated* (1730–32); *The Importance of the Doctrine of the Holy Trinity Asserted* (1734); and *Review of the Doctrine of the Eucharist* (1737). His work did much to check the increase of latitudinarian ideas within the church of England at the time. He died on Dec. 23, 1740.

WATER-LETTUCE (*Pistia stratiotes*), an aquatic plant of the arum family (Araceae, *q.v.*), very widely distributed in tropical and subtropical regions; in the United States it is native to slow streams from Florida to Texas. It is a tender, floating perennial, rarely becoming anchored by its long feathery roots. The wedge-shaped, light-green leaves form a rosette, about 6 in. broad, which is somewhat similar to a half-grown lettuce plant before the head is formed. In the cup-like centre of the rosette are borne the small white flowers. The water-lettuce is often grown in water gardens and as an aquarium plant.

WATER-LILY, a name somewhat vaguely given to almost any floating plant with conspicuous flowers, but applying more especially to the species of *Nymphaea, Nuphar,* and other members of the family Nymphaeaceae. These are aquatic plants with thick fleshy rootstocks or tubers embedded in the mud, and throwing up to the surface circular shield-like leaves, and leafless flower-stalks, each terminated by a single flower, often of great beauty, and consisting of four or five sepals, and numerous petals gradually passing into the very numerous stamens without any definite line of demarcation between them. The ovary consists of numerous carpels united together and free, or more or less embedded in the top of the flower-stalk. The ovary has many cavities and is surmounted by a flat stigma of many radiating rows as in a poppy. The fruit is berry-like, and the seeds are remarkable for having their embryo surrounded by an endosperm as well as by a perisperm. The leaf-stalks and flower-stalks are traversed by longitudinal air-passages, whose disposition varies in different species. The species of *Nymphaea* are found in every quarter of the globe. Their flowers range from white to rose-coloured, yellow and blue. Some expand in the evening only,

others close soon after noon. *Nymphaea alba* is common in some parts of Great Britain, as is also the yellow *Nuphar luteum* (*Nymphaea lutea*). The seeds and the rhizomes contain an abundance of starch, and are used in some places for food.

Nymphaea odorata, fragrant water-lily, and *N. tuberosa,* tuberous water-lily, are the conspicuous white water-lilies of eastern North America; *Nuphar advenum* is the common yellow water-lily or spatter-dock of the eastern States and Canada and *N. polysepalum,* Indian pond-lily, is its counterpart on the Pacific coast; *Brasenia schreberi,* the water-shield, with small yellow flowers, occurs across the continent.

Under the general head of water-lily are included the lotus of Egypt, *Nymphaea lotus,* and the sacred lotus of India and China, *Nelumbo speciosum,* formerly a native of the Nile, as shown by Egyptian sculptures and other evidence, but no longer found in that river. *Nelumbo luteum,* of the eastern United States, is the American lotus or water chinquapin (*q.v.*). The gigantic *Victoria regia,* with leaves 6 to 7 ft. in diameter and flowers 8 to 16 in. across, also belongs to this group. It grows in the backwaters of the Amazon, often covering the surface for miles: the seeds are eaten under the name water maize.

WATERLOO, a city of eastern Iowa, U.S.A., on the Cedar river, about 90 m. west of Dubuque and 275 m. west of Chicago. Pop. (1920) 36,230 (90% native white); 1940 federal census 51,743. It is in a rich farming and stock-raising region, and is headquarters of the Dairy Cattle congress and the National Belgian horse show. Among the manufactures are tractors, engines and dairy separators. The number of manufacturing establishments in 1941 was 107, the number of wage earners 12,103, the value of products $150,000,000 and the industrial pay roll was increased to $18,000,000 annually. The river here is 700 to 900 ft. wide; its clear water flows over a limestone bed through a rather evenly sloping valley in the middle of the city with enough fall to furnish valuable water power. The city is served by the Illinois Central (which has large construction and repair shops here), the Chicago, Rock Island and Pacific and the Chicago Great Western. The city was founded about 1846, laid out in 1854 and chartered in 1868. It doubled its population between 1890 and 1900, more than doubled it between 1900 and 1910 and increased it 36% between 1910 and 1920.

WATERLOO CAMPAIGN, 1815. On Feb. 27, 1815, Napoleon set sail from Elba with a force of 1,000 men and 4 guns, determined to reconquer the throne of France. On March 1 he landed near Cannes, and proceeded at once to march on Paris. He deliberately chose the difficult route over the French Alps because he recognized that his opponents would neither expect him by this route nor be able to exert combined operations in time to thwart him. Events proved the wisdom of his choice. His advance was a series of triumphs, his power waxing with every league he covered, and when he reached Paris the Bourbons had fled. But he had soon to turn his attention to war. His sudden return far from widening the breaches between the allies had fused them indissolubly together, and the four powers bound themselves to put 150,000 men apiece under arms and to maintain them in the field until Napoleon had been utterly crushed. To oppose their vast armies, Napoleon only had in March the 150,000 men he had taken over when Louis XVIII. hurriedly quitted the throne. Within ten days the emperor could have concentrated 50,000 men and struck straight at the small allied forces then in Belgium. But he wisely refrained from taking the immediate offensive. Such action could lead to no decisive result; and Napoleon therefore hastened forward the organization of an army with which to confront the Seventh Coalition. Meanwhile he sought by various means to detach Great Britain and Austria from the alliance.

Napoleon's Preparations and Plans.—By June 1 Napoleon had got together an army of 360,000 for the defence of France, one half of which was available for field service. In this army was comprised his whole means of defence; for he had no allies. On his return from Elba it is true Murat, the king of Naples, took his side; but recklessly opening an offensive campaign, Murat was beaten at Tolentino (May 2–3), and he found himself compelled to fly in disguise to France, where the emperor refused to give him an audience or employment. Napoleon thus deprived himself of the most brilliant cavalry soldier of the period. Murat's disaster had left the whole eastern frontier of France open to invasion. The country, too, was weakened by internal dissensions at the very moment when it was necessary to put every man in line to meet the rising tide of invasion.

In Belgium lay an ever-increasing force of Anglo-Dutch and Prussian troops under Wellington and Blücher. The eastern frontier was threatened by Austrian armies, and the Russians were slowly coming up. The allies determined to avoid any risk of defeat in detail. It was arranged that Wellington and Blücher should await in Belgium the arrival of the Austrians and Russians on the Rhine. Then about July 1 the general invasion of France would be begun. Affording each other mutual support, the allies would press forward on Paris, and, after defeating Napoleon, drive him within its works. This menacing danger forced Napoleon to strike prematurely, for he determined to crush Wellington and Blücher, whose forces lay dispersed in Belgium, before the Austrians and Russians poured across the eastern frontier.

In the early days of June Wellington and Blücher were disposed as follows. (*See* map.) The Anglo-Dutch Army, 93,000, headquarters at Brussels, were cantoned: I. Corps (Prince of Orange), 30,200, in the area Enghien-Genappe-Mons; II. Corps (Lord Hill), 27,300, in the area Ath-Audenarde-Ghent; reserve cavalry (Lord Uxbridge), 9,900, in the Dendre valley; whilst the reserve (Wellington), 25,500, lay around Brussels. The front was watched by Dutch-Belgian light cavalry.

Blücher's Prussian Army, 116,000, headquarters at Namur, were quartered: I. Corps (Zieten), 30,800, along the Sambre covering Fontaine l'Evêque-Fleurus-Moustier; II. Corps (Pirch), 31,800, in the area Namur-Hannut-Huy; III. Corps (Thielemann), 23,900, in the bend of the Meuse from Dinant to Huy; IV. Corps (Bülow), 30,300, around Liége. The front was watched by the Prussian outposts.

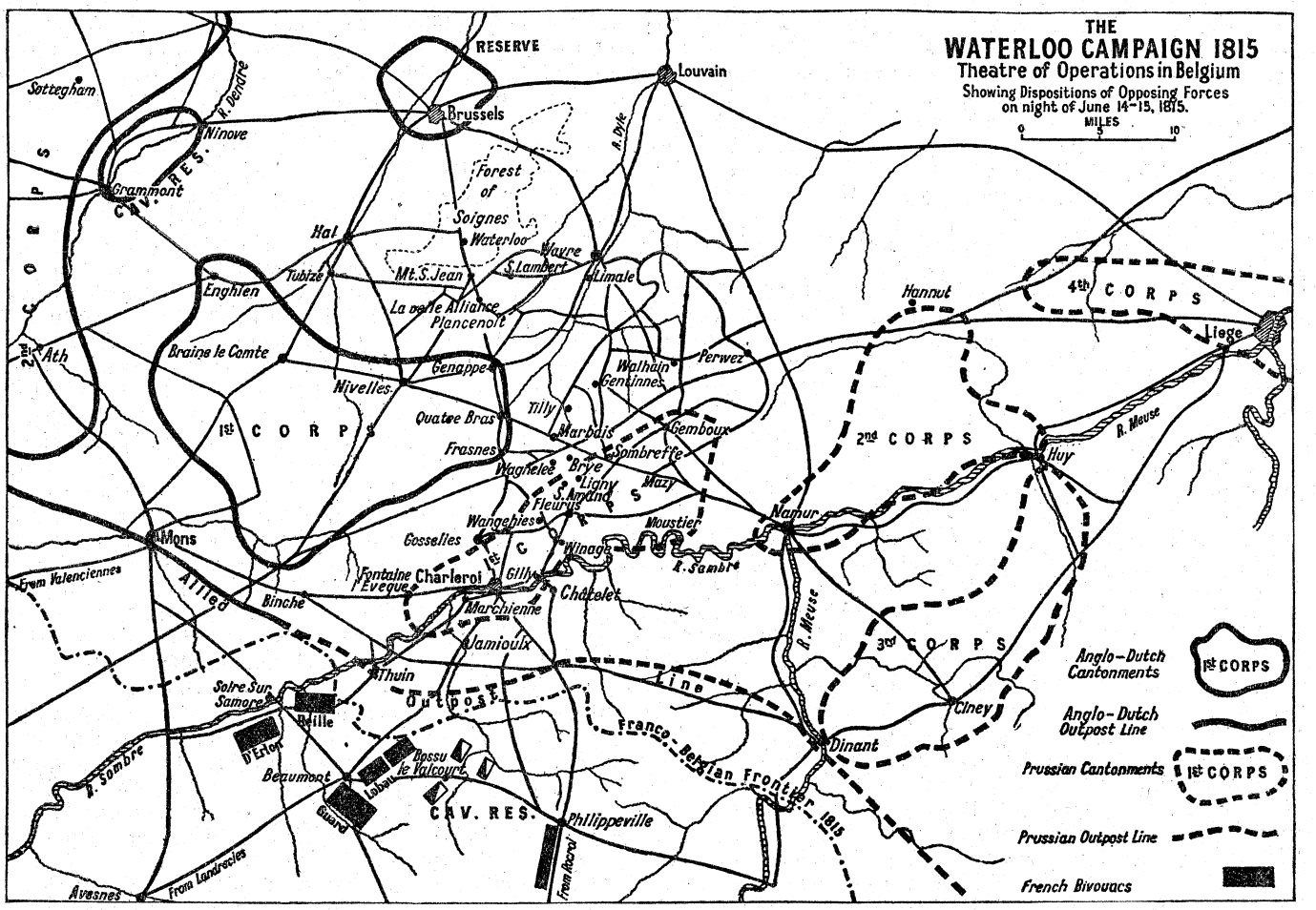
Thus the allied cantonments extended for nearly 90 m. and their mean depth was 30 m. To concentrate on either flank would take six days, and on the common centre, Charleroi, three days.

The allies had foreseen the very manoeuvre that Napoleon decided to adopt, and if an attempt was made to break their centre they intended to concentrate forwards and on their inner flanks, the Anglo-Dutch at Gosselies and the Prussians at Fleurus. They could then act united against Napoleon with a numerical superiority of two to one. They felt certain they would obtain the necessary three days' warning of the French concentration, as Napoleon's troops were then distributed between Lille, Metz and Paris (175 m. by 100 m.). To concentrate the French army, within striking distance of Charleroi, before the allies had moved a man to meet it was unthinkable. But it was the unthinkable that happened.

Whereas Blücher had covered Fleurus by Zieten's Corps, which by a yielding fight would secure the time for the Prussian concentration, yet Wellington had only covered Gosselies by a cavalry screen which was too weak to gain the time requisite for the Duke to mass there. Hence to enable him to concentrate as arranged Wellington relied on obtaining timely information of Napoleon's plans, which in fact he failed to obtain.

The French Concentration.—The emperor made his final preparations with the utmost secrecy. The "Armée du Nord" was to concentrate in three columns—around Solre, Beaumont and Philippeville—as close to Charleroi as was practicable. On June 6 the IV. Corps (Gérard) started and soon the whole army was in motion, every effort being made to hide the movements of the troops, for there was no great natural screen to cover the strategical concentration. On June 11 Napoleon left Paris for the front, and by June 14 he had achieved almost the impossible itself. There around Solre, Beaumont, and Philippeville lay his mass of men, 124,000, concentrated under his hand and ready to march across the frontier at dawn against the unsuspicious enemy. The allies still lay in widely distant cantonments and they had not moved a man to meet the foe.

The opposing armies were of very different quality. Welling-



ton's was a collection of many nationalities, and the kernel of British and King's German Legion troops numbered only 42,000. Blücher's army was undoubtedly more homogeneous and included no specially weak elements. Napoleon led out a veteran army of Frenchmen who worshipped their leader. But there were lines of weakness in his force. For various reasons, neither Davout, Murat, Suchet, nor Clausel were employed in the "Armée du Nord." Marshal Soult, appointed chief of the staff, possessed few qualifications for this post; and neither Ney nor Grouchy who, when the campaign began were given command of the left and right wings, possessed the ability or strategic skill necessary for such positions. Again the army was morally weakened by a haunting dread of treason; and, finally, it was too small for its purpose. Locked up in secondary theatres Napoleon had left 56,500 men, of whom he might have collected over 30,000 for the decisive campaign in Belgium. Had he concentrated 155,000 of his available force opposite to Charleroi on June 14, then the issue would hardly have been in doubt. As it was he left too much to Fortune.

For his advance into Belgium in 1815 Napoleon divided his army into two wings and a reserve. As the foe would lie away to his right and left front after he had passed the Sambre, one wing would be pushed up towards Wellington and another towards Blücher; whilst the mass of the reserve would be centrally placed so as to strike on either side, as soon as a force of the enemy worth destroying was encountered and gripped. To this end he had, on the 14th, massed his left wing (Reille and D'Erlon) around Solre, and his right wing (Gérard) at Philippeville; whilst the central mass (Vandamme, Lobau, the Guard and the Cavalry Reserve) lay around Beaumont. The orders for the French advance next day, among the finest ever issued, directed that the army should march at dawn and move to the Sambre at Marchienne and Charleroi. By evening it was expected that the whole would have crossed the Sambre, and would bivouac between the sundered allies.

The Passage of the Sambre.—At the very outset delays occurred. Vandamme, who was to lead the advance on Charleroi, was delayed by an accident that befell the single orderly who carried the orders to the III. Corps. Gérard, too, was late as his concentration had not been completed on the 14th. Zieten's outposts fought stubbornly to delay the French advance for 24 hours and give time for Blücher's concentration. As soon as the emperor reached the front he took vigorous action, nevertheless it was after noon before the Charleroi bridge was stormed. At the same time Reille crossed at Marchienne. The emperor at once began the advance up both the Fleurus and Quatre Bras roads. It was 3 P.M. when Marshal Ney joined the army and was at once given command of the left wing. Napoleon then proceeded with Grouchy to reconnoitre the Prussian position at Gilly, and, handing over the command of the right wing to the marshal, the emperor immediately returned to Charleroi and ordered Vandamme to go to the assistance of Grouchy.

The allies had been caught unprepared. But as soon as Blücher got the first real warning of imminent danger he ordered the immediate concentration of his army at Sombreffe. Unfortunately, the orders sent to Bülow were so hazy that Bülow did not realize the need for any special haste. Thus the IV. Corps was neutralized until after the 16th. But Pirch I. and Thielemann acted with satisfactory promptness and their corps reached Mazy and Namur by nightfall. Blücher in pursuance with his plan moved to Sombreffe.

Wellington's position at night was hardly safe or even satisfactory. It was not until 3 P.M. that definite news of the French advance reached Brussels, and even then the duke was not certain of the direction of Napoleon's main stroke. Consequently he ordered his divisions to concentrate at their alarm-posts and await further orders. The danger of Blücher's position was thus enormously increased. The allies do not appear to have decided upon the course to be taken in case they were surprised, and their system of inter-communication was most imperfect. Luckily

Wellington's subordinates at the critical point acted with admirable boldness. Prince Bernard, commanding the brigade at Quatre Bras, retained his position there to check the French advance instead of drawing off to mass with his division at Nivelles. His immediate superiors approved his action. Owing to these officers Wellington retained possession of the important strategical point of Quatre Bras. Consequently Ney's advance struck into Prince Bernard's advanced troops who were forced back. But Prince Bernard firmly held his main position at the cross-roads; and, as the day was drawing on, Ney wisely decided not to push on any farther and so risk isolating the left wing. He halted and reported to the emperor.

Meanwhile Grouchy and Vandamme wasted two hours deliberating in front of the Prussian brigade at Gilly. Then at 5:30 P.M. Napoleon again reached the front and vigour replaced indecision. After a brief cannonade Vandamme advanced with the bayonet and the Prussians gave way. Grouchy then moved on Fleurus and halted for the night.

Owing to Zieten's skill Blücher had secured his concentration area, one corps was in position, and two others were at hand. Thanks to his subordinates Wellington still retained a grip on Quatre Bras. His corps were assembling: I., Nivelles, Braine le Comte, Enghien; II., Ath, Grammont, Sotteghem; Cavalry, Ninove; Reserve, at Brussels. During the night the divisions were ordered to move to Nivelles, and at dawn the Reserve marched for Mt. St. Jean.

The duke had relied on information that did not come to hand. His intelligence officer, Colonel Colquhoun Grant, who was in France, was ordered to send back his reports to the duke through General Dörnberg at Mons. On June 15 Grant reported that the French Army was advancing, but Dörnberg refused to believe the report and returned it. Owing to this officer's presumptuous folly Grant's report only reached Wellington on June 18.

On the night of the 15th the "Armée du Nord" was disposed as follows:—Left Wing, Frasnes to Marchienne; Right Wing, in front of Fleurus and astride the Sambre at Châtelet; Centre (or Reserve), Guard, between Gilly and Charleroi; but Milhaud's Cuirassiers and Lobau's (VI.) Corps were still south of the Sambre. Thus, despite the delays, Napoleon had secured a dominant strategical position. The allies were still encouraged to attempt a risky forward concentration, whilst Napoleon's covering forces were sufficiently far forward to be able to grip whichever ally adventured his army first. The "Armée du Nord" lay concentrated "in a square whose sides measured 12 m. each; and it could with equal facility swing against the Prussians or the Anglo-Dutch, and was already placed between them."

16th June.—Early in the morning Prince Bernard was reinforced at Quatre Bras by the rest of his division (Perponcher's); and Wellington's other troops were now all on the march eastward except the reserve, who were heading southwards and halted at the cross-roads of Mt. S. Jean until the duke had resolved that their objective should be Quatre Bras. They then marched in that direction. Blücher meanwhile was making his arrangements to hold a position to the south of the Namur-Nivelles road and thus maintain uninterrupted communication with Wellington at Quatre Bras.

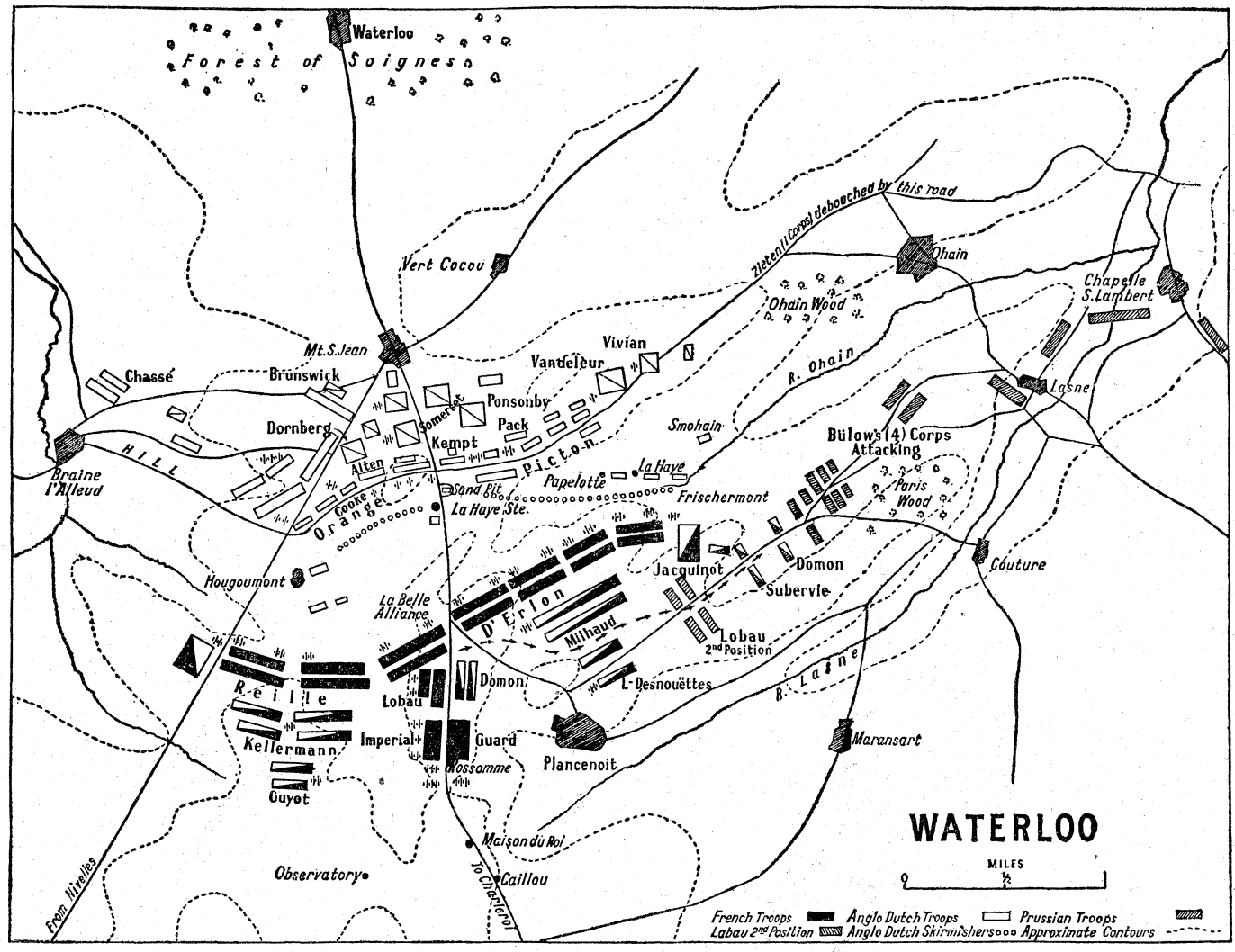
Napoleon spent the early morning in closing up his army, and writing what proved to be the most important letter of the campaign to Ney (Charleroi, about 8 A.M.): "I have adopted as the general principle for this campaign to divide my army into two wings and a reserve. . . . The Guard will form the reserve, and I shall bring it into action on either wing just as circumstances dictate. . . . According to circumstances I shall weaken one wing to strengthen my reserve. . . ." Here, in its simplest form, is the principle that underlies Napoleon's strategy in 1815. Only on the wing on which the reserve is brought into action will a decisive result be aimed at. The other is to be used exclusively to neutralize the other enemy, by holding him at bay.

Napoleon's plan for this day assumed that the surprised allies would not risk a forward concentration. The emperor intended to push an advanced guard to Gembloux to ward off Blücher, and move up the Guard to Fleurus. But once in possession of Sombreffe, the emperor would swing the reserve westward to join Ney, who should then have mastered Quatre Bras and have pushed out a force to link with Grouchy, as well as another body 6 m. to the northward. The centre and left wing would then march by night to Brussels. The allies would thus be irremediably sundered. Meanwhile Napoleon and the VI. Corps waited at Charleroi for further information. Up till noon Ney took no serious step to capture Quatre Bras, which still lay at his mercy. Grouchy reported that Prussian masses were coming up from Namur, but Napoleon ignored this. Before 10 A.M. Ney reported considerable hostile forces at Quatre Bras. The marshal was ordered to crush what was in front of him and report to Fleurus. Here Napoleon arrived at 11 A.M., still leaving Lobau at Charleroi. Napoleon at once reconnoitred the situation. Only one Prussian corps was showing, but it was disposed parallel to the Namur road, as if to cover a forward concentration. Had the decisive day arrived? If so, by 2 P.M. Vandamme, Gérard, Pajol and Exelmans would be available for the assault, and the Guard and Milhaud would act as a reserve. At 2 P.M. Napoleon ordered Ney to secure Quatre Bras, as the emperor was attacking the Prussian corps. Whichever wing succeeded first would then wheel inwards and help the other. The decisive flank had not yet become clear.

Blücher had determined to fight. Wellington, on arrival at Quatre Bras, finding all was quiet, rode over to meet Blücher at Brye. Considering no serious force was in front of Quatre Bras, Wellington ended the interview with the conditional promise that he would bring his army to Blücher's assistance at Ligny, if he was not attacked himself. But on his return to Quatre Bras he found the situation already critical.

Quatre Bras.—Ney had let slip the chance when he could have mastered Quatre Bras with ease, and thereby ensured co-operation with Napoleon. He waited to mass Reille's Corps before he advanced, though the Prince of Orange had only 7,500 troops at Quatre Bras. The Prince had boldly scattered his force, made wise use of cover and showed a firm front to Ney. It was 2 P.M. when the French attacked. East of the road the Dutch-Belgians were forced back and the line wavered. But at 3 P.M. Merlen's cavalry rode in from Nivelles, Picton and the 5th division marched up from Brussels, and Wellington himself returned. Picton stopped the French advance, but Reille's last division was thrown in on the French left, and a hot fight broke out. The Brunswick contingent now reached Wellington and at once attacked. It was 4:15 P.M. Ney had just received Napoleon's 2 P.M. order, and he promptly pressed his attack and almost cleared the Bossu wood. However, at 5 P.M. Alten's division arrived from Nivelles, and Ney realized that he needed D'Erlon's corps to gain the cross-roads.

About 5:15 P.M. Ney learned that D'Erlon, without his knowledge, had moved eastwards to co-operate at Ligny. Then at 5:30 P.M. he received Napoleon's order to seize Quatre Bras and swing in against Blücher who was pinned at Ligny. Napoleon added, "the fate of France is in your hands." Ney's duty was clear. He must hold Wellington at Quatre Bras and allow D'Erlon to ensure that a decisive success was gained that day at Ligny. In no case could D'Erlon return in time to be of any use at Quatre Bras. Ney, beside himself with rage, sent imperative orders to D'Erlon to return and ordered Kellermann's cuirassier brigade to break through Wellington's line. The charge was admirably executed. A British regiment, caught in line, was overthrown and lost a colour. But unsupported, the horsemen were then beaten back. At that moment Ney received a verbal message from Napoleon ordering him, whatever happened at Quatre Bras, to allow D'Erlon to carry out the move to Ligny. Despite remonstrance, Ney refused to reconsider D'Erlon's recall and plunged into the fight. Then about 7 P.M. the British Guards reached Wellington and at last gave him the numerical superiority. Promptly the duke attacked all along the line, and by nightfall the French had been driven back to Frasnes. The losses were, Anglo-Dutch 4,700, French 4,300. At 9 P.M., when the battle was over, D'Erlon arrived. The corps had reached the edge of the Ligny battlefield when it received the counter-order. Thinking he was still under



Ney, D'Erlon decided to leave one division at Wagnelée and to return to the left wing. The incident was immeasurably unfortunate for the French. Had D'Erlon been used betimes at Quatre Bras, Wellington would have been crushed; had he only engaged at Ligny, D'Erlon would have ensured Blücher's annihilation. But oscillating between the two fields the Corps took part in neither. At 10 P.M. Ney wrote a short and somewhat one-sided report to Soult.

Ligny.—On the other flank there had meanwhile been waged the very bitterly fought battle of Ligny. As Blücher's dispositions gradually became clearer the emperor realized that the first decisive day of the campaign had actually come and promptly made arrangements for defeating the Prussian army in his front. Blücher, to cover the Namur road, held with the I. Corps the villages of Brye, St. Amand, and Ligny, whilst behind his centre was massed the II. Corps, and on his left was placed the III. Corps. Wellington and Bülow on arrival would act as general reserve. Blücher's army was quite visible to Napoleon on the bare open slopes, the II. Corps being especially exposed. The emperor decided to bear down Blücher's centre and right with the corps of Vandamme and Gérard and with Girard's division which he had drawn into his operations, containing the Prussian left meanwhile with the squadrons of Pajol and Exelmans, assisted by a few infantry. The Guard and Milhaud were in hand at Fleurus. Further, he could order up Lobau, and direct Ney to move his rearward corps across and form it up behind Blücher's right. When the battle was ripe, he would crush the Prussian centre and right between the Guard and D'Erlon's corps. It was a somewhat complicated manoeuvre; for he was attempting to outflank his enemy with a corps that he had subordinated to Marshal Ney. Much depended on whether Ney would grasp the full purport of his orders. The usual Napoleonic simplicity was wanting at Ligny, and he paid in full for the want.

The Prussians numbered about 83,000 to Napoleon's 71,000 (including Lobau). About 2:30 P.M. the sound of Ney's guns to the westward proved that Wellington was attacked and Napoleon then opened the battle. A fierce fight soon raged for the villages of Ligny and St. Amand. By 3:15 P.M. the battle was in full swing and Napoleon wrote to Ney, saying, "The fate of France is in your hands," and ordering the marshal to master Quatre Bras and move eastwards to assist at Ligny. Directly afterwards, hearing that Ney had 20,000 men in front of him, he sent the "pencil-note" by General La Bédoyère, directing Ney to detach D'Erlon's corps to Ligny. This the A.D.C., in a fit of mistaken zeal, took upon himself to do. Hence the corps appeared too soon and in the wrong direction. It is clear that Ney's essential duty was to co-operate at Ligny, provided that Wellington was held fast at Quatre Bras. Unfortunately, in the heat of action, Ney misread his instructions. Meanwhile the emperor had ordered Lobau to move up to Fleurus. The fight for the villages raged fiercely and incessantly, and the places were captured and recaptured. Generally the French had the better of the fighting, and Blücher was compelled to use up more and more of his reserves. The fighting grew so furious that the troops literally melted away. Even the emperor had to call on his reserves. Just as the Young and Middle Guard moved to reinforce Gérard and Vandamme, the latter reported that a hostile column, 30,000 strong, was threatening his left (in reality it was D'Erlon). This sight unnerved Vandamme's exhausted troops, and guns had to be turned on them to quell a panic. It was nearing 6 P.M. Napoleon concluded that this could not be D'Erlon, as he had arrived too soon and was marching in the wrong direction.

Napoleon sent an officer to reconnoitre. As the French attacks slackened the Prussians rallied and counter-attacked, but they were beaten back by the Young Guard. By 6:30 P.M. Napoleon learned that the force was D'Erlon's, and that it had withdrawn westwards. Thus there was no direct co-operation from the Left Wing on this decisive day. The emperor had perforce to finish the battle single-handed.

Blücher now launched a general counter-stroke against Vandamme, but the chasseurs of the Guard drove back the Prussians in disorder and Napoleon's chance had come at last. As Lobau formed up near Fleurus, the guns of the Guard opened on Ligny to prepare Blücher's centre for assault. At 7:45 P.M. a crashing salvo from 60 guns heralded a combined onslaught by Gérard, the Guard, and Milhaud. This tremendous impact of picked troops pierced and broke the Prussian centre. Blücher promptly launched his cavalry reserve to stem the French advance. Leading a charge in person he was dismounted and ridden over, before he was rescued and borne from the field. Blücher had taken an unjustifiable personal risk, for at this crisis it was essential for the Prussians to be commanded by a chief who would keep loyally in touch and act in concert with his colleague. By 9 P.M. the battle was over and the French pressed resistlessly onwards. The beaten Prussians retired to the north of the Namur road. But in the failing light and in the uncertainty as to events on the left wing, immediate pursuit was out of the question.

The execution had again fallen short of the conception; Blücher though beaten was not destroyed, nor was his line with Wellington cut. If the Prussians now retired northwards, parallel to the direction which Wellington would follow perforce on the morrow, the chance of co-operating in a decisive battle would still remain to the allies; and Gneisenau's order issued by moonlight, directing the retreat on Tilly and Wavre, went far to ensuring the possibility of such combined action. However, Gneisenau was very remiss in not immediately reporting this vital move and the necessity for it to the duke, as it left the Anglo-Dutch inner flank quite exposed. Gneisenau apparently selected Wavre, not with the intention of assisting his ally, but rather to re-establish his own line of communication, and the presence of the Prussians on the field of battle of Waterloo must be put down to the immortal credit of Blücher and Grolmann, his quartermaster-general.

Gneisenau allowed the re-establishment of his communications to overweigh the paramount necessity of arranging concerted action with his ally. Probably Wellington's failure to co-operate at Ligny had heightened the Prussian chief-of-staff's unworthy suspicions of the duke's good faith. It was well for the allies that Blücher was able to resume command before Napoleon had time to profit from the dissensions that would probably have arisen had Gneisenau remained in control. The casualties at Ligny were very heavy. The Prussians lost 12,000 men and 21 guns, and the French 8,500 men. So close was the fighting that most of the 20,000 casualties lay on 2 sq. m. of ground.

Napoleon's plan of campaign had succeeded. Despite D'Erlon's misadventure, Ney's failure had placed the Anglo-Dutch army in a precarious position. Napoleon having beaten Blücher, the latter must fall back to rally and re-form. On the other flank Ney lay in front of Wellington, and the marshal could fasten upon the Anglo-Dutch army and hold it fast on June 17, sufficiently long to allow the emperor to close round its open left flank and deal it a death-blow. It was essential to deal with Wellington before Blücher could re-appear on the scene. Wellington was but imperfectly informed of the details of the result of Ligny. Certainly Blücher had despatched an aide-de-camp to warn Wellington that he was forced to retire. But the officer was shot and the message remained undelivered. Nor did Gneisenau repeat this important message directly he assumed temporary command. Gneisenau's neglect involved the allies in an unnecessary and very grave risk.

June 17.—Napoleon was unwell, and was not in the saddle as early as he would otherwise have been; and neither Soult nor Ney made any serious arrangements for an advance when every minute was golden. By early morning the duke had most of his army about Quatre Bras. But Blücher's defeat had rendered Wellington's position untenable. Still ignorant of Blücher's exact position, Wellington sent out a well-escorted officer to establish touch with the Prussians. He reported that the Prussians were drawing off to rally at Wavre. Then, about 9 A.M., a Prussian officer arrived to explain the situation and learn Wellington's plans. The duke replied that he should fall back and accept battle near Mt. S. Jean, provided he was assured of the support of one of Blücher's corps. He now subordinated everything to remaining in communication with Blücher. It was 2 A.M., June 18, before Wellington received an answer.

Covered by Thielemann the Prussians had drawn off towards Gembloux to join Bülow. Meanwhile, soon after dawn, the French cavalry rounded up some stragglers on the Namur road, and for a time confirmed the idea that Blücher was retiring on his base. The situation was still obscure, details about what had happened to Ney were wanting, and the direction of the Prussian retreat was uncertain. At 8 A.M. Ney was ordered to take up his position at Quatre Bras, or if he reported that it was impossible the emperor would co-operate. Napoleon meant that if only a rear-guard opposed Ney it was to be driven off and Quatre Bras occupied. But if Wellington was still there, the marshal was to hold him fast, and Napoleon would hasten up with the reserve and crush his enemy. Wellington in fact was there; but Ney did nothing to retain him, and at 10 A.M. the duke began to retire northwards. The last chance of bringing about a decisive French success was thus allowed to slip away.

Grouchy's Operations.—About 11 A.M. Napoleon came to a decision. He determined to send two cavalry corps, and Vandamme's and Gérard's corps, and Teste's division (33,000 and 110 guns) to follow the Prussians and discover if they intended uniting with Wellington in front of Brussels. As touch had been gained with Thielemann at Gembloux, Marshal Grouchy, who had been given command of the force, was ordered by the emperor to "proceed to Gembloux." This order the marshal obeyed literally. After an inconceivably slow march, in one badly arranged column moving on one road, Grouchy only reached Gembloux on June 17, and halted there for the night. Grouchy's cavalry who had been in touch with Thielemann's corps, at Gembloux, allowed it to slip away, and contact was lost for want of a serious effort to keep it. Grouchy did not proceed to the front and entirely failed to appreciate the situation. Pressing danger could only exist if Blücher had gone northwards, and northwards in the Dyle valley Grouchy should have sought for the Prussians. But on June 17 the marshal pushed no reconnaissances to the northward and westward of Gentinnes. (Actually Milhaud, when marching with Napoleon towards Quatre Bras, did see some Prussian infantry retiring northwards and reported this about 9 P.M. to Napoleon, but he attached little importance to it.) Had Blücher gone eastwards, then no danger threatened, for Grouchy could easily have held back any future Prussian advance on the line of the Dyle. Grouchy merely obeyed his orders literally and went to Gembloux. At nightfall the situation was in favour of the allies. The four Prussian corps were concentrated astride the Dyle at Wavre and Grouchy was actually outside them. After an unmolested retreat the Prussians were ready to take the field once more, and 24 hours before Napoleon had deemed it possible after their defeat at Ligny.

Napoleon's Pursuit of Wellington.—On the other flank, too, things had gone all in favour of Wellington. At noon Napoleon wrote to Ney that troops had been placed at Marbais to second the marshal's attack on Quatre Bras, yet Ney remained quiescent, and Wellington began his retreat unmolested. Thus on Napoleon's arrival only the duke's cavalry screen and some horse artillery remained on the position. As the emperor justly said, Ney had ruined France. This was the fatal mistake of the campaign. Although Napoleon opened a rapid pursuit as the cavalry screen crumpled up and decamped, yet he failed to entangle the rear guard so deeply as to force the duke to return to its assistance. Also a tropical thunderstorm considerably retarded the French pursuit. Only as the light failed did Napoleon arrive opposite to Wellington's position, and then by a masterly reconnaissance in force he compelled the duke to disclose the presence of virtually

the whole army. The French halted between Rossomme and Genappe, bivouacking in the sodden fields.

June 18.—During the night Wellington heard that Blücher would bring two corps certainly, and possibly four, to Waterloo, and the duke determined to accept battle. Yet so far was Wellington from divining Napoleon's plan that he stationed 17,000 men (including Colville's British division) about Hal, 8 m. to his right, to repel a turning movement that he groundlessly anticipated and to form a rallying point for his right in case his centre was broken. By making this detachment the duke ran a very grave risk. But with the 67,600 men and 156 guns which he had in hand, he took up a truly admirable "Wellingtonian position" in front of Mt. S. Jean. He used a low ridge to screen his main position, exposing comparatively few troops in front of the crest. He occupied Hougoumont with detachments of the British Guards and placed a King's German Legion garrison in La Haye Sainte, the key of his position. The duke also took care to distribute the troops so that the indifferent and immature were closely supported by those who were "better disciplined and more accustomed to war." Full arrangements for Blücher's co-operation were made through General Müffling, the Prussian attaché on the duke's staff. The duke was to stand fast and receive the attack, whilst Blücher closed round Napoleon's exposed right. Thus the Prussians were the real general reserve on this day.

Blücher kept his promise loyally, but the execution was faulty. The Prussians did not start marching at dawn, and the rear corps (Bülow) was selected to lead the column. A fire that broke out in Wavre further delayed the march. But, despite his hurts, the old marshal was in the saddle.

Luckily the wet state of the ground (largely cornfields) and the scattered bivouacs of the French caused Napoleon's attack to be put off until 11.30 A.M. Grouchy had reported at 10 P.M., 17th, from Gembloux that the Prussians were retiring towards Wavre and Perwez. He stated that he meant to follow the Wavre column, if it was the stronger, and separate it from Wellington. But this was impossible. Grouchy was outside the Prussian left and, by following it, he must inevitably drive the allies together. The emperor answered the letter at 10 A.M., and directed the marshal to march for Wavre. Napoleon's original plan must be kept in mind when considering this letter. It will then be seen to mean that Grouchy was to place his force on Blücher's inner flank and hold him back from Waterloo. But this is just what the letter does not state precisely; accordingly Grouchy (as Ney had done previously) misread it.

Meanwhile the French army formed up some 1,300 yards from Wellington's position. Although some misgivings filled the minds of such Peninsular veterans as Soult, Reille, and Foy, none assailed Napoleon. But the late hour at which the battle opened, and Napoleon's determination to break Wellington's centre instead of outflanking his left and farther separating the allies, deprived him of any chance of beating Wellington before Blücher could intervene. Napoleon drew up his army of 74,000 and 246 guns in three lines in full view of the Anglo-Dutch army. It was an imposing array of veteran troops backed by the dark masses of the Imperial Guard. As their emperor rode along the lines the troops acclaimed him with extraordinary enthusiasm.

WATERLOO

First Phase.—About 11.30 A.M. the battle was opened with an attack by one of Reille's divisions on Hougoumont. This was merely to draw Wellington's attention to his right, and in this it failed. Half-an-hour later a battery of 80 guns unlimbered on the long spur to the S.E. of La Haye Sainte to prepare the duke's centre for the main attack. But the crest of the "Wellingtonian position" sheltered the defence from the tempest of iron. After 1 P.M., and just before he gave orders for Ney to lead the main attack, the emperor scanned the battlefield, and on his right front he saw a dense dark cloud emerging from the woods at Chapelle Saint Lambert. It was soon discovered that this was Bülow's corps marching to Wellington's assistance. A letter was now awaiting despatch to Grouchy, and to it was added a postscript that the battle was raging with Wellington, that Bülow's corps had been sighted by the emperor, and that the marshal was to hasten to the field and crush Bülow. This order at least was clear, but it was sent 12 hours too late, and when Grouchy received it he was unable to carry it out. To neutralize Bülow when necessity arose, the emperor now detached Lobau together with the squadrons of Domon and Subervie. The general, however, hardly drew out far enough from the French right; otherwise the magnificent resolution he displayed and the admirable obstinacy with which his troops fought against ever-increasing odds are worthy of all praise. Thus as early as 1.30 P.M. the Prussian intervention deranged the symmetry of Napoleon's battle-array. The emperor never considered breaking off the fight and seeking a more favourable opportunity of beating the allies in detail. He was still determined to involve both Wellington and Bülow in a common ruin.

Second Phase.—Ney was therefore ordered to attack Wellington's centre with D'Erlon's corps. Owing to a misconception the columns used for advance were over-heavy and unwieldy, and the corps failed to achieve anything of importance. As D'Erlon's troops advanced the Dutch-Belgian brigade in front of the ridge, which had been subjected to an overwhelming fire from the 80 French guns at close range, turned about and retired in disorder through the main position. This, however, was the solitary success secured by the I. corps; for the left division failed to storm La Haye Sainte and Picton's division met the remainder of D'Erlon's corps face to face, engaging them in a murderous infantry duel in which Picton fell. During this struggle Lord Uxbridge launched two of his cavalry brigades on the enemy; and the "Union brigade" catching the French infantry unawares rode over them, broke them up, and drove them to the bottom of the slope with the loss of two eagles; but the British cavalry were driven back with great loss by fresh French horsemen hurled on them by the emperor. So far no success against Wellington had been achieved, and Bülow was still an onlooker.

Third Phase.—Ney was now ordered to attack La Haye Sainte again, but the attack failed. A furious cannonade raged, and the Anglo-Dutch line withdrew slightly to gain more cover from the ridge. Ney misinterpreted this manoeuvre and led out, about 4 P.M., Milhaud's and Lefebvre-Desnouëttes' horsemen (43 squadrons) to charge the allied centre between the two farms. For several reasons, the cavalry could only advance at a trot. As the horsemen closed they were received with volleys of case from the guns, and the infantry formed into squares. Against the squares the horsemen were powerless, and failing to break a single square, they were finally swept off the plateau by fresh allied horsemen. Kellermann's cuirassiers and the heavy horse of the Guard (37 fresh squadrons) now advanced to support the baffled cavalry, the latter falling in as supports. The whole 80 squadrons resumed the attack, but with no better result. The cavalry gradually became hopelessly entangled among the squares they were unable to break, and at last they were driven down the face of the ridge and the most dramatic part of the battle came to an end. Had these great cavalry attacks been closely supported by infantry, there can be little doubt that they must have achieved their object. But they were not. In his handling of the three arms together, Napoleon on this day failed to do justice to his reputation.

About 4.30 P.M. Bülow at last engaged. Lobau's men were gradually overpowered and forced back into Plancenoit, the village was stormed, and the Prussian round shot reached the main road. To set his right flank free the emperor called further on his reserve, and sent Duhesme with the Young Guard to Lobau's support. Together, these troops drove Bülow out of Plancenoit, and forced him back towards the Paris wood. But the Prussians had not yet changed the fate of the day.

Fourth Phase.—Napoleon now ordered Ney to carry La Haye Sainte at whatever cost, and this the marshal accomplished with the wrecks of D'Erlon's corps soon after 6 P.M. The garrison (King's German Legion) had run out of rifle ammunition and the French bursting in seized the post. This was the first decided advantage that Napoleon had gained during the day. The key of the duke's position was now in Napoleon's hands, Wellington's

centre was dangerously shaken, the troops were exhausted, and the reserves inadequate. But the Iron Duke faced the situation unmoved. Calmly he readjusted his line and strengthened the torn centre. Happily for him, Pirch I. and Zieten's corps were now at hand. Pirch I. moved to support Bülow; together they regained possession of Plancenoit, and once more the Charleroi road was swept by Prussian round shot. Napoleon, therefore, had to free his right flank before he could make use of Ney's capture. To this end he sent two battalions of the Old Guard to storm Plancenoit. The veterans did the work magnificently with the bayonet, ousted the Prussians from the place, and drove them back 600 yards beyond it. But Napoleon could not turn now on Wellington. Zieten was fast coming up on the duke's left, and the crisis was past. Zieten's advent permitted the two fresh cavalry brigades of Vivian and Vandeleur on the duke's extreme left to be moved and posted behind the depleted centre. The value of this reinforcement at this particular moment can hardly be overestimated.

Fifth Phase.—The French now fiercely attacked Wellington all along the line; and the culminating point of this was reached when Napoleon sent forward the Guard, less 5 battalions, to attack Wellington's centre. Delivered in three échelons, these final attacks were repulsed, the first échelon by Colin Halkett's British Brigade, a Dutch-Belgian battery, and a brigade of Chassé's Dutch-Belgian division; the second and third échelons by the Guards, the 52nd, and the Royal Artillery. Thus ended the fifth phase.

Rout of the French.—As the Guard recoiled (about 8 P.M.) Zieten pierced the north-east corner of the French front, and their whole line gave way as the allies rushed forward on their now defenceless prey. Three battalions of the Guard indeed stood their ground for some time, but they were finally overwhelmed. Afterwards, amidst the ruins of their army, two battalions of the 1st Grenadiers of the Guard defied all efforts to break them. But, with the exception of these two battalions, the French army was quickly transformed into a flying rabble. Bülow and Pirch I. now finally overpowered Lobau, once more recaptured Plancenoit, and sealed the doom of the French army. But Lobau's heroic efforts had not been in vain; they had given his master time to make his last effort against Wellington; and when the Guard was beaten back the French troops holding Plancenoit kept free the Charleroi road, and prevented the Prussians from seizing Napoleon's line of retreat.

When Wellington and Blücher met about 9.15 P.M. at "La Belle Alliance," the victorious chiefs arranged that the Prussians should take up the pursuit, and they faithfully carried out the agreement. Pushing on through the night, they drove the French out of seven successive bivouacs and at length drove them over the Sambre. The campaign was virtually at an end, and the price paid was great. The French had lost over 40,000 men and almost all their artillery on June 18; the Prussians lost 7,000, and Wellington over 15,000 men. So desperate was the fighting that some 45,000 killed and wounded lay on an area of roughly 3 sq.m. At one point on the plateau "the 27th (Inniskillings) were lying literally dead in square"; and the position that the British infantry held was plainly marked by the red line of dead and wounded they left behind them.

Grouchy's Operations June 18–19.—A few words may now be bestowed on Marshal Grouchy, commanding the right wing. The marshal wrongly determined on the 18th to continue his march to Wavre in a single column, and he determined, still more wrongly, to move by the right bank of the Dyle. Breaking up from bivouac long after dawn, he marched forward, via Walhain. Here he stopped to report to the emperor some intelligence which turned out to be false, and he remained for breakfast. Hardly had he finished when the opening roar of the cannonade at Waterloo was heard. Grouchy was now urged by his generals, especially by Gérard, to march to the sound of the firing, but he refused to take their advice, and pushed on to Wavre, where he found the Prussians (Thielemann's corps of 16,000 men) holding the passages across the Dyle. A fierce fight (called the Action of Wavre) began about 4 P.M., in which the Prussians were for long victorious. Instead of concentrating his force upon one bridge over the swampy and unfordable Dyle, Grouchy scattered it in attacks upon several; and when the emperor's despatch arrived, saying Bülow was in sight, the marshal was powerless to move westward. Towards the end of the day Colonel Vallin's Hussars stormed the Limale bridge, and a large part of Grouchy's force then promptly gained the left bank. The action continued till about 11 P.M., when it died out, to recommence shortly after dawn. Thielemann was at length overborne by sheer weight of numbers, and towards 11 A.M. he was forced to retire towards Louvain. The losses were considerable, about 2,400 men on each side.

Grouchy's victory was barren. In the far higher duty of co-operation he had failed miserably. His tactical achievement could avail the emperor nothing, and it exposed his own force to considerable danger. Whilst pondering on the course he should follow, the marshal received the news of the awful disaster that had overtaken the emperor at Waterloo. In a flash he realized his danger and made prompt arrangements to begin his retreat on Namur, the only line to France that was then available. This retreat he carried out resolutely, skilfully and rapidly, slipping past Blücher and finally bringing his force to Paris. But the rapid advance of the allies gave France no time to rally. Napoleon was forced to abdicate, and finding escape was impossible, he surrendered (on July 14) to the British—"the most powerful, the most unwavering and the most generous of his foes."

The causes of Napoleon's failure in the Waterloo campaign were as follows:—The French army was numerically too weak for the gigantic task it undertook. Napoleon himself was no longer the Napoleon of Marengo or Austerlitz, and though he was not broken down, his physical strength was certainly impaired. Ney failed to grasp and hold Wellington on the critical 17th of June; and on the 17th and 18th Grouchy's feeble manoeuvres enabled Blücher to march and join Wellington at Waterloo. Napoleon's chance of success was dangerously diminished, if not utterly destroyed, by the incompetence of the two marshals whom in an evil hour he selected for high commands.

Another dominant influence in shaping the course of events was the loyalty of Blücher to his ally, and the consequent appearance of the Prussian army at Waterloo. Nor must we overlook Wellington's unswerving determination to co-operate with Blücher at all costs, and his firmness on June 18; or the invincible steadiness shown by the British troops and those of the King's German Legion.

Reviewing this campaign at St. Helena, Napoleon laid the responsibility for the disaster of Waterloo on the inaction of Marshal Grouchy who, after he had lost touch with the Prussian army (which had crossed the Dyle at Wavre in order to work round to the north in the direction of Soignes), ignored the urgent representations of his officers, and in particular of General Gérard, and refused to unite his forces with the bulk of Napoleon's army, although he could hear the sound of the guns. However grave may have been Grouchy's error, it would be unjust to characterize his failure as treason. In any case, Marshal Grouchy, in spite of the miscarriage of his first mission, fearing to depart from the orders of the emperor, showed himself deficient not only in military insight but also in character.

In this article the writer has been greatly assisted by the advice and suggestions of Lt.Col. H. W. L. Hime, R.A. (A. F. Be.)

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WATERLOW, SIR ERNEST ALBERT (1850–1919), English painter, was born in London and received the main part of his art education in the Royal Academy schools, where, in 1873, he gained the Turner medal for landscape-painting. He was elected associate of the Royal Society of Painters in Water-Colours in 1880, member in 1894, and president in 1897; associate of the Royal Academy in 1890, and academician in 1903; and he was knighted in 1902. He began to exhibit in 1872 and has produced a considerable number of admirable landscapes, with and without figures, in oil and water-colour, handled with grace and distinction. One of his pictures, "Galway Gossips," is in the National Gallery of British Art. He died on Oct. 25, 1919.

See *Sir E. A. Waterlow, R.A., P.R.W.S.*, by C. Collins Baker (*Art Journal* Office, 1906).

WATERMARKS, the emblems or designs in paper used originally in Italy in the latter part of the 13th century. The orientals, who were the first to make paper, did not employ watermarks, although their method of fabricating sheets of paper was almost identical with that introduced into Europe during the middle 12th century.

The original Italian watermarks consisted of devices such as crosses, circles, triangles and forms of the simplest kind that could readily be twisted in wire. Until the middle of the 19th century all watermarks were formed in outline and were produced by the use of metal wires bent to the shape of the required design. These wire objects were then sewed to the mould on which the paper was to be formed, the wire leaving its impression in the wet sheet of paper by causing the fibres to lie thinner along its course. The ordinary watermarks in hand-made paper of the present day are made in the same manner as those from the inception of the art, the only difference being in the employment of finer wire and greater skill in their formation. Plate, fig. 3, shows the wire device on the covering of a laid paper mould from the 16th century; fig. 5 gives a section of an 18th century Dutch mould with the watermarking wires in place.

About the middle of the 19th century a more complicated and artistic form of watermarking was devised and instead of being limited to simple outline forms, it was possible to cause the paper to be made in any degree of thickness or tone desired. Fig. 1 shows a mould for the watermarking of a portrait. This mould has been made by first modelling the profile in a sheet of wax so that the various degrees of light and shade may be had and then making intaglio and cameo dies from the wax model by electrotyping. Closely-woven brass wire gauze is then subjected to great pressure between the two electrotype plates, the wire cloth or gauze taking the same contour as the original wax relief.

In forming sheets of paper on a hand mould the water drains through the woven wire, leaving the moist pulp in precisely the same thicknesses as those sculptured in the wax original. The watermarking of paper in colour was invented by Sir William Congreve in 1818 (English patent, Dec. 4, 1819, No. 4419) and consisted in placing coloured paper stock (pulp) in various layers to form a homogeneous sheet of paper.

The foregoing treats only of watermarks that are produced in hand-made paper where the moist pulp lies on the wire lettering or pressed wire design during the whole process of forming the sheet.

This naturally gives a brilliant and clear-cut watermark. In machine-made paper a wire cylinder known as a "dandy-roll" or a circular rubber form is used to impart the lettering or symbol to the moist paper by rolling over its surface *after* the web of paper has been formed. It is therefore not possible to produce as clear or distinct a watermark on a machine as it is by the use of a finely constructed mould in the hands of a skilled craftsman.

(D. Hu.)

WATERMELON (*Citrullus vulgaris*), an annual plant of the family Cucurbitaceae, (*q.v.*), native to tropical and southern Africa and widely cultivated since ancient times for its refreshing fruit. It is depicted in Egyptian paintings dating from the time of the pyramids.

The plant is a prostrate, long-running, hairy vine, with branched tendrils and large leaves, 4 in. to 7 in. long, somewhat oblong in outline and deeply cut into several narrow lobes, the leaf-stalks much shorter than the leaves. The flowers, borne singly in the axils of the leaves, are light yellow, about 1½ in. broad, and divided into five lobes. The fruit is a large pepo spherical to oblong in form, mostly smooth and uniform light or dark green or striped with light and dark portions, with a hard but not durable rind, and red, pink or yellow flesh containing numerous smooth, flat black, tan, brown, mottled or white seeds. Under cultivation the fruit attains very large size, often 1½ ft. to 2 ft. or more long and weighing from 20 lb. to 50 lb. or more, filled nearly to the rind with pleasantly flavoured pulp, with abundant sweet, watery juice. Watermelons are planted in "hills" about 8 ft. apart each way with two or three plants per hill. It is adapted to a wide range of soils and responds well to generous use of animal manures and chemical fertilizers. Resistant varieties have been bred in order to avoid damage by fusarium wilt, a soil-borne disease.

The watermelon is grown in most warm temperate countries, especially China, India, southern Russia, southern France, Egypt, South Africa and the southern United States. A harder, white-fleshed, red-seeded form, known as preserving melon or citron, is used for making conserves. In the 12-year period 1931–42, the average annual commercial crop of the United States was 66,712,000 melons. Georgia leads all other states in output, followed by California, Florida and Texas. (V. R. B.)

WATER-OPOSSUM or **YAPOCK** (*Chironectes minimus*), distinguished from other opossums by its aquatic habits, webbed hind feet, and peculiar colouration. Its ground colour is light gray, with four or five sharply contrasted blackish bands passing across its head and back giving it a very peculiar mottled appearance; the head and body together are about 14 in. long, and the tail a little more. It feeds on small fish, crustaceans and other water animals; its range extends from Guatemala to southern Brazil.

WATER POLO, as played throughout the world, consists of two games, the international hard ball game and the United States "soft ball." Both games develop stamina, swimming ability and good watermanship.

The games differ in the number of players, the type of ball, the scoring, but most of all in the actual play. The international game, as played in Europe, Asia, Australia and the Americas, features team play and excellent passing, mostly above the surface of the water, while the U.S. game, played only in the United States, is a rougher contest in which underwater tactics are integral parts of the play.

The game is played in the U.S. in a pool, in open water, or in the European "bath." In the international game the goals are from 19 to 30 yd. apart and are at each end of the bath which is not more than 20 yd. wide. Water depth is always 3 ft. or more. The pool for the U.S. game is from 60 to 75 ft. long and 20 to 40 ft. wide, the depth never less than 6 ft.

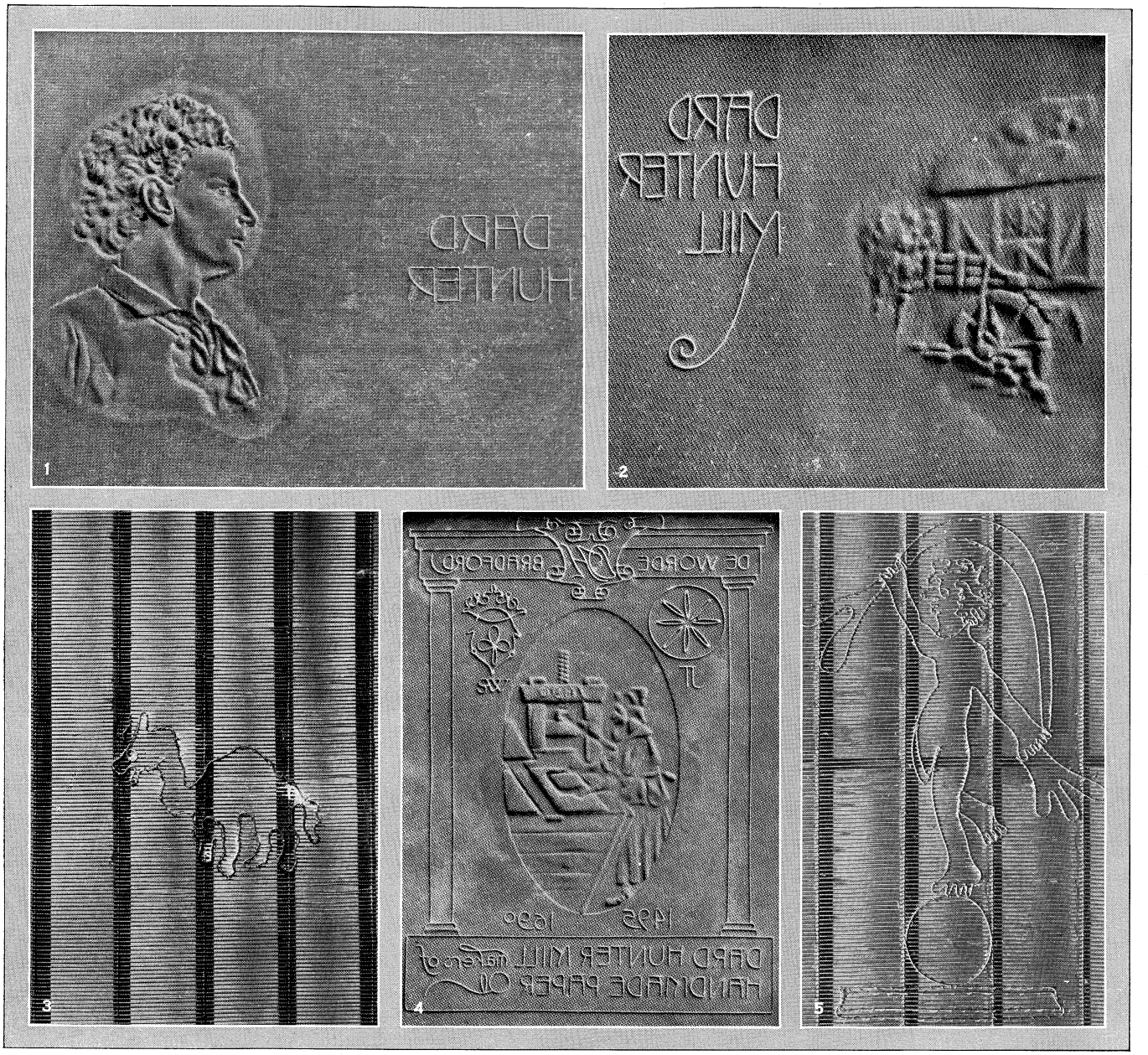
The international ball is leather covered, round and fully inflated, measuring between 27 and 28 in. in circumference, weighing between 14 and 16 oz.

The U.S. ball is inflated ⅞ full so that a good grip can be had with one hand. It is white rubber and between 7 and 8 in. in diameter.

In international polo goal posts are at least 1 ft. from the end of the "bath." The goals are 10 ft. wide and the crossbar is 3 ft. above the surface of the water when the depth is 5 ft. or over. At less than 5 ft. in depth, the crossbar is placed 8 ft. from the bottom of the "bath." Nets are attached to the goal posts in such a way as to close the whole goal area.

The U.S. game goals are merely boards, 4 ft. long and 18 in. high, marked in large letters "Goal." An international goal is scored by the entire ball passing beyond the goal posts, and under the crossbar.

The three types of U.S. goals consist of the touch goal, the thrown goal and the foul goal. In both games, after a goal is scored, the players return to their respective ends of the playing area.



WATERMARKS AND WATERMARKING DEVICES

1. A complete mould (with deckle) for the watermarking of a portrait. The profile is first worked in wax so that various degrees of light and shade may be gained, and then intaglio and cameo dies are made from wax model by electrotyping
2. Hand made paper mould, combining lettering, and light and shade device for forming sheets of paper in one colour. Wires of lettering and pressed woven wire of design cause wet paper pulp to lie in many thicknesses, thus forming watermark in the sheet of paper
3. Wire device for watermarking figure of a camel in sheets of paper. Old papermakers favoured animals for watermarks
4. Mould for making hand-made paper, which combines the ordinary wire lettering and designs with the complicated light and shade device. With this mould the oval centre is produced in separate colour from balance of sheet. The wheel or star watermark (upper right-hand side) is that of John Tate who established the first paper mill in England in 1495. Watermarking device (upper left-hand side) is that of William Rittenhouse who founded the first paper mill in the Colonies in 1690
5. Wire device for a watermark showing a child swinging a rope

Playing time for an international match is 20 minutes, four quarters of 5 minutes each, with one minute between quarters, and five minutes at half time for the change of ends. When the ball crosses the goal line, whether it be a goal or not, it shall be dead until the restart of the game. Time occupied by disputes, fouls, or when the ball is thrown from the field of play shall not be counted as time of play. The U.S. game consists of two halves of eight minutes each, with an intermission of five minutes between halves.

Four officials are used in the international game, six in the U.S.

Seven players constitute a team in international, six in the U.S. game, but, whereas the international game rules allow three substitutes, the U.S. game allows four. In international, substitutions for any player can be made, but only after a goal has been scored or at half time, except in case of illness. Substitutions, in the U.S. game, can be made by the team having possession of the ball, or at the discretion of the referee.

To start the international game the players enter the water and place themselves in a line with their respective goals after which the referee places the ball into the centre of the playing area. From the start a goal cannot be scored until the ball has been handled either by two players of one team, in which case the scorer shall be within half the distance of goal attacked, or by a player of each team. In the U.S. game, both teams line up at their respective ends of the pool, out of the water, the ball is placed in the centre of the playing area by the referee and at the sound of the referee's signal the teams start for the ball. Care should be taken that the signal to start or re-start is sufficiently loud to prevent mistakes.

There are two types of fouls in international, ordinary and wilful; four in the U.S., personal, technical, suspension and disqualifying.

The penalty for an ordinary foul is a free throw to the opposing side from the place where the foul occurred. The player nearest the spot where the foul occurred takes the throw. The other players remain in their respective positions from the blowing of the whistle until the ball has left the hand of the player taking the throw.

In wilful fouls a player fouled is awarded a penalty throw and the player committing the foul is ordered out of the water until a goal has been scored. A player to whom a penalty throw has been awarded proceeds to any point on the four-yard line and awaits the signal of the referee's whistle, when he immediately throws at the goal; should the ball rebound from the goal posts or crossbar it remains in play.

Penalties in the U.S. game are, for personal fouls, two throws at an unguarded goal from the 15-ft. mark, each successful throw to count one point; for technical fouls, one free throw at an unguarded goal, to count one point if successful; for a suspension foul the ball is awarded to the offended team after the suspended player has been removed from the game for a specified period of time, and for a disqualifying foul one free throw from the 15-ft. line, to count 3 points if successful. When once a decision has been given, the referee should not allow any player or spectator to question the ruling.

In the United States, water polo's popularity as a competitive sport has lessened, mainly because the colleges have dropped the sport temporarily. But the game has been rejuvenated as a means of training service men. The international game's last big-time competition was in the 1936 Olympic games. (E. T. K.)

WATER POWER: *see* ELECTRICAL POWER GENERATION: *Hydro-Electric Generation;* HYDRAULIC POWER TRANSMISSION; HYDRAULICS; TURBINE: WATER.

WATERPROOF FABRICS: *see* RAIN-PROOF FABRICS.

WATER PURIFICATION. The partial purification of water probably dates back to the earliest times. No doubt, when a water looked very turbid, it was strained through any convenient material, or the suspended matters were allowed to settle out on standing. We know, too, that mariners found that dirty ill-tasting water collected at one port became often sweet and clean before the next port was reached. It is also not improbable that boiling water to purify it may have been an ancient precaution. Ages ago, everyone must have recognized the potent force of heat, and our ancestors possibly had their suspicions that dirty water caused disease and hence used heat as the most likely method of destroying impurities. Probably too, all sorts of things may have been added to water with the object, if not of purifying it, of at least rendering it more potable. Certainly as far back as 1612 the importance of keeping filthy matters out of drinking water was well-known, for in an indenture, relating to the New river, the following words occur:

"Wee doe by these presents for us our heirs and Successors straightly charge and Comaund all pson and psons whatsoever That they or anie of them doe not hereafter cast or putt into the said new river anie earth rubbish soyle gravell stones dogges Catts or anie Cattle Carrion or anie unwholesome or uncleane thing nor shall wash nor clense anie clothes wooll or other thinge in the said river . . ."

". . . nor shall make or convey anie sincke, ditch Tanhowse dying howse or seege into the said river or to have anie fall into the same."

As time went on sand came to be recognized as an effective filtering material, judged, no doubt, at first, by the clarified condition of the filtered product. Sand filtration, as a practicable proposition, dates back to 1829 and the honour seemingly belongs to London (Chelsea Water Co.). Later, the purification of water by sand filtration became an established procedure and the method has been copied all over the world and is still talked about as the London system of water purification. Quite apart from the bacterial "findings," it came to be recognized that an adequately filtered water was safe as regards disease. Then Koch showed why safety was secured, by proving that filtration removed 98 per cent of the bacteria. By this time bacteria had been assigned a definite rôle in the causation of disease.

The London rate of filtration is very slow, namely, about 2 gallons per sq. ft. per hour, or about 4 inches vertical drop in the same time. Approximately, it is represented by observing the progress of the end of the minute hand of a watch as it hourly completes its circular journey. Fine sand (about 3 ft. in depth) was nearly always used, supported on a graded gravel substratum.

Efficacy of Sand.—At first, sanitarians wondered why sand could be so effective when the separate particles were so gross in size compared with bacteria. It came, however, eventually to be recognized that the sand particles gradually matured so that each grain was surrounded with a furry yet slimy coating. In addition, the particles at, or near, the surface were observed to be enveloped and covered over with a heavy coating of slimy material which eventually became so dense as practically to stop the passage of water through it. When this occurred it became necessary to empty the filter, scrape off the surface layers of dirty sand and wash it very thoroughly before replacement. When a bed was re-started the results at first were apt to be unsatisfactory, and the usual custom was to run the filtrate to waste for several hours, or days. Even when the filtered water was allowed to pass into consumption, many authorities advocated a specially low rate of filtration being maintained for several days. This filtration has greatly reduced water-borne epidemic disease.

The increasing difficulty of securing supplies near at hand gradually led the great towns to invade the uplands and moorlands. Then new troubles arose, for although very pure and soft, such waters were often peaty and highly coloured and some of them were acid and acted upon lead. Experience showed that waters of this kind were best treated by filtering them through mechanical filters at the rapid rate of about 50 gallons per sq. ft. per hour, using a coagulant (sulphate of alumina, dose usually about 1–2 grains per gallon) to remove the colour and render the filtered water attractive in appearance. These mechanical filters are easily and expeditiously cleaned by a reversal of the flow of water.

Many authorities consider that mechanical filters are not so effective in removing bacteria as the slow sand filters, but when the source of supply is unexceptionable epidemiologically this is a matter of small importance. The point is that by the use of a coagulant they can achieve results, as regards clarification, practically impossible in the case of slow sand filters. As regards action on lead, this is a serious matter, as lead is a cumulative poison. Fortunately, it is possible by the use of lime, in suitable doses, to render such waters absolutely safe for domestic use.

Turning now to more modern methods of purification, the

chlorination of water at Lincoln during the typhoid epidemic (about 1,000 cases and 100 deaths) there in 1905 marked a forward step to which special attention must now be directed.

Chlorination.—In the United States and Canada chlorination, for some years past, has been the rule, not the exception. In England, progress has been much slower, but the World War greatly altered things, thanks to the initiative of men like Horrocks and Sims Woodhead. Further, the bold step taken by the Metropolitan Water Board in chlorinating so huge a volume of water as over 100,000,000 gal. a day proved a great incentive to further investigation of this water purification.

The "chlorinators" plead that inasmuch as they destroy practically all the non-sporing bacteria of intestinal origin they incidentally kill all the microbes, associated with epidemic water-borne disease. It is a bold claim, but apparently sound on the basis of current knowledge. The "anti-chlorinators" urge that a "doped" water is *prima facie* open to condemnation, and assert that there have been conspicuous failures in the chlorination processes in the past due to break-downs in the plant, or to dangerous compromises between doses sufficient to sterilize the water and yet small enough to avoid taste troubles. They further claim that natural processes (*e.g.*, storage and slow sand filtration) remove at least 98% of the total number of bacteria in the original water of whatever sort they may be, and that prolonged experience has shown that this is an absolute protection from the diseases associated with the ingestion of impure water.

A third school claims that all purification processes are merely a retrograde movement—that safety lies alone in choosing virgin, uncontaminated sources of water supply, requiring no sort of purification. It is possible to sympathize strongly with this exalted attitude of mind, but practically we must face, to an increasing extent, the necessity of rendering impure waters safe for domestic use. As regards the "chlorinators" and the "anti-chlorinators," there is much to be said on both sides, and each case should be judged on its own merits. Chlorination is an exceedingly cheap process; less than one shilling per 1,000,000 gal. of water treated may suffice. It is disputed how the chlorine acts. Some say it has merely an oxidation effect, others claim that it has an intrinsic bactericidal action. The dose is usually from 0·25 to 0·5 of available chlorine per 1,000,000 (2·5 to 5 lb. of chlorine per 1,000,000 gallons). The time required for sterilization varies according to the dose and the quality of the water. A few minutes may suffice, but one to five hours or more should be aimed at.

Administration.—The chlorine can be administered as a soluble hypochlorite (*e.g.*, alkaline sodium hypochlorite), or as a solution of bleaching powder (chloride of lime), or as a solution made from the gas liquefied in and liberated from metal cylinders. The latter process is now most extensively used, and there are some highly ingenious forms of apparatus for measuring accurately the gas as it flows from the cylinders through the chlorine apparatus on its way to the vessels or towers used for its final solution. Whatever method is adopted, it is highly important that the mixture of the chlorine and the water to be treated should be rapid and complete.

Successes.—The success of the treatment is determined by the destruction of *B. coli*, a non-sporing excremental microbe, slightly more hardy than the typhoid bacillus and the cholera vibrio. It is also gauged by the circumstance that there are places where the incidence of water-borne diseases has been modified to a most gratifying extent since, and apparently as a result of, the introduction of chlorination processes.

Taste Objections.—Taste troubles have been a most serious factor in the problem. Frequently, in consequence, the dose has been reduced below the limits of safe sterilization. Recently, however, knowledge has increased by leaps and bounds. It is now known that the presence of certain bodies (*e.g.*, phenoloid substances) in excessively minute amount (less than 1 in 1,000 millions) may be the root of the trouble. These impurities may arise from atmospheric contaminations, or be conveyed by liquid pollutions (*e.g.*, washings from roads, etc.). Fortunately, valuable remedies (taste preventers) have been found, *e.g.*, potassium permanganate and ammonia (dose about 0·2 per 1,000,000 the latter in terms of nitrogen). Even the organic matter, naturally present in waters, is a taste preventer, or "remover" of real value. There is no reliable indication that chlorinated water has any deleterious effect on man, the lower animals, fish-life or horticultural operations. On the whole, the same may be said as regards its alleged injurious effect on metals. Chlorination is a factor of great importance in water purification, although this admission may be coloured with certain cautious limitations. It can increase the margin of safety and can bring almost any water to any pitch of epidemiological perfection required. In the language of "the man in the street," chlorine, in doses of 0·25 to 0·5 per 1,000,000, can render dangerous waters safe without giving them (at all events in conjunction with taste removers) any unpleasant taste, or conferring on them any undesirable characteristics. Beyond all question, chlorination has come to stay, although it may be wise to regard it as a most valuable adjunct to other purification processes rather than as an absolute panacea.

Excess Lime Process.—In 1912 a new method of purification called the excess lime process was described. In softening waters lime is added in amount equal to, or just short of, what is necessary to combine with the dissolved carbonic acid in the water and with the bicarbonates. Carbonate of lime is formed, which, being practically insoluble, is thrown down as a precipitate. This mechanically purifies the water to a considerable extent, but does not produce a true bactericidal effect. In the excess lime method slightly more lime is added, so as to leave the water caustically alkaline, and this produces a marked bactericidal action. The amount of excess necessary depends on the duration of contact and the amount of impurities in the water, but one part of lime (as CaO) per 100,000 parts of water is usually sufficient.

The following quotation may serve to illustrate the usefulness of the excess lime method:—

> . . . the experiments carried out by us during the last two years at the Langford experimental station of the Southend Water Co., using water from two comparatively small rivers, show that by acting on Sir A. Houston's suggestion to use excess lime better results can be obtained than by the use of chlorine, since chlorine does not remove any of the organic matter in solution, whereas the excess lime will remove at least 50% of this. Waters, therefore, which a few years ago would have been considered quite unsuitable for a supply, and which no system of purification then known would have rendered safe, can now be utilized.

The method proved highly successful (1917) at Accra (Gold Coast Colony) in dealing with an impure swamp water used for water works purposes. Its successful use in 1913 enabled Aberdeen to decide on the retention of the River Dee as a source of water supply, thus saving over £100,000 on alternative schemes. In 1914 it was shown at Sunbury that the raw River Thames could be purified to a wonderful extent. For example, the ten worst samples of the river water and of the outlet from the first tank gave, on the average, colour estimations of 155 and 37 respectively, a reduction of 76%. *B. coli* was found to be absent from 10,000 c.c. of the treated water, on ten separate days.

The method has disadvantages: for example, the cost, the difficulties attendant upon the neutralization of the excess of caustic alkalinity and the problem of disposing of lime sludge in the case of hard waters. On the other hand, the advantages are considerable. Questions of taste are eliminated. Hard waters may be softened and soft waters hardened by the process. Hard impure waters are not only softened and rendered safe bacteriologically but improved greatly, as judged by physical and chemical standards.

Water Tests.—The physical, chemical and bacteriological tests used in the examination of waters have not altered very materially during recent years. Physically, observations are made of the colour (using a colour meter), turbidity (gravimetrically, or with some form of turbidimeter) and opacity (as shown, for example, by passing a beam of light through the water), etc. Chemically, the chief tests are still for ammoniacal, albuminoid and oxidized nitrogen, chlorides, oxygen absorbed from permanganate, hardness, etc., although new tests, like the determination of the hydrogen-ion concentration, are being used extensively. Bacteriologically, the number of bacteria (especially at 37° C) and the *B. coli*

test still hold the field. In connection with the latter test, a vast amount of work has been done, but we are still uncertain what significance should be attached to the various races of *B. coli* encountered in water analyses. The tendency is to insist on the possession of, say, two positive attributes (lactose+indol+) which characterize human faecal microbes and then judge the matter on a *quantitative* basis. On the whole, the attempts to differentiate between *B. coli* of human intestinal origin and those derived from the lower animals, fish and birds have been most disappointing. The modern teaching is that as it is economically possible, by adequate purification processes, to eliminate (or nearly so) all "lactose+indol+*B. coli*," this standard should always be aimed at. Speaking generally, nearly all are agreed that there should be no *B. coli* of the kind referred to in 100 c.c. of water in more than half of the samples examined.

The interpretation of results has altered considerably during recent years, especially in those cases where chlorination is practised. The tendency is rather in the direction of condoning certain imperfections of quality (*e.g.*, the amount of organic matter present) provided that *B. coli* is killed. It is considered that if *B coli* is destroyed the occurrence of epidemic water-borne diseases is impossible and that therefore other inferential indices of safety lose much of their significance. But those who cling to past traditions regard chlorination as a short cut to apparent rather than real purity.

Natural Methods.—These methods of purification have not been neglected of late years. The value of storage is being increasingly recognized. The three factors making for safety are equalization, sedimentation and devitalization. By equalization is meant the dilution and averaging of any sudden access of pollutions to the water "feeding" a storage reservoir. Sedimentation means the settling out of solid impurities. Devitalization implies the gradual extinction of undesirable bacteria under conditions of storage which are unfavourable to the continued vitality of pathogenic microbes. Nature's method of purification has certain disadvantages. Just as some things die, so do others multiply, sometimes with embarrassing results. There are the diatoms, the protozoa, green and blue growths, etc. Some of these growths give rise to taste troubles (*e.g.*, tabellaria, synura, uroglena, etc.); others exercise a serious blocking or choking effect on sand filtration processes (*e.g.*, asterionella, synedra, cyclotella, fragilaria, etc.). Copper sulphate (in doses of 0·1 to 1·0 per 1,000,000; 1 to 10 lb. per 1,000,000 gal.) has been proved to be a valuable algicidal agent. The smaller doses have no injurious action on fish, but with the maximum doses care is needed, especially with trout.

Filters.—A new and interesting development is the suggestion that rapid (mechanical) filters should be used to remove nearly all the suspended matters (including algal and other growths) from water, and worked at the very rapid rate of 100–200 gal. per sq.ft. per hour. In order to cover the additional cost involved it is hoped that it may be feasible to work slow sand filters at six instead of two gal. per sq.ft. per hour as a final filtration process. The underlying idea is that slow sand filters might be worked considerably faster than is usual if rapid filters were used antecedently to remove the bulk of the suspended matters. Those who favour these departures usually advocate chlorination as an additional safeguard, or, at all events, as a stand-by measure.

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(A. C. Ho.)

WATER RIGHTS. By the law of England the property in the bed and water of a tidal river is presumed to be in the Crown or as a franchise in a grantee of the Crown, and to be extra-parochial. The bed and water of a non-tidal river are presumed to belong to the person through whose land it flows, or, if it divide two properties, to the riparian proprietors, the rights of each extending to midstream (*ad medium filum aquae*). In order to give riparian rights, the river must flow in a defined channel, or at least above ground. The diminution of underground water collected by percolation, even though malicious, does not give a cause of action to the owner of the land in which it collects, it being merely *damnum sine iniuria*, though he is entitled to have it unpolluted unless a right of pollution be gained against him by prescription. The right to draw water from another's well is an easement (*q.v.*) not a *profit à prendre*, and is therefore claimable by custom. As a general rule a riparian proprietor, whether on a tidal or a non-tidal river, has full rights of user of his property. Most of the statute law will be found in the Fishery Harbours Act, 1915, and the Salmon and Freshwater Fisheries Act, 1923. In certain cases the rights of the riparian proprietors are subject to the intervening rights of other persons. These rights vary according as the river is navigable or not, or tidal or not. For instance, all the riparian proprietors might combine to divert a non-navigable river, though one alone could not do so as against the others, but no combination of riparian proprietors could defeat the right of the public to have a navigable river maintained undiverted. We shall here consider shortly the rights enjoyed by, and the limitations imposed upon, riparian proprietors, in addition to those falling under the head of fishery or navigation. (*See* also FORESHORE.)

The right of use of the water of a natural stream cannot be better described than in the words of Lord Kingsdown in 1858: "By the general law applicable to running streams, every riparian proprietor has a right to what may be called the ordinary use of water flowing past his land—for instance, to the reasonable use of the water for domestic purposes and for his cattle, and this without regard to the effect which such use may have in case of a deficiency upon proprietors lower down the stream. But, further, he has a right to the use of it for any purpose, or what may be deemed the extraordinary use of it, provided he does not thereby interfere with the rights of other proprietors, either above or below him. Subject to this condition, he may dam up a stream for the purposes of a mill, or divert the water for the purpose of irrigation. But he has no right to intercept the regular flow of the stream, if he thereby interferes with the lawful use of the water by other proprietors, and inflicts upon them a sensible injury" (*Miner* v. *Gilmour*, 12 Moore's P.C. Cases, 156). The rights of riparian proprietors where the flow of water is artificial rest on a different principle. As the artificial stream is made by a person for his own benefit, any right of another person as a riparian proprietor does not arise at common law, as in the case of a natural stream, but must be established by grant or prescription. If its origin be unknown the inference appears to be that riparian proprietors have the same rights as if the stream had been a natural one (*Baily* v. *Clark*, 1902, 1 Ch. 649). The rights of a person not a riparian proprietor who uses land abutting on a river or stream by the licence or grant of the riparian proprietor are not as full as though he were a riparian proprietor, for he cannot be imposed as a riparian proprietor upon the other proprietors without their consent. The effect of this appears to be that he is not entitled sensibly to affect their rights, even by the ordinary as distinguished from the extraordinary use of the water. Even a riparian proprietor cannot divert the stream to a place outside his tenement and there use it for purposes unconnected with the tenement (*McCartney* v. *Londonderry and Lough Swilly Rly. Co.*, 1904, A.C. 301).

The limitations to which the right of the riparian proprietor is subject may be divided into those existing by common right, those

imposed for public purposes, and those established against him by Crown grant or by custom or prescription. Under the first head comes the public right of navigation, of anchorage and fishery from boats (in tidal waters), and of taking shell-fish (and probably other fish except royal fish) on the shore of tidal waters as far as any right of several fishery does not intervene. Under the second head would fall the right of eminent domain by which the State takes riparian rights for public purposes, compensating the proprietor, the restrictions upon the sporting rights of the proprietor, as by Acts forbidding the taking of fish in close time, and the Wild Birds Protection Acts, and the restrictions on the ground of public health, as by the Rivers Pollution Act, 1876, and the regulations of port sanitary authorities. The jurisdiction of the State over rivers in England may be exercised by officers of the Crown, as by commissioners of sewers or by the Board of Trade, under the Crown Lands Act, 1866. These powers have now been transferred to the Ministry of Transport. Rivers are frequently controlled by conservation under special acts, upon which their powers mainly depend (see *Thames Conservators* v. *Kent,* 1918, 2 K.B. 272). A bridge is erected and maintained by the county authorities, and the riparian proprietor must bear any inconvenience resulting from it. An example of an adverse right by Crown grant is a ferry or a port. The rights established against a riparian proprietor by private persons include the right to land, to discharge cargo, to tow, to dry nets, to beach boats, to take sand, shingle or water, to have a sea-wall maintained, to pollute the water (subject to Rivers Pollution Act), to water cattle, etc. Where the river is navigable, although right of navigation is common to subjects of the realm, it may be connected with a right to exclusive access to riparian land, the invasion of which may form the ground for legal proceedings by the riparian proprietor (see *Lyon* v. *The Fishmongers' Company,* 1876, 1 A.C. 662). There is no common-law right of support by subterranean water. A grant of land passes all water-courses, unless reserved to the grantor.

A freshwater lake appears to be governed by the same law as a non-tidal river, surface water being *pars soli.* The preponderance of authority is in favour of the right of the riparian proprietors as against the Crown. Most of the law will be found in *Bristow* v. *Cormican,* 1878, 3 A.C. 648.

Unlawful and malicious injury to sea and river banks, towing paths, sluices, flood-gates, mill-dams, etc., or poisoning fish, is a crime under the Malicious Damage Act, 1861.

A *Mill* may be erected by any one, subject to local regulations and to his detaining the water no longer than is reasonably necessary for the working of the wheel. But if a dam be put across running water, the erection of it can only be justified by grant or prescription, or (in a manor) by manorial custom. On navigable rivers it must have existed before 1272. The owner of it cannot pen up the water permanently so as to make a pond of it.

Bathing.—The reported cases affect only sea-bathing, but Hall (p. 160) is of opinion that a right to bathe in private waters may exist by prescription or custom. There is no common-law right to bathe in the sea or to place bathing-machines on the shore. Prescription or custom is necessary to support a claim, whether the foreshore is the property of the Crown or of a private owner (*Brinckman* v. *Matley,* 1904, 2 Ch. 313). Bathing in the sea or in rivers is now often regulated by the by-laws of a local authority. (*See* also FERRY; WEIR.)

Scotland.—The law of *Scotland* is in general accordance with that of England. The Crown has (1) a right of property in the *solum* and salmon fisheries of the sea—and tidal navigable rivers—within the three miles' limit, which is *inter regalia minora* and may be alienated by express or implied grant, and (2) a right of navigation and white fisheries in the same which is *inter regalia majora* and inalienable. A Crown charter of lands "bounded by the sea" is a habile title to prescribe a right to the *solum* of the foreshore, between high- and low-water mark of ordinary spring tides, and if the charter contain a clause *cum piscationibus* it is a habile title to prescribe a right to the salmon fishing *ex adverso* of the lands. Where the foreshore is acquired under a Crown grant it remains subject to public uses incidental to navigation and white fishing. Persons engaged in the herring fishery off the coast of Scotland have, by 11 Geo. III. c. 31, the right to use the shore for 100 yd. from high-water mark for landing and drying nets, erecting huts and curing fish. The right of ferry is one of the *regalia minora* acquirable by prescriptive possession on a charter of barony. Sea-greens are private property. The right to take seaweed from another's foreshore may be prescribed as a servitude. The riparian proprietors have several rights in the *solum* of a fresh-water loch and a right in common to use its surface for boating, fishing and shooting (*Mackenzie* v. *Banks,* 1878, 3 App. Cas. 1324). As between opposite riparian proprietors the *medium filum* is only of importance in determining rights of property in the *solum,* or the exercise of fishing rights, where the opposite proprietors have each rights of fishing but neither has had exclusive possession. *See* the Salmon Fisheries (Scotland) Acts 1828 to 1868. In *Ireland* the law is similar to that of England. In *R.* v. *Clinton,* I.R. 4 C.L. 6, the Irish court went perhaps beyond any English precedent in holding that to carry away drift seaweed from the foreshore is not larceny. The Rivers Pollution Act, 1876, was re-enacted for Ireland by the similar Act of 1893.

United States.—In the *United States* the common law of England was originally the law, the State succeeding to the right of the Crown. This was no doubt sufficient in the 13 original States, which are not traversed by rivers of the largest size, but was not generally followed when it became obvious that new conditions, unknown in England, had arisen. Accordingly the soil of navigable rivers, fresh or salt, and of lakes, is vested in the State, which has power to regulate navigation and impose tolls. The admiralty jurisdiction of the United States extends to all public navigable rivers and lakes where commerce is carried on between different States or with foreign nations (*Genesee Chief* v. *Fitzhugh,* 12 Howard's Rep. 443). And in a case decided in 1893 it was held that the open waters of the great lakes are "high seas" within the meaning of s. 5346 of the Revised Statutes (*U.S.* v. *Rodgers,* 150 U.S. Rep. 249). A State may establish ferries and authorize dams. But if water from a dam overflow a public highway, an indictable nuisance is caused. The right of eminent domain is exercised to a greater extent than in England in the compulsory acquisition of sites for mills and the construction of levees or embankments, especially on the Mississippi. In the drier country of the west and in the mining districts, the common law as to irrigation has had to be altered, and what was called the "Arid Region Doctrine" was gradually established. By it the first user of water has a right by priority of occupation if he give notice to the public of an intention to appropriate, provided that he be competent to hold land. (*See* EASEMENT; FISHERIES; SERVITUDE.)

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WATERS, TERRITORIAL. In international law "territorial waters" are the belt of sea adjacent to their shores which States regard as being under their immediate territorial jurisdiction, subject only to a right of innocent passage through them by vessels of all nations. As to the breadth of the belt and the exact nature of this innocent right of passage, however, there is still much controversy. The three miles' limit recognized and practised by the majority of States seems to have been derived from the cannon range of the period when it was adopted as between Great Britain and the United States, towards the close of the 18th century. Bynkershoek, in his *Dominion of the Sea* (1702), had adopted the principle of self-protection. Since fortresses can give effective protection within range of their cannon, he argued that the respect was not due to the presence of cannon, but to the fact that the State was in a position to enforce respect. This it could do from any point along its shore. Hence his well-known doctrine: *terrae dominium finitur, ubi finitur armorum vis.* The doctrine

satisfied a requirement of the age and became a maximum of international law, both for the protection of shore fisheries and for the purposes of neutrality. Denmark, Norway and Sweden maintain that the special configuration of their coasts necessitates the exercise of jurisdiction over a belt of four miles; Chile, Turkey and Uruguay claim jurisdiction over five miles; France, Portugal and Spain over six miles. The writers and specialists on the subject are quite as much divided. A British Fishery Commission in 1893 reported: "the present territorial limit of 3 miles is insufficient," and that, for fishery purposes alone, this limit should be extended. By the convention (May 6, 1882) between Great Britain, France, Belgium, Holland, Germany and Denmark relating to the regulation of the fisheries in the North sea, the limit of territorial waters as between the contracting parties is fixed at 3 m. measured from low-water mark and from a straight line drawn from headland to headland at the points where they are 10 m. across. In the British Act of June 29, 1893, giving effect to a subsequent convention (Nov. 16, 1887) between the same parties for the regulation of the liquor traffic in the North sea, "territorial waters" are declared to be as defined in the Territorial Waters Jurisdiction Act 1878. In this Act the definition is as follows:—

"The territorial waters of Her Majesty's dominions in reference to the sea means such part of the sea adjacent to the coast of the United Kingdom, or the coast of some other part of Her Majesty's dominions, as is deemed by international law to be within the territorial sovereignty of Her Majesty; and for the purpose of any offence declared by this Act to be within the jurisdiction of the admiral, any part of the open sea within one marine league of the coast measured from low-water mark shall be deemed to be open sea within the territorial waters of Her Majesty's dominions."

The definition only restricts the operation of the 3 m. limit to offences dealt with in the Act, and does not deal with bays. The Act of 1893 declares that the articles of the convention "shall be of the same force as if they were enacted in the body of the Act," but this convention gives no definition of territorial waters.

The jurisdiction exercised in British territorial waters under the Territorial Waters Jurisdiction Act of 1878 is asserted without distinction between them and inland waters.

League of Nations.—The subject has been exhaustively dealt with by the Institute of International Law, the International Law Association and the American Institute of International Law. All these societies have drafted conventions dealing with the general principles governing the use of the seas, and with the particular regulations proposed to be enforced. The Institute of International Law recommends a territorial zone of six marine miles; the International Law Association a zone of three marine miles from low water mark; whilst the American Institute leaves this zone undefined. In consequence of the opinion of the Committee of Experts for the Progressive Codification of International Law appointed by the Council of the League of Nations on Sept. 22, 1924, that the subject of territorial waters was ripe for codification, a draft convention was prepared by Dr. Walther Schücking.

The draft was circulated to all the States, accompanied with a questionnaire including a general question, viz., "whether there were problems connected with the law of the territorial sea considered in its various aspects, which might find this solution by way of convention, and if so what those problems are and what solutions should be given to them, and in particular what should be the rights of jurisdiction of a State over foreign commercial ships within its territorial waters or in its ports." Twenty-three States replied in the affirmative.

League of Nations Draft Convention.—By the draft convention by Dr. Schücking which is proposed as a basis for discussion a State is to have an unlimited right of dominion over the sea which washes its coast to the extent of six marine miles, subject to the rights of common user by international law, such dominion including rights over the air above the said zone and the soil and sub-soil beneath it.

Outside this zone, *i.e.*, on the high seas, a State may only exercise control for purposes of self-protection, customs or sanitation, and other rights may only be granted by an International Waters Office to a riparian State if demonstrably urgently necessary, and such grants shall not include rights of exclusive economic user.

In the case of bays which are wholly within the territory of one State, the territorial waters shall follow the sinuosities of the coast, but if the mouth is 12 marine miles across, then the zone shall commence from a line drawn across the mouth, unless a greater distance than 12 marine miles has been established by continuous and immemorial usage. Where islands are situate within six marine miles of the coast, the territorial zone is measured from the outermost; where they are situate outside, each island will have its own territorial zone of six marine miles. Where a strait is wholly within one State and neither entrance exceeds 12 marine miles, the whole waters shall be territorial. Where the shores belong to different States and the strait does not exceed 12 m., the territorial waters shall be divided by the middle line. The coasting trade is preserved as at present and also the right of pursuit and arrest of a vessel on the high seas for an offence committed within territorial waters. Whilst enjoying the right of innocent passage, warships are not exempt from any special regulations which may be made. A foreign merchant vessel when in port shall be subject to the civil jurisdiction of the riparian State. Criminal jurisdiction shall be restricted to the punishment of offences committed on board which are not directed against a member of the crew or against passengers and their property and to cases in which the captain has asked for assistance and in which the peace of the port or public order has been disturbed. All disputes arising out of the application or interpretation of the convention shall be referred to the Permanent Court of International Justice or to an *ad hoc* court of arbitration.

Proposed International Commission.—Germany, Great Britain and the United States are all strongly opposed to the proposal for a six miles' territorial zone for general purposes. The solution would appear to be a three mile zone with unlimited jurisdiction for all and particularly for neutrality purposes, and an extended jurisdiction according to local conditions and requirements, *e.g.*, for fishing; for customs such as one hour's sailing in the United States and 12 miles in Italy and Norway; for sanitation; for police purposes and for public safety. Prof. Alvarez was the first to propose—at the suggestion of the present writer—the creation of an international commission, consisting of representatives from the maritime States, to supervise the control of the high seas. In his draft convention presented to the Stockholm conference of the International Law Association in 1924, he proposed to give power to the commission to authorize maritime States to occupy portions of the high seas for a given period for installations designed to serve one of the following purposes of general interest, viz.: (1) bases for non-military aircraft, *i.e.*, floating islands; (2) wireless telegraphy stations; (3) submarine-cable stations; (4) lighthouses; (5) scientific research; (6) stations for assisting the victims of shipwreck. Also to allow a State or a syndicate to occupy the high seas temporarily for the recovery of wrecks or treasure.

Bays and Gulfs.—In the case of bays and gulfs it is generally agreed that all inland waters the entrance to which does not exceed six miles are territorial waters. But there is no agreement if they exceed this distance what the distance should be. Some suggest ten miles, some twelve miles. Referring to the Bristol channel, Lord Stowell in 1801 declared that the Crown had from "a pretty remote antiquity always asserted something of that special jurisdiction which sovereigns of other countries have claimed and exercised over certain parts of the sea adjoining their coasts." In *Cunningham's Case* it was held that "the whole of this inland sea between the counties of Somerset and Glamorgan is to be considered as within the counties by the shores of which its several parts are respectively bounded." This, said Lord Blackburn in the *Conception Bay Case*, pointed to "the headlands in Pembroke and Hartland point in Devonshire as being the *fauces* of that arm of the sea"; he added, "we find a universal agreement that harbours, estuaries and bays land-locked, belong to the territory of the nations which possess the shores round them."

In the *Moray Firth Case* Lord Guthrie held that the Moray Firth within the headlands of Duncansbay head to Rathary point, a distance of 73 miles, was within the territorial waters of Scotland. Lord Killacky declared that the firth seemed to him to be *prima facie* a bay of well-marked headlands and penetrating far into the heart of the country. While admitting that in width at the mouth and in general configuration it was larger than most "bays" properly so-called, he considered helpful the analogies of the Bristol channel and the Firths of Clyde and Forth. The same conclusion was reached in the case of Palk's bay in the Gulf of Manaby by the High Court of Madras, and the claim of Queensland over the waters lying within the Great Barrier reef, in places more than 100 m. out to sea, has never been contested by foreign powers. In the *Fagernes* (1926) p. 185 Mr. Justice Hill decided that the waters of the Bristol channel west of a line drawn where the channel is about 20 m. wide, was within the *fauces terrae*. At the hearing in the court of appeal, after a statement by the attorney-general that he was instructed by the secretary of State to say "that the spot where this collision is alleged to have occurred is not within the limit to which the territorial sovereignty of His Majesty extends," the decision of Mr. Justice Hill was reversed by a majority of the court.

The American decisions are in line with the British. In The *Alleganean* (1885) it was held that Chesapeake bay was within the territorial jurisdiction of the United States upon the grounds that its headlands are well marked and but 12 m. apart; that it is wholly within American territory; that from its earliest history it has been claimed to be territorial waters and the claim has never been contested; that it cannot become the pathway from one nation to another; and from the doctrines of the recognized authorities upon international law, as well as the holdings of the English courts as to the Bristol channel and Conception bay. Similar judgments upon similar grounds were delivered in subsequent cases.

The following instances show that the six miles' limit is more honoured in the breach than in the observance. France claims as territorial waters Concale bay which is 17 m. across; Norway the Varangar fiord which is 32 m.; Great Britain the Bay of Chaleurs which is 16 m., Miramiche bay which is 14½ m., and Hudson bay which is over 100 m.; the United States Delaware bay which is 18 m., Cape Cod bay which is 32 m., Monterey bay which is 19 m., as well as inlets of a similar character. In the *North Sea Fisheries Arbitration* of 1910, the attorney-general on behalf of Great Britain said—"it is also undoubted law that a State can exercise sovereignty over certain portions of the sea enclosed within its territories by headlands or promontories." The

claim, he said, had never been abandoned. The true position is this: Inland waters are not necessarily territorial waters, but as Chief Justice Hale said they *may* be. To render such waters territorial in the eyes of international law two conditions therefore are essential: First the State possessing the circumjacent land must be physically competent to exclude other States from the whole of the waters so surrounded; and secondly, the acquiescence of other States in the claims to exclude must be present. This in fact has been the practice. It may well be imperative for a State to claim such jurisdiction for reasons of national defence, police administration, sanitation, customs, commerce or industry. To limit bays to the maximum of 12 m. "unless a greater distance has been established by continuous and immemorial usage," would prevent all future claims. The same objection applies to the limit of 12 m. for the entrance of straits. The question has been submitted to a committee appointed by the League of Nations. (H. H. L. B.)

WATER-SCORPION, an aquatic hemipterous insect of the family *Nepidae,* so called from its superficial resemblance to a scorpion, which is due to the modification of the anterior pair of legs for prehension, and to the presence of a long slender process, simulating a tail, at the posterior end of the abdomen. The common British species (*Nepa cinerea*) lives in ponds and stagnant water. The common genus in the United States is *Ranatra.*

WATERSHED, the land-form separating the head streams tributary to two different river basins. Alternative terms are "water-parting" and "divide" (*q.v.*).

WATERSPOUT, the name applied to the funnel-shaped cloud of the tornado (*q.v.*) when it occurs at sea. The funnel point seems to descend slowly from the lower side of the heavy nimbus clouds. Beneath this point the sea appears agitated and a cloud of spray forms, into which the funnel point dips, and the whole has the appearance of a water column which (by eye estimation) has been given as 20 to 30 ft. in diameter and 250 to 300 ft. high; the bulk of the liquid in the column consists of rain-water. The top usually travels more quickly than the base. The phenomenon seldom lasts as long as 30 minutes.

WATER SUPPLY. A sufficient supply of potable water is essential to man. The word potable means that the water shall be bright, clear and sparkling, free from suspended matters, reasonably soft, free from chemical poisons and in such condition that it cannot cause typhoid fever, cholera, diarrhoea or other water-borne disease, nor have any injurious action on metals. The water should be available at such pressures as will enable a supply by gravity to reach the upper floors or cisterns.

Water is needed for domestic purposes, including sanitation, also for industries, where a high degree of purity is often needed. The availability of suitable supplies determines the location of such industries. Water must also be supplied for fire extinction, street watering, supplies to public buildings and institutions and the flushing of sewers.

Estimation of Requirements.—A local estimate should be made of the average daily quantity which will be required in from 25 to 50 years' time. This estimate involves the prediction of the probable increase of population and of the quantity to be used for all purposes expressed in gallons per head per day. Factors involved are the character of the town, the habits of the people and the various industries which are established or likely to be established. The rate per head varies widely not only throughout any particular country but also as between countries. General experience indicates that almost invariably the rate per head shows an upward trend.

For example a small country town in England where there is but little industrial usage may require 18 or 20 gallons: a large commercial city may use for all purposes 35 or 40 gallons, and in America supplies up to 100 gallons are fairly common and in several instances in the United States much larger quantities are used. Liverpool may be cited as a typical large city and of the total supply of 34·7 gallons per head in 1927 domestic purposes account for 21·7 gallons, trade and shipping (supplied by meter) 9·1 gallons, public purposes 1·6 gallons and sundry other purposes including fire extinction 3·3 gallons.

In America the higher consumption is partly due to a higher standard of living and a more lavish use of water and partly to waste due to faulty house fittings and to leaky distribution mains; an analysis of statistics covering 136 American cities having a population exceeding 25,000 shows that, on the average, where less than 10% of the services are metered the consumption per head is 128 gallons, whilst with 50% or more metered services the consumption is only 52 gallons.

Consumption and Distribution.—The variations in consumption have also to be considered in designing aqueducts and distribution works. The aqueduct by which the water is carried from the source of supply to the town terminates in a main service reservoir, and the capacity of this reservoir depends, in both gravitation and pumping schemes, upon (a) the fluctuations in supply during the maximum day, week and month as compared with the average; (b) on the time required to repair a break in the aqueduct; and (c) on the reserve required to meet the probable maximum demand in case of fire. In addition to main service reservoirs there are minor service reservoirs with capacities of about 250,000 gallons up to 4,000,000 gallons.

The maximum hourly demand for a town with a population of several hundred thousand will be 50% to 100% in excess of the average hour taken over the day: the demand of the maximum day will be 20–40% in excess of the average day's demand: the maximum week will exceed the average week by 15–30% and the maximum four weeks will exceed the average four weeks by 10–20%.

The hourly fluctuations and to some extent the daily fluctuations are usually catered for in the minor service reservoirs which will also be first drawn upon in the event of fire, but the storage to meet the fluctuations over longer periods and the reserve to cover periods when the aqueduct may be out of commission is provided in the main service reservoir, and this in practice would have a capacity equal to 2–4 days of the average supply in the case of a gravitation supply; this storage would be increased if the aqueduct traversed ground liable to subsidence and reduced if the ground were good and the aqueduct, where of pipes, was in duplicate with fairly frequent cross connections. Where a supply is pumped the aqueduct, or rising main, is usually fairly accessible, and pumping machines in duplicate, so less storage would be sufficient. Should the pumps work only part of the day the storage must also be capable of meeting the demand when the pumps are idle.

The amount of water required as a special reserve for fire extinction is usually small as compared with that necessary for other purposes, and is sometimes neglected, but an approximate rule applicable to industrial towns in Britain is that $80{,}000\sqrt{x}$, when x is the population in thousands, will give the extra storage in gallons. This storage should be available in the minor service reservoirs, and should be appropriate to the particular district and population supplied by each such reservoir.

Whilst the distribution mains should be capable of meeting the maximum hourly demand, the criterion which really decides their capacity, especially in sub-districts, is the demand for fire extinction, and for this purpose the distribution mains should be capable of carrying $\frac{750}{\sqrt{x}}\%$ of the average hourly rate of ordinary consumption. Thus in a sub-district having a population of 2,250 the average day's supply might be 72,000 gallons, the average hour therefore being 3,000 gallons and the maximum hour of the maximum day $3{,}000\times1{\cdot}75\times1{\cdot}25=6{,}600$ gallons, whereas the fire demand would be $\frac{750}{\sqrt{2{\cdot}25}}=500\%$ of 3,000 or 15,000 gallons an hour, and the main should therefore be capable of carrying 21,600 gallons an hour.

Source of Supply.—Schemes of water supply may be divided broadly into two groups according to the general source, and the method of collection. In the first or surface water group we have (1) rain water collected from roofs, etc.; (2) water from (a) upland rivers, (b) lowland rivers; and (3) water from lakes. In the second or ground water group we have water derived from (1) springs; (2) shallow wells; (3) deep and artesian wells; and (4) horizontal galleries. Whilst rain water from roofs or specially constructed tanks and ground water from shallow wells may, in general, be sufficient for individual supplies or for small groups

of consumers, such supplies are not suitable for public supplies and are therefore not further considered here.

Public water supplies may, from the nature of the works required, be divided into two broad groups—gravitational and pumping schemes. Gravity supplies may be obtained from upland rivers and sometimes from elevated lakes and springs, whilst supplies obtained from lowland rivers, deep wells, horizontal galleries, and sometimes from low level lakes and artesian wells, involve pumping.

Gravitational Schemes.—In the case of upland supplies the amount of storage provided must be such as will afford continuity of supply and the elevation should be such that when the reservoir is drawn down to the lowest draw-off level, it not only commands the greater part, if not all, of the area to be supplied, but also allows for the necessary fall to overcome the friction in the aqueduct and for the loss of head in filtration.

As most impounded waters are soft, it is now usual to install filters at the head of the aqueduct, and, during or after the filtration process, the water is so treated as to have a small residual alkalinity which inhibits any deleterious action on the materials, especially pipes, of which the aqueduct may be constructed. Whereas a large main conveying soft moorland water may have its capacity reduced by as much as 40% by tuberculation or nodular encrustation within twenty years, the same main conveying filtered and hardened water will not suffer any appreciable reduction in carrying capacity. In the older aqueducts, the only way of maintaining a reasonable capacity is by mechanical scraping at intervals, but once this process is adopted, it is found that the necessity of scraping increases in frequency as time goes on.

The necessity for filtration and hardening or softening of spring waters depends upon the possibility of pollution and the geological formation from which the springs derive their water.

Pumping Schemes.—Where the source is a lowland river or a low level lake the water may be abstracted by means of a simple intake or intakes protected by duplicate screens leading to a sump from which the water is pumped into sedimentation basins, and after a period of storage depending upon the amount of matter in suspension and other factors it is filtered, hardened or softened, and, if necessary, sterilized, and finally pumped into the service reservoir. Where the water is derived from deep wells or from infiltration galleries in the pervious bed or banks of a river, sedimentation is not required and, generally, filtration is unnecessary, though such waters may require softening and sterilization.

Choice of Source.—Recent developments in the methods of water purification have made it possible to consider many waters as potentially suitable for public supply purposes which but ten or twenty years ago would have been entirely ruled out. It follows that the choice between utilising a relatively pure water from a distant elevated source or a water of a much lower standard from a nearer source which calls for pumping and greater working cost in filtration and other treatment, is now largely a question of cost of water. This means the cost per 1,000 gallons delivered at the main service reservoir after taking into account interest and sinking fund charges and annual working expenses—cost of labour, chemicals, fuel, repairs and maintenance.

The initial cost of water from a gravitation scheme is usually high because the impounding reservoir and all or part of the aqueduct must be constructed at the outset of sufficient size to meet the ultimate requirements, although the initial demand may be but 20 or 25% of the ultimate. Another factor, which applies particularly to British work, is that it has been the practice of Parliament to insert a Clause in the Act authorising the construction of impounding reservoirs whereby one-tenth to one-third of the yield of a catchment area is to be released in a more or less regular flow from the reservoir as "compensation water," and this of course may place a serious additional burden on the undertakers. In the United States the riparian and other interests are most frequently compensated by monetary payments.

It is therefore evident that for the economical development of impounding schemes, a relatively large initial demand is desirable and this, in a measure, explains the modern tendency to the formation of joint Water Boards with the consequent reduction in the cost of water to each constituent authority.

In a pumping scheme, on the other hand, the initial capital expenditure is, as a rule, much smaller, and the working expenses are larger but roughly proportionate to the quantity of water pumped. The capacity of such schemes can also be augmented from time to time as required to keep a few years ahead of the demand at relatively small cost, whereas when the demand is approaching the yield of an impounding reservoir it is necessary to construct another similar reservoir and duplicate increasingly long lengths of the aqueduct, so that it is usually advantageous for a single authority to embark on a pumping scheme where there is any choice.

Impounding Reservoirs.—The considerations which determine the capacity of the impounding reservoir are dealt with under RESERVOIRS, and the type of dam by which the reservoir may be created under DAMS. It may, however, be emphasized that frequently as much as 30 or 40% of the cost of the dam may be expended on subsurface works for preventing undue leakage through pervious beds under the structure or round its flanks, and a masonry dam may have to be carried to considerable depths to ensure that the structure rests upon material strong enough to withstand the loading which is the resultant of the water pressure and the weight of the dam itself.

An essential preliminary to the selection of the site for a dam is a thorough geological investigation of the area within the limits assigned to the dam, and a general examination of the valley above the dam; such an investigation will not only prevent waste of money in locating a dam at an unsuitable site, but will also enable a much closer estimate of the cost of the work than would otherwise be possible. In this connection the use of boreholes only as a means of exploration is insufficient, and may lead to erroneous conclusions: they should be used to supplement the results obtained from trial shafts and to clear up doubtful points.

The cementation process by means of which cement is injected under pressure through drilled holes over the site of a dam, has of recent years been used to strengthen rock which otherwise might have had insufficient strength, and also to seal up fissures and joints through which water might escape. This process therefore makes it possible to use sites or structures which might otherwise have been considered unsuitable, and in more favourable sites, to reduce the extent of the subsurface work.

Gravitation Aqueduct.—In fixing the size of the various portions of the aqueduct an allowance over the average daily supply which the aqueduct is intended ultimately to carry, apart from any allowance required to meet loss of capacity due to encrustation, must be made to cover the filling up of the terminal service reservoir after depletion consequent upon a burst in the aqueduct, and also to cover seasonal variations. The precise allowance depends on the length of the aqueduct, its liability to interference, accessibility and the economic possibilities of terminal storage; in general 10 per cent. would be sufficient: this might be reduced if a relatively large storage—5 or 6 days—could be economically obtained at the end of a long and costly aqueduct, and increased if the aqueduct were short or only 2 or 3 days' storage could be obtained. The aqueduct is chiefly of cut and cover or tunnel with relatively short connecting lengths of pipe line or lines where the general route can more or less contour the hillsides, or entirely or chiefly of pipe line with short intervening lengths of tunnel where the route crosses hills.

The tunnel and cut and cover portions are made capable of taking the ultimate yield of the source: for this quantity two or more pipe lines, side by side, may be required, but initially only one line would be laid, the others being added wholly or in part and cross-connected to the original line and to each other as the growth of demand necessitates. These portions act also as break-pressure tanks, so that the maximum pressure to which any particular length of pipes is subjected is that corresponding to the top water level in the preceding tunnel or cut and cover.

When of appreciable length, the tunnel and cut and cover portions should be provided with automatic self-closing outlet valves

designed to close when the flow exceeds the normal by more than a predetermined amount, to prevent undue loss of water in the event of a burst in the ensuing pipes, and each pipe should have a reflux valve at its termination to prevent loss of water in the other direction. Where an aqueduct consists wholly of pipes, break-pressure tanks of relatively small capacity are located at suitable high points, and the inlet to these tanks is controlled by some form of float regulator to prevent loss by overflow, and the outlet by a self closing valve. To facilitate testing and repairs, long mains are provided with stop-valves at intervals of about 1½–2 miles with scour valves at depressions, and air valves at all summits. Where the lining is with either cement, mortar or bitumen, it is well to combine the air-valve and an access manhole to facilitate the making of joints. Where unlined pipes, liable to encrustation, are used, hatch pipes should be provided for the passage of the "scraper." Additional air valves are provided in any long lengths of main which are laid to flat gradients, or at any sudden change of gradient.

Pumping Machinery.—Where coal is available of suitable cost and quality, the triple expansion steam engine using superheated steam is still the most efficient pump against a constant head. Where centrifugal pumps are used they may be driven by steam turbines. The Diesel Engine has proved so reliable in ship propulsion, that it is being widely used. It is equally efficient in large and small units. Where electric current is cheap, motor driven pumps are frequently adopted: better terms can be obtained if the pumping avoids the peak hours of the generating station, and automatic controls can be installed to effect this.

For intermittent work or small quantities, electric motors, oil engines, or gas engines, may be used.

Where the suction lift does not exceed about 25 feet either direct acting or centrifugal pumps may be used: where the suction lift exceeds this limit, three-throw plunger pumps may be used in conjunction with a suction well of ample size, or where space is a consideration, as in a borehole, vertical spindle turbine centrifugal pumps may be employed.

Where water has to be raised from great depths by means of boreholes, the air-lift pump is frequently the only arrangement available: it has the advantage of having no moving parts, and although its efficiency is low it is considered to have advantages in certain cases, which compensate for the lack of efficiency.

Rising Main.—In contradistinction to a gravitation supply, where the general hydraulic gradient and therefore the dimensions of component parts of the aqueduct are, for a given capacity, fixed within close limits by the levels of the impounding and main service reservoirs, the hydraulic gradient of the rising main is determined by purely economic considerations. The terminal level, *i.e.*, the top water level of the service reservoir, is fixed by the level of the area to be supplied from that reservoir, but the head against which the pumps are designed to work, and which determines the hydraulic gradient under which the rising main will operate, must be above that due to the service reservoir.

The carrying capacity of the main is a function of its size and hydraulic gradient: the flatter the gradient the larger the pipe and the smaller the head against which the pumps will operate, for, in addition to the purely static lift given by the difference between the level in the suction well and the level in the service reservoir, there is the friction head which is the product of the hydraulic gradient and the length of the main. Conversely, a smaller and less costly pipe may be used at the expense of increasing the pumping head, the size of the pumping units, and the cost of pumping. In its simplest terms, the economic size of the rising main is that diameter for which the sum of the interest and sinking fund charges on the cost of the pipe line, the pumping units and the building, the service reservoir and filters (if required) and of the annual working expenses, is a minimum.

Service Reservoir.—When the main service reservoir is supplied with filtered water or deep well water it is usually covered in order to prevent contamination and algal growths. Covering also helps to maintain the water at an even temperature and, especially in hot climates, prevents loss of water by evaporation. Even if reservoirs are not covered initially, it frequently happens that the building up of the surrounding land has rendered covering necessary, and as this can only be done by throwing the reservoir out of commission, it is really economy to cover all but the largest reservoirs at the outset. The smaller service reservoirs are located in populous districts and are invariably covered.

Both large and small reservoirs are constructed of concrete, reinforced concrete or brickwork and concrete. They may be rectangular, circular or hexagonal in plan, and their shape depends not only upon the contour of the ground, but also to some extent on the form of roof covering. For capacities up to one million gallons, the economic depth may be from 10 to 12 feet, whilst at 30 millions, the depth may be 30 feet. Usually service reservoirs are surrounded by an earthen bank and the roof is soiled over.

The concrete floor is usually flat with sufficient fall for drainage during cleaning, and in all but the smallest reservoirs, a division wall of part or full height may be provided to enable a part of the storage to be available during cleaning. The roof may be of flat reinforced concrete slabs resting upon a system of main and secondary beams of reinforced concrete, or steel beams encased in concrete. It may consist of longitudinal arches in brickwork or concrete, which spring either from girders or from transverse flying arches, these arches being supported on massive piers, or, as is frequently found in American practice, the piers may support a system of concrete groined arches. Still another and economical form of covering consists of a series of relatively thin plain concrete domes springing from concrete groined arches which, in turn, are supported by hexagonal concrete block columns. Ample provision for ventilation should be made especially in tropical countries, and in these countries mosquito netting is essential.

Apart from the main service reservoir it is usual to provide one or more minor reservoirs upon suitably elevated sites to meet the hourly and possibly daily fluctuations of supply in the more or less immediate vicinity, and to hold an appropriate reserve for fire extinction. Where no site at the required elevation is available, watertowers supporting elevated tanks of cast iron, steel or reinforced concrete, holding 20,000 to 500,000 gallons, and standing 50 to 100 feet above the ground, are used. Minor service reservoirs, located at the ends of main distribution pipes remote from the main service reservoir, are advantageous in that they enable smaller and less costly connecting mains to be used, and also give more regular pressures in the districts served.

Distribution.—There are two methods of charging for domestic supplies: as in Britain, it may be by a water rate at so much per cent. of the annual value, or, as in many American and Continental cities, at so much per 1,000 gallons by meter. Where the supply is metered, it is to the user's interest to maintain his fittings in proper condition, and in America, the introduction of meters invariably leads to a considerable reduction in consumption.

Quite apart from leaky fittings there may be loss of water in the distribution mains, and in a well-organised Water Department, the detection and prevention of leakage and waste is an important part of the work of maintenance.

The outflow from all service reservoirs should be metered, and a close observation of the rates of flow during the night hours will indicate whether there is any serious loss of water in the area supplied from that reservoir. For more detailed observations, the town is divided up into districts, the night supply to each of which can by an appropriate system of valve control be made to pass through a Deacon Differentiating Waste Water Meter. This meter carries a paper diagram mounted on a drum, which is caused by clockwork to revolve uniformly; each house service is controlled by a stop cock accessible to the Waterworks Officials; these cocks are closed in turn and the time of doing so is noted; where there is leakage taking place the closing of the cock will cause a step in the diagram, and the time at which the step occurs will, on reference to the night inspector's log, enable that particular house to be located. The fittings in that house are examined and the user is called upon to remedy the defects which are notified.

When all the stop cocks in the district have been closed, there may still be a flow recorded on the meter, and this represents leakage from the distribution system which may, as a rule, be readily

located by a stethoscope in the hands of an experienced man. The modern practice of re-surfacing roads with reinforced concrete adds considerably to the cost of mending defects in mains.

Native quarters in tropical towns are usually supplied from stand pipes, and unless these are very frequently inspected and well maintained, serious loss of water may occur.

Distribution System.—Where the area of supply has a wide range of level, it is usual to divide it up into zones each commanded by a service reservoir or water tower at an appropriate elevation in order to prevent the pipes and fittings being subjected to excessive pressure with consequent increased liability to loss and waste of water, or the same result may be obtained by the use of pressure reducing valves. The same principle is adopted also when the higher districts have to be supplied by pumping, or repumping, in order to restrict the quantity of water pumped to that requisite for the higher districts only. Where current is available electrically driven centrifugal pumps are installed, and automatically come into action when the level in the upper reservoir falls to a pre-determined level: it can also be arranged that the pumping shall be confined to certain hours if by so doing, the peak hours at the generating station are avoided, and a more favourable tariff for current is thereby obtained.

The general requirements of a satisfactory distribution system are, well laid mains of durable material, laid at such depths as will prevent damage by frost or traffic, of sufficient capacity to meet all demands at an adequate pressure, usually not less than 3 inches internal diameter, and so arranged and intercommunicated that in the event of a burst or for any other reason, a small section may be isolated rapidly; a sufficiency of hydrants appropriate to the various parts of the district; master meters registering the quantities delivered into the several districts; and adequate means of detecting leakage and waste.

Mains.—The mains may be of cast iron, steel, galvanised iron or asbestos-cement. The cast iron and steel pipes may be simply coated internally and externally with Dr. Angus Smith's Solution where the ground in which the pipes are laid has no adverse effect on metals and where the water has sufficient alkalinity to inhibit corrosion or incrustation.

If the water is soft or otherwise likely to cause tuberculation, such pipes should either be of larger diameter to allow for the falling off in carrying capacity, or the pipes must be lined with cement mortar or bituminous compound, and the nature of the lining is not only a question of cost, but also of suitability for the particular water supplied. The thickness of the lining depends upon the size of the pipe, being thinner in the smaller pipes.

The choice of a special type of lining may restrict its use to pipes of such a size that a person can enter them if the making good of the internal joints from the inside is necessary in order to secure continuity in the lining, and this consideration more particularly affects steel pipes, where the consequences of pitting are relatively of greater importance than in the much thicker cast iron pipes.

For protection against external corrosion coated steel pipes may be effectively protected by wrapping with Hessian cloth impregnated with hot bitumen, but great care has to be taken to prevent damage to this wrapping. Where the ground in which the pipes are to be laid contains particularly aggressive constituents, it may be necessary to surround the pipes with concrete or to refill the trench with other and more suitable earth. In tropical countries, where aqueduct mains traverse bad ground, they may be laid on or above the surface, but in such cases expansion and contraction, in the absence of expansion joints, may give rise to leaky joints, though a lead joint, with a depth of lead of 3 inches, under pressure of 200 to 300 feet, will allow of a movement of as much as an inch without leakage.

Joints.—The joints in metal mains are usually of the socket and spigot type made with yarn and lead: of recent years various proprietary substitutes for lead have been used, chiefly in America, with the view to eliminating that caulking which a run lead joint requires, and cement caulked in an almost dry state instead of lead has also been adopted with some measure of success. Galvanised pipes with screwed joints are frequently used for the smaller distribution mains, especially in tropical countries where freight and transport are heavy items of expense.

In Italy asbestos-cement pipes have been used of recent years instead of cast iron pipes in sizes ranging from the smallest distribution pipe up to large trunk mains. These pipes are made with double spigots and jointed by means of collars either of the same material or of cast iron with inserted rubber rings. With most waters and in ordinary ground they are not liable to deterioration, either inside or out. *See* also RESERVOIRS, DAMS, WELL, AQUEDUCTS and WATER PURIFICATION.

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WATER-THYME (*Anacharis canadensis* or *Elodea canadensis*), a submersed aquatic of the frog-bit family (Hydrocharitaceae), native to America, where it is called water-weed. It was introduced into Ireland about 1836, and soon spread and became a weed in waterways, ditches, streams and ponds in England and on the continent. The staminate and pistillate flowers are borne on separate plants. If, as in England, only one kind of plant is present, the species produces no seeds but spreads by vegetative propagation. *A. occidentalis* is a common native species of the northern United States. *A. densa,* native to Brazil, is widely introduced as an aquarium plant.

WATERTOWN, a town of Massachusetts, U.S.A., on the Charles river. Pop. (1940) 35,427. There are two old burying grounds, one of which has been in use since 1642, and a number of colonial houses. The town includes mounds and earthworks thought by Prof. E. N. Horsford to be remains of a Norse settlement of the 11th century. The federal government maintains one of its principal arsenals at Watertown, occupying 188·5 ac. along the river. Several of the original low brick buildings (1816–20) are still in use. The town has numerous and varied manufactures, with an annual output valued at $60,000,000. Watertown was one of the earliest of the Massachusetts Bay settlements, founded in 1630 by Sir Richard Saltonstall and the Rev. George Phillips, and for the first quarter century it ranked next to Boston in population and area. Since then its territory has been greatly reduced. The first protest in America against taxation without representation was made by the people of Watertown, on the occasion of a levy for erecting a stockade fort in Cambridge. The first grist mill in the Colony was established here about 1632, and one of the first woollen mills in America in 1662. Here the Provincial Congress met from April to July 1775; the Massachusetts general court from 1775 to 1778; and the Boston town meetings during the siege of Boston. For several months early in the Revolution the committees of safety and correspondence made Watertown their headquarters, and from here Gen. Joseph Warren set out for Bunker Hill. Theodore Parker conducted a private school in Watertown from 1832 to 1834.

WATERTOWN, a city of northern New York, U.S.A. It has a municipal airport. Pop. (1920) 31,285 (81% native white); 1940 federal census 33,385. The Thousand islands are 22 mi. N. and the Adirondacks 45 mi. N.E. The city's parks include one of 196 ac., two large athletic fields, municipal golf links, swimming pools and children's playgrounds. There is a beautiful public library (1904), a memorial to Governor Roswell P. Flower, whose home was there. Among its products, valued in 1937 at $14,475,301, are paper-making machinery, railroad air brakes, paper, fabrics, knitted garments, women's dresses, electrical machinery, flour and breakfast foods, thermometers and optical goods. The city owns a hydroelectric plant of 7,500 h.p. (opened 1927).

Since 1920 it has had a city manager. Watertown was founded in 1800, and named after the water power, used since 1802. It was incorporated as a city in 1869. The first portable steam engine made in the United States was made in Watertown in 1847, and there, in the store of Moore & Smith, F. W. Woolworth in 1878 first conceived the idea of setting up special counters with goods priced at five and ten cents.

WATERTOWN, a city of South Dakota, U.S.A., on the Big Sioux river, near Lake Kampeska and Lake Pelican, 200 mi. W. of Minneapolis. Pop. 1940 federal census 10,617. The city has a large meat-packing plant, flour mills and machine shops. The city was founded in 1882 and incorporated in 1885.

WATERTOWN, a city of Wisconsin, U.S.A., on the Rock river. Pop. 10,613 in 1930, 11,301 in 1940. It is the seat of Northwestern college (Lutheran, 1865) and Sacred Heart college (Catholic, 1872). It ships dairy products and stuffed goose. Watertown was founded about 1836 by colonists from Watertown, N.Y. After 1848, there was a large influx of Germans, including Carl Schurz, who began his law practice there.

The village was incorporated in 1849 and chartered as a city in 1853.

WATER TURBINE: *see* TURBINE: WATER.

WATER-TURKEY: *see* SNAKE-BIRD.

WATERVILLE, a city of Maine, U.S.A. Pop. (1920) 13,351 (22% foreign-born white); 1940 federal census 16,688. Water power from the Ticonic falls, and later an ample supply of hydroelectric current, have made Waterville an important manufacturing centre. It has large cotton and worsted mills and other plants. In Winslow, directly across the Kennebec river, is a large pulp and paper mill. The city is the seat of Colby college, founded in 1813 as the Maine Literary and Theological institution. The Belgrade lakes are 10 mi. W. of the city and some of the best fishing-grounds in the state are in the vicinity. Settlement there began about the middle of the 18th century. Waterville was set off from Winslow and incorporated as a town in 1802. In 1883 it was incorporated as a city, adopting a city charter in 1888.

WATERVLIET, a city of New York, U.S.A. Pop. (1920) 16,073 (84% native white); 1930 federal census 16,083; 1940, 16,114. It has railroad shops and extensive manufactures of bells, iron and steel castings, stoves, ladders, woollen goods, paper and wooden boxes, asbestos products, spun silk, men's clothing and various other commodities. Within the city limits is the oldest U.S. arsenal (1807), with 2,300 employees. Watervliet was originally called West Troy. It was incorporated as a village in 1836 and as a city (under its present name) in 1896. Since 1918 it has had a commission-manager form of government. In 1776 "Mother Ann" Lee and her followers established the first Shaker settlement in America near the present site of Watervliet.

WATERWAYS: *see* CANALS AND CANALIZED RIVERS; INLAND WATER TRANSPORT.

WATFORD, a municipal borough in the Watford parliamentary division of Hertfordshire, England, 17¾ mi. N.W. of London by the L.M.S.R., served also by the London Passenger Transport board. Pop. (1938) 65,690. Area 8.24 sq.mi. The Early English church of St. Mary has good monumental work of the early 17th century. Watford has corn mills, breweries, iron foundries and engineering works and makes motor accessories and other articles. The Tuesday market dates from 1116. The town was incorporated 1922. At Bushey, a residential suburb 1 mi. S.E., are the Colne Valley water-works, which supply a section of London. The grammar school at Aldenham, 2 mi. N.E., was founded 1596 and ranks as a minor public school.

WATKINS GLEN, a village of New York, U.S.A., at the south end of Seneca lake, in the heart of the Finger Lake region. Resident pop. 1940, 2,913 federal census. Medicinal springs and the beauty of the "Glen" have made it one of the noted health and pleasure resorts of the country, and 18 brine wells provide raw material for the manufacture of 170,000 tons of salt annually. The most noted of the mineral springs is one on the property of the Glen springs, a large health resort and hotel established in 1890 to provide the "Nauheim treatment" in America. Its properties are similar to those of the springs at Bad Nauheim, but the mineral content is about five times as great. The famous glen is a narrow winding gorge 2 m. long, with walls from 100 to 300 ft. high, through which flows a small stream (with a total descent of 1,200 ft.) in many falls, cascades and pools. It is in a State park of 800 ac., entered from the main street of the village. The first settlement here was made in 1788 by two men from Connecticut. In 1794 came Dr. Samuel Watkins, in whose honour the village was named in 1852, after having been known first as Salubria and incorporated in 1842 as Jefferson.

WATLING STREET, the Early English name for the great road made by the Romans from London past St. Albans (Roman *Verulamium*) to Wroxeter (Roman *Viroconium*) near Shrewsbury and used by the Anglo-Saxons, just as a great part of it is used to-day. According to early documents the name was at first Waeclinga (or Waetlinga) straet; its derivation is unknown; but an English personal name may lie behind it. After the Conquest the road was included in the list of four Royal Roads which the Norman lawyers recorded or invented. (*See* ERMINE STREET.) Later still, in the Elizabethan period and after it, the name Watling Street seems to have been applied to many Roman or reputed Roman roads in various parts of Britain. In particular, the Roman "North Road" which ran from York through Corbridge and over Cheviot to Newstead near Melrose, and thence to the Wall of Pius, and which has largely been in use ever since Roman times, was not unfrequently called Watling Street, though there was no old authority for it and throughout the middle ages the section of the road between the Tyne and the Forth was called Dere Street. For its course near London, see *Royal Comm. on Hist. Monuments, Inventory of London* (1928).

WATSON, JOHN BROADUS (1878–), American psychologist, was born at Greenville, S.C., on Jan. 9, 1878. He graduated at Furman university (M.A. 1900), continuing his studies at the University of Chicago (Ph.D. 1903). After serving as assistant and instructor in experimental psychology at the University of Chicago he was appointed professor of experimental and comparative psychology at Johns Hopkins university in 1908, being also director of the psychological laboratory there until 1920. Later he was a lecturer at the New School for Social Research. He became known as the leading exponent of behaviourism. (*See* BEHAVIOURISM.) In 1917 he served as major in the aviation section of the Signal Corps, U.S. Reserves, and with the A.E.F. He was editor of *The Psychological Review,* 1908–15; he became joint editor of *The Journal of Animal Behavior* in 1910 and editor of *The Journal of Experimental Psychology* in 1915. He wrote *Animal Education* (1903); *Behavior: An Introduction to Comparative Psychology* (1914); *Psychology from the Standpoint of a Behaviorist* (1919); and *Behaviorism* (1925; revised 1930). In 1924 he entered private business.

WATSON, JOHN CHRISTIAN (1867–1941), Australian politician, was born at Valparaiso, Chile, on April 9, 1867, when his parents were on their way as emigrants to Australasia. He was educated at the public school of Oamaru, N.Z., and as a boy began work as a compositor. He attached himself to the Labour party in politics. He was president of the Sydney Trades and Labour Council in 1890. From 1894–1901 he was a member of the New South Wales legislature. In 1901 he was elected to the Commonwealth parliament, and for a short time in 1904, on the resignation of Deakin, he was prime minister and treasurer. He resigned after a few months, though he continued to lead the Labour party until 1908. He died Nov. 18, 1941.

WATSON, THOMAS (*c.* 1557–1592), English lyrical poet, was born in London, probably in 1557. He proceeded to Oxford, and while quite a young man enjoyed a certain reputation, even abroad, as a Latin poet. His *De remedio amoris,* which was perhaps his earliest important composition, is lost, and so is his "piece of work written in the commendation of women-kind," which was also in Latin verse. He came back to London and became a law-student. The earliest publication by Watson which has survived is a Latin version of the *Antigone* of Sophocles, issued in 1581. It is dedicated to Philip Howard, earl of Arundel, who was perhaps the patron of the poet, who seems to have

spent some part of this year in Paris. Next year Watson appears for the first time as an English poet in some verses prefixed to Whetstone's *Heptameron,* and also in a far more important guise, as the author of the *Hecatompathia* or *Passionate Centurie of Love.* This is a collection or cycle of 100 pieces, in the manner of Petrarch, celebrating the sufferings of a lover and his long farewell to love. Although they profess to be sonnets, they are really written in triple sets of common six-line stanza, and therefore have 18 lines each. The metre has had no imitators. In 1585 he published a Latin translation of Tasso's pastoral play of *Aminta,* and his version was afterwards translated into English by Abraham Fraunce (1587).

Watson was now, as the testimony of Nashe and others prove, regarded as the best Latin poet of England. In 1590 he published, in English and Latin verse, his *Meliboeus,* an elegy on the death of Sir Francis Walsingham, and a collection of *Italian Madrigals,* put into English by Watson and set to music by Byrd. Of the remainder of Watson's career nothing is known, save that on Sept. 26, 1592 he was buried in the church of St. Bartholomew the Less, and that in the following year his latest and best book, *The Tears of Fancie,* or *Love Disdained* (1593), was posthumously published. This is a collection of 60 sonnets with 14 lines each. Spenser may have alluded to Watson in *Colin Clout's Come Home Again,* when he says:—

> Amyntas quite is gone and lies full low,
> Having his Amaryllis left to moan.

He is mentioned by Meres in company with Shakespeare, Peele and Marlowe among "the best for tragedie," but no dramatic work of his has come down to us. He was, however, forerunner of Shakespeare (in *Venus and Adonis* and in the *Sonnets*).

(E. G.)

The English works of Watson, excepting the madrigals, were first collected by E. Arber in 1870. *Thomas Watson's "Italian Madrigals Englished"* (1590) were reprinted (ed. F. J. Carpenter) from the *Journal of Germanic Philology* (vol. ii., No. 3, p. 337) with the original Italian, in 1899. *See* also Sir Sidney Lee's Introduction (pp. xxxii.–xli.) to *Elizabethan Sonnets* in the new edition (1904) of *An English Garner.*

WATSON, WILLIAM (*c.* 1559–1603), English conspirator, was born in the north of England, probably on April 23, 1559. In 1586 he became a Roman Catholic priest in France, and during the concluding years of Elizabeth's reign he paid several visits to England; he was imprisoned and tortured more than once. Under James I. he was involved in the "Bye plot," or "Watson's plot." It was arranged that James should be surprised and seized, while the conspirators talked loudly about capturing the Tower of London, converting the king to Romanism, and making Watson lord keeper. One or two of the conspirators drew back; but Watson and his remaining colleagues arranged to assemble at Greenwich on June 24, 1603, and under the pretence of presenting a petition to carry out their object. The plot was a complete failure; Henry Garnet and other Jesuits betrayed it to the authorities, and its principal authors were seized, Watson being captured in August at Hay on the Welsh border. They were tried at Winchester and found guilty; Watson and Clark were executed on Dec. 9, 1603, and Brooke suffered the same fate a week later. Before the executions took place, however, the failure of the Bye plot had led to the discovery of the Main plot. Brooke's share in the earlier scheme caused suspicion to fall upon his brother Henry Brooke, Lord Cobham, the ally and brother-in-law of Sir Robert Cecil, afterwards earl of Salisbury. Cobham appears to have been in communication with Spain about the possibility of killing "the king and his cubs" and of placing Lady Arabella Stuart on the throne. He was seized, tried and condemned to death, but although led out to the scaffold he was not executed. It was on suspicion of being associated with Cobham in this matter that Sir Walter Raleigh was arrested and tried.

See the documents printed by T. G. Law in *The Archpriest controversy* (1896–98); the same writer's *Jesuits and Seculars* (1889), and S. R. Gardiner, *History of England,* vol. i. (1905).

WATSON, SIR WILLIAM (1858–1935), English poet, born on Aug. 2, 1858, at Burley-in-Wharfedale, Yorkshire, was brought up at Liverpool, whither his father moved for business. In 1880 he published his first book *The Prince's Quest,* a poem showing the influence of Keats and Tennyson, but giving little indication of the author's mature style. Recognition came in 1890 with the publication of *Wordsworth's Grave,* which marked a reversion from the current Tennysonian and Swinburnian fashion to the meditative note of Matthew Arnold. Besides *Wordsworth's Grave* the volume contained *Ver tenebrosum* (originally published in the *National Review* for June 1885), a series of political sonnets indicating a fervour of political conviction which was later to find still more impassioned expression; also a selection with additions from the *Epigrams* of 1884, and among other miscellaneous pieces his tribute to Arnold, "In Laleham Churchyard." There followed: *Excursions in Criticism* (1893), a collection of review articles; *Lacrymae Musarum* (1893); *The Eloping Angels* (1893); *Odes and Other Poems* (1894); *The Father of the Forest* (1895); and *The Purple East* (1896), sonnets on the Armenian question; *Collected Poems* (1902); *Selected Poems* (1903); *For England* (1903); *New Poems* (1909); and also other verse, including *A Hundred Poems* (1922), a selection from various volumes, and *Poems, Brief and New* (1925). In 1917 Watson was knighted.

Sir William Watson's poetry is contemplative, not dramatic, and only occasionally lyrical in impulse. In spite of the poet's plea in his "Apologia" that there is an ardour and a fire other than that of Eros or Aphrodite, ardour and fire are not conspicuous qualities of his verse. Except in his political verse there is more thought than passion. Bearing trace enough of the influence of the romantic epoch, his poetry recalls the earlier classical period in its epigrammatic phrasing and Latinized diction. By the distinction and clarity of his style and the dignity of his movement William Watson stands in the classical tradition.

See also section on William Watson in *Poets of the Younger Generation,* by William Archer (1902); and for bibliography up to Aug. 1903, *English Illustrated Magazine,* vol. xxix. (N.S.), pp. 542 and 548.

WATSONVILLE, a city of Santa Cruz county, California. Pop. (1930) 8,344; in 1940 it had increased to 8,937 by the federal census. Over 15,000 ac. of the beautiful fertile Pajaro valley are planted to apples, which supply work for 75–100 packing houses, 28 driers, canneries and cider and vinegar works in the city. Small fruit, vegetables and other agricultural products are also shipped in large quantities. Watsonville was one of the early settlements of the state, founded in 1851. It was incorporated as a city in 1903.

WATT, JAMES (1736–1819), Scottish engineer, the inventor of the modern condensing steam-engine, was born at Greenock on Jan. 19, 1736. His father was a small merchant there, who lost his trade and fortune by unsuccessful speculation. James made his way to London, at the age of nineteen, to be apprenticed to a philosophical-instrument maker, John Morgan, in whose service he remained for twelve months. The hard work and frugal living forced him at the end of a year to seek rest at home, not, however, before he had gained a fair knowledge of the trade and become handy in the use of tools. On his return to Scotland in 1756 he tried to establish himself as an instrument maker in Glasgow, but the city guilds would not recognize a craftsman who had not served the full term of apprenticeship, and Watt was forbidden to open shop in the burgh. The college, however, took him under its protection, and in 1757 he was established in its precincts with the title of mathematical-instrument maker to the university.

Joseph Black, the discoverer of latent heat, then lecturer on chemistry, and John Robison, then a student, afterwards professor of natural philosophy at Edinburgh, became his intimate friends, and with them he often discussed the possibility of improving the steam-engine, the best type of which was at that time the Newcomen engine. It was then applied only to pumping water—chiefly in the drainage of mines; and it was so clumsy and wasteful in fuel that it was little used. Some early experiments of Watt in 1761 or 1762 had no direct result, but in 1764 his attention was seriously aroused by having a model of Newcomen's engine, which formed part of the college collection of scientific apparatus, given him to repair. Having put the model in order,

he was at once struck with its enormous consumption of steam, and set himself to find its cause and remedy.

In Newcomen's engine the cylinder stood vertically under one end of the main lever or "beam," and was open at the top. Steam, at a pressure scarcely greater than that of the atmosphere, was admitted to the under side; this allowed the piston to be pulled up by a counterweight at the other end of the beam. Communication with the boiler was then shut off, and the steam in the cylinder was condensed by injection of cold water from a cistern above. The pressure of the air on the top of the piston then drove it down, raising the counterweight and doing work. The injection water and condensed steam in the cylinder were drained out by a pipe leading down into a well.

After some unsuccessful efforts to remedy the difficulty Watt began a scientific examination of the properties of steam, studying by experiment the relation of its density and pressure to its temperature, and concluded that two conditions were essential to the economic use of steam in a condensing steam-engine. One was that the temperature of the condensed steam should be as low as possible, 100° F or lower, otherwise the vacuum would not be good; the other was, to quote his own words, "that the cylinder should be always as hot as the steam which entered it." In Newcomen's engine these two conditions were incompatible, and not for some months did Watt see a means of reconciling them. Early in 1765, the idea struck him that, if the steam were condensed in a vessel distinct from the cylinder, the temperature of condensation could be kept low and that in the cylinder high. Let this separate vessel be kept cold, either by injecting cold water or by letting it run over the outside, and let a vacuum be maintained in the vessel. Then, whenever communication was made between it and the cylinder, steam would pass over from the cylinder and be condensed; the pressure in the cylinder would be as low as the pressure in the condenser, but the temperature of the metal of the cylinder would remain high, since no injection water would touch it. Without delay Watt put his idea to the test, and found that the separate condenser acted as he had anticipated. To maintain the vacuum in it he added another new organ, namely, the air-pump, the function of which was to remove the condensed steam and injection-water along with any air gathered in the condenser.

To further his object of keeping the cylinder as hot as the steam that entered it, Watt supplemented his great invention of the separate condenser by several less notable but still important improvements. In Newcomen's engine a layer of water over the piston had been used to keep it steam-tight; Watt substituted a tighter packing lubricated by oil. In Newcomen's engine the upper end of the cylinder was open to the air; Watt covered it in, leading the piston-rod through a steam-tight stuffing box in the cover, and allowed steam instead of air to press on the top of the piston. In Newcomen's engine the cylinder had no clothing to reduce loss of heat by radiation and conduction from its outer surface; Watt not only cased it in non-conducting material, but introduced a steam-jacket, or layer of steam, between the cylinder proper and an outer shell.

All these features were specified in his first patent (*see* STEAM-ENGINE), which was obtained in January 1769, nearly four years after the inventions it covered had been made. In the interval Watt had been striving to demonstrate the merits of his engine by trial on a large scale. His earliest experiments left him in debt, and he agreed that Dr. John Roebuck, founder of the Carron ironworks, should take two-thirds of the profits of the invention in consideration of his bearing the costs. An engine was then erected at Kinneil, near Linlithgow, and this gave Watt the opportunity of overcoming many difficulties in details of construction. Meanwhile he was gaining reputation as a civil engineer. In 1767 he was employed to make a survey for a Forth and Clyde canal, which failed, however, to secure parliamentary sanction. During the next six years he made surveys for canals at Monkland, from Perth to Forfar, and along the lines afterwards followed by the Crinan and Caledonian canals. He prepared plans for the harbours of Ayr, Port-Glasgow and Greenock, for deepening the Clyde, and for building a bridge over it at Hamilton. In the course of this work he invented a simple micrometer for measuring distances, consisting of a pair of horizontal hairs placed in the focus of a telescope, through which sights were taken to a fixed and to a movable target on a rod held upright at the place whose distance from the observer was to be determined.

In 1768 Watt had met Matthew Boulton, who owned the Soho engineering works at Birmingham. Boulton agreed to take Roebuck's share in the invention, and to apply to parliament for an act to prolong the term of the patent. The application was successful, and in 1775 an act was passed continuing the patent for twenty-five years. By this time Watt had settled in Birmingham, where the manufacture of steam-engines was begun by the firm of Boulton & Watt. The partnership was a happy one. Boulton left the work of inventing to Watt, in whose genius he had the fullest faith, while he attended to the business side.

During the next ten years Watt developed the engine. Its first and, for a time, its only application was in pumping; it was at once put to this use in the Cornish mines. Further inventions followed in quick succession. Watt's second steam-engine patent is dated 1781. It describes five different methods of converting the reciprocating motion of the piston into motion of rotation, so as to adapt the engine for driving ordinary machinery. The simplest way of doing this was by a crank and fly-wheel; this had occurred to Watt, but had meanwhile been patented by another, and hence he devised "sun and planet wheels" and other equivalent contrivances. A third patent, in 1782, contained two new inventions of great importance. Up to this time the engine had been single-acting; Watt now made it double-acting; that is to say, both ends of the cylinder, instead of only one, were alternately put in communication with the boiler and the condenser. Up to this time also the steam had been admitted from the boiler throughout the whole stroke of the piston; Watt now introduced the system of expansive working, in which the admission valve is closed after a portion only of the stroke is performed, and the steam enclosed in the cylinder is then allowed to expand during the remainder of the stroke, doing additional work upon the piston without making any further demand upon the boiler until the next stroke requires a fresh admission of steam. He observed that, as the piston advanced after admission had ceased, the pressure of the steam in the cylinder would fall in the same proportion as its volume increased—a law which, although not strictly true, does accord very closely with the actual behaviour of steam expanding in the cylinder of an engine. Recognizing that this would cause a gradual reduction of the force with which the piston pulled or pushed against the beam, Watt devised a number of contrivances for equalizing the effort throughout the stroke. He found, however, that the inertia of the pump-rods in his mine engines, and the fly-wheel in his rotative engines, served to compensate for the inequality of thrust sufficiently to make these contrivances unnecessary. His fourth patent, taken out in 1784, describes the well-known "parallel motion," an arrangement of links by which the top of the piston-rod is connected to the beam so that it may either pull or push, and is at the same time guided to move in a straight line.

A still later invention was the centrifugal governor, by which the speed of rotative engines was automatically controlled. Another of Watt's contributions to the development of the steam-engine is the indicator, which draws a diagram of the relation of the steam's pressure to its volume as the stroke proceeds. The eminently philosophic notion of an indicator diagram is fundamental in the theory of thermodynamics; the instrument itself is to the steam engineer what the stethoscope is to the physician.

The commercial success of the engine was not slow. By 1783 all but one of the Newcomen pumping-engines in Cornwall had been displaced by Watt's. The mines were then far from thriving; many were even on the point of being abandoned through the difficulty of dealing with large volumes of water; and Watt's invention, by its economy, gave many of them a new lease of life. His engine used no more than a fourth of the fuel that had formerly been needed to do the same work, and the Soho firm usually claimed as royalty a sum equivalent to one-third of the saving.

Before Watt's time the steam-engine was exclusively a steam-

pump, slow-working, cumbrous and excessively wasteful in fuel. His first patent made it quick in working, powerful and efficient, but still only as a steam-pump. His later inventions adapted it to drive machinery of all kinds, and left it virtually what it is to-day, save in three respects. In respect of mechanical arrangement the modern engine differs from Watt's chiefly in that the beam, an indispensable feature in the early pumping-engines, has gradually given way to more direct modes of connecting the piston with the crank. The second difference is in the modern use of high-pressure steam. It is remarkable that Watt, notwithstanding the fact that his own invention of expansive working must have opened his eyes to the advantage of high-pressure steam, declined to make use of it. He persisted in the use of pressures that were little if at all above that of the atmosphere, while Trevithick ventured as far as 120 lb. on the square inch, a curious episode in the history of the steam-engine is an attempt by Boulton and Watt to obtain an act of parliament forbidding the use of high pressure steam on the ground that the lives of the public were endangered. The third respect in which a great improvement has been effected is in the introduction of compound expansion. Here, too, we find the Soho firm hostile, though the necessity of defending their monopoly makes their action natural enough. Hornblower had in fact stumbled on the invention of the compound engine, but as his machine employed Watt's condenser it was suppressed, to be revived after some years by Arthur Woolf (1766–1837). Watt in one of his patents (1784) describes a steam locomotive, but he never prosecuted this, and when William Murdoch, his chief assistant (famous as the inventor of gas-lighting), made experiments on the same lines, Watt gave him little encouragement. The notion then was to use a steam carriage on ordinary roads; its use on railways had not yet been thought of. When that idea took form later in the last years of Watt's life, the old man refused to countenance it.

On the expiry in 1800 of the act by which the patent of 1769 had been extended, Watt gave up his share in the business of engine-building to his sons, James, who carried it on with a son of Boulton for many years, and Gregory, who died in 1804. The remainder of his life was quietly spent at Heathfield Hall, near Birmingham, where he devoted his time to mechanical pursuits. His last work was the invention of machines for copying sculpture, one for making reduced copies, another for taking facsimiles by means of a light frame, which carried a pointer over the surface of the work, while a revolving tool fixed to the frame alongside the pointer cut a corresponding surface on a suitable block. We find him not many months before his death, presenting copies of busts to his friends as the work "of a young artist just entering on his eighty-third year." His life drew to a tranquil close, and the end came at Heathfield on Aug. 19, 1819. He was buried in the parish church of Handsworth.

Watt was twice married—first in 1763 to his cousin Margaret Miller, who died ten years later. Of four children born of the marriage, two died in infancy; another was James (1769–1848), who succeeded his father in business; the fourth was a daughter. His second wife, Anne Macgregor, whom he married before settling in Birmingham in 1775, survived him; but her two children, Gregory and a daughter, died young.

One of Watt's minor inventions was the press, patented in 1780, for copying manuscript by using a glutinous ink and pressing the written page against a moistened sheet of thin paper.

In the domain of pure science Watt claims recognition as a discoverer of the composition of water. Writing to Joseph Priestley in April 1783, with reference to some of Priestley's experiments, he suggests the theory that "water is composed of dephlogisticated air and phlogiston deprived of part of their latent or elementary heat." Watt's views were communicated to the Royal Society in 1783, Cavendish's experiments in 1784, and both are printed in the same volume of the *Philosophical Transactions.*

He was a man of warm friendships, and has numerous letters. They are full of insight: his own achievements are told with modesty and dry humour. In his old age Watt is described as a man stored with knowledge, full of anecdote, familiar with modern languages and a great talker. Scott so writes of him.

See J. P. Muirhead, *Origin and Progress of the Mechanical Inventions of James Watt* (3 vols., 1854); Muirhead, *Life of Watt* (1858); Smiles, *Lives of Boulton and Watt;* Williamson, *Memorials of the Lineage, etc., of James Watt,* published by the Watt Club (Greenock, 1856); *Correspondence of the late James Watt on his Discovery of the Theory of the Composition of Water,* edited by Muirhead (1846); Cowper "On the Inventions of James Watt and his Models preserved at Handsworth and South Kensington," *Proc. Inst. Mech. Eng.* (1883); Robison, *Mechanical Philosophy,* vol. ii. (1822).

WATTEAU, ANTOINE (1684–1721), French painter, was born in Valenciennes, of humble Flemish origin. At fourteen he was placed with Gérin, a mediocre Valenciennes painter. But he learnt more from Ostade's and Teniers's paintings in his native town. His earliest works suggest this influence. Gérin died in 1702, and Watteau, almost penniless, went to Paris, where he joined the scene-painter Métayer. Things went badly with his master, and Watteau, broken in health, worked in a factory where devotional pictures were turned out wholesale. Three francs a week and meagre food were his reward. Claude Gillot then took Watteau as assistant, but the young man soon excelled his master, whose jealousy led to a quarrel. Watteau and his pupil, Lancret, entered about 1708 the studio of Claude Audran, decorative painter and keeper of the collections at the Luxembourg. His *chinoiseries* and *singeries* date probably from this period.

Watteau painted at this time "The Departing Regiment," the first picture in his second and more personal manner, in which the touch reveals the influence of Rubens's technique, and the first of a long series of camp pictures. He found a purchaser for the picture, at the modest price of 60 livres, in Sirois, the father-in-law of his later friend and patron Gersaint, and was thus enabled to return to Valenciennes. There he painted a number of small camp-pieces, two of which are at the Hermitage in Leningrad.

After a short sojourn at Valenciennes, he returned to Paris, where he lived with Sirois. He obtained the second prize in the Prix de Rome competition (1709). Watteau was made an associate of the Academy in 1712, and a full member in 1717, on the completion of his diploma picture, "The Embarkment for Cythera," now at the Louvre.

Watteau now went to live with Crozat, the greatest private art collector of his time, for whom he painted a set of four decorative panels of "The Seasons." He lived for six months with his friend Gersaint, for whom he painted in eight mornings a wonderful signboard depicting the interior of an art dealer's shop. His health made it imperative for him to live in the country, and in 1721 he took up his abode with M. le Fèvre at Nogent. He continued working with feverish haste. Among his last paintings were a "Crucifixion" for the curé of Nogent, and a portrait of the famous Venetian pastellist Rosalba Carriera, who at the same time painted her portrait of Watteau. His restlessness increased with the progress of tubercular disease; and on the 18th of July 1721 he died in Gersaint's arms.

Watteau, though Flemish, was more French than his French contemporaries. He led a revolt against the pompous classicism of the Louis XIV. period and combined a poet's imagination with a power of seizing reality. In his art can be found the germs of impressionism. Later theories of light and its effect upon the objects in nature are foreshadowed by Watteau's *fêtes champêtres.* He is the initiator of the Louis XV. period, but his paintings are usually free from the licentiousness of Lancret and Pater, and Boucher and Fragonard. Watteau's art was highly esteemed by such fine judges as Sirois, Gersaint, the comte de Caylus, and M. de Julienne, the last of whom collected paintings and sketches, and published in 1735 the *Abrégé de la vie de Watteau,* an introduction to the four volumes of engravings after Watteau by Cochin, Thomassin, Le Bas, Liotard and others. Until 1875, when Edmond de Goncourt published his *Catalogue raisonné* of Watteau's works, also discovering Caylus's discourse on Watteau delivered at the Academy in 1748, prices of Watteau's paintings rarely exceeded £100. Then the reaction set in, and in 1891 the "Occupation according to Age" realized 5,200 guineas at Christie's, and "Perfect Harmony" 3,500 guineas. At the Bourgeois sale at Cologne in 1904 "The Village Bride" fetched £5,000.

The finest collection of Watteau's works was in the possession

of the German emperor, who owned as many as thirteen, all of the best period, and mostly from M. de Julienne's collection. At the Kaiser Friedrich museum in Berlin are two scenes from the Italian and French comedy and a *fête champêtre*. In the Wallace Collection are nine of his paintings, among them "Rustic Amusements," "The Return from the Chase," "Gilles and his Family," "The Music Party," "A Lady at her Toilet" and "Harlequin and Columbine." The Louvre owns, besides the diploma picture, the "Antiope," "The Assemblage in the Park," "Autumn," "Indifference," "La Finette," "Gilles," "A Reunion" and "The False Step," as well as thirty-one original drawings. Other paintings of importance are at the Dresden, Glasgow, Edinburgh, St. Petersburg and Vienna galleries; and a number of drawings are to be found at the British Museum and the Albertina in Vienna. Of the few portraits known to have been painted by Watteau, one is in the collection of the late M. Groult in Paris.

BIBLIOGRAPHY.—Since the resuscitation of Watteau's fame by the de Goncourts, an extensive literature has grown around his life and work. The basis for all later research is furnished by Caylus's somewhat academic *Life,* Gersaint's *Catalogue raisonné* (Paris, 1744), and Julienne's *Abrégé.* For Watteau's childhood, the most trustworthy information will be found in Cellier's *Watteau, son enfance, ses contemporains* (Valenciennes, 1867). Of the greatest importance is the *Catalogue raisonné de l'oeuvre de Watteau,* by E. de Goncourt (1875), and the essay on Watteau by the brothers de Goncourt in *L'Art du XVIIIe siècle. See* also monographs by P. Mantz (Paris, 1892), by P. Dargenty (1891), by G. Séailles (1892), by Claude Phillips (1895), by Camille Mauclair (1905, and 1920), and A. M. Hind, *Watteau, Boucher and the French Engravers* (1911).

WATTERSON, HENRY (1840–1921), American journalist, was born in Washington (D.C.), Feb. 16, 1840. His father, Harvey McGee Watterson, who succeeded James K. Polk as a Democratic representative in Congress, was a journalist and lawyer. The son as a youth had literary ambitions, and turned to journalism, acting for a short time as music critic on the New York *Times,* serving on the Washington daily *States,* etc. During the Civil War he was attached to the staffs of Generals Forrest, Polk, and Hood; was chief of scouts in the Johnston-Sherman campaign, and edited the *Rebel* in Chattanooga. After further newspaper work and the first of many trips abroad he became editor of the *Journal* at Louisville (Ky.). In 1868, with W. N. Haldeman, he founded and became editor of the Louisville *Courier-Journal,* a consolidation of the *Courier,* the *Democrat,* and the *Journal.* Haldeman and Watterson adopted a policy of business integrity and interest in the public service which soon made the *Courier-Journal* one of the most influential of southern newspapers. It had its unpopular days, however, in such times as the Reconstruction period, when it stood for conciliation between the two sections, and during the Free Silver and Greenback agitations when it advocated a sound currency. Watterson was Democratic representative in Congress for a short term (1876–77). In general he sought no office for himself. In Aug. 1918 he became "editor-emeritus." In April 1919 he resigned from the paper because of its support of the League of Nations. He died at Jacksonville (Fla.), Dec. 22, 1921. He wrote *History of the Spanish American War* (1898), *The Compromises of Life and Other Lectures and Addresses* (1903), and *"Marse Henry"; an Autobiography* (1919). Some of his *Editorials* were collected by Arthur Krock in 1923.

See "Henry Watterson and His 'Courier-Journal'" in O. G. Villard's *Some Newspapers and Newspaper-Men* (1926).

WATT-HOUR METERS, measure the total energy used in electric circuits ($\int$ecdt). The Board of Trade unit of electrical energy is the kilowatt hour (amperes × volts × hours ÷ 1,000). The energy taken from D.C. circuits at constant voltage can be measured by ampere-hour meters which may be of the electrolytic or dynamometer type; but in A.C. circuits the power factor has to be allowed for, and dynamometer or induction wattmeters provided with a time integrating device must be employed. (*See* INSTRUMENTS, ELECTRICAL.)

WATTIGNIES, a village of France 5½ mi. S.S.E. of Maubeuge, the scene of a battle in the French Revolutionary Wars (*q.v.*), fought on Oct. 15–16, 1793. The Allied Army, chiefly Austrians, under Coburg, was besieging Maubeuge, and the Revolutionary Army, preparing to relieve it, gathered behind Avesnes.

Even without the Maubeuge garrison Jourdan had a two-to-one superiority. The French however were still the undisciplined enthusiasts of Hondschoote. Their left attack progressed so long as it could use "dead ground" in the valleys, but when the Republicans reached the gentler slopes above, the volleys of the Austrian regulars crushed their swarms, and the Austrian cavalry, striking them in flank, rode over them. The centre attack, ordered by Carnot on the assumption that all was well on the flanks, was premature; like the left, it progressed while the slopes were sharp, but when the Republicans arrived on the crest they found a gentle reverse slope before them, at the foot of which were Coburg's best troops. Again the disciplined volleys and a well-timed cavalry charge swept back the assailants. The French right reached, but could not hold, Wattignies. At last, after a long fight, Carnot and Jourdan won the plateau, and Coburg drew off. His losses were 2,500 out of 23,000, Jourdan's 3,000 out of 43,000.

WATTLE AND DAUB or **DAB,** a term in architecture applied to a wall made with upright stakes with withes twisted between them and then plastered over. It is probably one of the oldest systems of construction. The Egyptians employed the stems of maize for the upright stakes; these were secured together with withes and covered over with mud, the upper portions of the maize stems being left uncut at the top, to increase the height. These uncut tops were bent out by the weight of the mud roof, and were probably the origin of the later cavetto cornice, the torus moulding below representing the heavier coil of withes at the top of the wall. Vitruvius (ii. 8) refers to wattle and daub; in the middle ages it was employed as a framework for clay chimneys, and for the filling in of half-timber.

WATTMETER, an instrument for the measurement of electric power or the rate of supply of electric energy to any circuit. For direct current (D.C.) circuits the power supplied is given in *watts* by multiplying together the current (in amperes) and the voltage; but, when alternating currents (A.C.) are used with inductive circuits, this product has itself to be multiplied by the power factor—a quantity which depends on the phase relationship of the current and the electromotive force. Wattmeters measuring this combined product are of three types: (a) electrostatic—used only in standardising laboratories, (b) dynamometer instruments based on the principle of the Siemens electrodynamometer, and (c) induction instruments. Types (a) and (b) may be used for both A.C. and D.C. supplies, but type (c) can be used only for A.C. circuits. (*See* INSTRUMENTS, ELECTRICAL.)

WATTS, GEORGE FREDERIC (1817–1904), English painter and sculptor, was born in London on Feb. 23, 1817. While hardly more than a boy he entered the Royal Academy schools; but his attendance was short-lived, and his further art education was confined to personal experiment and endeavour, guided and corrected by a constant appeal to the standard of ancient Greek sculpture. There are portraits of himself, painted in 1834; of Mr. James Weale, about 1835; of his father, "Little Miss Hopkins," and Mr. Richard Jarvis, painted in 1836; and in 1837 he exhibited at the Academy "The Wounded Heron" and two portraits. His first exhibited figure-subject, "Cavaliers," was shown at the Academy in 1839, and was followed in 1840 by "Isabella e Lorenzo," in 1841 by "How should I your true love know?" and in 1842 by a scene from *Cymbeline* and a portrait of Mrs. Ionides. At the exhibition in Westminster Hall held in 1843 in connection with the decoration of the new Houses of Parliament, Watts secured a prize of £300 for a design of "Caractacus led in triumph through the streets of Rome." This enabled him to visit Italy in 1844, and he remained there during the greater portion of the three following years, for the most part in Florence, where he enjoyed the patronage and personal friendship of Lord Holland, the British ambassador. For him he painted a portrait of Lady Holland, exhibited in 1848, and in his Villa Careggi, near the city, a fresco, after making some experimental studies in that medium, fragments of which are now in the Victoria and Albert Museum. Encouraged by Lord Holland the artist in 1847 took part in another competition, the third organized by the Royal Commissioners, this time for works in oil. Watts's car-

toon "Alfred inciting his subjects to prevent the landing of the Danes, or the first naval victory of the English," not only gained a first-class prize of £500 at the exhibition in Westminster Hall, but was purchased by the government, and now hangs in one of the committee rooms of the House of Commons. It led, moreover, to a commission for the fresco of "St. George overcomes the Dragon" (1848–1853), which forms part of the decorations of the Hall of the Poets in the Houses of Parliament. His offer to paint, gratuitously, a series of frescoes illustrating "The Progress of the Cosmos" for the interior of the great hall in Euston station was refused. A similar proposition made shortly afterwards to the Benchers of Lincoln's Inn resulted in Watts's execution of the fresco, "Justice: a Hemicycle of Lawgivers," in the hall.

While this large undertaking was in progress, Watts was working steadily at pictures and portraits. In 1849 the first two of his great allegorical compositions were exhibited—"Life's Illusions," an elaborate presentment of the vanity of human desires, and "The people that sat in darkness," turning eagerly towards the growing dawn. In 1850 he presented to the city of Manchester, in memory of the philanthropist Thomas Wright, the picture of "The Good Samaritan." In 1856 Watts paid a visit to Lord Holland at Paris, where he was then ambassador, and through him made the acquaintance and painted the portraits of Thiers, Prince Jerome Bonaparte and other famous Frenchmen.

In 1867 Watts was elected A.R.A., in the course of the same year, R.A. Thenceforward he exhibited each year, with a few exceptions, at the Academy, even after his retirement in 1896, and he was also a frequent contributor to the Grosvenor Gallery, and subsequently to the New Gallery, at which a special exhibition of his works was held in the winter of 1896–1897. With intervals of travel, he spent the greater part of his life in work at his studio, either at Little Holland House, Kensington, where he settled in 1859, or in the country at Limnerslease, Compton, Surrey. Apart from his art, his life was happily uneventful, the sole facts necessary to record being his marriage in 1886 with Miss Mary Fraser-Tytler, an early union with Miss Ellen Terry having been dissolved many years before; his twice receiving (1885 and 1894), but respectfully declining, the offer of a baronetcy; and his inclusion in June 1902 in the newly founded Order of Merit. He died on July 1, 1904.

Portraits.—Many of Watts's distinguished contemporaries sat to him for portraits. Among politicians are the duke of Devonshire (1883), Lords Salisbury (1884), Sherbrooke (1882), Campbell (1882), Cowper (1877), Ripon (1896), Dufferin (1897) and Shaftesbury (1882), Mr. Gerald Balfour (1899), and Mr. John Burns (1897); poets—Tennyson, Swinburne (1884), Browning (1875), Matthew Arnold (1881), Rossetti (1865, and subsequent replica) and William Morris (1870); artists—himself (1864, 1880, and eleven others), Lord Leighton (1871 and 1881), Calderon (1872), Prinsep (1872), Burne-Jones (1870), Millais (1871), Walter Crane (1891), and Alfred Gilbert (1896); literature is represented by John Stuart Mill (exhibited 1874), Carlyle (1869), George Meredith (1893), Max Müller (1895) and Mr. Lecky (1878); music, by Sir Charles Hallé; while among others who have won fame in diverse paths are Lords Napier (1886) and Roberts (1899), General Baden-Powell (1902), Garibaldi, Sir Richard Burton (1882), Cardinal Manning (1882), Dr. Martineau (1874), Sir Andrew Clark (1894), George Peabody, Mr. Passmore Edwards, Claude Montefiore (1894). Even more significant from an artistic point of view is the great collection of symbolical pictures in the Tate Gallery.

Subject Pictures.—Watts never wearies of emphasizing the reality of the power of Love, the fallacy underlying the fear of Death. To the early masters Death was a bare and ghastly skeleton, above all things to be shunned; to Watts it is a bringer of rest and peace, not to be rashly sought but to be welcomed when the inevitable hours shall strike. *Sic transit* (1892) shows a corpse, with the famous inscription, "What I spent I had; what I saved I lost; what I gave I have." So with the "Court of Death" in the Tate Gallery. Also we have "Love and Life," exhibited in 1885, a replica of an earlier picture in the Metropolitan Museum, New York, and of another version in the Luxembourg, Paris. "Love and Death," one version of which was exhibited in 1877 and others in 1896, and later; and "Love Triumphant" (1898).

Sculpture.—Founded admittedly on the Grecian monuments, there is a sculpturesque rather than pictorial quality in most of the paintings by Watts. To him, sculpture was thus natural. He visited the studio of Behnes, but was not his pupil. Among his works are a bust of "Clytie" (1868), monuments to the marquis of Lothian, Bishop Lonsdale and Lord Tennyson, a large bronze equestrian statue of "Hugo Lupus" at Eaton Hall (1884), and a colossal one of a man on horseback, emblematical of "Physical Energy," originally intended for a place on the Embankment, but destined to stand among the Matoppo Hills as an enduring evidence of the artist's admiration for Cecil Rhodes; a replica is now placed in Kensington Gardens. Much of his time and attention was given to the promotion of the Home Arts and Industries Association; he assisted Mrs. Watts with both money and advice in the founding of an art pottery at Compton, and in the building at the same place of a highly decorated mortuary chapel, carried out almost entirely by local labour; and it was entirely due to his initiative that the erection in Postmen's Park, Aldersgate Street, London, of memorial tablets to the unsung heroes of everyday life was begun.

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WATTS, ISAAC (1674–1748), English theologian and hymn writer, son of a clothier, was born at Southampton on July 17, 1674. The father, who afterwards had a boarding-school at Southampton, also wrote poetry, and a number of his pieces were included by mistake in vol. i. of the son's *Posthumous Works*. Isaac Watts studied at the Nonconformist academy, Stoke Newington, London. On leaving the academy he spent over two years at home, and began to write his hymns. In the autumn of 1696 he became tutor in the family of Sir John Hartopp at Stoke Newington, where he probably prepared the materials of his two educational works—*Logick, or the Right Use of Reason in the Enquiry after Truth* (1725), and *The Knowledge of the Heavens and the Earth made easy, or the First Principles of Geography and Astronomy Explained* (1726). In his twenty-fourth year Watts became assistant pastor of the Independent congregation in Mark Lane, London, and two years later he succeeded as sole pastor. In 1712 he went to live with Sir Thomas Abney of Abney Park.

Watts preached only occasionally, devoting his leisure chiefly to the writing of hymns (*see* Hymns), the preparation of his sermons for publication, and the composition of theological work. In 1706 appeared his *Horae Lyricae*, of which an edition with memoir by Robert Southey forms vol. ix. of *Sacred Classics* (1834); in 1707 a volume of *Hymns;* in 1719 *The Psalms of David;* and in 1720 *Divine and Moral Songs for Children.* His Psalms are free paraphrases, rather than metrical versions, and some of them ("O God, our help in ages past," for instance) are amongst the most famous hymns in the language. Isaac Watts died on Nov. 25, 1748, and was buried at Bunhill Fields.

Among the theological treatises of Watts, which are far from conventional orthodoxy, are: *Doctrine of the Trinity* (1722); *Essay on the Freedom of the Will* (1732); and *Useful and Important Questions concerning Jesus, the Son of God* (1746). He was also the author of a variety of miscellaneous treatises. His *Posthumous Works* appeared in 1773, and a further instalment of them in 1779. *The Works of . . . Isaac Watts* (6 vols.), edited by Dr. Jennings and Dr. Doddridge, with a memoir compiled by G. Burder, appeared in 1810–1811. His poetical works were included in Johnson's *English Poets,* where they were accompanied by a *Life,* and they appear in subsequent similar collections. *See* also Thomas Milner, *The Life, Times and Correspondence of Isaac Watts* (1834); and T. Wright, *Isaac Watts and Contemporary Hymn Writers* (1914). His *Letters 1730–1747* are printed in the *Proceedings* of the Massachusetts Hist. Soc., Series 2, vols. ix. and xii. (1895–99).

WATTS, SIR PHILIP (1846–1926), K.C.B. (1905), British naval architect, was born in Kent on May 30, 1846, of a family who had been shipbuilders for many generations, and was trained at the Royal school of naval architecture at Portsmouth. He entered the admiralty as a draughtsman, being promoted to the grade of constructor in 1883. After almost a year (Nov. 1884–Oct. 1885) on the staff at Chatham dockyard, Watts left the admiralty and became (1885–1901) director of the war shipping department of Armstrong, Withworth and Co., at Elswick. During this period he designed and built, in addition to British ships, many ships for foreign navies: Argentina, Norway, Portugal, etc. He also had a large share in the modern Japanese navy. On Feb. 1, 1902 he was appointed director of naval construction at the admiralty, and in this position was responsible for naval construction during the decade preceding the World War. The designs committee, set up at the instigation of Lord Fisher, who became first sea lord on Oct. 21, 1904, started the production of ships of the Dreadnought battleship and Indomitable battle-cruiser type. The responsibility of Sir Philip Watts was hardly lessened. He designed many classes of battleships, and all the battle-cruisers in the navy when the World War broke out were of his design. During his term of office his department took over from private firms the designing of submarines. In 1912 he became adviser to the admiralty on naval construction. In 1916 he returned as director of his firm at Elswick. He was elected F.R.S. in 1900. He died in London on March 15, 1926.

WATTS, WILLIAM (1782– ?), inventor, a native of Bristol found by experiment that drops of molten lead falling into water from a great height hardened into spherical form. He thus invented round shot, shot having been up to that time oblong in shape. He procured a patent, and "Watts Patent Shot" was patronized by George III., who presented him with plates of King Lung china, now on exhibition in the old shot tower, built by Watts, on Redcliffe Hill, Bristol.

WATTS-DUNTON, WALTER THEODORE (1832–1914), English man of letters, was born at St. Ives, Huntingdon, on Oct. 12, 1832, his family surname being Watts, to which he added in 1897 his mother's name of Dunton. He was originally educated as a naturalist, and saw much of the East Anglian gypsies, of whose superstitions and folk-lore he made careful study. He qualified as a solicitor and went to London, where he practised for some years, and contributed regularly to the *Examiner* and the *Athenaeum*. His article on "Poetry" in the ninth edition of the *Ency. Brit.* (vol. xix., 1885) was the principal expression of his views on the subject. Watts-Dunton was in later years Rossetti's most intimate friend. He was the bosom friend of Swinburne (*q.v.*), who shared his home for nearly thirty years before he died in 1909. In 1897 he published a volume of poems under his own name, *The Coming of Love*. His prose romance *Aylwin* (1898) attained immediate success, and ran through many editions in the course of a few months. Both *The Coming of Love* and *Aylwin* set forth, the one in poetry, the other in prose, the romantic and passionate associations of Romany life, and maintain the traditions of Borrow, whom Watts-Dunton had known well in his own early days. He edited George Borrow's *Lavengro* (1893), and *The Romany Rye* (1900); his *Studies of Shakespeare* appeared in 1910; in 1903 he published *The Renascence of Wonder*, a treatise on the romantic movement, as a preface to the third volume of Chambers's *Encyclopaedia of English Literature*, and in 1916 this, with his *Encyclopædia Britannica* article—both enlarged—was republished in book form as *Poetry and the Renascence of Wonder*. He died at Putney on June 6, 1914.

See T. St. E. Hake and A. C. Rickett, *The Life and Letters of Theodore Watts-Dunton* (2 vols. 1916).

WAUGH, BENJAMIN (1839–1908), English social reformer, was born at Settle, Yorkshire, on Feb. 20, 1839. He passed some years in business, but in 1865 entered the congregational ministry. Settling at Greenwich he devoted himself especially to children. He served on the London School Board from 1870 to 1876. In 1884 he founded the London society for the prevention of cruelty to children, of which he was honorary secretary. It was owing to information obtained by him that the Criminal Law Amendment Act of 1885 was passed. He secured a clause giving magistrates power to take the evidence of children too young to understand the nature of an oath. In 1889 he saw his society (of which he had been made director the same year) justified by the act for the prevention of cruelty to children, the first stepping-stone to the act of 1908. (*See* CHILDREN: PROTECTIVE LAWS.)

In 1895 a charter of incorporation was conferred on the society, but in 1897 its administration was attacked. An inquiry was demanded by Waugh, and the commission which included Lord Herschell, vindicated the society and its director. Waugh had given up pastoral work in 1887, and he retained his post as director until 1905. He died at Westcliff, near Southend, Essex, on March 11, 1908. Waugh edited the *Sunday Magazine* from 1874 to 1896. His *The Gaol Cradle, who rocks it?* (1873) was a plea for the abolition of juvenile imprisonment.

See R. Waugh, *Life of B. Waugh* with introd. by Lord Alverstone (1913).

WAUKEGAN, a city of Illinois, U.S.A., on Lake Michigan, 40 mi. N. by W. of Chicago. Population was 19,226 in 1920 (25% foreign-born white); 34,241 in 1940 by federal census. The city lies on a plateau 100 ft. above the lake. The streets are intersected by beautiful wooded ravines, which are bridged for traffic and utilized for parks. There is a good harbour, with coal docks. The site of Waukegan is designated on a map in a history of the United States published in London in 1795 as Little Fort, and the first settlers (1835) found decaying timbers of an old stockade. The village became the county seat in 1841, and in 1849 was incorporated, changing its name from Little Fort to the Pottawattomie equivalent. In 1859 it was chartered as a city. It was a post on the old Green Bay trail, built up a thriving lake traffic after 1845, and was reached by the Chicago and North Western railway in 1855.

WAUKESHA, a city of Wisconsin, U.S.A., 16 mi. W. of Milwaukee, on the Little Fox river. Population (1930) 17,176 (90% native white); 19,242 in 1940 by federal census. The mineral springs exploited in 1868 have led to the establishment of rest resorts and sanatoria. White Rock water and others are shipped from there all over the world. Motors, jacks, castings and other products are manufactured there. It is the site of Carroll college (Presbyterian, 1846). Waukesha is a shipping point for pure-bred Holstein and Guernsey cattle. Settled in 1836 as Prairieville, it was incorporated under its present name (Indian, supposed to mean "fox") in 1852, and in 1896 was chartered.

WAUPUN, a city of Wisconsin, U.S.A., 60 mi. N.W. of Milwaukee. Pop. in 1930, 5,768; in 1940, 6,798 by the federal census. It is the seat of the state prison and of the Central state hospital for the insane. It was founded in 1838 and incorporated in 1857. The name means "early dawn."

WAUSAU, a city of Wisconsin, U.S.A. Pop. (1930) 23,758 (82% native white); and 27,268 in 1940 by the federal census. The German element predominates. Wausau is in the red clover belt of the state, where dairying is one of the principal occupations. The city's land area of 7 sq.mi. extends back to high bluffs on either side of the river. Wausau has ample hydroelectric power, generated in local plants. Granite of several colours is quarried and there are silver fox farms. It is a city of diversified industry, logging being its most important. The village was incorporated in 1858, and was chartered as a city in 1880. The name is an Indian word meaning "far away."

WAUTERS, ÉMILE (1846–1933), Belgian painter, was born in Brussels in 1846. He studied under Portaels and Gérôme. In 1868 he produced a striking work, "The Battle of Hastings: the Finding of the body of Harold by Edith." A journey to Italy in no wise affected his individuality, which was as marked in his "The Great Nave of St. Mark's" (purchased by the king of the Belgians) as in his earlier work. As his youth disqualified him for the medal of the Brussels Salon, he was sent, by way of compensation, as artist-delegate to Suez for the opening of the canal. In 1870 Wauters exhibited his great historical picture of "Mary of Burgundy entreating the Sheriffs of Ghent to pardon the Councillors Hugonet and Humbercourt" (Liége museum) which created a great sensation. Even more celebrated was the "Madness

of Hugo van der Goes" (1872, Brussels museum), a picture which gained for him the grand medal at the Salon and led to the commission for two large works decorating the Lions' stair case of the Hôtel de Ville. His vast panorama, "Cairo and the Banks of the Nile" (1881), 380 ft. by 49 ft., was exhibited with extraordinary success in Brussels, Munich and The Hague. Wauters also painted some admirable portraits, sometimes using pastel as a medium.

See M. H. Spielmann, *Magazine of Art* (1887); A. J. Wauters, *Magazine of Art* (1894); Joseph Anderson, *Pall Mall Magazine* (1896); G. Seraé ("Wauters as a Painter of Architecture"), *Architectural Record* (1901).

WAUWATOSA, a city of Wisconsin, U.S.A. Pop. 5,818 in 1920 (89% native white) and was 27,769 in 1940 by the federal census. It is a suburb of Milwaukee and is known as the city of homes and recreation. The city was founded in 1847 and incorporated in 1892. The name is a modification of an Indian word meaning "firefly."

WAVE ANTENNA, a horizontal radio aerial, the physical length of which is of the same order of magnitude as that of the signaling waves to be received, and which is so used as to be strongly directional.

WAVE LENGTH, in radio, the distance traveled in one period or cycle by a periodic disturbance. The distance between corresponding phases of two consecutive waves of a wave train. The quotient of velocity by frequency. For a discussion of theory *see* PHYSICS, ARTICLES ON; ELECTRIC WAVES; for wave lengths in broadcasting and wireless *see* WIRELESS TELEGRAPHY: *Communication.*

WAVELLITE, a mineral consisting of hydrated aluminum phosphate, $Al_3(OH)_3(PO_4)_2+4\frac{1}{2}H_2O$, crystallizing in the orthorhombic system. Distinct crystals are of rare occurrence, the mineral usually taking the form of hemispherical or globular aggregates with an internal radiated structure. It is translucent and varies in colour from gray or white to greenish, yellowish, etc. The hardness is 3.5, and specific gravity 2.32. It was first found, at the end of the 18th century, by Dr. W. Wavell near Barnstaple, Devon, where it lines crevices in a black slaty rock.

WAVE MECHANICS, a particular form of quantum mechanics which was developed as the result of researches by Louis de Broglie and Erwin Schrödinger in 1925–26. As loosely used, the term wave mechanics is practically synonymous with quantum mechanics. *See* the article on QUANTUM MECHANICS, especially the section entitled *wave mechanics.* (J. H. V. V.)

WAVERLY, a village of Tioga county, New York, U.S.A. Pop. 1940, 5,450, federal census. The Pennsylvania borough of South Waverly (pop. 1,212 in 1940) is separated from Waverly only by the State line; and the neighbouring boroughs of Sayre (*q.v.*) and Athens (7,569 and 4,215 respectively in 1940) are also part of the same community. It was named after Scott's novels.

WAVE SCROLL, in architecture and the decorative arts, a continuous line which starts as a spiral, then suddenly reverses its curvature and by a long, concave sweep rises to form the beginning of the next spiral of the series.

WAVES OF THE SEA. It may easily be observed that when smooth water is struck by wind the surface is immediately covered by a ribbed pattern of transverse inequalities about one inch from crest to crest travelling very slowly in the direction of the wind, and however long the breeze continue there is no increase of their size or speed immediately adjacent to the shore off which it blows. To leeward, however, there is an increase in the height and speed of the ridges and the distance between their crests. This distance is called the wave-length, the distance for which an individual ridge can be traced, the crest-length. In the deep waters of the open ocean the height, speed and wave-length is limited only by the velocity of the wind, but even the largest lakes have not sufficient room for full growth. Our knowledge of the height of waves at sea is mostly obtained by the primitive method of finding how high above the ship's water-line the observer must stand so that the passing crests shall top the horizon.

During a voyage from Liverpool to Boston, U.S.A., by the "Ivernia" the wind on Dec. 7, 1900, was a strong gale, number 9 on Beaufort's scale of force, reckoned as having an average speed of 50 statute or land miles per hour. The writer observed that the waves, which met the ship at a considerable angle, usually topped the horizon when the view-point was 30 feet above the ship's water-line and that a position 43 feet above that line had to be taken up in order to be on a level with the tops of the largest waves.

On Feb. 9, 1907, bound from New York for Southampton there was only a moderate breeze, but the "Minnehaha" rolled heavily in a huge swell from the north-west. The origin of the swell was revealed to us by a message from the "Cedric" to the north, which reported a strong north-west gale. The actual level of the trough of the waves was determined by means of a heavy rope let down over the ship's side, and the true height of the swells, which were of nearly uniform size, was found to be slightly more than 41 feet. Of the height of waves in a whole gale, Beaufort's force 10, average wind velocity 59 miles per hour, the writer has obtained estimates from master mariners, with the details of accompanying conditions which are necessary to give precise meaning to these statements. The records prove a height of nearly 50 feet.

Formula and Practice.—On Dec. 29, 1922, in the course of a prolonged storm in the North Atlantic, the wind reached and maintained for a considerable time the maximum or hurricane velocity, computed at 75 miles an hour and upwards. The "Majestic," hove-to and rode easily among the waves which were of remarkable regularity and phenomenal size. Under these favourable conditions observations were recorded and it was found that the height of the waves from trough to crest exceeded 70 feet.

It is clear that the height of the waves finally produced in the open ocean is in direct, simple proportion to the velocity of the wind. The larger waves occurring at short intervals which chiefly attract attention have about eight feet of height, reckoning from trough to crest, for each 10 miles-an-hour velocity of wind, but their apparent height is less when the ship is borne upon two waves.

In order to determine the height of the waves we must place ourselves so as to be on a level with the crests. In judging from this level the wave-length or distance between crests, dimensions have been obtained far below that which had been calculated by the usual mathematical formula from the period of the waves, the interval of time between the arrival of crests, and the question therefore arose whether the eye had been deceived or the calculation applied to conditions not contemplated in the mathematical theory. The answer was obtained by the writer on Dec. 21, 1911, when the "Egypt" was hove-to in the Bay of Biscay. The waves rose rather more than 30 feet above the ship's water-line, and from the promenade deck, which gave an eye-height of 27 feet, the wave-length appeared to be scarcely equal to the length of the vessel whereas the period indicated that it should be greater. Ascending to the navigating bridge where the view-point was 54 feet above water-line the whole length of the ship was seen to lie well within the interval between wave-crests, and the wave-length as judged from this position agreed with the period. The apparent wave-length from this elevated position was also in mathematical agreement with the speed of the waves which was determined from the time which they took to run the length of the stationary ship. That the eye is so greatly deceived in judging wave-length from near the level of the crests is due to the very slight convexity of the ridges, and the apparent brow of both the receding and advancing wave being much nearer than the true summit.

On the occasion above referred to when the ship was hove-to the speed of the waves (determined in unusually favourable conditions) was about forty-seven miles an hour when the velocity of wind, calculated from the recorded number on Beaufort's scale, was 52 miles an hour. It appears therefore that only a 5 mile-an-hour wind was blowing over the wave-crests, just enough to turn a weather-cock or to make leaves rustle. Thus the wind, which had blown all night with great violence in the direction of the heavy swell already running in the Bay, had increased its speed so much that there was no longer any buffeting, wave and wind being an harmonious procession.

Observers are agreed that the waves finally formed in a great storm of long continuance are not so steep as those in a moderate gale. According to mathematical theory, if the speed of the waves be doubled their length is increased four-fold, and so on, the wave-length increasing as the square of the speed. But the height only increases in simple proportion with that velocity, so that the steepness of the final waves would diminish in exact proportion to the violence of the storm.

Final Dimensions.—In pursuit of the enquiry into the final dimensions of waves produced by wind by the writer, observations were made during a voyage from Southampton to Trinidad and back in 1912 upon the period of the waves. The interval of time between the arrival of successive wave-crests at a fixed mark is necessarily the same as the time of subsidence and upheaval of a wave-crest. It was found during the course of the voyage that a single observer could easily determine the period, and hence by calculation the speed, of the waves by timing with a stop-watch the up-and-down oscillation of patches of foam, and that the period of the swell then running could also be determined by the same means. Later observations of movement of foam patches with and against wind made at the turn of current on a tidal river proved that the drift of the foam was too slow to invalidate the results. On a subsequent voyage from Trinidad to Southampton, with a fresh breeze most of the way, a cup-and-ball anemometer was mounted on the navigating bridge, and from the reading of the instrument, combined with observation of the direction of the wind relative to the course of the ship, the speed of the wind which drove the waves was measured.

The daily record of results showed no definite relation between speed of wind and wave, although in the trade-wind belt the weather conditions were steady. Fortunately, however, the direction and speed of the ocean swell, the longer undulation produced by former winds or derived from a distance, had also been recorded. The daily observations having been grouped according to the direction of the swell, it was found that when this was the same as the direction of the waves proper, the speed of the waves was nearly as great as that of the wind, which blew across the ridges as a "light air," the force 1 of Beaufort's scale, sufficient to impart a drift to the smoke from a chimney but not strong enough to turn a wind vane. When, however, the swell met the waves or crossed their direction, the speed of the wave was much less than that of the wind. The height of the waves was also greatly reduced by these conditions, an observation which suggests that the rapidity with which wind raises waves on lakes and enclosed seas is connected with absence of conflicting swell. The most rapid increase of wave-height, however, occurs on the somewhat rare occasion when a rising wind on the open ocean blows in the same direction as that in which the swell is running and with a speed greater than that of the swell. This was the condition which produced the large and regular waves observed in the Bay of Biscay on Dec. 21, 1911.

Squalls.—In a rising sea the tops of the waves are cut off and blown away in spray during the squalls of a few minutes' duration which punctuate the gale, but when the storm has continued for a long time the effect of a squall is to increase the height of the waves, and this action is especially noticeable when the storm is abating. Thus on December 22, 1906 on a voyage from Liverpool to Puerto Colombia, while still in the North Atlantic, with a heavy sea and a following wind having the force of a moderate gale, the writer judged that a violent squall lasting four minutes increased the height of the waves by about seven feet. As the squall travelled on, the rear of the group of higher waves could be seen travelling ahead, soon to pass out of sight. On the next day, Dec. 23, when the gale had dropped to a strong breeze, a squall of three minutes' duration increased the height of the waves by about six feet, and considerably increased their crest-length. Two minutes after the passing of the squall the ship was among waves of the average size, but a group of several great ridges could be seen ahead. On the following day, Dec. 24, the wind fell considerably and the waves were much lower. At about 5 P.M. a narrow band of black cloud stretching from the zenith to the horizon on either hand passed over the ship. Its transit, which occupied about five minutes, was attended by only a slight increase of wind but was nevertheless accompanied by a group of at least a dozen large waves among which the ship rolled heavily. Ten minutes after the passing of the cloud the ship was among waves of the same size as before.

If the viewpoint during these three days had been the cockpit of an aeroplane at a considerable height, with good conditions of visibility, the ribbed pattern of the sea would have been marked by stripes, owing to the recurrence of groups of higher and more regular ridges. If the speed of waves so formed be greater than the average they will outrun the others when the wind dies down and herald the approach of the main body by a slow-booming surf. Observations by the writer on the Dorset coast in the winter of 1898–99 when a succession of great storms occurred in the North Atlantic, point to the conclusion that a group of waves of greater speed as well as greater height is associated with each squall. On the afternoon of Dec. 29, 1898, in fine weather during off-shore wind, large breakers succeeded one another for three-quarters of an hour without interruption, one-hundred-and-thirty-nine in all. The average interval was 19 seconds, showing that their speed when in deep water was 66½ miles per hour.

The wave-length calculated from the period is 1,850 feet, so that while in deep water the length of the group from front to rear was 49 miles. This main body had been heralded a few hours earlier by the arrival of five groups of large breakers containing from four to seven members with an average interval of 20 seconds, corresponding to a speed in deep water of 69½ miles per hour. The interval elapsing between the first breaker of the first group and the last of the last group was 52 minutes, which is comparable with the 45-minute duration of the main body that followed in the afternoon. The time occupied by each group in discharging its breakers ranged from one minute to a little more than two minutes. The data indicate therefore that squalls of one to two minutes' duration occurring at about ten minute intervals had engendered groups of waves possessing greater speed which had outrun the main body and reached the shore some hours earlier.

The longest period of swell recorded during this stormy winter was on Feb. 1, 1899 when a group of twelve breakers arrived at intervals of 22½ seconds, corresponding to a speed in deep water of 78½ miles an hour. Anemometers at shore stations in Great Britain did not record a sustained velocity so great as this, 70 miles an hour maintained for two hours being the highest. On the other hand velocities much greater than 78½ miles per hour lasting for some seconds are occasionally recorded by anemometers on our shore stations, as much as 106½ miles per hour having been registered. Waves with a speed of 100 miles an hour would have a period of 28·6 seconds which is far greater than that of any North Atlantic swell recorded by the writer. A storm which lasts for hours is punctuated by squalls which last for minutes, so the squalls are punctuated by gusts which last for seconds at most, and it appears that the speed of the swiftest groups of waves approximates to the average speed of wind during the squall but does not approach that of its momentary gusts. Our habit of thinking of a squall as short-lived is due to the circumstance that we are not able to keep company with its progress. Individual squalls travelling from twenty to forty miles an hour have been traced by the recording instruments of meteorological stations during an unbroken march of a thousand miles.

Squall-action on Waves.—Let us now consider how many waves are simultaneously subject to the action of a squall. A squall which advances at 40 miles an hour (no matter what be the velocity of wind developed therein) and which passes over in three minutes, is two miles, 10,560 feet, from front to back, and this may be called its length of fetch upon the sea. The breakers which came in groups of four to seven on the morning of Dec. 29, 1898 had a period of twenty seconds and the length of the waves while in deep water was therefore 2,050 feet. A three-minute squall travelling at forty miles an hour would act upon five such waves simultaneously, and the waves, reacting on the air, would throw it into conformable undulations superposed upon eddies between the crests of the water waves. A three-

second gust during this squall would be only 176 feet from front to back and could therefore have no comparable effect upon the group of waves.

It has been pointed out that a single observer upon a vessel under way can readily and quickly determine the period of the waves by noting the time taken by a patch of foam in falling and rising. If a swift running, slow-heaving swell be present, its period of oscillation can also be determined from the foam spots, for the slower heave is easily watched, not, as might be expected, camouflaged by the shorter waves. The time of subsidence and upheaval in seconds multiplied by $3\frac{1}{2}$ gives the velocity of the wave or swell in miles per hour. When nearing the northern limit of the trade-wind belt on a voyage from Barbados to Southampton, waves travelling 16 miles an hour were recorded by the writer in an easterly breeze of 19 miles an hour, together with a swell from a northerly quarter with a period of $13\frac{1}{4}$ seconds and consequently a speed of $46\frac{1}{2}$ miles an hour, which must have been produced by a strong gale, the term for a sustained average wind-velocity of 50 miles an hour.

Much of the region in which the true hurricane or typhoon occurs is not ordinarily subject to long-period swells, and when such are observed it is desirable that seamen should have precise data for judging the force of wind which produced them, for if very great it is certainly associated with these whirling storms which are so disastrous to shipping. If the navigating officer will note the number of seconds occupied by the subsidence and upheaval of a patch of foam as it falls and rises with the swell and multiply the number by $3\frac{1}{2}$ he will know at once that the product is only a few miles an hour less than the velocity of the wind which produced the swell, and will therefore be able to place the distant disturbance in its category in Beaufort's scale of force with greater precision than if he rely upon "sea sense" unaided by measurement.

In order to realise the process of wave transmission after the wind has dropped, let us picture the profile of a wave from one trough to the next following trough. The water between the first trough and the crest is rising, that between the crest and the next trough, falling. The continual rise of front is the advance of the wave; in the subsiding back of the mound we see the action of the propelling agent, which is the force of gravity. The less the depth of water participating in the transmission, the slower will be the progress of the rising front, and for any given depth of water there is a limiting speed of transmission which can be calculated from the force of gravity. A strong gale in the North Atlantic produces waves more than 800 feet from crest to crest travelling 45 miles an hour, and after the wind drops the speed is maintained as long as the depth of water is comparable with the wave-length, but when the depth is reduced from 800 to 8 feet the speed is diminished to about one quarter, and the distance between crests reduced to 200 feet. Thus the league-long crests, widely separated, of the ocean swell travelling swiftly up the English Channel are bent back near the coasts of France and England, upon which rollers, ranged nearer to one another advance more slowly but reach the shore at intervals of time equal to the period of the swell.

When the depth of water below the troughs is comparable to the height of the waves from trough to crest we can no longer say that there is definite depth in which the wave as a whole is being transmitted, and in fact the rate of transmission is considerably greater at crest than trough. The ridges then cease to be symmetrical, become steep-fronted and cusped, and at last the cusp curls over in a scroll and falls.

Beaches.—At Eastbourne during the larger, or spring, tides near the times of new and full moon the difference of level between high and low water is about twenty feet. At high water on a calm day the sea is a few feet below the top of the bank of shingle. At low water the whole bank of shingle and an almost level stretch of sand beyond lies exposed. At high water on a rough day there is sufficient depth for large rollers to hold together until near the shore, so that a spectator on the beach can watch the process of steepening and curling over from close quarters. The relation of the depth of water in which a wave breaks to the height of the wave varies somewhat with the slope of shore and direction of wind, but the facts may be expressed in a general way by saying that a wave crest is on the point of breaking when its height above the trough behind it is equal to the depth of water below that trough. The depth of water in front of the wave which is about to break upon a sloping shingle beach depends upon the amount of backwash which it happens to encounter from the surge of the preceding breaker and it may even fall upon bare shingle.

Shingle beaches are the wave's own making, for wherever the conditions of supply cause a pile of pebbles to gather on the shore, the stones flung up by the waves tend to collect. These are driven up in the full depth of the surge flung by the breaker, but the settlement of water in the crevices of the shingle diminishes the depth of the backwash and consequently many stones are stranded. The stranding action is most marked with buoyant materials, hence the wrack of driftwood, sea-weed and shells which forms a line at the highest reach of the surge.

The seaward slope beyond low-water mark of spring tides at Eastbourne is extremely slight. This has two consequences, first that a large wave breaks far out from the shore, secondly that its discharge is not dissipated as a surge but initiates a new kind of wave which is transmitted to the shore across the intervening sheet of shallow water. The new wave is the perfect type of a bore, the foaming front very steep, the slope behind so gradual as to escape the notice of the eye. The foaming ridge travels steadily towards the shore with unchanging form but diminishing height. If we fix our attention upon a particular patch of foam we shall see that it is left behind by the foaming front as long as the water has some inches depth, but when the depth is reduced to about one inch the foam of the overfall is pushed along by the advancing ridge, accumulating in a scroll of froth which is finally left stranded on the sandy beach. These foaming ridges, sometimes called waves of translation, can be followed by the eye without difficulty, their individuality being persistent, but among deep-sea waves individuality is strangely elusive. The eye is attracted by and follows trustfully the wave which is larger than its fellows but soon finds that it is no longer looking at the largest wave, which is now the next behind, the first having outrun the supply of energy. This elusive effect is best illustrated in a group of waves in smooth water such as that produced by throwing a stone into a pond. The front wave of the group flattens out until it ceases to be visible while at the rear of the group a new wave appears. In water which is deep as compared with the wave-length the rate of advance of the group is only one half the speed of the individual waves, which travel through the group. In shallower water the waves do not so quickly outrun the energy and when the depth is very small in proportion to the wave-length the two rates of transmission are the same, and we have the typical bore, or wave of translation.

Wind always shifts during a storm, but deep-sea waves once formed travel with unchanged direction under the action of gravity, hence we should not think of a regular procession of long-crested ridges as typical but exceptional in a stormy sea, which is properly and characteristically a welter of over-riding ridges culminating in peaks which curl and break in caps of foam which the wind whips off and drifts in clouds of flying spray. In the course of many voyages the writer has only twice seen a really regular sea during a storm, that in the Bay of Biscay to which reference has already been made being the most spectacular because, when morning came, the clouds broke and a brilliant sun shone upon deep blue water laced and fretted with silver foam. The lofty standpoint of the navigating bridge gave a broad view of the great procession of mile-long crests charging on from the horizon, regular in alignment as ranks of cavalry and advancing at a speed of more than forty miles an hour.

Height of Waves.—Under certain conditions, however, the height of waves is more impressive than their crest-length or their speed. When during the growth of the waves in a storm the condition is reached at which each ridge or peak passing near the ship tops the horizon, the whole character of the scene is transformed. From a condition in which the waves seem mere mounds,

we suddenly pass to that in which they assume the appearance termed mountainous. When the vessel is buried in the trough of the waves only four or five ridges, comprising three or four wavelengths, intervene between the spectator and the horizon, but there is little to suggest that the view has been narrowed to an unusually small scale, and the steepness of the ship's side tends to make the horizon seem more distant than if the station were a sloping eminence of equal height. Moreover, the greater storm-waves usually occur during squalls, and these are often accompanied by driving rain which hazes the atmosphere and consequently seems to extend the view. The writer has observed such a narrow environment of four or five waves less than forty feet in height looking like a prospect some miles in extent with moving hills hundreds of feet high. (V. Co.)

WAXAHACHIE, a town of Texas, U.S.A.; county seat of Ellis county. Pop. 7,958 in 1920 (23% Negroes), and was 8,655 in 1940 federal census. It is the seat of Trinity university (Presbyterian), established in 1869. In the city is a large mail-order nursery. The Midlothian oil field, 10 mi. N.W. of Waxahachie, was founded in 1852.

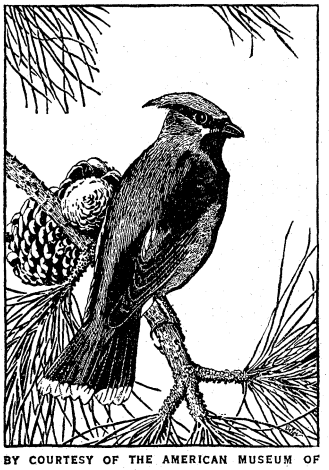
WAX FIGURES. Beeswax is possessed of properties which render it a most convenient medium for preparing figures and models, either by modelling or by casting in moulds. At ordinary temperatures it can be cut and shaped with facility; it melts to a limpid fluid at a low heat; it mixes with any colouring matter, and takes surface tints well; and its texture and consistency may be modified by earthy matters and oils or fats.

Figures in wax of their deities were used in the funeral rites of the ancient Egyptians, and deposited among other offerings in their graves; many of these are now preserved in museums. That the Egyptians also modelled fruits can be learned from numerous allusions in early literature. Among the Greeks during their best art period, wax figures were largely used as dolls for children; statuettes of deities were modelled for votive offerings and for religious ceremonies, and wax images to which magical properties were attributed were treasured by the people. Wax figures and models held a still more important place among the ancient Romans. The masks (*effigies* or *imagines*) of ancestors, modelled in wax, were preserved by patrician families, this *jus imaginum* being one of the privileges of the nobles, and these masks were exposed to view on ceremonial occasions, and carried in their funeral processions. The closing days of the Saturnalia were known as *Sigillaria,* on account of the custom of making, towards the end of the festival, presents of wax models of fruit and waxen statuettes which were fashioned by the *Sigillarii* or manufacturers of small figures in wax and other media. The practice of wax modelling can be traced through the middle ages, when votive offerings of wax figures were made to churches, and the memory and lineaments of monarchs and great personages were preserved by means of wax masks as in the days of Roman patricians. In these ages malice and superstition found expression in the formation of wax images of hated persons, into the bodies of which long pins were thrust, in the confident expectation that thereby deadly injury would be induced to the person represented; and this belief and practice continued till the 17th century. Indeed the superstition still survives in the Highlands of Scotland. With the renaissance of art in Italy, modelling in wax took a position of high importance, and it was practised by some of the greatest of the early masters. The bronze medallions of Pisano and the other famous medallists owe their value to the art qualities of wax models from which they were cast by the *cire perdue* process; and indeed all early bronzes and metal work were cast from wax models. The *tête de cire* in the Wicar collection at Lille is one of the most lovely examples of artistic work in this medium in existence. Wicar, one of Napoleon's commissaries, brought this figure from Italy. It represents the head and shoulders of a young girl. It has been claimed as a work of Greek or Roman art, and has been assigned to Leonardo da Vinci and to Raphael, but all that can be said is that it probably dates from the Italian Renaissance. In Spain beautiful wax figures of saints, distinguished in form and colouring, were achieved in the realm of religious art. Till towards the close of the 18th century modelling of medallion portraits and of relief groups, the latter frequently polychromatic, was in considerable vogue throughout Europe. About the end of the 18th century Flaxman executed in wax many portraits and other relief figures which Josiah Wedgwood translated into pottery for his jasper ware. The modelling of the soft parts of dissections, etc., for teaching illustrations of anatomy was first practised at Florence, and is now very common. Such preparations formed part of a show at Hamburg in 1721, and from that time wax-works, on a plane lower than art, have been popular attractions. Such an exhibition of wax-works with mechanical motions was shown in Germany early in the 18th century, and is described by Steele in the *Tatler.* The most famous exhibition is that of Marie Tussaud (*q.v.*) in London.

WAX MYRTLE or **CANDLEBERRY,** popular names of species of *Myrica,* especially *M. cerifera* and *M. carolinensis* (bay-berry or wax-berry), small shrubs native to eastern North America, the fruits of which have a waxy covering and are utilized as a source of vegetable wax, used especially in New England for making candles. The Sierra wax myrtle or sweet bay (*M. hartwegi*) is a similar shrub, found in the Sierra Nevada mountains; the western wax myrtle (*M. californica*), a large evergreen shrub with resinous wax-covered fruit, occurs along the coast from Los Angeles to Washington. *M. gale* is the native British gale or sweet-gale (*q.v.*). *Rhus succedanea* is the wax-tree of Japan.

WAXWING, a bird (*Bombycilla garrulus*), the type of the Passerine family *Ampelidae.*

It is distinguished from almost all other birds by the curious expansion of the shaft of some of its wing-feathers at the tip into a flake that looks like scarlet sealing-wax. An irregular winter visitant, sometimes in countless hordes, to central and southern Europe, it was of old time looked upon as the harbinger of war, plague or death. The waxwing, though breeding yearly in some parts of northern Europe, is as irregular in the choice of its summer quarters as in that of its winter retreats. The species exhibits the same irregular habits in America. It has been found in Nebraska in "millions," as well as breeding on the Yukon and on the Anderson river.



BY COURTESY OF THE AMERICAN MUSEUM OF NATURAL HISTORY

CEDAR WAXWING, OR CEDAR BIRD, (BOMBYCILLA CEDRORUM)

Beautiful as is the bird with its full erectile crest, its cinnamon-brown plumage passing in parts into grey or chestnut, and relieved by black, white and yellow —all of the purest tint—the external feature which has invited most attention is the "sealing-wax" already mentioned. This is nearly as much exhibited by the kindred species, *B. cedrorum,* the cedar-bird or cedar waxwing, of North America, which is distinguished by its smaller size, the yellower tinge of the lower parts and the want of white on the wings. In *B. japonica,* of south-eastern Siberia, and Japan, the remiges and rectrices are tipped with red, but with no dilatation of the feather shafts. Both the waxwing and cedar-bird seem to live chiefly on insects in summer, but are addicted to berries during the rest of the year, and will gorge themselves if opportunity allow.

WAYCROSS, a city of Georgia, U.S.A. Pop. 16,763 in 1940 federal census. Waycross ships lumber, naval stores, tobacco, corn, sugar cane, and other agricultural products; and has railroad shops, meat-packing plants, a modern shoe factory, lumber mills, a beehive factory and other manufacturing establishments. The city was founded in 1870 and chartered in 1909.

WAYLAND, FRANCIS (1796–1865), American educationist, was born in New York city on March 11, 1796. He graduated at Union college in 1813 and studied medicine in Troy and in New York city. In 1816 he studied theology in Andover Theological seminary, and in 1817–21 was a tutor at Union college, to which

after five years as pastor of the First Baptist church of Boston he returned in 1826 as professor of natural philosophy. In 1827 he became president of Brown university. In the 28 years of his administration he gradually built up the college, formed a library and gave scientific studies a more prominent place. He also worked for higher educational ideals outside the college, writing textbooks on ethics and economics, and promoting the free school system of Rhode Island. His *Thoughts on the Present Collegiate System in the United States* (1842) and his *Report to the Corporation of Brown University* of 1850 pointed the way to educational reforms, particularly the introduction of industrial courses, which were only partially adopted in his lifetime. He died on Sept. 30, 1865. He was an early advocate of the temperance and antislavery causes. He was one of the "law and order" leaders during the "Dorr rebellion" of 1842, and was called "the first citizen of Rhode Island."

His son, FRANCIS WAYLAND (1826–1904) graduated at Brown in 1846 and studied law at Harvard; he became probate judge in Connecticut in 1864, was lieutenant governor in 1869–70, and in 1872 became a professor in the Yale law school, of which he was dean from 1873 to 1903.

Among Wayland senior's numerous published works are: *Elements of Moral Science* (1835, repeatedly revised and translated into foreign languages); *Elements of Political Economy* (1837), in which he advocated free trade; *The Limitations of Human Responsibility* (1838); *Memoirs of Adoniram Judson* (1853); *Elements of Intellectual Philosophy* (1854); and a brief *Memoir of Thomas Chalmers* (1864).

See *The Life and Labors of Francis Wayland* (1867) by his sons Francis and Heman Lincoln; the shorter sketch (Boston, 1891) by James O. Murray in the "American Religious Leaders" series; and an article by G. C. Verplanck in vol. xiv. of the *American Journal of Education*.

WAYLAND THE SMITH, hero of romance (Scand. *Völundr,* Ger. *Wieland*). The legend of Wayland probably had its home in the north, where he and his brother Egill were the types of the skilled workman, but there are abundant local traditions of the wonderful smith in Westphalia and in southern England. His story is told in one of the oldest songs of the Edda, the *Völundarkviða,* and, with considerable variations, in the prose *Þiðrekssaga* (Thidrek's saga), while the Anglo-Saxon *Beowulf* and *Deor's Lament* contain allusions to it. The first part of the tale contains obviously mythical features connected with his parentage and marriage. The second part concerns Völundr, lord of the elves, the cunning smith, who, with his sword Mimung, made famous in German epic poetry, defeated in fight at the court of king Niþoþr, the smith Amilias. Niþoþr, in order to secure Völundr's services, lamed him and established him in a smithy. The smith avenged himself by the slaughter of Niþoþr's two sons and the rape of his daughter Bodvildr, then soared away on wings he had prepared. The story in its main outlines strongly resembles the myth of Daedalus, but the dénouement of this tale, which first appeared in European literature in the *De obedientia* (*Opera,* Venice, 3 vols., 1518–19) of Jovianus Pontanus (d. 1503), is different. The Aaron of Shakespeare's *Titus Andronicus* was derived from this source. King Rhydderich gave a sword fashioned by Wayland to Merlin, and Rimenhild one to Child Horn. English local tradition placed Wayland Smith's forge in a cave close to the White Horse in Berkshire.

The earliest extant record of the Wayland legend is the representation in carved ivory on a casket of Northumbrian workmanship of a date not later than the beginning of the 8th century. The fragments of this casket, known as the Franks casket, were presented to the British Museum by Sir A. W. Franks. One fragment is in Florence.

See also Vigfússon and Powell, *Corpus poet. bor.* (i. pp. 168–174, Oxford, 1883); A. S. Napier, *The Franks Casket* (Oxford, 1901); G. Sarrazin, *Germanische Heldensage in Shakespere's Titus Andronicus* (Herrig's *Archiv.,* xcvii. Brunswick, 1896); P. Maurus, *Die Wielandsage in der Literatur* (Erlangen and Leipzig, 1902); C. B. Depping and F. Michel, *Véland le Forgeron* (Paris, 1833). Sir Walter Scott handled the Wayland legend in *Kenilworth;* there are dramas on the subject by Borsch (Bonn, 1895), English version by A. Comyn (London, 1898); August Demmin (Leipzig, 1880); H. Drachmann (Copenhagen, 1898); and one founded on K. Simrock's heroic poem on Wieland is printed in Richard Wagner's *Gesammelte Schriften* (vol. iii. 2nd ed., Leipzig, 1887).

WAYNE, ANTHONY (1745–1796), American soldier, was born in the township of Easttown, Chester county, (Pa.), on Jan. 1, 1745. He first saw service at the head of a Pennsylvania battalion during the retreat of Benedict Arnold, after the Quebec campaign. In 1777 he was commissioned brigadier general, as a reward for his distinguished service at Ticonderoga. He took a prominent part in the battles of Brandywine and Germantown, and at Monmouth he turned the fortunes of the day by his stubborn and successful resistance. His greatest stroke was the storming of Stony Point, where in person he led the midnight attack of his troops over the walls of the British fort. This well planned enterprise won for Wayne the popular sobriquet of "Mad Anthony." Wayne also did much to counteract the effect of Benedict Arnold's treason and of the mutiny of the Pennsylvania troops. In 1781 he was sent south to join Gen. Nathaniel Greene, but in Virginia he was deflected to aid Lafayette against Lord Cornwallis. In 1792 Washington appointed him to succeed St. Clair in the command of the western army with the rank of major general. The government continued its efforts to induce the Indians to allow white settlements beyond the Ohio, but upon the failure of a mission in 1793 Wayne advanced to Greenville, a port on a branch of the Great Miami. In July of 1794 Wayne's regulars were reinforced by about 1,600 Kentucky militia, and the combined forces advanced to Fort Defiance on the Miami river. Here Wayne made a final effort to treat with the Indians, and upon being rebuffed, moved forward and decisively defeated them in the battle of Fallen Timbers. This defeat, supplemented by the treaty of Greenville, which he negotiated with the Indians, on Aug. 3, 1795, resulted in opening the northwest to settlement. Wayne retained his position as commander of the army after its reorganization, and he rendered service in quelling the proposed filibustering expeditions from Kentucky against the Spanish dominions, and also took the lead in occupying the lake posts delivered up by the British. While engaged in this service he died at Erie (Pa.) on Dec. 15, 1796.

See J. Munsell, (ed.), *Wayne's Orderly Book of the Northern Army at Fort Ticonderoga and Mount Independence* (Albany, 1859); Boyer, *A Journal of Wayne's Campaign* (Cincinnati, 1866); William Clark, *A Journal of Major General Anthony Wayne's Campaign against the Shawnee Indians* (MSS. owned by R. C. Ballard Thruston); Charles J. Stillé, *Major General Anthony Wayne and the Pennsylvania Line* (Philadelphia, 1893); J. R. Spears, *Anthony Wayne* (1903); Thomas Boyd, *Mad Anthony Wayne* (1929).

WAYNESBORO, a borough of Pennsylvania, U.S.A., near the Maryland boundary (the Mason and Dixon line). Pop. (1940) 10,231 by federal census. Waynesboro lies 710 ft. above sea level, at the foot of South mountain, in the beautiful Blue Ridge region. Beneath are many caves and caverns. At Mont Alto, 6 mi. N., is the Pennsylvania state forest school (1903). A settlement was established here about 1734. For 20 years it was called Mount Vernon; then Wallacetown, until the close of the Revolution, when it was renamed in honour of Gen. "Mad Anthony" Wayne. A village was platted in 1797, and in 1818 it was incorporated as a borough. A municipal-manager form of government was adopted in 1922.

WAYNFLETE, WILLIAM (1395–1486), English lord chancellor and bishop of Winchester, was the son of Richard Pattene or Patyn, alias Barbour, of Wainfleet, Lincolnshire (*Magd. Coll. Oxon. Reg.* f. 84b), whose monumental effigy, formerly in the church of Wainfleet, now in Magdalen college chapel at Oxford, seems to be in the dress of a merchant. He went to Oxford. In 1430 he was headmaster of Winchester college. In 1440 Henry VI founded Eton college, and after visiting Winchester appointed Waynflete provost. Waynflete had to arrange for the financing and completion of the buildings at Eton. In the last year (1446–47) of his provostship the full roll of scholars, 70, was already complete. The provost was still in high favour with Henry, for when Beaufort, bishop of Winchester, Henry's uncle, died (April 11, 1447) Henry wrote the same day to the chapter of Winchester, the prior and monks of St. Swithin's cathedral, to elect Waynflete as his successor. On July 13, 1447, he was consecrated in Eton church, when the warden and fellows and

others of his old college gave him a horse at a cost of £6, 13*s.* 4*d.*, and 13*s.* 4*d.* to the boys. Subsequent visits to Winchester inspired Henry with the idea of rebuilding Eton church on cathedral dimensions. Waynflete was principal executor of his "will" for that purpose.

Waynflete, as bishop, lost no time in following the example of Wykeham and his royal patron in becoming a college founder. In 1448 he obtained a licence for founding Magdalen college, Oxford. On Jan. 9, 1449, Waynflete was enthroned in Winchester cathedral in the presence of the king; and, probably partly for his sake, parliament was held there in June and July 1449, when the king frequently attended the college chapel, Waynflete officiating. When Jack Cade's rebellion occurred in 1450 Waynflete was employed with Archbishop Stafford, the chancellor, to negotiate with the rebels at St. Margaret's church, Southwark, close to Winchester House. A full pardon was promised, but on Aug. 1 Waynflete was one of the special commissioners to try the rebels. The king became insane in 1454. On the death of the chancellor, John Kemp, archbishop of Canterbury, during the sitting of parliament, presided over by the duke of York, commissioners, headed by Waynflete, were sent to Henry to ask him to name a new chancellor, apparently intending that Waynflete should be named. But no answer could be extracted from the king, and after some delay Lord Salisbury took the seals. During York's regency, both before and after the battle of St. Albans, Waynflete took an active part in the proceedings of the privy council. With a view to an ampler site for his college, Waynflete obtained on July 5, 1456, a grant of the Hospital of St. John the Baptist outside the east gate at Oxford and on July 15 licence to found a college there. Having obtained a papal bull, he founded it by deed of June 12, 1458, converting the hospital into a college with a president and six fellows, to which college two days later Magdalen Hall surrendered itself and its possessions, its members being incorporated into "the New College of St. Mary Magdalen."

Meanwhile Waynflete himself had been appointed chancellor, the seals being delivered to him by the king in the priory of Coventry in the presence of the duke of York, apparently as a person acceptable to both parties. In Oct. 1457 he took part in the trial and condemnation for heresy of Reginald Pecock, bishop of Chichester. Only Pecock's books and not the heretic were burned. Waynflete presided as chancellor at the parliament at Coventry in Nov. 1459, which, after the Yorkist catastrophe at Ludlow, attainted the Yorkist leaders. It was no doubt because of this that, three days before the Yorkist attack at Northampton, he resigned the chancellorship (1460). But Waynflete does not seem to have been regarded as an enemy by the Yorkists, though he was a personal friend of Henry's, for the rights of the bishopric of Winchester were confirmed to him in 1462, and he took an active part in the restoration of Eton college under Edward IV, and in the building of the church, now called the chapel, at Eton. Yet he received a pardon in 1469, and in 1471, in the latter case probably because he welcomed Henry on his release from prison.

In 1474 Waynflete, being the principal executor of Sir John Fastolf, who died in 1459, leaving a much-contested will, procured the conversion of his bequest for a collegiate church of seven priests and seven almsmen at Caistor, Norfolk, into one for seven fellows and seven poor scholars at Magdalen. In the same year that college took possession of the alien priory of Sele, Sussex, the proceedings for the suppression of which had been going on since 1469. The new, now the old, buildings at Magdalen were begun the same year, the foundation stone being laid in the middle of the high altar on May 5, 1474 (Wood, 207). The college was completed in 1480, and this date, not the earlier one, is usually given as the foundation date. Magdalen college school was founded at the gates. In Sept. 1481 Waynflete received Edward IV in state at the college, where he passed the night, and in July 1483 he received Richard III there in even greater state, when Master William Grocyn, "the Grecian," a fellow of New college, "responded," in divinity. In 1484 Waynflete gave the college the endowment for a free grammar school at his name-place, Wainfleet, sufficient to produce for the chantry-priest-schoolmaster £10 a year, the same salary as the headmaster of Magdalen school, and built the school which still exists almost untouched, a fine brick building with two towers, 76 ft. long by 26 ft. broad. The next year saw the appropriation to the college of the Augustinian Priory of Selborne, Hants.

Waynflete died on May 11, 1486, and was buried in Winchester cathedral. The effigy in Magdalen college chapel at Oxford is an authentic portrait.

WAYS AND MEANS COMMITTEE: *see* EXCHEQUER.

WAYZGOOSE, a term for the annual outing of English printers and their employees. It may be a misspelling for "wase-goose," from *wase,* M.E. for "sheaf," thus meaning harvest goose, the "stubblegoose" mentioned by Chaucer in "The Cook's Prologue."

It is more probable that the merry-making was an imitation of the grand goose-feast annually held at Waes, in Brabant, at Martinmas.

Certainly the goose has long ago parted company with the printers' wayzgoose, which is usually held in July.

WAZIR: *see* VIZIER.

WAZIRABAD, a town of British India, in Gujranwala district of the Punjab, near the right bank of the river Chenab, 62 mi. N. of Lahore. Pop. (1931) 20,707. It is an important railway junction.

The main line of the North-Western railway here crosses the Chenab by the Alexandra bridge, opened in 1876. Boat-building and manufactures of steel and iron are carried on.

WAZIRISTAN, a mountain tract in the North-West Frontier province of India within the British sphere of influence, the boundary with Afghanistan having been demarcated in 1894. Only a portion, consisting of the Tochi valley, with an area of about 700 sq.mi. and a population (1903) of 24,670, is directly administered.

Northern and Southern Waziristan together had an area of 5,218 sq.mi. and 201,783 inhabitants in 1931.

The Tochi and the Gomal rivers enclose the central dominating range of Waziristan from northeast to southwest, geologically connected with the great limestone ranges of the Suliman hills to the south, and dominated by the great peaks of Shuidar (Sheikh Haidar) and Pirghal, both of them between 11,000 and 12,000 ft. above the sea. From these peaks westwards a view is obtained across the grass slopes and cedar woods of Birmal and Shawal (lying thousands of feet below) to the long, serrated ridges of the central watershed which shuts off the plains of Ghazni. To the eastward several lines of drainage strike away for the Indus, and are, as usual, the main avenues of approach to the interior of the country. They are the Khaisora and the Shakdu on the north, which, uniting, join the Tochi south of Bannu, and the Tank Zam (which is also called Khaisor near its head) on the south. The two former lead from the frontier to Razmak and Makin, villages of some local importance, situated on the slopes of Shuidar; and the latter leads to Kaniguram, the Waziri capital, and the centre of a considerable iron trade. Kaniguram lies at the foot of the Pirghal mountain.

The Waziri tribes are the largest on the frontier, but their state of civilization is very low. They are a race of robbers and murderers, and the Waziri name is execrated even by the neighbouring Mohammedan tribes, who seem inclined to deny their title to belong to the faith. Their physique is excellent.

Except in a few of the highest hills, which are well-wooded, the Waziri country is a mass of rock and stones, bearing a poor growth of grass and thinly sprinkled with dark evergreen bushes; progress in every direction is obstructed by precipices or by toilsome stony ascents, and knowledge of the topography comes only as the result of long acquaintance. Broken ground and tortuous ravines, by making crime easy and precaution against attack difficult, have fostered violence among the people and developed in them an extraordinary faculty of prudence and alertness. The Waziri has developed into a raider, and a highwayman. The women enjoy more freedom than among most Pathan tribes. The blood-feud is a national institution.

The Waziris, who number some 48,000 fighting men altogether,

are divided into two main sections, the Darwesh Khel (30,000), referred to as "Wazirs," and the Mahsuds (18,000), with smaller sections and attached tribes numbering 18,000 more.

The Darwesh Khel are the more settled and civilized of the two, and inhabit the lower hills bordering on Kohat and Bannu districts and the ground lying on both sides of the Kurram river, between Thal on the north and the Tochi Valley on the south. The Mahsuds, who inhabit the tract of country lying between the Tochi Valley on the north and the Gomal river on the south, have earned for themselves an evil name as the most confirmed raiders on the border. The Mahsud country, especially that part within reach of British posts, is more difficult even than Tirah. The Tochi Valley is inhabited by a degraded Pathan tribe, known as Dauris, who have placed themselves under British protection since 1895.

British expeditions were needed against various sections of the Waziris in 1852, 1859, 1860, 1880, 1881, 1894, 1897 and 1902.

The success of Sir Robert Sandeman in subduing the wild tribes of Baluchistan had led to a similar attempt to open up Waziristan to British civilization; but the Pathan is much more democratic and much less subject to the influence of his maliks than is the Baluchi to the authority of his chiefs; and the policy finally broke down in 1894, when the Waziris made a night attack upon the camp of the British Delimitation Commission at Wana. The attack was delivered with such determination that the tribesmen penetrated into the centre of the camp, and it was only with the greatest difficulty that friend could be distinguished from foe. A large force of 11,000 British troops subsequently traversed the tribal country, destroyed their towers and dictated terms, one of which was that the Tochi Valley should be occupied by British garrisons. But still there was trouble, which led to the Tochi expedition of 1897; and, in spite of the further lessons taught the Waziris in two expeditions in 1902, the attempt to "Sandemanise" Waziristan was given up by Lord Curzon. The British garrisons in the Tochi and Gomal valleys were withdrawn, and two corps of tribal militia, from 1,300 to 1,500 strong, were gradually formed to replace the British troops. During the Great War, the Mahsuds gave constant trouble and during the third Afghan war the militia were withdrawn, portions going over to the enemy. Three years of war succeeded the invasion, and it was not till a motor road was driven from Jandola through the heart of the country to Bannu, and a large cantonment built at Razmak, close to the centre of the Mahsud country that order was restored.

See *Grammar and Vocabulary of Waziri Pashto,* by J. G. Lorimer (Calcutta, 1902); Paget and Mason's *Frontier Expeditions* (1884); *Mahsud Waziri Operations* (1902), Blue-book.

CAMPAIGNS IN WAZIRISTAN

The Wazirs are Pathans speaking Pushtoo. Consequently, they have a very close racial and linguistic affinity with the adjacent Afghan population. The country, moreover, lies midway between the Khyber and Bolan Passes and has thus remained outside the orbit of the chief campaigns that have been fought on the north-west frontier. In addition, it had never been subjected to the administration of the Government of India.

There is no need to recount in detail the course of the earlier expeditions into Waziristan. In 1860, after some stiff little actions a column of all arms occupied Kaniguram and Makin, the centres of population in Mahsud country. Again, in 1879, the Mahsuds were subjected to an economic "blockade." In 1893 a well-conducted expedition under Sir W. Lockhart overran Waziristan. In 1896 Wana was occupied at the request of the Wazirs themselves. In 1900 a second blockade of the Mahsuds was initiated, but dragged on for over a year until several columns had devastated the most fertile of the Mahsud valleys. In 1917 a brief expedition penetrated up the R. Shahur and effected a temporary submission of the Mahsuds.

The close of the World War was followed in May, 1919, by the outbreak of the Third Afghan War. For some time past Wazirs and Mahsuds alike, excited by Afghan propaganda, had been growing bolder in their brigandage. The climax came when the evacuation of the military posts maintained in the Tochi and Gumal Valleys was effected. These trade routes had in the past been guarded by fortified posts garrisoned by native forces known as the Northern and Southern Waziristan Militia respectively. These forces, composed of tribesmen under British officers, with few exceptions deserted early in 1919, and thereby provided their Mahsud compatriots with an invaluable stock of rifles and ammunition; while, more serious still, they formed a nucleus of skilled leaders for the *lashkars.* However, in December, 1919, an expeditionary force was under the command of Major-General S. H. Climo, C.B. The total of this force amounted to no less than 30,000 combatants, figures later augmented.

On Nov. 9 the first move was made up the Tochi Valley, where, on the 17th, General Climo received unconditional surrender of the Tochi Wazir tribes at a ceremonial *jirga* held at Datta Khel. This result enabled the striking force to be transferred southwards to deal with the Mahsuds. It was now decided to move the striking force to the Tank Zam valley and to advance in one column by that route to Kaniguram and Makin in the heart of the Mahsud country. The force was completely assembled at Jandola on the Tank Zam by December 13, whereupon a beginning was made to piquet the valley on either flank by "crowning the heights" with small fortified works.

On Dec. 17 the Mahsuds made a fierce and somewhat treacherous onslaught on the advanced troops of the striking force, or "Derajat column," under cover of a parley. They were driven back and the column moved next day. An attempt to seize Mandanna Hill, made on the 19th, failed. A second attempt, on the 20th, conducted by stronger forces as well as supported by aircraft, met with negligible resistance; the occupation of the ridge was complete. Leaving 100 men to complete the fortification of a detached post on the hill, the troops returned to camp. No sooner had they withdrawn than a fierce Mahsud attack swept away the remaining detachment, and the hill was lost again. A similar attempt to seize Tarakai or Black Hill on the 22nd eventually succeeded, but not before some savage Mahsud attacks had nearly brought about another similar defeat. The Mahsud losses, occasioned by some close quarter fighting and artillery fire, proved very heavy for this class of warfare. Tarakai was held as the enemy retired.

On the 25th Mandanna Hill was occupied afresh and permanently. An advance of 4 miles was made to Kotkai where the column remained until Jan. 7, preparing to force a precipitous defile known as the Ahnai Tangi. A first attempt was made on the 7th. Owing to the short hours of daylight, the operation was abandoned. A second attempt, on the 9th, met with no better result. Once more, on the 10th, a third attempt failed. In view of this situation, now daily growing more unsatisfactory, General Skeen ordered a night march for the small hours of the 11th. This bold decision, unusual in mountain warfare, was justified by the result. On the 14th the entire column passed through the defile.

The task was still formidable. The eastern bank of the Tank Zam was formed by two long ridges, the nearer being christened "Flathead Left" and the further "Flathead Right," while to the north of a deep depression came yet another height dubbed "Marble Arch." The right flank guard soon became heavily engaged on Flathead Left while the advanced guard met with a heavy fire from Marble Arch and was checked. After a very stubborn and savage action at close quarters, Flathead Left was taken and held throughout the day, aircraft contributing to this result. The column was then able to encamp undisturbed. After a night march on the 28th, the column passed through the gorge.

Although the Mahsud resistance was on the wane, Afghan emissaries were busy stirring them to further efforts. Two Afghan mountain guns arrived to reinforce moral persuasion. On Feb. 1, General Skeen once more ordered a night march against the Mahsud position, held in great strength, near Aka Khel. A striking success resulted; the enemy's resistance collapsed with no seeming hope of its reviving; Afghan help did not materialize, while the two mountain guns proved but a dismal failure. From this moment onwards there was to be no more serious fighting. But the Mahsuds showed no sign of accepting the Government's terms and so the column marched further up the Tank Zam Valley. But there was a change of policy in that there was now

a coercive policy enforced, appropriate measures being taken for the destruction of Mahsud property.

On Feb. 16 the column arrived at Tauda China, 2 m. distant from Makin, which centre of population and agriculture, failing submission by the Mahsuds, was to be ravaged. According to the terms of an ultimatum, the days of grace expired on Feb. 19, when, until the 29th, the fortified Mahsud villages were systematically shelled or raided. On March 2 the column moved to Kaniguram, the only so-called "town" of the the Mahsud country. The place itself was not occupied, the troops being kept within a fortified camp constructed at Ladha close by the town. The resulting situation proved embarrassing. A certain number of rifles were surrendered, but as a whole the Mahsuds remained untamed and hostile. The column remained at Ladha when, on April 6, it carried out an important punitive operation north-west of Kaniguram. This showed the tribesmen to be still as contumacious and bellicose as ever. Ladha was consequently converted into a standing camp connected with Tank by a strong series of posts down the Tank Zam valley. The Waziristan force was reduced, the Derajat column as such was broken up; one brigade remained at Ladha while another guarded the road to Tank. Then finally, in the autumn, the long deferred expedition to Wana was organized as the Wana Wazirs had failed to comply with the Government's demands for reparation for the outrages of 1918–19. Moreover, the Wazirs were then undoubtedly harbouring Afghan agents who were intriguing against the Government of India.

On Nov. 12 the Wana column, commanded by Major-General W. S. Leslie, C.M.G., left Jandola for Sarwekai where a lengthy pause was made. Then, on Dec. 15, the troops moved again and reached Wana on Dec. 22. The only incident of the advance was a spirited little affair at the pass of Granai Mara Narai where a night march once more dislodged the Wazirs from their position virtually without fighting. The beginning of 1921 thus found a brigade of Indian troops at Ladha and Wana respectively with every prospect of a permanent occupation of Waziristan. But one important circumstance was about to alter the entire problem of Waziristan. A great circular motor road was now to be constructed from Bannu up the Tochi Valley; thence across the passes to Razmak and so down the whole Tank Zam valley to Tank. This road would allow of military operations being conducted under very different conditions to those prevailing in 1919–20. Moreover, the Royal Air Force was now in possession of a new aerodrome at Dardoni in the Tochi Valley. Lastly, two 6-inch howitzers were to be stationed at Ladha.

At the close of 1922, on the impending completion of the new motor road, the garrison of Ladha was ordered to move into the new and more salubrious camp of Razmak. The Mahsuds, mistaking this change for a symptom of weakness, committed acts of open hostility. The situation grew so bad that punitive operations became inevitable. The plan of operations was for one brigade to advance from Razmak and to unite with the brigade from Ladha in the Makin area. Before this could be effected the last stages of the motor road had to be completed and this proved an arduous task. Starting from Idak in the Tochi Valley the 7th Brigade reached Razmak on Jan. 23, then effecting a junction with the 9th Brigade from Ladha on Feb. 4 at Tauda China. The Makin area was once more devastated; aeroplanes, 6-inch and 3·7 howitzers were all employed in the task. By the 12th enough destruction had been accomplished, and on the 22nd the last recalcitrant tribes made their submission.

WAZZĀN, a small town, 60 mi. N.W. by N. of Fez, Morocco, on the slopes of the Djebel Bu-Hallal. Pop. (official est., 1941) of Wazzān, chief town of a territory, 19,230 natives and about 1,000 Europeans. It manufactures a coarse woollen cloth, from which the hooded cloaks (called *jellábs*) are made. Here is Dár D'manah—House of Safety—as it is sanctuary for any who gain its limits, on account of the tomb of a sainted Idrisi Sherif, who lived there in 1727, and was the founder of one of the important religious brotherhoods of the Muslim world, called the Taïbiya. After the conquest of Algeria, the sherifs of Wazzān, chiefs of the brotherhood, were placed under the protection of France. French troops occupied Wazzān in 1920. (P. W. I.)

WEAKFISH (*Cynoscion regalis*), an important North American food-fish, so-called from its tender mouth. It inhabits sandy shores of the Atlantic coast from Cape Cod to Florida and is greenish-brown above, silvery below, with brown markings. The weakfish is also known as squeteague and sea-trout (its trade name). It very rarely reaches a weight of 30 lb. (average 5 lb.).

WEALD, THE, a district in south-east England. It includes the portions of Sussex, Kent and Surrey enclosed between the North and South Downs. With the exception of the eastern part, it is drained by rivers running northward and southward through gaps in the Downs (*q.v.*). The Weald was formerly covered by the forest of Andredesleah or Andredsweald ("the wood or forest without habitations"). About 1660, the total area under forest was over 200,000 acres. The chief remains of the forests are Ashdown, St. Leonards and Tilgate, and the nomenclature often indicates former woodland, as in the case of Hurstpierpoint (*hurst* meaning wood), Midhurst, Fernhurst, Billingshurst, Ashurst and many others. The forests were interspersed with lagoons; and the rainfall caused marshes. The Wealden forests were used extensively for fuel in the former ironworks of Sussex. The Forest Ridges, running east to west in the centre of the Weald, preserve its ancient character. Formed of the Hastings sands they are the main water-parting of the Weald, dividing the Vale of Sussex from the Vale of Kent. Here the iron industry, worked by the Romans and earlier, became important in the 16th and 17th century and died out early in the 19th century. The Andredesleah formed a physical barrier which kept the South Saxons isolated from other Saxon kingdoms.

WEALTH. In economics wealth may mean either a stock or fund existing at a given time or a flow of valuable goods and services during a period of time. In dealing with the production, exchange, distribution and consumption of wealth, economics is concerned very largely with the origins of the community's annual income and with the disposition which is made of it. This annual flow of income, or national dividend, may be conceived of as comprising all of the valuable commodities which pass into the hands of their final consumers during the year, together with the valuable personal services (*e.g.*, the services of the Government, of physicians, of actors, of household servants) rendered during the year, apart from those which come to the consumer embodied, as we might say, in the products of industry and trade. Alternatively, the community's annual flow of wealth may be identified with its annual product, which comprises the personal services directly rendered to consumers, as aforesaid, together with the results of all that is accomplished during the year in forwarding products towards their final form and destination, and in augmenting the community's productive equipment. The two conceptions overlap, for both include the products of work which is performed and comes to its final fruition within the year. But one conception includes, in addition, the ripened fruits of work done in the past, while the other includes fruits of present work which will reach their maturity only in future years. The money value of what we may call consumers' real income (the first of the two conceptions) will not, in general, be the same as the money value of the annual product. In a prosperous community, where saving is growing relatively to consumption, the money value of the annual product will be the larger of the two. It is always approximately equal to the aggregate amount of the net money incomes received during the year. It lends itself better to statistical measurement than consumers' real income does, and, it is the better index of the community's economic welfare.

Viewed as a stock or fund, wealth is an aggregate of scarce and valuable objects. Some of these valuable objects are given by nature, others are the products of man's industry and thrift, but all of them, irrespective of their origins or their cost, are valued prospectively, looking towards the future, with reference to their importance as aids to production or to their more direct beneficial uses. Wealth can be described by means of a stock-taking or inventory, but it can be summed or measured as a whole only in terms of its money value. Wealth is always something owned, whether the ownership be private or public. Its value is the sum of the values of existing property rights. Securities, such as stocks,

shares and bills, are among the objects of property, but if these are to be counted as wealth, account must be taken of the circumstance that they are offset by an equal amount of "negative wealth" —the liabilities of their issuers. In arriving at the wealth of the people of a given country or region (as distinguished from the wealth *within* that country or region), the net balance of external assets and external liabilities must be included.

It is obvious that the degree of a country's economic well-being depends upon the character and extent of its unappropriable resources—sunshine, rainfall, rivers, harbours—as well as upon the appropriable objects of wealth within its borders. Is not a navigable river, therefore, as much an item in a nation's wealth as a railway or a canal? Yes, in the sense that a nation's wealth is larger because of an abundance of these natural advantages. No, if is meant that no evaluation of a nation's wealth is complete if separate account is not taken of such things. (*See* also ECONOMICS and CAPITAL.) (A. Yo.)

WEALTH, NATIONAL. The wealth of a country may mean *either* the value of the objects found within its boundaries, regardless of the ownership of those objects in part by people living abroad, or the wealth of the inhabitants, including their foreign possessions, and excluding wealth within the country held by people abroad. The confusion between these two ideas has played havoc with discussions on such subjects as "The Taxable Capacity of Ireland." (*Vide* Stamp's *British Income Property* p. 369.) It is the latter sense—the wealth of the inhabitants expressed in current money values—that is mainly under consideration here.

Wealth in private hands (or belonging to individuals) is not easy to define, for there are various shades of ownership:

(1) Absolute personal disposition of the whole "fee simple" value of a house, land or other object.

(2) Trust interests, where ownership is more limited and free disposal is barred, but where the ownership of a source of income for a period has a capital value.

(3) Collective ownership with only potential specific allocation to individuals, such as the reserves of companies which may be of higher value in the hands of the company than the aggregation of the market value of individual interests therein.

(4) Collective ownership, without the *possibility* of individual allocation, or social private wealth, such as churches, clubs, etc.

(a) City and local property, like waterworks, buildings and trams, having a "value" determinable by deliberate comparison with privately owned objects.

(b) National property, varying from a museum to a navy, which can less easily be given a "purchase price."

Uses to Which the Figures of National Wealth Are Put. —These include:

(1) Tests of "progress," by way of comparisons between different years, to show the accumulation of capital, and really valid where the level of prices has remained fairly constant; tests of the distribution of wealth, according to the form or embodiment which wealth takes, *e.g.* between houses, lands and bonds; tests of the effects of changes in the rate of interest, or in the value of money.

(2) Tests of the relative "prosperity" or resources of different nations or communities, at the same point of time either as a whole, or per head of the population, and also in relation to their national debts and taxation.

(3) Comparisons of income with capital and property.

(4) Consideration of the distribution of wealth according to individual fortunes, and changes in that distribution.

(5) Consideration of the applicability and yield of schemes of taxation, *e.g.*, the capital levy.

(6) Questions relating to war indemnities and "ability to pay."

The summary presented to the Royal Statistical Society by Sir Josiah Stamp in May 1919 endeavoured to present the position as in 1914. High authorities had argued that the wealth of the United Kingdom in 1914 was approximately £10,000,000,000, others had placed it as high as £24,000,000,000, but in each case the estimates were associated with polemical matters. Sir Josiah's figure was £14,310,000,000.

Methods of Computation.—(1) *Based on data arising through the taxation of incomes.* (a) *Collective Taxation or Taxation at the Source.* The statistics of such taxation covering the whole profits of corporate bodies, such as public companies, before their distribution to individuals and whether actually distributed or not, obviously lead to comprehensive results. Where *sources* of income are attacked for revenue purposes, and the *destination* of income is ignored, it is not necessary for elaborate estimates to be made for income remaining in collective or semi-collective ownership; moreover, such a tax system allows of profits being presented for different classes of business or income, and so enables them to be capitalised on an appropriate basis. There may, however, be a danger that this method will give too high a result, if sufficient allowance is not made for income going out of such companies to foreigners or persons living entirely abroad, which thus forms no part of the national income.

Risk of error arises in three ways:

(i.) Evasion in the tax system itself.

(ii.) Legal omissions from the scheme of tax (*i.e.*, "garden produce" as non-taxable income, "enjoyment" income from movable property).

(iii.) The basis of capitalisation, viz., the number of years purchase adopted.

This method, generally known as the "Giffen" method, though not invented by him, is the main basis for the valuation for the United Kingdom. It will be found to a limited extent available in the United States, South Africa and other dominions.

(b) *Taxation of income on Individual Returns.*

Where statistics of this character are available, they may be utilised for capital valuations, but only with some difficulty. If there is a rough division of income into earned income and income from property, it is, of course, of assistance in the capitalisation. The chief defects are:

(i.) The considerable extent to which evasion takes place in this particular type of taxation.

(ii.) Omission of all income held or accumulated collectively.

(iii.) Difficulty in determining the ratio of income to capital on the average, which makes capitalisation a far greater difficulty than under (a) (iii.) above.

(2) *Based on Material Provided by the Annual Taxation of Capital.*

(a) *Particular Classes of Property, such as Land or Buildings.*

Obviously these details supply a part only of the whole capital valuation, and they more properly belong to the "inventory method" referred to below. Unless the values are regularly revised on uniform lines, without local differences, they form but a rough basis, and there are always difficulties in determining the extent to which other forms of wealth (*i.e.*, company shares or business profits) duplicate these values. Some of the Continental systems of taxation supply material of this order, and the Australian States have regularly revised valuations which are valuable because they constitute so large a fraction of the total wealth.

(b) *General Property Valuation.*—The particulars furnished by a system of annual taxation upon all classes of property, should, in theory, form an ideal basis for a valuation. As a matter of fact, however, in practice, even such a tax as the General Property Tax in the United States, is full of defects. The valuations of personal property tend to disappear altogether (as was the case during the eighteenth century with the British "Land Tax") or else to be negligible in amount, leaving real property alone to bear the burden. This real property is assessed on very diverse lines in different areas, and is admittedly much below the selling values in many States.

(3) *Based on Data arising through Taxation of Capital at Irregular Periods.*

(a) *Statistics of "Estates" chargeable with Duties on passing at Death.*

This method has the appearance of being the most satisfactory and scientific of all. A special *ad hoc* valuation is made periodically of all wealth held in individual ownership, and it is only required to ascertain what proportion of the whole comes under

review in any given year, or, alternatively, at what intervals of time the same item of wealth will be recharged to duty on the average, in order to compute the total wealth belonging to individuals. But this apparently simple task is, in practice, fraught with many difficulties, and the method of ascertainment of the "multiplier," though greatly improved of late years, is still open to doubt or inquiry upon important points. The adequacy of the capitalisation of collective wealth and the impossibility of saying how much is *not* reflected in their values are serious drawbacks.

(4) *The Inventory Method.*

This method aims at a valuation, in the aggregate, of each "form" in which wealth is embodied, without regard to the ownership by individuals, companies, etc. It is often called the "objective" method. It depends for its success almost entirely upon the existence of statistical material compiled for other purposes, *e.g.*, import and export statistics, local government taxation figures, expert valuations of mineral resources, statistical enumerations of objects to which an average value can be applied. Examples of the last mentioned are the valuation of shipping by reference to the total tonnage multiplied by an average value per ton, or of mining capital by the average capital invested per ton of output, or of live stock by the number of each kind multiplied by an average price, or even of business, by a co-efficient. There are few classes of statistics that have not been pressed or coaxed into service for the "inventory" method, and further illustration can best be seen below.

The chief defects of the method are:

1. The impossibility of testing how far the ownership of the wealth is within the country or not. It is obvious, for example, that if half the farms in a country are mortgaged to or owned by foreigners, their gross value will give a false statement of national wealth in the sense defined.

2. The difficulty of determining whether all forms of wealth have been included.

3. The risk of overlapping, *e.g.*, stock and shares duplicated with real property owned by companies.

4. The absence of tests of profit earning capacity. For example, the carriages, railway lines, stations, etc., of a railway company are all "valued," and their aggregate comes to, say, £5,000,000. The railway as a whole may have been losing money for years, or, may be making several millions a year.

It is contended however that this difficulty may be exaggerated. As a general rule, on capitalisation of plus and minus "goodwill," the differences tend to cancel out, and an aggregate of valuations as "going concerns" tends to approximate to invested capital, except when there are striking changes in the value of money and rate of interest.

British National Wealth.—Sir Josiah Stamp's valuation of British national wealth for 1914 was as follows:—

	Capital value (Million £)
1. Lands	1,155
2. Houses, etc.	3,330
3. Other profits (Sch. A)	22
4. Farmers' capital	340
5. Sch. C, National Debt, etc.	1,148
6. Railways in the United Kingdom	1,143
7. Railways out of the United Kingdom	655
8. Coal and other mines	179
9. Ironworks	37
10. Gasworks	182
11. Waterworks, canals, and other concerns (Sch. A)	278
12. Indian, colonial, and foreign securities	621
13. Coupons	383
14. Other profits and interest	276
15. Businesses not otherwise detailed	2,770
16. Income accruing abroad and not remitted	400
17. Income of non-income-tax paying classes derived from capital	200
18. Movable property, etc., not yielding income (furniture, etc.)	800
19. Government and local property	400
Total valuation	14,319
Or, in round figures	14,300

5. The difficulty of accurately determining any "averages" employed as factors. If they are the results of impressions, they may be considerably in error, and even if they are the product of actual observations they ought usually to be carefully "weighted" in their application to the different classes. He has also given the following record for previous years:—

Date	£ millions.	
1800	1,750 (Great Britain)	Beeke
1812	2,700 (United Kingdom)	Colquhon
1822	2,500 ,, ,,	Lowe
		Vide Giffen, "Growth of Capital," p. 110
1833	3,600 ,, ,,	Pablo de Pabrer
1852	10,000 ,, ,,	W. Farr (includes personal capital)
1845	4,000 ,, ,,	Giffen
1868	6,115 ,, ,,	Giffen
1875	8,548 ,, ,,	Giffen
1885	10,037 ,, ,,	Giffen
1896	10,125 ,, ,,	Milner
1895	10,663 ,, ,,	Economist, following Giffen (1911, p. 1,087)
1905	13,036 ,, ,,	Economist, following Giffen (1911, p. 1,087)
1909	13,986 ,, ,,	Economist, following Giffen (1911, p. 1,087)
1902	11,413 ,, ,,	Money
1903	15,000 ,, ,,	Giffen (50 per cent. added to 1885 figures, "Economic Inquiries," II. 362)
1905	12,671 ,, ,,	Fabian Society
1911	13,716 (England and E. Wales)	Crammond
1912	16,472 (United Kingdom)	E. Crammond S. J., 1914
1914	16,000 ,, ,,	Money

Wealth of Various Countries.—Sir Josiah Stamp's summary of the estimated wealth of eighteen leading countries of the world at the outbreak of the World War in 1914 is set forth in the accompanying table giving the total wealth for each country and also the amount *per caput* of the population.

Country	National capital			
	Estimates based on the work of	Approximation to accuracy: Grade*	Amount in million £	Amount per head of population
				£
United Kingdom	Stamp	I.	14,500	318
United States	Official, King	II.	42,000	424
Germany	Helfferich, etc.	II.	16,550	244
France	Pupin, Théry	II.	12,000	303
Italy	Gini	III.	4,480	128
Austria-Hungary	Fellner	III.	6,200	121
Spain	Barthe	IV.	2,940	144
Belgium	Official	III.	1,200	157
Holland	Stuart	III.	1,050	167
Russia	Neymarck	IV.	12,000	85
Sweden	Flodstrom, Fochlbeck	III.	940	168
Norway	Gini	IV.	220	90
Denmark	Gini	IV.	500	176
Switzerland	Gini	IV.	800	205
Australia	Knibbs	I.	1,530	318
Canada	Bankers' Assocn.	II.	2,285	300
Japan	Stamp	IV.	2,400	44
Argentine	Bunge	III.	2,400	340

*Grade I. Estimate is not likely to be inaccurate to a greater extent than 10 per cent.
Grade II. Estimate is not likely to be inaccurate to a greater extent than 20 per cent.
Grade III. Estimate is not likely to be inaccurate to a greater extent than 30 per cent.
Grade IV. Estimate may be inaccurate to a greater extent than 40 per cent.

Post-War Estimates.—Owing to economic dislocation, to the rapid changes in the value of a common measure, gold, and to still more rapid change of national currencies as well as various other factors that must be considered, no really reliable estimates have been possible. Many rough guesses have been made, *e.g.*,

National Wealth of Certain Countries

Country	Year	National wealth	In sterling at par	In sterling at current rate of exchange in May 1926	Current rate of exchange in May 1926
Great Britain .	1923	£20,000 millions	..	£20,000 millions	..
Canada . .	1923	$25,000 ,,	£ 5,100 millions	£ 5,400 ,,	$4·465=£1
India . . .	1922	Rs. 15,000 crores	£10,000 ,,	£10,000 ,,	15 rs.=£1
United States .	1923	$355,000 millions	£72,900 ,,	£81,200 ,,	$4.37=£1
France . .	1923	Fr. 1,200,000 ,,	£47,600 ,,	£14,400 ,,	82·88 fr.=£1
Italy . . .	1923	L. 611,000 ,,	£24,222 ,,	£ 6,100 ,,	100 15–32 lire=£1

Sir Josiah Stamp s valuation for Great Britain and Ireland for 1928 was as follows (figures in million £) :—Real property: Buildings 4,500, Land 950; Farmers' capital 450; Profits and Interest 16,170; Profits below income tax level 475; Furniture and movable property 1,500; Government and local property 900; Total 24,945; Less: belonging to people abroad 500; Gross wealth 24,445; Deduct debt charges 6,400; Net wealth 18,045. He pointed out the much greater importance, since the war, of problems relating to the effect of the national debt upon gross and net wealth.

Wealth of the United States.—The most recent figure of the wealth of the United States, was a Government estimate for 1922 of 321,000 million dollars, or, say, 65,000 million £. The savings of the United States since that time indicate that the total wealth at the end of 1928 will amount to $394,500,000,000, an increase of 22·9 per cent. over the 1922 figure. The per capita wealth is estimated to have increased from $2,938 in 1922 to $3,287 in 1928. The prospect is that the total wealth at the end of 1929 will amount to $408,700,000,000 and the per capita wealth to $3,366.

The following table shows the estimated savings and increase in wealth of the United States since 1922, according to two authorities.

Savings and Wealth of the United States (in Million $)

	Total savings	Total wealth	Per capita wealth	Total wealth alternative estimates*
1922	$ 9,200	$321,000	$2,938	$321,000
1923	10,800	331,800	2,998	339,900
1924	11,100	342,900	3,059	337,900
1925	12,100	355,000	3,077	362,400
1926	12,600	367,600	3,138	356,500
1927	13,200	380,800	3,210	346,400
1928	13,700	394,500	3,287	360,100
1929	14,200	408,700	3,366	.....

*Recent estimates by National Industrial Conference Board.

The same authorities estimate the wealth of the entire British Empire as $210,000 million and the whole world at $1,100,000 million. This means that the United States, with only 6·3 per cent. of the world's population and only 5·3 per cent. of the world's land area, has approximately 35 per cent. of the world's wealth. The United States has 78 per cent. of all the automobiles in the world, 72·5 per cent. of the telephones, 58·5 per cent. of the telephone and telegraph lines, 38·3 per cent. of the monetary gold, 34 per cent. of the railroad mileage, 23·6 per cent. of the hogs, 21·7 per cent. of the ships, and 21·5 per cent. of the cotton spindles.

BIBLIOGRAPHY.—*Journal of the Royal Statistical Society*, various dates, on the "Multiplier"; (*1931*) on "The National Capital." *See* Sir Josiah Stamp, *British Income and Property* (1916), and *Current Problems in Finance and Government*. (J. S.)

WEALTH, PRIMITIVE. In primitive society the social character of wealth is more apparent; the freedom of individuals to dispose of it is limited by the interests of the community as a whole. The motives which lead to its accumulation are not purely economic, for ambition and rivalry play an important part. Transfer of it from one person to another is ruled by etiquette, often onerous, its observance backed by force of custom. Primitive wealth is embodied in objects of interest, these varying in type in different cultures. Among many African tribes cattle are the greatest treasure; the Indians of north-west America chiefly prize furs, canoes and copper plaques. In some societies human beings possess an acknowledged economic worth, women and slaves being transferable wealth. The close dependence of uncivilized people upon nature renders food a universal object of value. But primitive wealth is not confined to things of purely practical interest. Luxury articles are often most prized. In the Pacific, fine woven mats (Samoa), feather capes and cloaks (Hawaii), large polished axe blades (New Guinea), and ornaments such as whales' teeth (Fiji), greenstone *heitiki* figures (New Zealand), or shell armlets and necklaces (Melanesia) play a most prominent part in the socio-economic life.

In primitive society rank and wealth usually go hand in hand. By gift, loan and rewards for service chiefs dispose of their income to their people, and, generosity being esteemed a prime virtue, maintain thereby their prestige and influence. The importance of wealth lies in its distribution; hoarding is condemned. But as the economic and social life is built upon reciprocity, freedom in giving is also conducive to material prosperity. Destruction of wealth, as in the Amerindian potlatch, springs from an exaggeration of this attitude of respect for wealth in action.

The manipulation of primitive capital and the financing of native enterprise on a large scale proceeds along these lines. When for example a Maori community desired to build a new house or canoe the chief generally took the lead. From his stores of wealth he provided gifts for specialist craftsmen. At the stages of work where a large quantity of labour power was required he assembled the people and by providing them with meals, a feast or gifts of food, furnished the necessary incentive to them to undertake the task. The economic activities of a primitive people are marked by this constant circulation of wealth.

See B. Malinowski, "Primitive Economics of Trobriand Islanders," *Economic Journal* (1921), *Argonauts of the Western Pacific* (1922); R. Thurnwald, "Die Gestaltung der Wirtschaftsentwicklung," *Erinnerungsgabe für Max Weber* I. (1923); art. "Reichtum" in M. Ebert's *Reallexikon der Vorgeschichte;* R. Firth, "Some Features of Primitive Industry," *Economic Journal* (1926). (R. F.)

WEALTH AND INCOME, DISTRIBUTION OF. Modern enquiries into the distribution of capital wealth are mainly confined to the total wealth of individuals in classes according to the amount of total fortune in each grade, whereas enquiries into the distribution of income, while predominantly similar in the attention given to relative amounts, also extends to two other fields. There is a consideration of the distribution according to trades and occupations (*e.g.*, the shares which agriculture, mining, etc., represent of the aggregate) and the third type divides income according to its economic character—interest on capital, economic rent, the reward of work by hand or brain.

Distribution of Capital Wealth Amongst Individuals.—Information on the question is almost entirely derived from the government statistics of taxation of estates falling under liability at death. It is necessary to ascertain by the tables of mortality the number of people *living* at any time for *each death* in each grade. The highest fortunes tend to be held by the oldest people and, therefore, the "multiplier" in these grades is quite small compared with that in the lower grades of fortune where the average age of those coming under liability to estate duty is lower. The large fortune with a small multiplier and the small fortune with a larger multiplier, tend to give some equality to the *total* fortunes at each grade in ages. The result of the whole computation is generally known as the "multiplier," and this is applicable to the total sum falling under charge in a year in order to ascertain the aggregate fortune of all inhabitants living. This total is substantially less than the aggregate wealth of the country, because of the large sums held collectively by companies (in reserves), by clubs, trusts, societies and other corporations, which are either not reflected at all or else only imperfectly reflected in statements of *individual* wealth. In the separate grades, each with its separate

"multiplier" to get the total fortune in that particular grade, the system of *inter vivos* giving the distribution of capital by its owners during their lifetime, which increases with each increase in the death duties, affects the results and has to be allowed for by special adjustments. (*See* the *Colwyn Committee* on *Taxation and the National Debt* (App. xxiii.)

British Capital Estimate.—By this method the aggregate value of estates in Great Britain exceeding £5,000 in the hands of living individuals is estimated to be £11,000,000,000. This aggregate is estimated to be distributed among the living owners according to age-group and according to range of wealth as shown:

Great Britain: Estimated Classification of Capital by Reference to Value of Estate and Age of Owner
(Estates exceeding £5,000 only)

Range of Estate	£ millions								
	Age-groups								Total
	20–24	25–34	35–44	45–54	55–64	65–74	75–84	85 and over	
£									
5,000 to 10,000 .	21	110	257	450	418	242	96	17	1,611
10,000 to 25,000 .	22	95	440	614	690	414	174	32	2,481
25,000 to 50,000 .	60	83	240	396	461	363	132	26	1,761
50,000 to 100,000.	..	48	256	349	377	285	117	25	1,457
100,000 to 250,000.	..	..	315	355	384	302	154	28	1,538
250,000 to 500,000.	72	26	2	237	209	165	59	9	779
500,000 to 1,000,000	5	1	105	162	154	113	38	15	593
Exceeding 1,000,000	..	..	8	236	341	117	57	21	780
Total .	180	363	1,623	2,799	3,034	2,001	827	173	11,000

These figures relate mainly to the position of affairs in 1923–24.

It will be seen that, for all fortunes over £5,000 disregarding ages, the percentage distribution is as follows:

	a	b	c
5,000– 10,000 . .	14·7	14·9	11·6
10,000– 25,000 . .	22·6	23·8	21·0
25,000– 50,000 . .	16·0	14·2	16·4
50,000– 100,000 . .	13·2	13·0	13·6
100,000– 250,000 . .	14·0	17·0	15·4
250,000– 500,000 . .	7·1	7·7	9·7
500,000–1,000,000 . .	5·4	4·1	5·7
1,000,000 and over . .	7·1	5·3	6·5
	100·0	100·0	100·0

Col. (a) gives the equivalent of the Inland Revenue table. Col. (b) gives the results of computations by Sir Josiah Stamp for 1921 for England and Wales only (*Current Problems*, p. 260). Col. (c) is derived from information furnished to the Select Committee on Increase of Wealth (War) by the Board of Inland Revenue in 1920 (App. to Report p. 236) as an estimate for wealth immediately after the war, say, at June 1919. This deals with a corpus of post-war Wealth of 13,046 million £. distributed as follows:

	£ millions	Percentage of total
Not exceeding 5,000	3,948	30·5
From 5,000– 10,000	1,054	8·0
10,000– 25,000	1,909	14·6
25,000– 50,000	1,500	11·5
50,000– 100,000	1,241	9·5
100,000– 250,000	1,400	10·8
250,000– 500,000	884	6·8
500,000– 750,000	351	2·7
750,000–1,000,000	169	1·3
Over 1,000,000	590	4·5
	13,046	100·0

Sir Josiah Stamp gave the following figures based thereon, for the total wealth of all classes (*Wealth and Taxable Capacity*):

Distribution of British Fortunes

Million £		Persons		Fortune in £
4,555		..		under 5,000
1,917 . . .	held by . . .	169,040 . . .	to	10,000
2,202 . . .	„ „ . . .	138,460 . . .	„	25,000
1,731 . . .	„ „ . . .	48,810 . . .	„	50,000
1,432 . . .	„ „ . . .	20,570 . . .	„	100,000
1,615 . . .	„ „ . . .	11,200 . . .	„	250,000
1,020 . . .	„ „ . . .	2,971 . . .	„	500,000
405 . . .	„ „ . . .	653 . . .	„	750,000
195 . . .	„ „ . . .	230 . . .	„	100,000
681 . . .	„ „ . . .	322 . . .	over	1,000,000

15,053 million £ of which 10,500 million £ is held by 392,256 persons.

"Thus we get two-thirds of the wealth held by just under 400,000 people, and the top one-third by 36,000 people. I think it is difficult to derive much *reliable* information as to whether the tendency is for individual fortunes to become increasingly great, that is for the proportion of wealth held by a fixed percentage of the whole population to become greater. The statistics have to be looked at over a considerable period, and they are affected by legal changes. The rates of mortality for the different age groups change slowly and affect the "multiplier" so that it is difficult to establish a statistical proof of a kind sufficiently rigid for so important an assertion."

It is misleading to say that "two-thirds of the wealth is held by less than 1 per cent of the population" for, as Carr Saunders and Caradog Jones say, "It takes no account of the fact that the ultimate units in society regarded in relation to wealth are families rather than persons. The equal distribution of property implies an equal holding among heads of households rather than an equal distribution among all living persons, including babies in their cradles. It gives a more just impression to take the percentage of occupied persons over 20. We then estimate that about 2½ per cent of occupied persons over 20 hold about two-thirds of the wealth, and that about 2½ in 1,000 of occupied persons over 20 hold one-third of the wealth."

Distribution of Income in Great Britain.—Dr. Bowley estimated for the United Kingdom that in 1910 all income receivers could be divided into two classes, 1·1 per cent who took 30 per cent of the whole national income and 98·9 per cent who shared the rest between them. The national income here apparently means that part of it accruing to individuals. Another division of the same total showed that 44 per cent went to only 5½ per cent of all income receivers.

Dr. Bowley's conclusions for the pre-war period were: "The broad results of this investigation are to show that the national dividend increased more rapidly than the population in the generation before the war, so that average incomes were quite one-third greater in 1913 than in 1880. The increase was gained principally before 1900, since when it barely kept pace with the diminishing value of money. The increase was shared with remarkable equality among the various economic classes. Property obtained a diminishing share of the home product, but an unchanged share of the whole income when income from abroad is included.

"The only marked alteration that has been found is the increase of the intermediate class that contains persons with small salaries, profits or earnings in other forms than wages. These include clerks and others in retail and wholesale distributive trade, and the younger or less successful persons in teaching and other professions.

"Manual labourers have been a diminishing proportion of the British population. More of the whole effort of the population has turned to direction, distribution and exchange, and relatively less to production. This has been rendered possible, it may reasonably be presumed, by the increasing services of capital to production, and probably also by the increased intelligence of labour."

British Incomes in 1801 and 1920.—Sir Josiah Stamp made a comparison over 120 years (1801 and 1920), the main conclusions of which were as follows:

Of the total number of people with incomes over £200 per annum in 1801, the £200 to £500 class were 61·5 per cent, in 1920 71·3 per cent; the £500 to £1,000 class were 21·3 per cent, in 1920 15·8 per cent; the £1,000 to £2,000 class 10·3 per cent, in 1920 7·8 per cent; the £2,000 to £5,000 class were 5·3 per cent, in 1920 3·7 per cent; the over £5,000 class were then 1·4 per cent, in 1920 1·3 per cent. In this sense there were in 1920 *relatively* fewer rich people; for each class, save the lowest, was in 1920 a smaller percentage than before. But this result is entirely due to the 1920 preponderance of the £200 to £500 class. Perhaps it was by 1920 easier to bring in these people to assessment than it used to be in 1801, and the numbers then may have been exceptionally defective. Let us assume that condition, and deal with only the total number having incomes of over £50,000 per annum. Then we get a remarkably close parallel.

The £500 to £1,000 class were . . . . . 56%, in 1920 55·2%
" £1,000 " £2,000 " " . . . . . 26·3%, " 1920 27·3%
" £2,000 " £5,000 " " . . . . . 13·9%, " 1920 13·0%
" over £5,000 " " . . . . . 3·8%, " 1920 4·5%

This indicates that the people with over £500 a year were in 1920 distributed in income classes practically the same as in 1801. But if we look at the *amounts* of income in the classes, the results are rather different, for there was *relatively* a larger sum in the hands of the "over £5,000" class in 1920 than in 1801. He gave a table for incomes over £500:

	1801	1920
£ 500–£1,000	24·4	22·3
1,000– 2,000	23·2	21·8
2,000– 5,000	26·7	21·8
Over 5,000	25·7	34·1

This result is consistent with the following theoretical solution: The total nominal income increased much more than the total population—the increase surged upwards through all the fixed classes, so that there was in 1920 a smaller population in the ranks of the poorest, with a nominal income of say under £80 a year, and many more in the over £5,000 class, but the *slope* of distribution had hardly altered.

Let us examine this in the light of the total numbers and sums assessed. The population subjected to the tax law had increased not quite five times, but the people with incomes over £200 had increased on these tables 25 times, and their income 24 times; even if we suppose the old tables were only half the truth, there was in 1920 an increase in numbers and income of 12½ times, or 2½ times the rate of the increase in population. If we take those over £500, the numbers are 19 times, and the income 22 times as great, and halving these again, for precaution, we have, roughly, an increase at twice the rate of increase of the population.

Before and After the World War.—For a pre-war and post-war comparison, Bowley and Stamp computed that the proportion of the national income going to super-tax payers in 1911 has been estimated at 8 per cent. The super-tax limit was then £5,000. If allowance is made for the change in the value of money the comparable figure in 1924 was £9,500. The proportion of persons with incomes above this amount in 1924 was 5½ per cent. It would appear, therefore, that, measured by percentage, and allowing for the legal avoidance of super-tax, some ground has been lost by this section in the period of 13 years.

The following table is given to show the percentage of total income and individuals classified according to the source of income:

Source	Percentage of total income		Percentage of total individuals	
	1913–14	1922–23	1913–14	1922–23
Mines and manufactures	6·9	6·9	10·1	8·1
Distribution and transport	8·2	8·9	15·3	12·3
Professions, finance, etc.	8·3	5·1	12·1	11·0
Employments, directors' fees, etc.	4·3	7·8	35·5	39·2
Total	27·7	28·7	73·0	70·6

A British Official Estimate of Income Distribution.—The Board of Inland Revenue gave the Royal Commission on Income Tax (1920) a complete distribution table of the whole assessed income for 1919 amounting to 2,073 millions (subject to a considerable margin of error) as follows (revised in their 64th Annual Report, p. 112):—

Class of income		Actual income	Number of incomes
Exceeding	Not exceeding		
£	£	£	
130	160	488,887,960	3,490,000
160	200	355,250,000	2,031,400
200	250	165,000,000	751,700
250	300	110,700,000	411,000
300	400	126,206,191	372,900
400	500	78,890,000	180,000
500	600	58,696,107	108,700
600	700	47,904,000	74,850
700	800	44,696,000	60,400
800	900	40,022,000	47,640
900	1,000	36,583,000	38,920
1,000	1,500	118,088,285	98,430
1,500	2,000	75,554,431	44,440
2,000	2,500	54,701,849	24,870
2,500	5,000	130,030,000	37,760
5,000	10,000	114,870,000	16,720
10,000	15,000	58,650,000	4,850
15,000	20,000	35,005,000	2,043
20,000	25,000	22,022,000	992
25,000	39,000	17,680,000	650
30,000	40,000	23,471,000	685
40,000	50,000	17,333,000	390
50,000	75,000	21,467,000	358
75,000	100,000	11,782,000	137
100,000	..	33,690,000	165
Total of incomes £2,000 and over		540,701,849	89,620
Total of income distributed amongst individuals		2,287,179,823	7,800,000
Other income not so distributed		260,000,000	..
Grand total of incomes exceeding £130 a year		2,547,179,823	7,800,000

United States: Distribution of Income.—The distribution of national income in the United States has been computed for 1918 as follows:—

Income class	Actual distribution		Percentage distribution	
	Number '000	Amount $ million	Number	Amount
$				
Under zero	200	−125	·5324	·22
0– 500	1,828	685	4·86	1·18
500– 1,000	12,531	9,819	33·35	16·94
1,000– 1,500	12,498	15,296	33·26	26·40
1,500– 2,000	5,222	8,918	13·89	15·39
2,000– 3,000	3,065	7,314	8·15	12·62
3,000– 5,000	1,383	5,174	3·68	8·93
5,000– 10,000	587	3,937	1·56	6·79
10,000– 25,000	192	2,808	·5112	4·85
25,000– 50,000	42	1,399	·1094	2·41
50,000– 100,000	14	952	·0373	1·64
100,000– 200,000	5	672	·0132	1·16
200,000– 500,000	2	570	·0053	·98
500,000–1,000,000	.4	220	·0010	·38
1,000,000 and over	.2	316	·0004	·55
	37,569.6	57,955	100·0	100·0

In the year 1918, for which the best information exists, it is estimated that about 86 per cent of those who had earnings had incomes of less than $2,000 and 14 per cent more than $2,000. The former class took 60 per cent of the national income and the latter 40 per cent. It was estimated that the 5 per cent (of those having earnings) who received the largest incomes, had a share in the aggregate of 25 per cent, this share having declined from 33 per cent in 1913 to 1916. The National Bureau of Economic Research, working on rather scanty details, estimated that for

1918 the most prosperous 1 per cent of income receivers took 14 per cent of the total; the most prosperous 20 per cent took 26 per cent of the total, the most prosperous 20 per cent about 47 per cent of the total. Starting from the top of the income scale, in order to include one per cent of the income receivers, they had to go down to people receiving $8,000 a year. Similarly to include 5 per cent of the income receivers, they had to go down to $3,250; to include 20 per cent down to $750 approximately.

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WEAPON: *see* AMMUNITION; ARMS AND ARMOUR; GUN, MACHINE; HALBERT; LANCE; ORDNANCE; PISTOL; SMALL ARMS, THE DEVELOPMENT OF; SWORD.

WEAPONS, PRIMITIVE. Among primitive peoples it is often impossible to say of any object whether it is a weapon of war or an implement of agriculture or the chase. Thus in Assam the knife or *dao* fells trees, kills animals, defends its owner against human aggression and takes heads for him. A bow and arrow may be used for war or for hunting only. Instruments of war may be roughly classified as those of offence and defence.

Stones.—The earliest missiles which man or sub-man used were the untrimmed stick or stone, hand-thrown. (*For* BOWS AND ARROWS, BLOWGUN, and the weapons of civilized peoples *see* separate articles.) To give greater force and carrying-power to stones, devices such as the sling and pellet-bow have been constructed. By far the most common sling is the *cord sling,* found sporadically throughout the world. It consists of a wide, short strip of material, which forms a pouch to hold the stone, to the ends of which one or more strings are fastened for grasping in the hand. The *pellet-bow,* a more elaborate contrivance found in India, is a bow fitted with two strings; between these, about half-way down, is a small pouch for holding the stone or clay pellet.

Throwing-sticks and Clubs.—The stick thrown by hand has also become a specialized weapon. As an object for piercing it has developed into the dart, javelin, spear and arrow; as an object for stunning or crushing into the throwing-stick and throwing-club. As an implement of the chase the throwing-stick was used in ancient Egypt and is still found in Abyssinia, India and among the Hopi of North America; as a weapon of war, however, the flat throwing-stick is practically confined to Australia, though two specimens have also been found in the island of Santo (New Hebrides, West Pacific). In Australia the fighting *boomerang* (*q.v.*) is rather long and narrow and curved within the plane of the flattened sides. It differs from the better known returning *boomerang,* which is of lighter build and curved out of the plane of the sides, which propeller-like twist gives it its returning powers. This latter is used exclusively for fowling or as a game. The Australian *waddy,* and the *ulas* of Fiji are throwing-clubs; the former has typically a flat triangular head, the latter is short with a spherical head and a handle carved to make the grip more sure. Other clubs are sometimes thrown without being specially designed for the purpose. The many-bladed throwing-knives of certain tribes in the Sudan, of those throughout the Congo basin and north to Lake Chad are metal derivatives of the African wooden throwing club.

Throwing-spears.—As to piercing missiles, such as darts, javelins and throwing spears, the variety is endless. The simplest are composed of a single piece of wood one end of which is pointed and often hardened in the fire. More usually there is a separate shaft and fore-shaft of which the latter is often heavily barbed by means of carving or the attachment of separate pieces of bone or wood. Heads of obsidian or other stone, bone and—especially in Africa—metal are often added. To give greater range to the throwing spear certain tribes use mechanical aids, of two main varieties, the *spear-thrower* and the *beckett.* The former, constructed of wood or bamboo, performs the function of an extra joint in the arm. The spear lies along the spear thrower, with its butt resting against a projecting peg, or, where the thrower is of bamboo, in the slight socket made by the septum of the node. This device is typical of Australia; it is also used in parts of New Guinea and in some of the islands of Micronesia, and was formerly used in Central and South America, whether in the chase or war is not clear. The Eskimo and tribes of the northwest coast of America also use it for discharging harpoons and fish-spears.

The *beckett* consists of a short length of cord with a knot at one end. It is wrapped once round the spear, the knot passing under the free end and being thereby kept in place. The free end of the cord is then wrapped round the index finger of the throwing hand. The resultant action when the spear is thrown is on the same principle as that of the sling, and the spear is given greater force in its flight than if thrown by hand, and is made to spin as it flies. For use in warfare the *beckett* appears to be restricted to Oceania, but as a toy it is found both in Australia and Europe. A similar contrivance was used by the soldiers of ancient Greece and Rome and also by some North African peoples who may well have borrowed it from them. It differs from the *beckett* in that the cord is attached to the spear and is not retained in the hand.

In East Africa an unusual form of spear-thrower is found. A shaft of wood terminating in a swollen head has this part hollowed out; into it is fitted the butt of the spear. The man then manipulates the thrower as though it were a part of the spear-shaft, but it does not leave his hand.

Bolas.—An unusual missile now used almost exclusively for hunting or as a game is the *bolas.* Among the Patagonians and the Gauchos of La Plata, who formerly used it in warfare, it is composed of three (less commonly two) balls of stone connected with each other at a common centre by thongs several feet long. One ball is usually smaller than the rest, and this is held while whirling the *bolas.* The aim is to entangle the victim in the thongs rather than to kill him. Among the Ho of Togoland, West Africa, a long cord with a stone attached at either end is similarly used for hindering an advancing enemy. Elsewhere a few tribes in Central and East Africa use the same instrument as a toy. The Eskimo uses a many-thonged *bolas* for catching birds.

Thrusting-spears and Clubs.—These are the most important weapons used in hand-to-hand fighting. The former are very similar to the throwing-spears, though usually heavier, and, since nicety of balance is not necessary more often made without a separate foreshaft. Many of them are heavily barbed as in the beautiful specimens found in Fiji. Clubs are of diverse kinds. Primarily they are for bruising or crushing, but some, such as the bird-headed clubs which are used in New Caledonia are well adapted for piercing. A distinction can also be made between those which are all of one piece and those having a head of different material from the shaft—usually of stone. Among those of the former type the business end is usually considerably thicker than the shaft and carved with spikes or rugosities (sometimes in imitation of its prototype the torn-up sapling) which make it more effective; but in the W. Pacific bat-shaped clubs, called by the early travellers "swords," are also found, though to-day they seem to be used more often for ceremonial than for military purposes. Clubs made entirely of any material other than wood are not very common, but the nephrite *mere* and bone *patu* of the Maoris are examples, and also the rhinoceros horn clubs of the Bechuana. These former are not only striking but also thrusting weapons, and are supplied with sharpened edges for the latter purpose.

Poisons.—The art of poisoning their weapons is known to many tribes. The poison is extracted from plants, as the upas tree in Indonesia, and also sometimes from reptiles and insects. In many parts of the world, however, weapons are said to be poisoned but are not, for deaths due to tetanus which so often followed wounds from these have frequently been mis-attributed to poison. The belief arose partly from the statements of the natives themselves, partly from the presence (in the West Pacific) of a green gummy substance at the base of the arrow or spear-heads. The latter is, however, only the vegetable cement fastening

head to foreshaft, while the former refer to the magical power supposed to be given the weapon by using human instead of animal bone for the head or barbs.

Primitive Armour.—With the exception of shields, weapons of defense are not common among primitive peoples, though some have armour of a sort. In New Guinea, a few tribes wear a body-covering of basket work, sometimes with a high back to protect the neck and head. In the Gilbert Islands, owing to the dearth of timber, native weapons of the ordinary kind are not found, but in their stead, slender spears and many pronged "swords" edged with sharks' teeth; as a protection against these, armour of coconut fibre is worn often covering the whole person, including the head. From West Africa and among the Baggara of the northeast occasional suits of chain mail have been recorded, probably the result of Arab influence. Plate armour is found in northeast Asia and on the northwest coast of America, and among the Haida cuirasses of wooden or bone slats are used, whose form is reminiscent of this. In Indonesia corselets of hide or basketry and wadded coats covered with feathers give protection, and helmets of cane or skin are also found in this area and in Indo-China, and Assam.

Shields.—Shields vary greatly in material and form. In Africa hide and basketry are much used, the former mainly in the east and south among the cattle-rearing people. In Indonesia, Australia and the Pacific region those of wood are more common, though basketry ones are also found. The Australian shields are small and light, suitable for parrying blows, and in this are similar to those of the Dinka and Mundu of the Sudan; elsewhere they are mostly for covering the most vital parts of the body. The shield is essentially the means of defense for those who use the club and spear and who fight mainly in the open. It is not convenient for a bow and arrow people, since it interferes with the free use of both hands. In New Guinea, however, this difficulty has been overcome. Among the Tapiro pygmies of Netherlands New Guinea a small shield is hung around the neck in a net bag in such a way as to protect the chest. Among the Gulf tribes of Papua a large wooden shield, which has in its upper edge a deep slot for the passage of the left arm, is suspended over the shoulder, so that a man can draw his bow while keeping covered the whole of his body which is towards the foe.

See Horniman Museum Handbook, *Weapons of War and of the Chase.* (C. H. W.)

WEAR, river, Durham, England, rising in the Pennine chain, and traversing a valley of 60 mi. to the North Sea. Through a narrow and picturesque valley, the stream flows to Bishop Auckland, then meanders past the bold peninsula which bears the cathedral of Durham. Later the river becomes navigable, carrying a great traffic in coal, and having its banks lined with factories. At the mouth is Sunderland (*q.v.*).

WEASEL (*Mustela nivalis*), the smallest European species of the group of mammals of which the polecat and stoat are well-known members (*see* CARNIVORA). The weasel has an elongated slender body, head small and flattened, ears short and rounded, neck long and flexible, limbs short, five toes on each foot, all with sharp, compressed, curved claws, tail rather short, slender, cylindrical, and pointed at the tip, and fur short and close. The upper-parts are reddish brown, the under-parts white. In cold regions the weasel turns white in winter, but less regularly and at a lower temperature than the stoat, from which it is distinguished by its smaller size and the absence of the black tail-tip. The length of the head and body of the male is about 8 in., that of the tail 2½ in.; the female is smaller. The weasel is distributed throughout Europe and northern and central Asia; and is represented by closely allied animals in North America. It possesses all the active, courageous and bloodthirsty disposition of the rest of the genus. Mice, rats, water-rats, moles and frogs constitute its principal food. It can pursue its prey not only through holes and crevices and under dense herbage, but can follow it up trees, or into the water, swimming with ease. It constructs a nest of dried leaves and herbage, placed in a hole in the ground or hollow tree, in which it brings up its litter of four to six young ones. The mother will defend her young with the utmost desperation. Instances are known of weasels being met with in packs.

Among the American species may be mentioned the pygmy weasel (*M. rixosa*), probably a race of the true weasels and the long-tailed weasel (*M. frenata*) of the United States, which is chocolate-brown above and may turn white in winter. The short-tailed weasel (*M. cicognani*) is about 5 in. shorter than the last and is darker in summer. It inhabits Canada and the northern United States and the fur is an important source of ermine.

WEATHER: *see* METEOROLOGY.

WEATHERFORD, a city of Texas, U.S.A. Pop. 6,203 in 1920, 94% native white, 5,924 in 1940 federal census. It is the seat of a junior college (Methodist). The city operates under a commission. The town was incorporated in 1878.

WEATHER FORECASTING is the practical application of the principles of meteorology (*see* METEOROLOGY). For as long as man has been subject to the vicissitudes of weather he has probably attempted to forecast it. The layman still makes a weather forecast for his own use by a casual inspection of the state of the sky. On the basis of the sequence of weather events transpiring in his vicinity, some particularly keen observers make reasonably good predictions for the next 24 hours. In many areas of the northern hemisphere, for example, the farmer recognizes that when the wind shifts into the east and clouds appear on the southwestern horizon rain or snow often follow within the next 24 hours. To the mariner a rapidly falling barometer indicates a severe windstorm. Forecasts of this nature, based entirely upon observations of weather in the immediate vicinity, undoubtedly have been made by man for many centuries, although history has not recorded any public or official weather service based solely on such methods.

Development.—One of the notable advances in weather forecasting as a science came with the discovery that weather is for the most part not manufactured *in situ,* but rather that broad zones covering hundreds of square miles frequently experience the same type of weather at one time; and particularly that these zones of similar weather characteristics move from place to place over the earth. The important discovery that weather moves was first recognized by Benjamin Franklin in 1743 when he noted that a storm he experienced in Philadelphia on a September day moved on to Boston the following day. This discovery was confirmed by subsequent studies in other parts of the world.

The construction of weather maps, charts on which synchronous weather observations from many stations are plotted and analyzed, marked the beginning of scientific forecasting technique. Such a portrayal of weather over large areas at the same time is called a *synoptic* chart. The earliest examples of synoptic weather charts go back to about 1820 and are credited to Heinrich Wilhelm Brandes in Germany. However, the synoptic chart to portray weather did not come into effective use until the development of the electric telegraph, when it became possible to collect and assemble weather reports in time to prepare a synoptic weather chart for practical use. Thus in 1850 daily telegraphic maps were issued in the United States by the Smithsonian institution. Considerable impetus to weather forecasting was afforded by the occurrence of a strong storm in the Black sea during the Crimean War (1854–56). This storm caused considerable damage to the French fleet. The French emperor, Napoleon III, impressed by the world-famed discovery of the planet Neptune by the astronomer U. J. Leverrier, charged him with the task of organizing a system of weather forecasting in order to foresee such devastating storms. Gathering what observations he could, particularly from observatories and universities, Leverrier plotted a series of weather maps and thereby discovered that the storm had moved in a fairly simple manner from one chart to the next, and that a simple extrapolation of the movement could have produced a valuable forecast.

The attack on the problem of weather forecasting by means of synoptic charts was thereafter pursued in many countries with great enthusiasm. It was soon discovered, however, that the development and movement of storms in general was not as straightforward as the first series of charts showed. Erratic storms with widely varying characteristics appeared on the synoptic charts.

The physics underlying these storms and their movements was a matter of almost complete ignorance and speculation. Partly as a result of the many complexities and the unavailability of a rational theory of storms, those who were commissioned with the responsibility of making weather forecasts developed a completely empirical approach. To a large extent this approach involved the geometry of the weather map; that is, the relative positions and intensities of the stormy and fair weather areas together with a well-developed photographic memory of previous cases in which similar maps had been experienced. This purely empirical type of approach led to the formulation of many rules-of-thumb by forecasters. These rules were almost entirely restricted to the particular area with which the forecaster was concerned, and consequently the advancement of weather forecasting as a world-wide physical science proceeded very slowly. Meanwhile a small band of theoretical meteorologists attempted to attack the basic problems of the behaviour of the atmosphere and develop hypotheses which later helped put a physical foundation under weather forecasting.

The period beginning with World War I saw the start of intensified effort in bridging the gap between theoretical meteorology and empirical forecasting. These developments were largely the result of efforts of the Norwegian school of meteorologists, notably Vilhelm and Jakob Bjerknes. Deprived of weather observations in belligerent countries the Norwegians made a more careful analysis of a very close network of weather reports than had ever been done. Working closely with theoretical physicists and meteorologists they developed the polar front theory. Upon this development largely hinges the modern technique of weather forecasting.

The polar front theory recognizes that most storms originate along the boundary between two air currents moving approximately parallel but in opposite directions and having a sharp difference in temperature between them. Such a boundary, called a *front* by Bjerknes, is found in various places in the atmosphere, notably between the circumpolar easterlies and the middle-latitude westerlies (*see* WINDS, GENERAL CIRCULATION OF), where it is known as the *polar front*. Bends or "waves" in this front occur from various causes and lead to the development of storm (cyclonic) centres. Since the colder of the two air currents has the greater density, it flows southward underneath the warmer westerly current. It is the upward-forcing of this warmer air that causes cloud formation and rain or snow. The condensation of the moisture results from the expansional cooling against the lowering of the pressure with height. Once a disturbance of this kind develops, it may intensify in an unstable manner as the density adjustment between the two currents, which are unable to mix, proceeds. Great sweeps of the cold polar air proceed southward causing abrupt changes in temperature and weather in the latitudes of the westerlies. Thus, by tracing the exact positions of the polar front and its disturbances, it was found that forecasting accuracy could be improved.

During World War II the science of weather forecasting received tremendous stimulation because of the necessity of taking weather into consideration as a vital factor in planning and conducting such diversified branches of military operation as bombing raids, offensives and invasions. The D-day invasion of June 6, 1944, was postponed 24 hours on the basis of weather forecasts. The German counteroffensive of Dec. 1944 (the battle of the Bulge) in the Ardennes was timed on the forecast of extensive fog which hid the armies from Allied bombing and strafing. Routine bombing missions over axis- and Japanese-held territory were always planned in part on the basis of weather forecasts.

World War II also promulgated the development of new forecasting techniques through the establishment of a farflung network of stations at which soundings of the upper atmosphere were obtained. These soundings are obtained through radiosondes, small radio transmitting instruments carried aloft by balloons whose transmitted signals are intercepted at the ground to give a graphic picture of the temperatures, pressures and humidities at various levels up to about 20 km. (13 mi.). In addition, small free balloons are observed visually or charted with the help of radar which enables the forecaster to obtain a picture of the winds aloft. Near the end of World War II the network of upper air stations was sufficient to permit construction of synoptic maps at high levels around the entire northern hemisphere.

Peacetime reconversion (1946) found an increasing demand for weather information and forecasts over the world. Thus commercial air lines, flying world-girdling routes, require weather forecasts for safe operation. Similarly, ocean shipping needs forecasts of severe storms; the farmer wants to know the weather outlook as far ahead as possible to plan his planting and harvesting of crops. The uses to which weather forecasts were being put in 1946 could easily consume several pages of this encyclopædia. The ordinary weather forecasts published in the press and broadcast over the radio reach millions of people every day and in many cases form the basis for planning activities.

Essentially, the practice of weather forecasting as of 1946 involved two steps: first, the diagnosis or analysis of the current weather and the weather leading up to it; and second, the prognosis or attempt to portray the future state of the weather over some specified time interval covered by the forecast. While the analysis and the prognosis are intimately linked, it is not necessary, and perhaps not desirable, for the forecaster to carry on his own analysis. This can be done by a separate group of weather chart analysts.

BACKGROUND FOR WEATHER FORECASTS: THE ANALYSIS (AS PRACTISED IN 1946)

At specified times each day weather observations are taken at meteorological stations and ships at sea throughout the world. There are visual observations such as the type and amount of cloud present in the sky, the current state of the weather, *e.g.*, light rain, showers, snow flurries, visibility (the horizontal distance an object can be seen) and also observations made by instruments. Among the latter are elements such as wind direction and speed, temperature and amount of precipitation (rain or snow) which has fallen. All this information is contained in a numerically coded weather report transmitted from the observing station by radio, telegraph or teletype. The reports are then fed into central forecasting offices where they are decoded and plotted on synoptic weather charts in a convenient shorthand notation. Similar observations are made by ships at sea.

Other observations are made at stations where radiosonde records are evaluated, resulting in records of temperature, air pressure and humidity at different heights in the atmosphere. The direction and speed of the winds aloft are obtained by observations of pilot balloons, by theodolite or radar. This information is also coded, distributed and plotted in a convenient form on synoptic charts.

There is well-developed international co-operation among the meteorological services of the world so that synoptic maps can be plotted to give a picture of the weather over the entire northern hemisphere. The inadequacy of ship reports in the southern hemisphere prior to 1946 made it impossible to obtain such a complete picture.

Some estimate of the tremendous mass of data may be gained from the number of stations over the United States which transmitted surface weather reports four times a day. There were in 1946 about 700 of these stations. There were also 54 radiosonde stations and 140 pilot balloon stations. However, the network of observing stations in most other parts of the world was not so dense. The data were particularly sparse in arctic regions and over certain parts of the oceans.

The analysis of sea-level maps consists essentially of delineating extensive air currents and their boundaries, thereby arriving at a broad-scale picture which gives at a glance the major weather processes taking place in the atmosphere. This form of analysis, called air-mass analysis, stems from the Norwegian polar front theory as formulated by V. and J. Bjerknes and collaborators in 1919 *et seq.* When analyzed in this manner the maps show extensive areas, often as large as one-third to one-half of North America, which are dominated by one air mass, a large body of

air whose characteristics are much the same from region to region within the boundaries of the air mass.

The boundaries between different air masses are called fronts and it is along these boundaries that the principal bad weather zones are found.

The primary considerations used in analyzing the weather maps in terms of air masses and fronts are:

(1) The life history of the air currents appearing on the map, where they have come from and how the winds are directing them. This element of analysis is called "continuity."

(2) The location of zones across which the weather elements change most rapidly; these are the fronts.

An important phase of analysis lies in the construction of a field of isobars or lines running through points of equal barometric pressure. (*See* ISOBAR.) This pressure field is constructed upon the framework of the air masses and fronts. The isobars take on importance because they are intimately associated with the flow of air or circulation which to a large extent determines the motion of the fronts and air masses. Buys Ballot's law, perhaps the most used concept in weather analysis and forecasting, states that if an observer in the northern hemisphere stands with his back to the wind the lower pressure lies to his left. This rule serves to connect the observed wind and pressure field as shown by isobars, and thus to afford an important analytical tool. It also becomes important in forecasting the winds providing a future picture of the isobaric pattern is known.

The isobars and fronts are also closely interrelated, so that the drawing of both is done through mutual adjustment. The movement of the fronts is to a large extent governed by the circulation or flow of air currents which in turn is governed by the isobars. In general, the fronts emanate from centres where the barometer readings are low. These areas of low pressure are variously called cyclones, lows, depressions or polar front waves. (*See* CYCLONE.) The last term refers to the fact that the areas of low pressure are chiefly formed as waves along frontal surfaces. The waves form at the boundary between two media of different density, the warm and the cold air, and to some extent an analogy may be drawn between these waves and those produced at the surface of a body of water. The formation of the initial bulge or wave along the front constitutes the first stage in the life history of a cyclone in accordance with the polar front theory as advanced by Jakob Bjerknes in 1919.

When fronts and isobars have been drawn on a synoptic chart, and the air masses have been labelled with the help of convenient symbols, the analyst shades areas where precipitation is falling.

For the most part this completes the analysis of the primary weather chart. Such a chart is shown in fig. 1. Analyses are then made of various upper air charts used in the preparation of the forecast. There are numerous types of these, the number and type constructed varying considerably from place to place throughout the world and depending in large part upon the supply and nature of the data, the staff available and the personal preference of the forecaster. Some of the more commonly used charts are:

(1) Charts showing the pressure distribution (isobars), temperature distribution (isotherms) and winds at upper levels in the atmosphere. Generally, charts are drawn for the 5,000, 10,000, 20,000 and 30,000 foot levels. In 1946 there appeared to be a trend to construct charts on which the height or contour of certain fixed pressure surfaces is plotted and analyzed rather than pressure charts for fixed levels.

(2) Atmospheric cross-sections which offer a picture of a vertical slice of the atmosphere along some especially interesting route.

(3) Graphs from upper soundings at individual stations showing the distribution of temperature and moisture with elevation (or pressure).

All these charts, and often others, help to give the forecaster a three-dimensional picture of the structure of the atmosphere. It is noteworthy that even by 1946 no one had devised a practical and simple method of displaying in time for use all this information for quick assimilation by the forecaster. Therefore, he had to study many different charts and diagrams to obtain essentially one three-dimensional picture.

THE PROGNOSIS (AS PRACTISED IN 1946)

After the analysis has been completed, the stage is set for preparing the forecast. Essentially, two steps are involved:

(1) Making a prognosis of what tomorrow's map (or that for some specified future period) will look like.

(2) Interpreting the prognostic chart in terms of weather and description of weather in the interval between observed and prognostic chart.

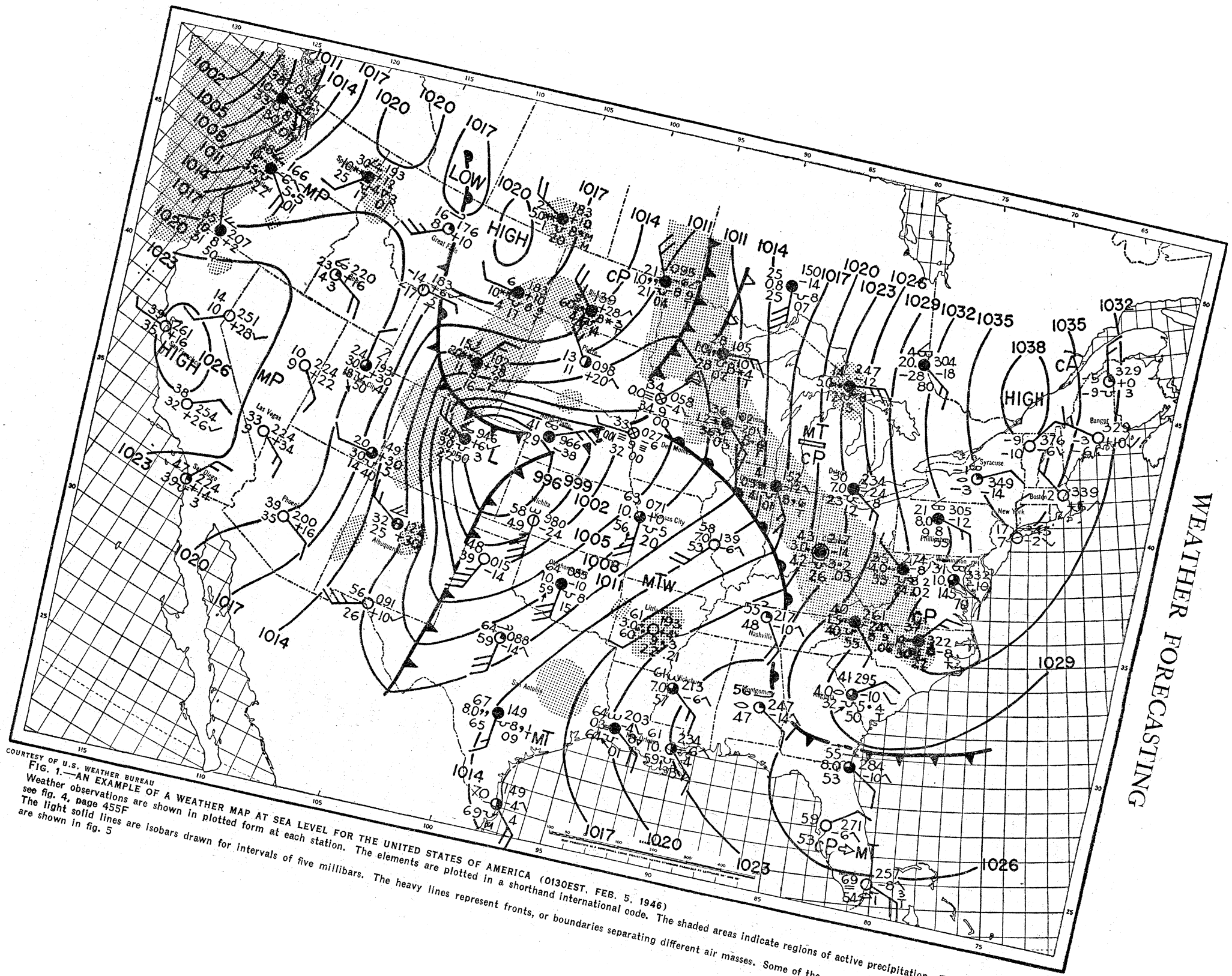
The sea-level prognostic chart, which the forecaster constructs, consists of the fronts, air masses, isobars and precipitation zones as he visualizes them let us say 24 hours in advance. Obviously, the elements to be included in a prognostic chart need not be limited to these four items, but in 1946 this was the current practice, and it was believed that other weather phenomena were fairly well prescribed by these elements when used in conjunction with the series of past-observed maps available. Just as the sea-level weather analysis is the primary diagnostic chart so is the sea-level prognosis the primary prognostic chart. But the prognosis is not limited to the sea-level chart. Prognostic upper-level isobaric charts are also constructed, particularly for the 10,000 ft. level in the atmosphere. During the 20 years preceding 1946 upper-level charts received more and more attention from forecasters, and the trend of development in 1946 appeared to be that the sea-level chart, then considered primary, might eventually be reduced at least to equal importance with upper-level charts. Since the fronts and cyclones are present in the upper air as well as at the ground, it is clear that the upper-level and sea-level charts are intimately connected and therefore so are the prognoses at sea level and aloft. For this reason it is possible to test the internal consistency of the prognosis by certain comparisons between sea-level and upper-air charts.

The most-exploited concept in preparing a prognostic chart, whether at sea level or aloft, is the simple fact that practically all elements on the weather map—fronts, air masses, isobars, clouds, precipitation areas—move, and for the most part can be followed from map to map. This fact goes back to Benjamin Franklin and also to Leverrier's discoveries in the middle of the 19th century. But the statement that the "weather moves" is true only insofar as the physical processes producing the weather move. When the physical processes making the weather cease to behave in a simple manner so also does the weather.

The concept of fairly regular movement has led to numerous techniques for predicting future movements based upon the past behaviour. Perhaps the simplest and most effective of these "extrapolation" techniques consists in entering on the primary synoptic chart the past positions of certain well-defined features of the chart. Thus the forecaster plots on his chart the six hourly positions of the centres of low and high pressure for the past day or two, and beside these positions he may indicate the lowest or highest pressure (the intensity) of the centre. Thus he has at a glance the continuity of motion and changes in intensity for the past two days leading up to his map. He now connects the points representing the positions of the centres and obtains generally a smooth curve giving the tracks or trajectories of these centres. If the movement is speeding up (accelerating), slowing down (decelerating) or intensifying, it is seen from the tracks.

In a like manner the forecaster may track the positions of a cold or a warm front, a cloud shield, a precipitation area, an isotherm or almost any meteorological element which behaves in a fairly continuous manner. To the extent that the movement continues in the future as indicated in the past, his prognosis will be successful.

The most elaborate technique of extrapolation of the weather map was set forth by Sverre Petterssen in 1933. This technique occupied in 1946 a conspicuous place in the forecaster's routine.



COURTESY OF U.S. WEATHER BUREAU

FIG. 1.—AN EXAMPLE OF A WEATHER MAP AT SEA LEVEL FOR THE UNITED STATES OF AMERICA (0130EST, FEB. 5, 1946)

Weather observations are shown in plotted form at each station. The elements are plotted in a shorthand international code. The shaded areas indicate regions of active precipitation. For key to symbols see fig. 4, page 455F

The light solid lines are isobars drawn for intervals of five millibars. The heavy lines represent fronts, or boundaries separating different air masses. Some of the symbols used for the more common fronts are shown in fig. 5

Essentially, Petterssen treated the kinematics of the fields of pressure and pressure change. The field of pressure is, of course, determined by the isobars, while the pressure changes are depicted by isallobars (lines of equal pressure change over a specified time interval). The most widely used pressure changes are those computed for three-hour intervals, and these changes are called barometric tendencies. Thus the weather map represents through the isobars an instantaneous snapshot of a moving pressure field, and at the same time through the isallobars a picture of the instantaneous rate of change of the pressure field. These elements furnish the basis for kinematically computed extrapolations.

The elements of the weather maps to which kinematical computations are applied are chiefly expressed by the configuration of the isobars. The primary types of isobaric configurations into which most observed patterns fall may be broken down into the simple forms indicated in fig. 2. These are:

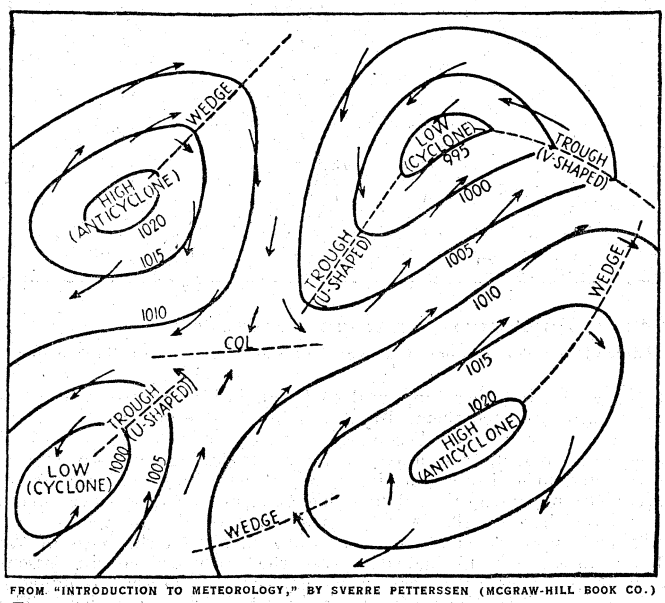
(1) Areas of high and low pressure (anticyclones or highs and cyclones or lows), which take the form of closed isobaric curves of increasing (highs) or decreasing pressure (lows) as the centre is approached.

(2) Troughs, which are elongated areas of low pressure extending from the centres of cyclones. It is in these troughs that fronts are generally found.

(3) Wedges or ridges, which are elongated areas of high pressure extending from the centres of anticyclones.

(4) Cols, which are areas between two cyclones and two anticyclones arranged as shown in fig. 2.

Before kinematical computations are made, it is necessary to sketch the isallobars or lines along which the pressure changes



FROM "INTRODUCTION TO METEOROLOGY," BY SVERRE PETTERSSEN (MCGRAW-HILL BOOK CO.)

FIG. 2.—TYPES OF PRESSURE SYSTEMS OBSERVED ON DAILY WEATHER MAPS

in the past three hours (the barometric tendency) have the same value.

Just as there exists a pressure gradient, defined as the rate of change of the pressure with distance measured normal to the isobars, so is there also an isallobaric gradient which expresses the rate of change of the barometric tendency with distance measured normal to the isallobars.

A trough of low pressure will obviously move away from the region where pressures are rising and toward the area where they are falling. Or, if we chose some line (axis) along which the motion of the trough is to be computed, the movement (V) of the trough in three hours will be

$$V=\frac{\text{isallobaric gradient along the axis at the trough line}}{\text{rate of change of pressure gradient along the axis at the trough line}}$$

In practice these quantities are read off the map by taking a finite distance measured on either side of the trough and interpolating between isobars and isallobars.

A similar computation may be made for ridges, where the ridge must move away from the region of falling pressure toward the region of rising pressure.

It is also possible to use this formula for the motion of centres of high and low pressure. In this case two axes are chosen and computations are made along both as though dealing with ridges or troughs. The displacement of the pressure centre in three hours is then given by the intersection of perpendiculars drawn from the axes at the points indicating the displacement along each axis.

These computations give only the instantaneous velocity and take no account of the accelerations which may be occurring. Petterssen also developed methods for taking into account the acceleration, but in actual practice this is not done, in part because of the fact that the inclusion of the acceleration terms appears to add little to the success of the computations.

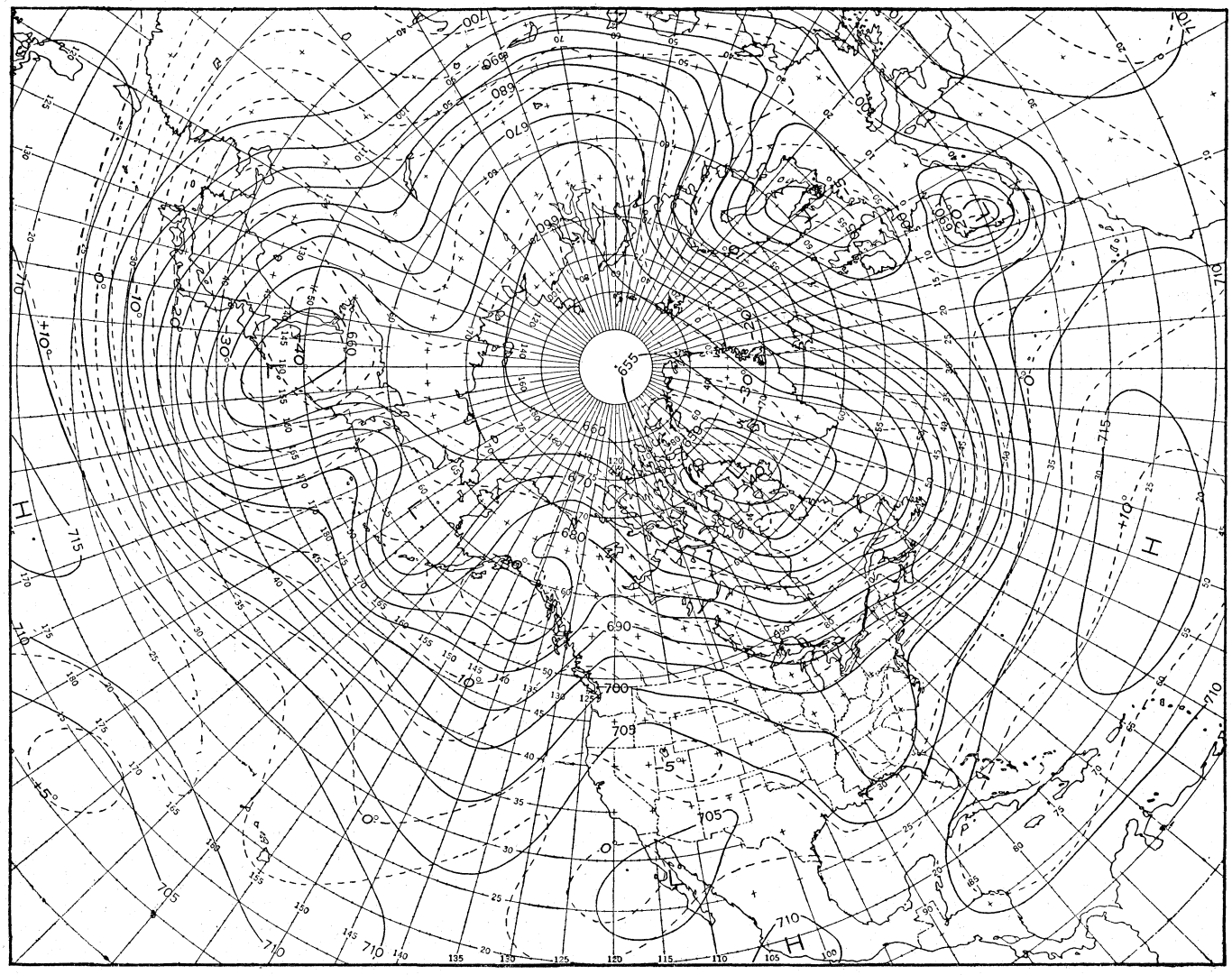
The advantage of this kinematical technique is that it is objective and can be performed equally well by all meteorologists. Its disadvantage lies in the fact that it gives at best only an expression of what is taking place at the moment and assumes that the future behaviour of systems will take place exactly at the same rate as currently operating. For this reason many forecasters who have available maps at 3- or 6-hour intervals prefer to carry out the extrapolations by following the continuity from map to map as described previously.

In addition to the methods of extrapolation there are a number of tools based largely upon physical reasoning that are used in constructing a prognostic chart. One such physical method lies in forecasting the position of fronts. Since a cold front marks the boundary between an advancing cold air mass which is displacing a warm one, the cold air can advance no more rapidly than the wind component directed perpendicularly to the front. The wind at the surface, however, is not a good indicator in this regard because of the irregular effect of friction on the wind created by the earth's surface. A more truly representative measure of flow of the cold air driving the front may be found at an elevation of about 3,000 ft. where the effect of surface friction is small or absent. The speed of these winds can often be determined directly from pilot balloon observations or obtained indirectly by use of the well-known relationships between the spacing of the isobars and the strength of the wind (the geostrophic wind equation). It then remains to compute the component of the wind in the cold air which is directed normally to the front.

The speed of warm fronts may similarly be computed by measuring the rate at which the cold air is retreating ahead of the front. Here the surface friction operates to such an extent that the indicated speed may be as much as 30% too large. In practice the forecaster uses conveniently constructed graphical scales to compute the displacements indicated by the geostrophic wind equation.

Many other physical tools are directly associated with the polar front theory. Some indications used are: (1) new waves often develop on fronts where the temperature contrast is sharp; (2) new waves tend to form on slowly-moving fronts; (3) cyclone waves will usually deepen and occlude more rapidly when the air masses comprising them show strong temperature contrast, particularly at higher levels; (4) cyclones tend to move in the direction of the current of warmest air around them (the warm sector).

Through the day-to-day study of aerological data the interrelation of surface and upper-air maps becomes clarified. The pressure patterns aloft are observed to be appreciably simpler in structure than the surface maps. The complex arrangement of isobaric systems at the surface generally gives way to a series of long wave-like patterns in the isobars at the 10,000 ft. level, and these waves extend at least up to the stratosphere (averaging about seven miles above the earth). The waves are composed of extensive ridges and troughs and the wave length (distance from ridge to ridge or trough to trough) is usually of the order of 500 to 1,000 mi. A sample chart at the 10,000 ft. level is shown in fig. 3. By 1946 the problem of the movement and change of shape of these troughs and ridges became one of the most actively pursued in meteorological investigation. Each trough is generally associated with one primary frontal system along which one or more cyclones are present. The intensification of the frontal systems and the subsequent behaviour of the individual cyclones is largely determined by the deepening or filling of the upper-level troughs. A rational theory of these "waves in the westerlies" was first put forward by J. Bjerknes in 1936, and considerable advances in knowledge in this field were made by Carl-Gustaf Rossby and collaborators (1938 *et seq.*). Some of the practical indications expressed by studies of these waves are: (1) waves of long length move slowly while short waves move rapidly; (2) waves of large amplitude (deep



COURTESY OF U.S. WEATHER BUREAU

FIG. 3.—AN EXAMPLE OF A MAP SHOWING THE PRESSURE AND TEMPERATURE DISTRIBUTION AT 10,000 FEET IN THE ATMOSPHERE

Isobars (lines of equal pressure in millibars) are shown as solid lines, isotherms (lines of equal temperature in degrees Centigrade) are shown as broken lines

troughs and intense ridges) move slowly.

When isotherms, lines of equal temperature (*see* ISOTHERM), are drawn on upper-level pressure charts, they also exhibit a wave-like character. (*See* fig. 3.) But waves in the isotherms often have a quite different pattern from those of the isobars. They may parallel the isobars in some regions but be completely out of phase (*e.g.*, a ridge in the isobars appears in the same region as a trough in the isotherms) in others, and intermediate stages of interweaving of patterns may be found elsewhere. Many empirical rules have been formulated to indicate the motion and changing intensity of the troughs and ridges aloft on the basis of the relation between isotherms and isobars. Two of the most commonly used are: (1) when isobars and isotherms run parallel at a pressure trough (or ridge) it remains stationary or moves slowly (isobars and isotherms are then "in phase"); (2) when isotherms and isobars run so that isobaric ridges coincide with isotherm troughs, the movement of the pressure field is rapid.

Perhaps the most useful rules for forecasting the degree of intensification of troughs and ridges apply the empirical rule that as cold air is replaced by warm in the layer from three to ten km., pressures generally rise, while the replacement of warm air by cold leads to falling pressure. This rule is well supported by statistical studies. Therefore, if the forecaster can predict the transport (advection) of air and estimate the resulting temperature change, he obtains an estimate of the pressure change. Some indication of the advection of air may be obtained from the winds and isobars aloft and by certain methods of computing air trajectories.

Just as with the sea-level chart, there is continuity to the motion and development of the ridges and troughs aloft. For this reason it is possible to follow them from map to map and make simple extrapolations leading to a first estimate of their future positions.

In 1946 the construction of a prognostic chart at upper levels was not generally carried on as a routine feature at most forecast centres in the world, but there appeared to be an increasing group of forecasters who prepared them. But the method of preparing the upper-level prognoses had not become nearly as standardized as sea-level prognoses. In fact, there appeared to be developing a controversy as to the fundamental procedure in prognosis; namely, should the upper-level chart be prognosticated first, independent of the sea-level chart, later cross-checking the internal consistency of the prognoses? Or should the upper-level prognosis be done chiefly on the basis of the surface prognosis? In the latter case the procedure consists essentially of preparing a sea-level prognostic chart, and then building a series of upper-air charts using the sea-level prognosis as a base. The essence of this technique or any procedure which attempts to interrelate upper air and sea level charts is the hydrostatic equation

$$\frac{dp}{dz} = -\rho g$$

which states that the rate of change of pressure with height, $\frac{dp}{dz}$ is proportional to the density, ρ, of the air and is a function of the value of the acceleration of gravity, g (*see* ALTIMETRY); g varies with latitude and altitude, but its variation is small compared with the observed variations of ρ. From this general equation, or developments from it, it is possible to compute the pressure at any level, knowing the pressure at one level and the density of the intervening air column between this level and the one at which the pressure is desired. Thus, if the sea-level pressure distribution is known or forecast, the upper-level pressure distribution may be determined knowing the density of the intervening air columns. Likewise, a sea-level map can be constructed from an upper-level chart. The obvious difficulty in using this technique as a forecasting tool is that not only the pressure distribution but also the density distribution must be forecast correctly. Attempts to do this are made by various methods involving the advection (or carrying along) of air masses, assuming that their average

densities through a thick layer do not change much. In 1946, there seemed to be considerable controversy as to how successfully this advective procedure could be applied in forecasting.

The general method, called the differential method, received considerable attention in England during World War II, when forecasts of winds at upper levels became important in planning bombing missions. There it was believed that the knowledge and experience of forecasting the sea-level map was so much more extensive than that of forecasting the upper-air map directly that the differential method involving the advective forecast gave the best results. But by 1946 many forecasters felt that much additional information of forecast value could be obtained by making independent prognoses at sea level and aloft, later applying the differential method chiefly as a check on the internal consistency of the forecast patterns. In this case the density field necessary to harmonize the surface and upper-air maps is computed and tested for reasonableness from the advective hypothesis.

The upper-level map and prognosis not only give clues to the intensification of the fronts and cyclones observed on the surface maps but also provide indications for the motion of the cyclones. Thus a cyclone tends to move parallel to the upper-level (10,000 ft.) isobars over its warm sector and with a speed proportional to the speed aloft. (Generally, the motion has a component in toward the lower pressure aloft.) The direction of the motion of the cyclone by the upper-level current is called "steering," a phenomenon stressed particularly in the decade 1930–40 by the German school of meteorologists.

FORECASTING THE WEATHER FROM THE PROGNOSTIC CHARTS (AS PRACTISED IN 1946)

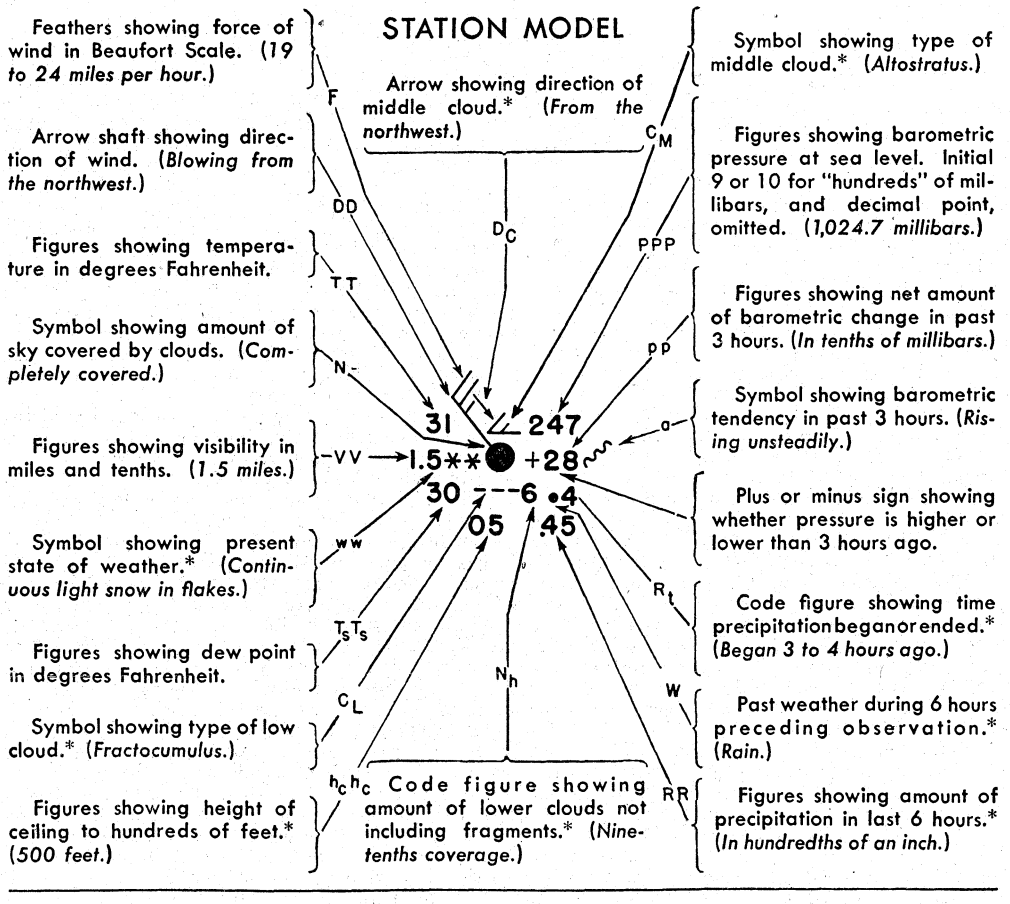
The groundwork for the weather forecast lies in the prognostic charts and the observed sequence of weather maps leading up to the prognosis. The positions and continuity of the fronts and air masses and the configuration of isobars for the most part determines the forecast of weather elements. The forecast of wind direction and speed is easily made by direct reference to the latest observed and the prognostic pressure distributions, utilizing Buys Ballot's law and a geostrophic wind scale. The sequence of wind changes can be conveniently interpolated between the current and prognostic charts.

Cloud and precipitation forms and amounts may be first estimated from the forms characterizing the fronts and air masses of the currently observed synoptic chart and the motion of these same fronts and air masses as indicated by the prognostic chart. The first approximation makes the assumption that the weather associated with air masses and fronts remains the same as the systems move. While this simple technique enjoys considerable success, it is perhaps overstressed by most weather forecasters and frequently leads to serious errors in the weather forecast even though the prognostic charts are fundamentally correct. Therefore, the forecaster must consider the changes or modifications occurring in the air masses and at the fronts as they move.

The modification of weather along the fronts is largely determined by the extent of deepening or filling indicated by the comparison of current and prognostic pressure troughs associated with the front at the surface and aloft. Deepening troughs are associated with increased and thickening clouds, heavier precipitation, increased wind and a sharpening temperature contrast across the front. Filling troughs are associated with a tendency to dissipation of existing cloud forms, lessening or termination of precipitation, decreased wind and lessening of the temperature contrast across the front.

The physical properties of the air masses entering into the circulation at the fronts also take on importance in estimating the modification of the weather. For example, as a cyclone moves into an area where increasingly moist and warm air currents are being fed into it, the cloud forms and precipitation areas are apt to become more extensive. Similarly a cyclone drawing into it air of increasingly dry characteristics becomes freer of clouds and precipitation. The forecaster has before him a clear view of the types of air currents entering the cyclone from the plots of moisture and temperature with elevation, and from the moisture and temperature values on the upper air charts. The modification of the air masses and the accompanying modification of the weather associated with them varies considerably with season of the year, type of terrain over which air mass is moving, original characteristics of the air mass and the pattern of flow to which the air mass is subjected.

The type of air mass modification associated with the nature of the flow of the air mass is largely concerned with whether the flow is becoming increasingly cyclonic (increasing curvature as with isobars around a cyclone) or increasingly anticyclonic. In the former case it may be shown that general ascending motion must occur, a condition favouring increased cloud and precipitation. Conversely, increasing anticyclonic flow leads to descending motion and dissipation of cloud and precipitation. The indications of such changes of flow are expressed by comparison of the prognostic isobars with those on the current map. These effects are usually reflected in the pressure changes, falling where ascending motion is occurring and rising where descending motion is taking place.



Special Note on Station Model: Elements marked with an asterisk are omitted when data are not observed or not recorded. The letter "M" is used for "missing" data. The code letter symbols for each weather element are also shown above.

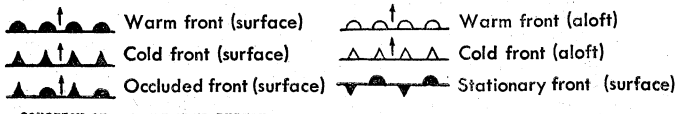
FIG. 4.—PLOTTING MODEL FOR WEATHER OBSERVATIONS

AIRWAYS FORECASTS

The rapid increase in flying has brought with it increasing demands for specialized weather forecasts. A typical forecast for a scheduled airflight stresses ceiling, visibility, turbulence (degree of bumpiness), possibility of ice formation on the aircraft, winds aloft, tops of clouds and gustiness at the surface. (*See* TURBULENCE; ATMOSPHERIC; ICE ON AIRCRAFT.) The time interval embraced by these forecasts varies with the length of the flight in terms of distance and cruising speed of the type of plane. While the conditions in flight must be forecast, in 1946 emphasis was placed upon the terminal weather conditions; that is, what weather the pilot experiences when he arrives at his destination. The emphasis on terminal conditions has been due chiefly to improvements in navigational aids and aircraft, making it possible for high performance planes to fly through or above most bad weather zones. But forecasts of in-flight weather are still of considerable importance, particularly for planning flight time (through tail wind forecasts) and in severe turbulence and icing conditions.

The dependence of safe aircraft operation upon meteorology was clearly established by 1946. Yet meteorologists and others could not help but ponder the question of the extent to which subsequent development of improved navigational aids and aircraft might lessen this dependence and possibly make aviation as independent of weather as railroading.

The basis of forecasts for aviation is practically identical with that for the day-to-day forecasts as discussed. However, the degree of detail which must be considered demands certain additional aids. For one thing, it requires up-to-the-minute weather information



COURTESY OF U.S. WEATHER BUREAU

FIG. 5.—SYMBOLS USED FOR DESIGNATING FRONTS

from a close network of reporting stations. This requirement is met over many commercial flying routes through special observation centres about 40 to 50 mi. apart which report their weather by teletype or radio every hour or even more frequently during periods of bad weather. Special reports of actual conditions in flight are also radioed to the ground stations from commercial aircraft, and these reports are used in making the forecast.

Perhaps the principal concepts used in making a short airways forecast, for example for a period from six to eight hours in advance, consist of: (1) making a careful survey of the structure of the atmosphere over the route which the pilot is to fly; (2) deciding what air masses and fronts are apt to cause a change in the weather over the route during the period covered by the forecast.

That latter problem is simply a special case of the more general forecast problem as discussed above. However, for forecasts of so short a period the forecaster does not construct a prognostic chart on paper, but rather does it mentally. The reason for this is that the rate of change of properties of air masses and fronts, as well as the movement of these elements is usually relatively small during a six- to eight-hour period. Thus while the average speed of fronts is perhaps 25 miles per hour, the speed of most commercial aircraft is more than 200 miles per hour.

In order to assist in surveying the flying conditions along a route some airways meteorologists prepare a vertical cross-section chart of the atmosphere along the route. On this chart are entered such items as temperatures, winds, cloud bases and top, levels where icing may be reported or indicated, zones of turbulence, etc.

The technical aspects of airways forecasting involve many detailed atmospheric phenomena such as the formation and dissipation of fog and low cloud, the changes in visibility introduced by local smoke sources, the effect of obstacles like mountains or surrounding air currents and so on. These phenomena are to a large extent regional or local in character.

LONG-RANGE FORECASTING

The interval of time for which forecasts can be made by the general techniques described is no greater than 48 hours. In fact, the degree of success which can be achieved beyond 36 hours is very small when compared to a chance forecast based on climatological records. Therefore, for forecasts of more than 48 hours it is necessary to make use of other techniques.

For the most part a person who is interested in obtaining long-range forecasts is primarily interested in knowing not the normal behaviour of weather in his region, but rather the deviation from normal expected during a given period. If he has lived or operated a business in a particular area for a long period of time he is acquainted with the normal behaviour of weather. He can recognize without recourse to climatological data periods when it has been very cold, warm, wet or dry.

In terms of the meteorologist, then, a long-range weather forecast should express the departure from normal of the various meteorological elements, and any system of long-range forecasting which purports to possess some degree of skill must enjoy more success than statements based solely on climatological records.

When these criteria are established for judging long-range forecasting methods, very few of them can withstand close scrutiny. This is especially true of forecasts of weather conditions beyond a month in advance. Some very slight degree of success has been obtained by highly generalized forecasts of temperature and precipitation for certain areas for monthly periods, but the margin of success is so small in excess of climatology that this system of forecasting is considered in the experimental stage. Although expansive claims are sometimes made about them, forecasts covering longer periods than a month have not conclusively demonstrated any appreciable degree of skill. For this reason the following discussion of long-range methods is restricted to those techniques which during the years of World War II and subsequently, showed enough skill so that it cannot reasonably be attributed solely to the use of climatology. But even these systems in 1946 were looked upon by some meteorologists with a quizzical and doubting eye.

These forecasts cover a period of about one week in advance, and cannot express with any appreciable reliability the detailed weather expected at any point at a specific time. Rather they attempt to express in more general terms the average conditions expected over the following week, whether the week will average warmer or colder than normal and whether the precipitation will be light, moderate or heavy for the time of the year. The forecaster also attempts to describe roughly the general trend of events during the week; that is, whether relatively cold weather will come at the beginning, middle or end of the week and during which part of the week precipitation is most likely.

Two methods of preparing such forecasts which achieved popularity during the period 1940–46 are the analogue method and the general-circulation method. The former method involves chiefly the basic concept that weather maps of past years can be found which resemble the current map to a sufficient degree so that the subsequent weather of the past (historical) maps will indicate what will occur in the future. In other words, the assumption is made that weather types and sequences repeat themselves over the years, and if the proper resemblance of maps is found (called a good analogue) a forecast may be obtained from the past maps. The other method involves the broad-scale circulation features of the earth's atmosphere and is a physical method of attack.

The analogue method is probably as old in essence as the construction of synoptic weather maps. Some of the concepts of the general circulation method date back to 1881 with the work of the French meteorologist, Leon Philippe Teisserenc deBort. Both methods expanded considerably during World War II when long-range forecasts were required by the military services of the world. Some of the basic work in the analogue technique was done by the Russian school of meteorology under the guidance of Boris Pompeevich Multanovsky during the period 1900–40, *et seq.* Later on, partly in a search for successful long-range techniques, considerable work on this problem was undertaken by the U. S. army air forces. The development of the general circulation method is credited largely to the American school of meteorologists working under the stimulus of Carl-Gustaf Rossby (1936, *et seq.*).

The theory underlying the analogue method is that if two maps are found which are identical, then the physical properties must be identical and the subsequent behaviour of the weather identical. The problem then resolves into finding the proper analogue. The selection is made from an archive of historical weather maps at sea level prepared for about 40 years and covering the entire hemisphere. This can be done by classifying and cataloguing the maps in terms of some outstanding characteristics of the pressure and frontal pattern. The analogue is generally restricted to season of the year. After a primary selection of possible analogues, a further elimination is made visually in order to choose the best analogue. Once this map is chosen, the maps following it, with or without slight modifications, represent the weather forecast. The advantages cited by those who practice analogue methods are: (1) that it is objective and does away with the necessity of complex and perhaps subtle reasoning inherent in physical methods which are not perfected; (2) it is relatively fast in operation, and forecasts can be turned out rapidly; (3) the analogues so selected automatically contain in them the modification of weather peculiar to various regions and thus automatically incorporate the climatology.

The opponents of the analogue technique point out that: (1) in order for an analogue to be successful in long range forecasting it must bear a good resemblance over large areas covering perhaps much of the entire hemisphere, since the weather over one region inevitably has some effect on other areas later on; (2) in order to bear true physical similarity, the maps must be similar aloft as well as at the surface, and upper-air maps for many past years are not available owing to the lack of upper-air observations; (3) in order for the weather to repeat in the same manner in two cases, the sequence of events must have developed in the same way.

When these restrictions are placed on an analogue, it becomes virtually impossible to find a good one in the short span of 40 years of record. The fact that no two weather maps are ever strictly alike was recognized early in meteorology. Nevertheless in 1946 the analogue method was still used, although the revival of enthusiasm during World War II seemed to have subsided considerably.

The physical method of approach involving the general circulation of the atmosphere has for its basis the slowly-changing broad-scale features of circulation which dominate the weather for extended periods of time. These features are brought to light by average or mean charts showing the pressure distribution aloft (at 10,000 ft.) and sea level for extended periods of time, generally five days. The purpose of the averaging process is to suppress the irregular and complex day-to-day irregularities of the weather map and bring into sharp focus the large-scale pressure patterns on which the irregularities are superimposed. At 10,000 ft. the mean maps show waves which appear as long sinusoidal perturbations superimposed on a broad westerly current circulating around the hemisphere. For this reason they are referred to as waves in the westerlies. These waves characterize the layer of air from three to ten km. Studies made by Rossby in 1938 showed that the motion of the waves at any latitude may be eastward or westward depending upon their wave length and the average strength of the west wind belt in which they are embedded. Thus the velocity of the mean trough given by Rossby is

$$c = U - \frac{\beta L^2}{4\pi^2}$$

where c is the velocity of the trough (positive to the east); U the

average strength of the west wind component; L the wave length (from trough to trough or crest to crest); and β the rate of change northward of the Coriolis parameter (earth's deflective force). From the formula it is seen that long waves move slowly eastward or may retrograde (move westward) while short waves move more rapidly eastward. Moreover, faster eastward motion is favoured by strong west winds. When $U=\frac{\beta L^2}{4\pi^2}$, $c=0$, and the waves remain stationary. It must be recognized that the air particles do not generally move with the speed of the troughs and ridges. In fact, the speed of the individual air particles is usually many times the speed of the waves. The waves found aloft on the daily map also move at a much faster speed than the mean troughs and ridges. The importance of mean troughs for determining weather lies in observations that cold air masses flow into the troughs from northern latitudes, and as these cold air masses converge with warm tropical currents ahead of the troughs fronts and cyclones develop.

The mean trough also represents a locus of maximum intensification of the troughs of the daily maps, so that daily troughs approaching the region of the mean trough deepen and fill when leaving it. Clearly, a forecast of mean trough positions goes a long way toward indicating the zones characterized by stormy weather. The mean troughs and ridges are also associated with mean pressure patterns at sea level. These mean maps are also computed as averages from the daily maps. The sea-level patterns contain large cells of high and low pressure which have a strong tendency to persist, moving and altering their characteristics but slowly. Because of their quasi-stationary character and the control they exert on the long period weather regime, these cells were named "centres of action" by the French meteorologist Teisserenc deBort in 1881. In the northern hemisphere, in winter, there are five principal centres of action—the Iceland and Aleutian Lows, the Atlantic and Pacific Highs and the Siberian High—all named after the region of their most frequent habitat. The complete explanation of these centres of action was still not known to meteorologists in 1946, although increased upper air data had thrown considerable light on their behaviour. The theory of Rossby associates the mean waves in the westerlies with the centres of action, the mean troughs emanating from the semipermanent lows and the mean ridges from the semipermanent highs. The changes in position and intensity of the centres of action are therefore ascribed largely to the behaviour of the mean troughs and ridges in the westerlies.

The relationship given by Rossby's formula indicates that for steady state conditions (in which there is no motion of the mean troughs or ridges) the wave spacing is determined by the strength of the west wind component aloft. This quantity, called the zonal index, can be computed from the pressure distribution. Owing to the relationship between index and wave length of the mean troughs, and also to the fact that geographical features of the earth's surface tend to favour certain places for trough formation, the patterns on upper-level and sea-level mean maps may be broadly classified in terms of zonal index. Thus there are "low index" (weak westerlies) patterns characterized by short waves aloft usually with large amplitudes and "high index" (strong westerlies) patterns characterized by long waves of small amplitude. The corresponding sea-level patterns for low index thus have more centres of high and low pressure than for high index.

The zonal index is also to some extent associated with general weather conditions over temperate latitudes. Strong west winds (high index) in winter carry the warm oceanic air masses in over the continents and the lack of north-south motions of air (the meridional components) does not permit strong intrusions of cold polar air masses. Hence high index is generally associated with relatively mild weather over most of the temperate latitudes. Conversely, low index is generally associated with cold weather, particularly over large portions of the continents.

The practical application of the zonal index and the trough formula to problems of extended forecasting involves many auxiliary charts and techniques which cannot be described briefly, and in view of the imperfect and transitional nature of long-range forecasting practice, it is perhaps wise not to discuss them at length. The steps in the preparation of a long-range forecast by the general circulation method are essentially:

(1) The analysis and interpretation of mean charts and sea level and aloft in terms of zonal index and waves in the westerlies.
(2) The prognostication of zonal indices for the coming week based upon statistical and synoptic evidence (the evolution of the pressure patterns toward high or low index states).
(3) The prognosis of the position and intensity of waves in the westerlies as portrayed at the 10,000 ft. level, indicated by the zonal index, the Rossby formula (with empirical corrections), the history of continuity of the troughs (kinematical methods) and the relation of temperature and pressure fields aloft.
(4) The prognosis of a sea-level chart making use of the interrelation between upper-level and sea-level charts through the general differential method.
(5) Prognosis of anomalies of temperature and precipitation for the period covered by the forecast, based essentially on the appearance of the prognostic charts.
(6) Application of tests of internal consistency to the entire prognosis.
(7) Construction of a set of daily prognostic charts giving a schematic picture of the general paths of cyclones and anticyclones, fronts and air masses, expected to make up the mean prognosis.

It will be noted that the general line of procedure is similar to that used in short-range forecasting practice. Indeed, surprisingly enough, many steps in this procedure were first developed in connection with long-range forecasting and later applied to short-range predictions.

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WEATHERING, in architecture, the sloping surface on the upper side of a coping, projecting moulding or band course, arranged so as to throw off rain water, known as wash. The expression "to the weather" is used to describe the length of a slate exposed below the edge of the next lapping course.

WEAVER, JAMES BAIRD (1833–1912), American lawyer and political leader, was born at Dayton (O.), on June 12, 1833. He studied law at Cincinnati (O.), and served on the Union side in the Civil War. He was a representative in Congress in 1879–81 and in 1885–89, being elected by a Greenback-Democratic fusion. In 1880 he was the candidate of the Greenback party for president, and received a popular vote of 308,578; and in 1892 he was the candidate of the People's party, and received 22 electoral votes and a popular vote of 1,041,021. He died at Des Moines (Ia.), on Feb. 6, 1912.

WEAVER-BIRD, the name by which a family (Ploceidae) of birds are usually known, from their often elaborately interwoven nests. They are small sparrow-like birds, but the males are often conspicuously coloured. Perhaps the most remarkable is the African sociable grosbeak (*Philetaerus socius*); some 100 or 200 pairs build their grass nests together in one tree, forming a gigantic mushroom-shaped mass. Each nest is entered from below. The subfamily of the widow-birds (Viduinae) have long tail-feathers, reaching in *Vidua paradisea,* a bird the size of a sparrow, a foot in length. This decoration is confined to the males. The Ploceidae are closely related to the Fringillidae (*see* FINCH), and are distributed over Africa, Australia and the warmer parts of Asia.

WEAVING. The process of weaving consists in interlacing, at right angles, two or more series of flexible materials, of which the longitudinal are called warp and the transverse weft. Weaving, therefore, embraces only one section of the textile industry, for felted, plaited, netted, hosiery and lace fabrics lie outside this definition. Felting consists in bringing masses of loose fibres, such as wool and hair, under the combined influences of heat, moisture and friction, when they become firmly interlocked in every direction. Plaited fabrics have only one series of threads interlaced, and those at other than right angles. In nets all threads are held in their appointed places by knots, which are tied wherever one thread intersects another. Hosiery fabrics, whether made from one or many threads, are held together by intersecting a series of loops; while lace fabrics are formed by passing one set of threads between and round small groups of a second set of threads, instead of moving them from side to side.

The invention of spinning (*q.v.*) gave a great impetus to the introduction of varied effects; previously the use of multi-coloured threads provided ornament for simple structures, but the demand for variety extended far beyond the limits of colour, and different materials were employed either separately or conjointly, together with different schemes of interlacing. Eventually the weaver was called upon to furnish articles possessing lustre, softness and delicacy; or those that combine strength and durability with diverse colourings, with a snowy whiteness, or with elaborate ornamentation. To meet the requirements the world has been searched for raw materials. From the animal kingdom, wool, hair, fur, feathers, silk and the pinna fibre have long been procured. From the vegetable kingdom, cotton, flax, hemp, jute, ramie and a host of other less known materials are derived. Among minerals there are

gold, silver, copper, brass, iron, glass and asbestos. In addition, strips of paper, or skin, in the plain, gilt, silvered and painted conditions are available. Finally, artificial fibres are used, especially artificial silk, which has come into very extended use.

The processes of bleaching (*q.v.*), mercerizing (*q.v.*), dyeing (*q.v.*), printing (*see* TEXTILE PRINTING) and finishing (*q.v.*) contribute to the resultant product.

FABRIC STRUCTURE AND DESIGNING

The following classification will be adopted: Group 1, to include all fabrics made from one warp and one weft, provided both sets of threads remain parallel in the finished article and are intersected to give the requisite feel and appearance. Group 2, to include (*a*) fabrics constructed from two warps and one weft, or two wefts and one warp, as in those that are backed, reversible and figured with extra material; (*b*) two or more distinct fabrics built simultaneously from two or more warps and wefts, as in two, three and other ply cloths; (*c*) fabrics built by so intersecting two or more warps and wefts that only one texture results, as in loom-made tapestries and figured repps. Group 3, to include fabrics in which a portion of the weft or warp rises vertically from the ground-work of a finished piece, as in velveteens, velvets, plushes and piled carpets. Group 4, to embrace all fabrics in which one portion of the warp is twisted partially, or wholly, round another portion, as in gauzes and lappet cloths.

The structure of a cloth, and its ornamentation by weaving, is worked out by the cloth designer on squared paper. Successive vertical lines of squares are taken to represent the warp threads, whilst horizontal lines similarly represent weft threads. A filled-in square then indicates that the warp thread it represents is above the weft, whereas a blank means weft above warp. This can be seen clearly in fig. 1. When two or more warps or wefts are used in a cloth, different colours or kinds of marks are generally used to show the working of the different warps or wefts. Thus, in fig. 15 the crosses represent ground warp above ground weft, whereas the filled squares show ground warp above the extra or figuring weft.

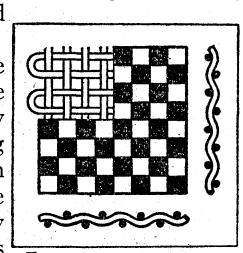


FIG. 1.—PLAIN CLOTH

Fabrics in Group 1.—These are affected by the nature and closeness of the yarns employed in their construction, by colour, or by the scheme of intersecting the threads. The most important section of this group is *Plain cloth,* in which the warp and weft threads are approximately equal in thickness and closeness, and pass over and under each other alternately, as in fig. 1, which shows a design, plan and two sections of plain cloth. Such a fabric would, therefore, appear to admit of but slight ornamentation, yet this is by no means the case, for if thick and thin threads of warp and weft alternate the resultant fabric may be made to assume a corrugated appearance on the face, while beneath it remains flat, as in poplins, repps and cords. A plan and a longitudinal section of a repp cloth are shown in fig. 2. Colour may also be employed to ornament plain fabrics, and its simplest application produces stripes and checks. But colour may convert these fabrics into the most artistic productions. Tapestries only differ from simple plain cloth in having each horizontal line of weft made up of numerous short lengths of parti-coloured thread. Many fine specimens of this art have been recovered from ancient Egyptian and Peruvian tombs, and many are still produced in the Gobelins and manufactories of Europe.

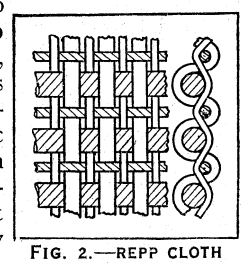


FIG. 2.—REPP CLOTH

Twills are next in importance to plain cloth on account of their wide range of application and great variety of effects; in elaborately figured goods their use is as extensive as where they provide the only ornament. Twills invariably form diagonal ribs in fabrics, and these are due to the intervals at which the warp and weft are intersected; thus two or more warp threads are passed over or under one or more than one weft thread in regular succession. Twills are said to be equal when similar quantities of warp and weft are upon the face of a fabric, unequal when one set of threads greatly preponderates over the other set. Fig. 3 shows the design for an equal, and fig. 4 that for an unequal twill, each of which requires four warp and weft threads to complete the scheme of intersections. If the ribs form angles of 45 degrees, the warp and weft threads per inch are about equal in number, but for an unequal twill the material most in evidence should be closest and finest. The angle formed may be greater or less than 45 degrees, as in figs. 5, 6, which are both derived as shown from the same base weave. Twills are *simple* and *fancy;* both terms refer to the schemes of intersecting. In the former the same number of warp threads are placed successively above or below each weft thread, and the ribs are of uniform width, as in figs. 3, 4. In the latter more warp threads may be above one pick than another, the ribs may vary in width and small ornament may be introduced between the ribs, as in figs. 5, 6 and 7. Twills may be broken up into zig-zags, lozenges, squares and other geometrical designs, all of which may be produced by reversings in the diagonal lines, or by reversing the weave of an unequal twill. Fig. 8 is a zigzag, namely, a twill reversed in one direction. Fig. 9 is a diamond, or a twill reversed in two directions, and fig. 10 is a diaper, which gives a warp face in one place and a weft face in another.

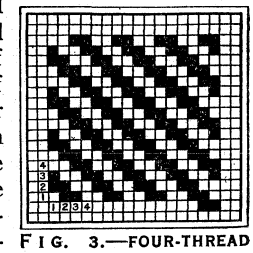


FIG. 3.—FOUR-THREAD $\frac{2}{2}$ TWILL

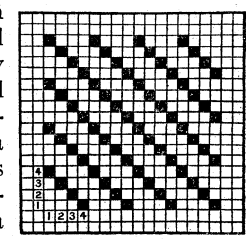


FIG. 4.—FOUR-THREAD $\frac{1}{3}$ TWILL

Satins and *sateens* form another important section of Group 1. In a satin the bulk of the warp, and in a sateen the bulk of the weft, is on the face of a fabric. If perfect in construction both present a smooth, patternless appearance, which is due in part to the scheme of intersections, in part to using fine material for the surface threads and placing it close enough together to render the points of intersection invisible; the threads of the other set being coarser and fewer in number. Satins differ from twills in having each warp thread lifted, or depressed, separately, but not successively. From five to upwards of 30 threads of warp and weft are required to complete the various schemes of intersecting. If the intervals between the intersections are equal the weave is said to be perfect, as in fig. 11, but if the intervals are irregular it is said to be imperfect, as in fig. 12. In *Damasks* a satin is combined with a sateen weave, and since any desired size and shape of either weave may be produced, great facilities are offered for ornamentation. But in combination neither the satin nor the sateen can be perfect in construction, for one requires a preponderance of warp, the other a preponderance of weft; it follows that every point of intersection is distinctly visible on both surfaces.

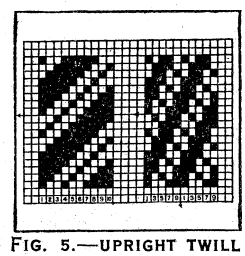


FIG. 5.—UPRIGHT TWILL

Brocades are fabrics in which both sets of threads may be floated irregularly upon the surface to produce ornamental effects, and they may be taken as typical of all one warp and one weft fabrics that are figured by irregularly floated materials, whether the threads are uniformly or irregularly distributed, and whether one weave or several weaves be employed.

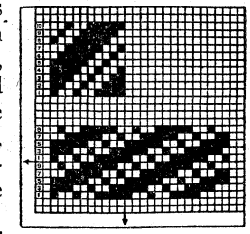


FIG. 6.—RECLINING TWILL

Group 2.—This group includes all backed and reversible fabrics, as well as those ornamented with extra material and compounded. Cloths intended for men's wear are often *backed,* the object of which is to give weight and bulk to a thin texture without interfering with the face effects. Either warp or weft may be used as backing; in

the former there are two series of warp to one series of weft threads, while in the latter there are two series of weft to one series of warp threads. The face material is superposed upon that of the back, but the ratio of face threads may be one or two to one of back. In order to avoid disturbing the face weave, only those threads are used to bind the backing that are hidden by the face, as in fig. 13, which gives the design and a transverse section of a backed fabric. A is face weft, B back weft, and the circles are warp threads; of the latter C, D are beneath both B and A. This diagram will serve equally as a longitudinal section of a warp-backed fabric, if A represents a thread of face warp, B a thread of back warp and the circles are weft threads. Weft backing is capable of giving a more spongy feel to a fabric than warp, because softer materials may be used, but in these fabrics the length output of the loom is reduced by reason of the wefts being superposed. Warp-backed fabrics, whether uniformly coloured or striped, do not materially reduce the output of a loom, for every weft thread adds to the cloth length. *Reversible* fabrics may have either two series of differently coloured wefts or warps to one of the other series, in which event they may be similarly figured on both sides by causing the threads of the double series to change places, as in the design and transverse section, fig. 14; or, by allowing one series to remain constantly above the other, as in backed cloths, both sides may be similar or dissimilar in colour and pattern. *Fabrics figured with extra material* may have two series of warp or weft threads to one series of the other set, and they may yield reversible or one-sided cloths. The figuring may be done entirely by the extra material placed above or below a ground texture, as in fig. 15, or ordinary and extra materials may be used conjointly for figuring. In fig. 15 the waved lines and circles represent a section of the plain cloth ground which shows a thread of extra material. *Compound cloths* must have at least two textures, both as distinct in character as if woven in separate looms. They have many advantages over backed cloths, thus: the same design and colouring may be produced on both sides; where bulk and weight are required a fine surface texture may be formed over a ground of inferior material, and soft weft be passed between the upper and lower textures; the fabric is more perfect and admits of either simple or elaborate patterns being wrought upon the surface, with simple ones beneath, as in piqués and matelassés. One texture may be constantly above the other and connected at the selvages only, as in hose pipes and pillow slips; or at intervals a thread may pass from one texture into the other, in which event both are united, as in many styles of bedcovers and vestings. As many as from three to twelve textures may be woven simultaneously and united, as in woven beltings. It differently coloured, the textures may change places at pleasure, as in Kidderminster carpets. There may be from one to three threads of face warp to one of back, and the wefting may or may not correspond with the warping. Fig. 16 shows the face and back weaves, the design, and a transverse section of a compound cloth with two threads of face warp and weft to one of back, and both are stitched together. The circles in the upper and lower lines represent face and back warps respectively, and A, B, C are weft threads placed in the upper and lower textures. In the design, filled squares show face warp lifted above face picks, crosses show back warp lifted over back picks, dots indicate face warp lifted over back picks, and the oblique marks show the binding of the two fabrics by back warp lifted over a face pick. *Loom-made tapestries and figured repps* form another section of Group 2. As compared with true tapestries, the loom-made articles have more limited colour schemes, and their figured effects may be obtained from warp as well as weft, whether interlaced to form a plain face or left floating more or less loosely. Every weft thread, in passing from selvage to selvage, is taken to the surface where required, the other portions being bound at the back. Some specimens are reversible, others are one-sided, but, however numerous the warps and wefts, only one texture is produced. When an extra warp of fine material is used to bind the wefts firmly together a plain or twill weave shows on both sides. If a single warp is employed, two or more wefts form the figure, and the warp seldom floats upon the surface. Where warps do assist to form figure it rarely happens that more than three can be used without overcrowding the reed. Fig. 17 gives the design, and a transverse section of a reversible tapestry in four colours, two of which are warps and two wefts. If either warp or weft is on the surface, corresponding threads are beneath. The bent lines represent weft and the circles warp. In this design the marks indicate the colours showing on the surface of the cloth, and *not* the lifting of the warp. Thus, crosses show No. 1 warp on the surface, filled squares show No. 2 warp, dots show No. 1 weft and oblique marks No. 2 weft on the face of the fabric. Each vertical line of squares represents one thread of each warp and each horizontal line represents one thread of each weft. *Figured repps* differ from plain ones in having threads of one, or more than one, thick warp floated over thick and thin weft alike; or in having several differently coloured warps from which a fixed number of threads are lifted over each thick weft thread; the figure is due to colour.

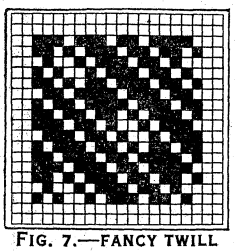


FIG. 7.—FANCY TWILL

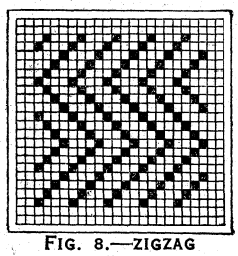


FIG. 8.—ZIGZAG

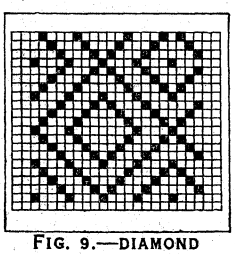


FIG. 9.—DIAMOND

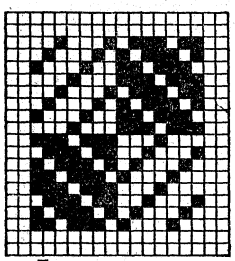


FIG. 10.—DIAPER

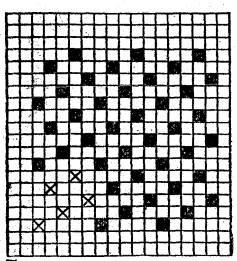


FIG. 11.—FIVE-THREAD SATEEN

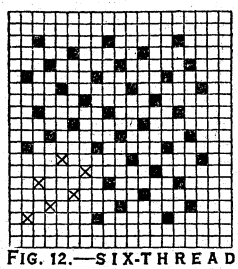


FIG. 12.—SIX-THREAD SATEEN

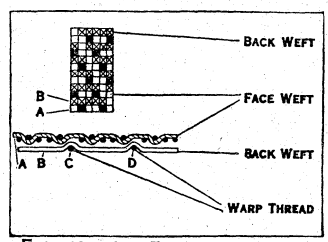


FIG. 13.—WEFT BACKED FABRIC

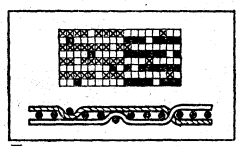


FIG. 14.—WEFT REVERSIBLE FABRIC

Group 3. Piled Fabrics.—In all methods of weaving hitherto dealt with the warp and weft threads have been laid in longitudinal and transverse parallel lines. In piled fabrics, however, portions of the weft or warp assume a position at right angles to the surface of the cloth. If the former there are two series of weft threads, one being intersected with the warp to form a firm ground texture, the other being bound into the ground at regular intervals, as in the design and transverse section of a velveteen, fig. 18; the circles and waved lines form plain cloth, and the loose thread A is a pile pick. After leaving the loom all threads A are cut by pushing a knife lengthwise between the plain cloth and the pile. As each pick is severed both pieces rise vertically and the fibres open out as at B. Since the pile threads are from two to six times as numerous as those of the ground, and rise from an immense number of places, a uniform brush-like surface is formed. Raised figures are produced by carrying the threads A beneath the ground cloth, where no figure is required, so that the

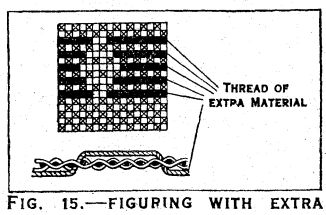


FIG. 15.—FIGURING WITH EXTRA WEFT

knife shall only cut those portions of the pile weft that remain on the surface. The effect upon the face varies with the distribution of the binding points, and the length of pile is determined by the distance separating one point from another. When *chenille* is used in the construction of figured weft-pile fabrics, it is necessary to employ two weaving operations, namely, one to furnish the chenille, the other to place it in the final fabric. Chenille is made from groups of warp threads that are separated from each other by considerable intervals; then, multi-coloured wefts are passed from side to side in accordance with a predetermined scheme. This fabric is next cut midway between the groups of warp into longitudinal strips, and, if reversible fabrics such as table-covers and curtains are required, each strip is twisted axially until the protruding ends of weft radiate from the core of warp, and form a cylinder of pile. In the second weaving this chenille is folded backward and forward in a second warp to lay the colours in their appointed places and pile projects on both sides of the fabric. If chenille is intended for carpets, the ends of pile weft are bent in one direction and then woven into the upper surface of a strong ground texture. *Warp-piled fabrics* have at least two series of warp threads to one of weft, and are more varied in structure than weft-piled fabrics, because they may be either plain or figured, and have their surfaces cut, looped or both. *Velvets and plushes* are woven single and double. In the former case both ground and pile warps are intersected with the weft, but at intervals of two or three picks the pile threads are lifted over a wire, which is subsequently withdrawn; if the wire is furnished with a knife at its outer extremity, in withdrawing it the pile threads are cut, but if the wire is pointed a line of loops remains, as in terry velvet. Fig. 19 is the design and two longitudinal sections of a Utrecht velvet. The circles are weft threads, and the bent line is a pile thread, part of which is shown cut, another part being looped over a wire. The circles are repeated to show how the ground warp intersects the weft. In the design the filled squares show the pile warp lifted over the wires. *Double plushes* consist of two distinct ground textures which are kept far enough apart to ensure the requisite length of pile. As weaving proceeds the pile threads are interlaced with each series of weft threads, and passed from one to the other. The uniting pile material is next severed midway between the upper and lower textures, and two equal fabrics result. Fig. 20 gives three longitudinal sections of a double pile fabric. The circles A, B are weft threads in the upper and lower fabrics respectively; the lines that interlace with these wefts are pile warp threads which pass vertically from one fabric to the other. At C, D the circles are repeated to show how the ground warps intersect the wefts, and at E the arrows indicate the cutting point. *Figured warp-pile fabrics* are made with regular and irregular cut and looped surfaces. If regular, the effect is due to colour, and this again may be accomplished in various ways, such as (*a*) by knotting tufts of coloured threads upon a warp, as in Eastern carpets; (*b*) by printing a fabric after it leaves the loom; (*c*) by printing each pile thread before placing it in a loom, so that a pattern shall be formed simultaneously with a pile surface, as in tapestry carpets; (*d*) by providing several sets of pile threads, no two of which are similar in colour; then, if five sets are available, one-fifth of all the pile warp must be lifted over each wire, but any one of five colours may be selected at any place, as in Brussels and Wilton carpets. Fig. 21 is a longitudinal section of a Brussels carpet. The circles represent two tiers of weft, and the lines of pile threads, when not lifted over a wire to form loops, are laid between the wefts; the ground warp interlaces with the weft to bind the whole together. When the surface of a piled fabric is irregular, also when cut and looped pile are used in combination, design is no longer dependent upon colour, for in the former case pile threads are only lifted over wires where required, at other places a flat texture is formed. In the latter case the entire surface of a fabric is covered with pile, but if the figure is cut and the ground looped the pattern will be distinct.

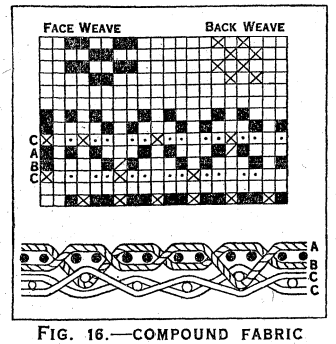


FIG. 16.—COMPOUND FABRIC

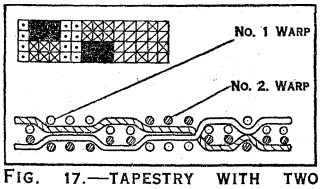


FIG. 17.—TAPESTRY WITH TWO WARPS AND TWO WEFTS

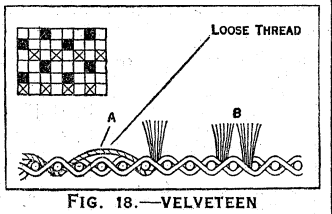


FIG. 18.—VELVETEEN

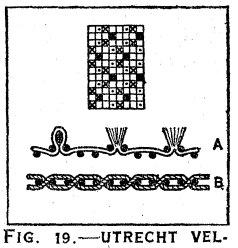


FIG. 19.—UTRECHT VELVET

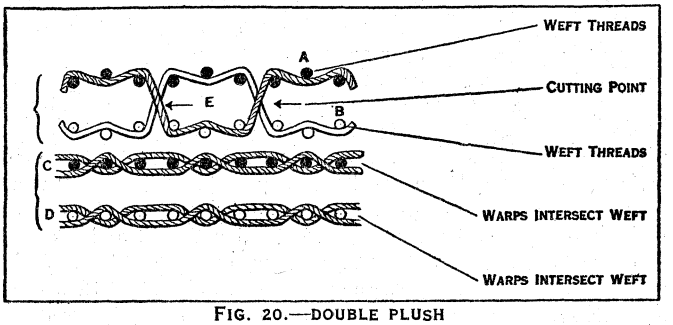


FIG. 20.—DOUBLE PLUSH

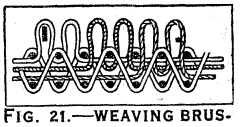


FIG. 21.—WEAVING BRUSSELS CARPET

Group 4. Crossed Weaving.—This group includes all fabrics, such as gauzes, in which the warp threads intertwist amongst themselves to give intermediate effects between ordinary weaving and lace. Also those, such as Lappets, in which some warp threads are laid transversely in a piece to imitate embroidery. *Plain gauze* embodies the principles that underlie the construction of all crossed woven textiles. In these fabrics the twisting of two warp threads together leaves large interstices between both warp and weft. But although light and open in texture, gauze fabrics are the firmest that can be made from a given quantity and quality of material. One warp thread from each pair is made to cross the other at every pick, to the right and to the left alternately, therefore the same threads are above every pick, but since in crossing from side to side they pass below the remaining threads, all are bound securely together, as in fig. 22, which shows a longitudinal section and also a plan of gauze. *Leno* is a muslin composed of an odd number of picks of a plain weave followed by one pick of gauze. In texture it is heavier than gauze, and the cracks are farther apart transversely. *Fancy gauze* may be made in many ways, such as (*a*) by using crossing threads that differ in colour or count from the remaining threads, provided they are subjected to slight tensile strain; (*b*) by causing some to twist to the right, others to the left simultaneously; (*c*) by combining gauze with another weave, as plain, twill, satin, brocade or pile;

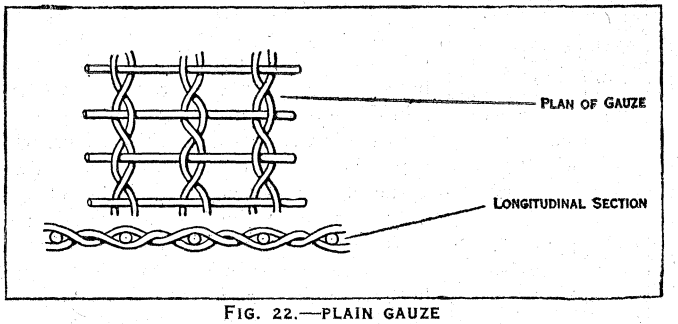


FIG. 22.—PLAIN GAUZE

(*d*) by varying the number of threads that cross, and by causing those threads to entwine several ordinary threads; (*e*) by passing two or more weft threads into each crossing, and operating any assortment of crossing threads at pleasure.

Lappet weaving consists in diapering the surface of a plain or gauze fabric with simple figures. This is done by drawing certain warp threads into a transverse position and then lifting them over a thread of weft to fix them in the texture, after which they are moved in the opposite direction and lifted over the following pick, the cloth being generally woven with the face side down. The material between one binding point and another must float loosely, and this limits the usefulness of lappet figuring. In fig. 23 the thick lines show a lappet spot upon a plain texture.

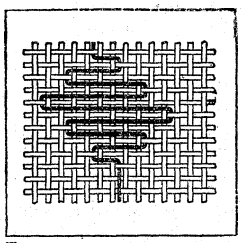


FIG. 23.—LAPPET FABRIC

Notwithstanding diverse structure, intricate machines are not essential to the production of either simple or complex textures; the most elaborate and beautiful specimens of the weaver's art have been manufactured upon simple machinery.

WEAVING MACHINERY

The longitudinal threads of a fabric are called warp, caine, twist and organzine, and the transverse threads are weft, shoot, woof, filling and tram. A loom for weaving these threads into cloth must provide for: (1) Shedding, *i.e.*, raising and lowering the warp threads in a predetermined sequence so as to form two lines between which the weft may be passed. (2) Picking, or placing lines of weft between the divided warp. (3) Beating-up, or striking each weft thread into its appointed position in the fabric. (4) Letting-off, or holding the warp tense and delivering it as weaving proceeds. (5) Taking-up, or drawing away the cloth as manufactured. (6) Temples, for stretching the fabric widthwise in order to prevent the edge threads of a warp from injuring the reed, and from breaking. Fig. 24 illustrates these operations. Shedding is generally done by controlling the warp threads by eyed healds, which are lifted or lowered to form the shed. The weft is inserted by the shuttle after the shed has been formed, and beating-up is done by the reed which is moved forward by the slay or batten. Intermittently driven rollers take up the cloth and a frictional drag, applied to the warp beam by a weighted rope or chain, regulates the let-off and warp tension. Power looms require the above-named contrivances to act automatically; and, in addition, (7) a weft-fork, to stop the loom when the weft

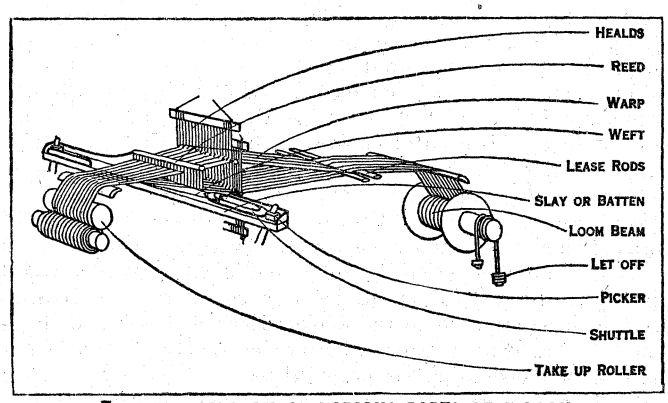


FIG. 24.—DIAGRAM OF VARIOUS PARTS OF A LOOM

becomes exhausted or breaks. (8) Mechanism for stopping the loom when the shuttle fails to reach its appointed box. (9) For weaving cross stripes, multiple shuttle boxes are needed to bring different colours, or counts of weft, into use at the proper time. (10) In some looms a device for automatically ejecting a spent cop, pirn or shuttle, and inserting a full one is requisite. (11) If a weaver has to attend to a greater number of looms than usual, a device for stopping the loom when a warp thread fails is essential. In addition to the loom itself, weaving machinery includes preparatory machines required to get the warp and sometimes the weft threads ready for the loom. Warp thread—or rather yarn—generally requires re-winding from the spinning frame bobbins or cops on to larger bobbins; warping a number of these yarns side by side on to a beam or into an untwisted rope; sizing the yarn to lay projecting fibres and to strengthen the

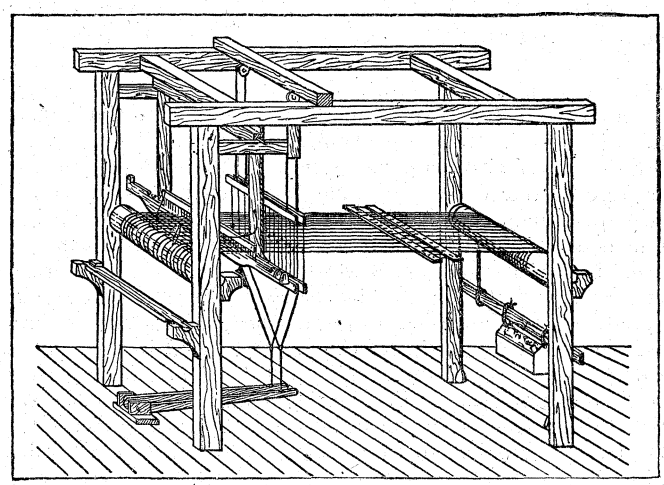


FIG. 25.—DIAGRAM OF HAND LOOM

yarn for weaving; finally, winding the sized yarn on to the loom beam and getting it ready for weaving in the loom.

The Hand-loom.—During the 17th and the first half of the 18th century it was observed that wherever any branch of the textile industry had been carried to a high state of excellence the looms used to manufacture a given fabric were similar in essentials, although in structural details they differed greatly. Prior to the invention of the fly shuttle by John Kay, in 1733, no far-reaching invention had for generations been applied to the hand-loom, and subsequently the Jacquard machine and multiple shuttle boxes represent the chief changes. A hand-loom as used in Europe at the present time (*see* fig. 25) has the warp coiled evenly upon a beam whose gudgeons are laid in open steps formed in the loom framing. Two ropes are coiled round this beam, and weighted to prevent the warp from being given off too freely. From the beam the threads pass alternately over and under two lease rods, then separately through the eyes of the shedding harness, in pairs between the dents of a reed, and finally they are attached to a cloth roller. For small patterns healds are used to form sheds, but for large ones a Jacquard machine is required. Healds may be made of twine, of wire or of twine loops into which metal eyes, called mails, are threaded. But they usually consist of a number of strings which are secured above and below upon wooden laths called shafts, and each string is knotted near the middle to form a small eye. From two to 24 pairs of shafts may be employed, but the healds they carry must collectively

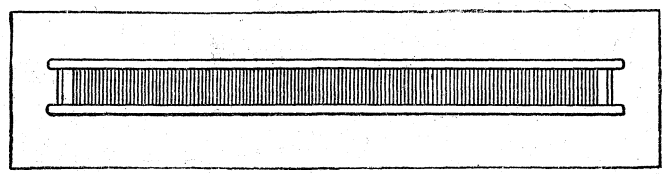


FIG. 26.—WEAVER'S REED

The warp threads are passed, generally in pairs or threes, through the dents or spaces between the reed wires

equal the number of threads in the warp. These healds will be equally or unequally distributed upon the shafts according to the nature of the pattern to be woven, and the threads will be drawn through the eyes in a predetermined order. The upper shafts are suspended from pulleys or levers, and the lower ones are attached directly or indirectly to treadles placed near the floor. The weaver depresses these treadles with his feet in a sequence suited to the pattern and the scheme of drawing the warp through the healds. When the treadle is pressed down, at least one pair of shafts will be lifted above the others, and the warp threads will ascend or descend with the healds to form a shed for the shuttle to be

passed through (*see* SHUTTLE). The reed (fig. 26) is the instrument by which weft is beaten into position in the cloth; it also determines the closeness of the warp threads, and guides a moving shuttle from side to side. It is made by placing strips of flattened wire between two half round ribs of wood, and binding the whole together by passing tarred twine between the wires and round the ribs. Such a reed is placed in the lower portion of a batten, which is suspended from the upper framework of the loom. In front of the reed, and immediately below the warp, the projecting batten forms a race for the shuttle to travel upon from side to side. Before Kay's invention a shuttle was thrown between the divided warp and caught at the opposite selvage, but Kay continued the projecting batten on both sides of the warp space and constructed boxes at each end. Over each box he mounted a spindle and upon it a driver, or picker. Bands connected both pickers to a stick which the weaver held in his right hand, while with the left hand he controlled the batten. A treadle is pressed down by one foot to form a shed; the batten is pushed back till a sufficient portion of the shed is brought in front of the reed and the depressed threads lie upon the shuttle race; a clear way is thus provided for the shuttle. A quick movement of the stick tightens the cord attached to a picker and projects the shuttle from one box to the other. The batten is now drawn

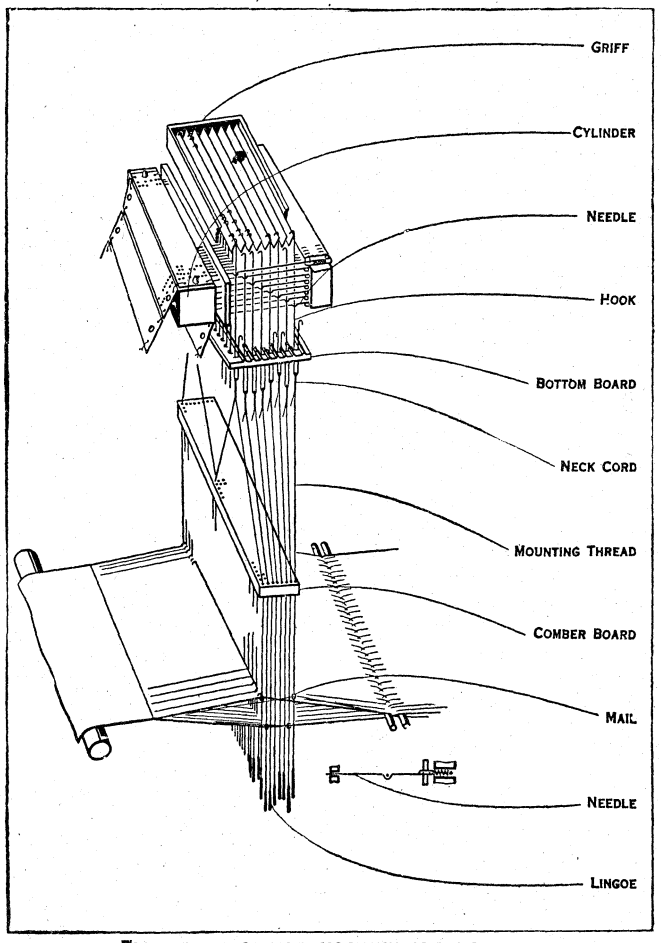


FIG. 27.—JACQUARD MACHINE AND HARNESS
This method of shedding is required for the production of all fabrics ornamented by woven floral designs

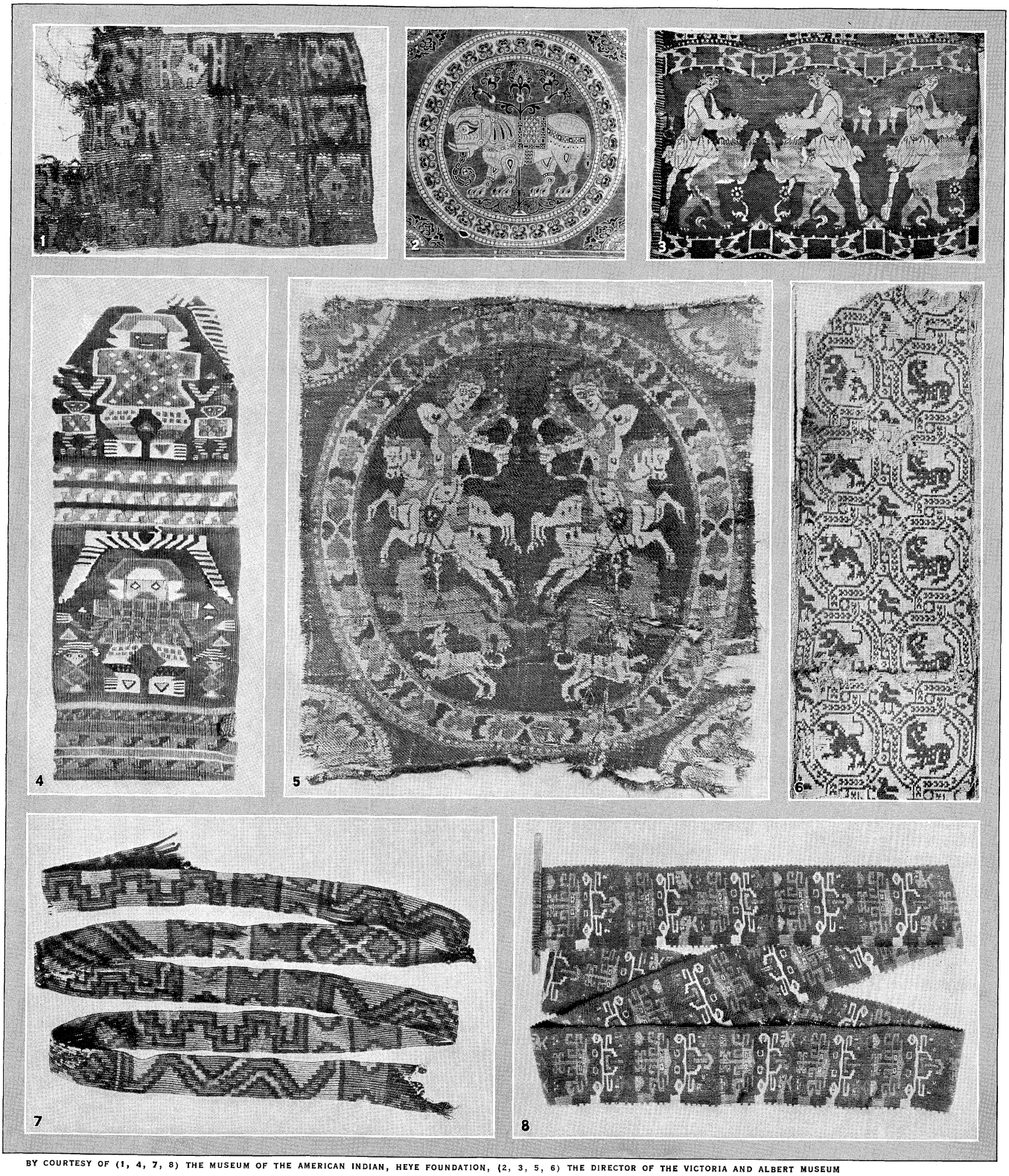
forward, and the reed beats up the weft left by the shuttle. As the next treadle is depressed to form another division of the warp for the return movement of the shuttle, the last length of weft is enwrapped between intersecting warp threads, and the remaining movements follow in regular succession.

In cases where the weft forms parti-coloured stripes across a fabric, also where different counts of weft are used, shuttles, equal in number to the colours, counts or materials, must be provided. By Robert Kay's invention of multiple shuttle boxes, in 1760, much of the time lost through changing shuttles by hand was prevented. His drop boxes consist of trays formed in tiers and fitted into the ordinary shuttle boxes. Each tray is capable of holding a shuttle, and by operating a lever and plug with the forefinger and thumb of the left hand the trays may be raised and lowered at pleasure to bring that shuttle containing the colour next needed into line with the picker.

The Draw Loom.—Large figured effects were formerly produced in draw looms, where the warp threads were so controlled by separate strings that any assortment could be lifted when required. To the lower end of each string a dead weight, called a lingoe, was attached, and a few inches above the lingoe a mail was fixed for the control of a warp thread. The strings passed through a comber board which held the mails and warp threads facing the proper reed dents. Still higher up, groups of strings were connected to neck cords; each group consisted of all strings required to rise and fall together constantly. If, for example, in the breadth of a fabric there were 12 repeats of a design, 12 strings would be tied to the same neck cord, but taken to their respective places in the comber board These parts of a draw loom harness are clearly shown in fig. 27 which represents a Jacquard machine and harness. Each neck cord, after being led through the perforated bottom board and over a grooved pulley, was threaded through a ring on the top of a vertical cord called the simple, and passed horizontally to, and tied upon, a bar rigidly fixed near the ceiling of the weaving room. The simple cords were similarly attached to a bar placed near the floor. From one hundred to several thousands of neck and simple cords could be used in one harness. The design to be reproduced in cloth was read into the parallel lines of the simple by looping a piece of string round each cord that governed warp threads to be lifted for a given shed; after which all the loops were bunched together. By pulling at a bunch of loops the simple cords were deflected and they caused all warp threads controlled by them to be lifted above the level of those undisturbed. Similar bunches of loops were formed for every shed required for one repeat of a design, and they were pulled in succession by the draw-boy, while the weaver attended to the batten and picking.

The Jacquard Machine.—This is the most important invention ever applied to the hand-loom, but it is not the work of one man; it represents the efforts of several inventors whose labours extended over three-quarters of a century. This apparatus has taken the places of the simple, the loops, the pulleys and the draw-boy of the older shedding motion, but other parts of the harness remain unchanged. In 1725 Basile Bouchon substituted for the bunches of looped string an endless band of perforated paper by which the simples for any shed could be selected. In 1728 M. Falcon constructed the machine since known as the Jacquard and operated it through the medium of perforated cards, but it was attached to the simple cords and required a draw-boy to manipulate it. In 1745 Jacques de Vaucanson united in one machine Bouchon's band of paper and the mechanism of Falcon. He placed this machine where the pulley box previously stood, and invented mechanism for operating it from one centre.

In a Jacquard machine the warp threads are raised by rows of upright wires called hooks (fig. 27). These are bent at both extremities and are normally supported upon a bottom board which is perforated to permit the neck cords from the harness beneath to be attached to the hooks. Each of a series of horizontal needles—one of which is shown enlarged and detached at the foot of the drawing—is provided with a loop and a crank; the former to permit of a to-and-fro movement, the latter to receive a hook. The straight ends of the needles protrude about one-quarter of an inch through a perforated needle board, but the looped ends rest upon bars placed in tiers. A wire passed through all the loops of the needles which form one vertical line limits the extent of their lateral movement, and small helical springs impinge upon the loops of the needles with sufficient force to press them and their hooks forward. A frame called a griff, is made to rise and fall vertically by a treadle which the weaver actuates with one foot. This frame contains a blade for each line of hooks, and when the blades are in their lowest position the hooks are free and vertical with their heads immediately over



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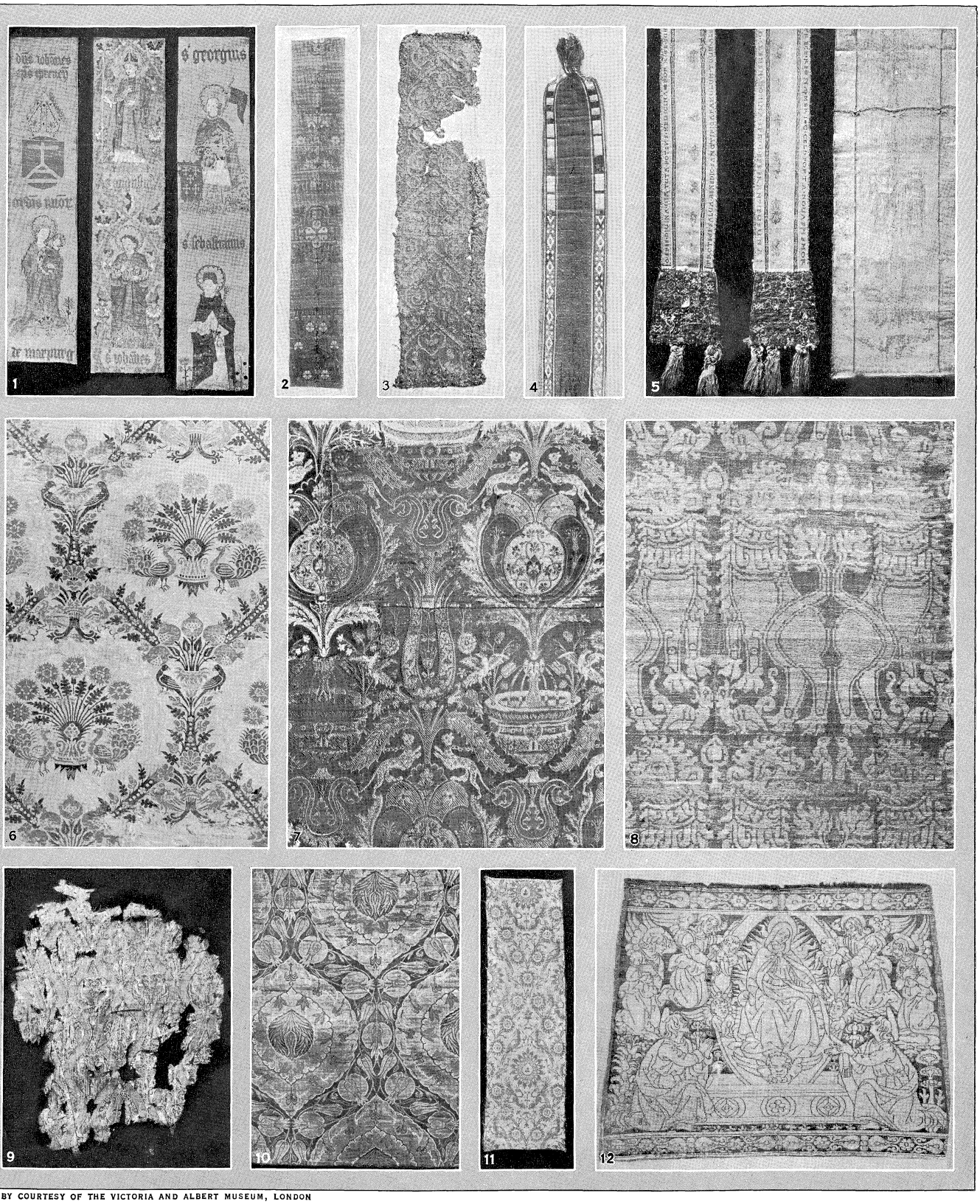
SPECIMENS OF ANCIENT WEAVING

1. Fragment of fabric woven by the Incas. Taken from a grave in Pachacamac, Peru. 2. Portion of the silk wrapping of tomb of Charlemagne with fanciful elephant and sacred tree device in a roundel. Possibly of Baghdad manufacture, 9th century. 3. Syrian or Anatolian silk weaving of the 5th century depicting Samson slaying the lion. 4. Inca woven fabric with figures of persons. Discovered in an ancient grave in Ancon, Peru. 5. Syrian or Persian silk weaving of the 5th century, showing mounted hunters engaged in the chase. 6. Syrian and Coptic flax weaving of the 5th or 6th century. Discovered at Akhmin, upper Egypt. 7. Long narrow strip of Inca fabric with typical design found in a grave in the Nasca valley. 8. A wider strip of Inca woven fabric that was also discovered in one of the Nasca valley graves

WEAVING



BY COURTESY OF THE VICTORIA AND ALBERT MUSEUM, LONDON

EXAMPLES OF MEDIAEVAL WEAVING

1. Cologne orphreys woven in silk and gold threads. Faces of the Virgin and Child are embroidered, (1425–1450). 2. Another specimen of Cologne orphrey also woven with gold and silk threads and bearing Latin inscriptions, late 15th century. 3. Part of a narrow band with chevron spaces filled with delicate scroll ornament. Woven in silk and gold thread, 13th century. 4. Portion of Clavus or narrow band from a Coptic tunic of the 9th or 10th century. 5. (Left) German late 12th or early 13th century orphrey woven in gold and silk threads with Latin inscription along the edges. (Right) part of broad band or orphrey woven in gold and silk threads and bearing figures of the Crucifixion and Annunciation. German work of the 13th century. 6. Italian damask or brocade silk fabric of 15th century manufacture. 7. Example of Venetian silk weaving. Design shows Ottoman influence, 16th century. 8. Byzantine weaving, 11th century. Red silk and gold thread used. 9. Fragment of Byzantine silk of the 12th century. 10. Ottoman silk and gold thread weaving of the 16th century, with ogival framed ornament. 11. Piece of north Italian silk weaving, 14th century, pattern planned on original basis with fantastic birds. Cone forms contain sham Arabic inscriptions. 12. Apparel of a Dalmatic woven in Venice late in 15th century. The pattern depicts the Virgin in glory

the blades, hence an upward movement given to the griff would lift all the hooks and thereby all the warp threads. Only certain hooks, however, must be lifted with the griff, and the selection is made by a quadrangular block of wood, called a cylinder, and cards which are placed upon it. Each face of the cylinder has a perforation opposite each needle, so that if the cylinder be pressed close to the needle board the needle points will enter the holes in the cylinder and remain undisturbed. But if a card, which is not perforated in every possible place, is interposed between the cylinder and the needles, the unpunctured parts of the card close up some of the holes in the cylinder and prevent corresponding needles from entering them. Each needle so arrested is thrust back by the advancing card; its spiral spring is contracted and its hook is tilted. If at this instant the griff ascends, its blades will engage the heads of all vertical hooks and lift them, but those that are tilted will remain unlifted. So soon as the pressing force of a card is removed from the needles the springs restore both needles and hooks to their normal positions. Cards are perforated by special machinery from a painted design, after which they are laced into a chain and passed over conical pegs upon the cylinder; the number required to weave any pattern equals the number of weft threads in that pattern. The cylinder is generally drawn out and turned by each upward movement of the griff, and restored to the needles by each downward movement, so that each face in succession is presented to the needles, and each rotatory movement brings forward a fresh card. As the griffe rises with vertical hooks a shed is formed, and a thread of weft is passed across the warp. The griff then descends and the operation is repeated but with a new combination of lifted threads for each card. A Jacquard may contain from 100 to 1,200 hooks and needles, and two or more machines may be mounted upon the same loom.

The Power-loom.—Little is known of the attempts made before the beginning of the 17th century to control all parts of a loom from one centre, but it is certain the practical outcome was inconsiderable. In the year 1661 a loom was set up in Danzig, for which a claim was made that it could weave four or six webs at a time without human aid, and be worked night and day; this was probably a ribbon loom. In order to prevent such a machine from injuring the poor people the authorities in Poland suppressed it, and privately strangled or drowned the inventor. M. de Gennes, a French naval officer, in 1678 invented a machine whose chief features consisted in controlling the healds by cams, the batten by cams and springs and the shuttle by a carrier. From 1678 to 1745 little of importance appears to have been done for the mechanical weaving of broadcloth, but in the last-named year M. Vaucanson constructed a very ingenious, self-acting loom, on which the forerunner of the Jacquard machine was mounted; he also adopted de Gennes' shuttle carrier.

During the last quarter of the 18th century it was generally believed that, on the expiry of Arkwright's patents, so many spinning mills would be erected as to render it impossible to consume at home the yarns thus produced, and to export them would destroy the weaving industry. Many manufacturers also maintained it to be impossible to devise machinery which would bring the production of cloth up to that of yarn. It was as a protest against the last-named assertions that Dr. Edmund Cartwright, a clergyman of the Church of England, turned his attention to mechanical weaving. More fortunate than his predecessors, he attacked the problem after much initial work had been done, especially that relating to mechanical spinning and the factory system, for without these no power-loom could succeed. In 1785 Dr. Cartwright patented his first power-loom, but it proved to be valueless. In the following year, however, he patented another loom which has served as the model for later inventors to work upon. He was conscious that for a mechanically driven loom to become a commercial success either one person would have to attend several machines or each machine must have a greater productive capacity than one manually controlled. The thought and ingenuity bestowed by Dr. Cartwright upon the realization of his ideal were remarkable. He added parts which no loom, whether worked manually or mechanically, had previously been provided with, namely, a positive let-off motion and warp and weft stop motions; and he planned to size the warp while the loom was in action. With this machine he commenced to manufacture fabrics at Doncaster, and by so doing discovered many of its shortcomings, and these he attempted to remedy: by introducing a crank and eccentrical wheels to actuate the batten differentially; by improving the picking mechanism; by a device for stopping the loom when a shuttle failed to enter a shuttle box; by preventing a shuttle from rebounding when in a box; and by stretching the cloth with temples that acted automatically. In 1792 Dr. Cartwright obtained his last patent for weaving machinery. This provided the loom with multiple shuttle boxes for weaving checks and cross-stripes. But all his efforts were unavailing, and it became apparent that no mechanism, however perfect, could succeed so long as warps continued to be sized while a loom was stationary. His plans for sizing them while a loom was in operation, and also before being placed in a loom, both failed. Still, provided continuity of action could be attained, the position of the power-loom was assured, and means for the attainment of this end were supplied in 1803 by William Radcliffe and his assistant, Thomas Johnson, by their inventions of the beam warper and the dressing sizing machine.

For upwards of 30 years the power-loom was worked under numerous difficulties. The mechanism of the loom itself, the preparatory processes and the organization of the industry were all imperfect. Textile workers were unused to automatic machinery, and many who had been accustomed to labour in their own homes refused employment in mills, owing to dislike of the factory system and the long hours of toil which it entailed. Yet improvements in every branch of the textile industry followed each other in quick succession, and the loom slowly assumed its present shape. By using iron instead of wood in its construction, and centring the batten, or slay, below instead of above the warp line, the power loom became more compact than the hand-loom.

In the modern power-loom (figs. 28 and 29), motion is communicated to all the working parts from a main shaft A, upon which two cranks are bent to cause the slay to oscillate; by toothed wheels this shaft drives a second shaft, C, at half its own speed. For plain weaving four tappets are fixed upon the second shaft—two, D, for moving the shuttle to and fro, and two others, E, for moving the healds, L, up and down through the medium of treadles M, M. For other schemes of weaving shedding tappets

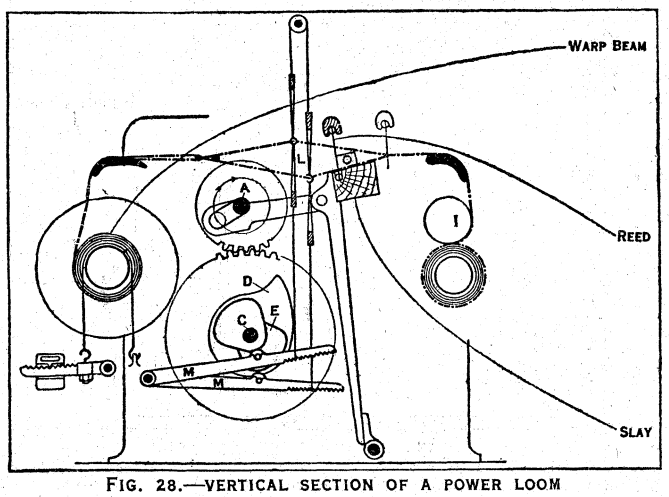


FIG. 28.—VERTICAL SECTION OF A POWER LOOM

are more numerous, and are either loosely mounted upon the second shaft or fixed upon a separate one. In either event they are driven by additional gearing, for the revolutions of the tappets to those of the crank shaft must be as one is to the number of picks in the repeat of the pattern to be woven. The warp beam is often put under the control of chains instead of ropes, as used in hand looms, and the chains are attached to adjustably weighted levers, whereby the effectiveness of the weights may be varied at pleasure. In the manufacture of heavy fabrics, however, it may be necessary to deliver the warp by positive gearing, which is either

connected, or otherwise, to the taking-up motion. The cloth is drawn forward regularly as it is manufactured by passing it over the rough surface of a roller, I, and imparting to the roller an intermittent motion each time a pick of weft is beaten home. This motion is derived from the oscillating slay, and is communicated through a train of wheels. The loom is stopped when the weft fails by a fork-and-grid stop motion, which depends for its action on the lightly balanced prongs of a fork, N. These prongs come in contact with the weft, between the selvage of the web and the shuttle box each time the shuttle is shot to the side at which the apparatus is fixed. If the prongs meet no thread they are not depressed, and being unmoved a connection is formed with a vibrating lever by which the loom is stopped. On the other hand, if the prongs are tilted, the loom continues in action. If more than one shuttle is used it may be necessary to feel for each, instead of alternate threads of weft. In such cases a fork is placed beneath the centre of the cloth and lifted above a moving shuttle; if in falling it meets with weft it is arrested and the loom continues in motion, but if the weft is absent the prongs fall far enough beneath the shuttle race for a stop to act upon a lever and bring the loom to a stand. To prevent a complete wreck of the warp it is essential to arrest the loom when a shuttle fails to reach its appointed box. For this purpose there are two devices, which are known respectively as fast and loose reed stop motions. The first was invented in 1796 by Robert Miller, and its action depends upon the shuttle, as it enters a box, raising two blades, K, which if left down would strike against stops and so disengage the driving gear. The second was invented in 1834 by W. H. Hornby and William Kenworthy; it is an appliance for liberating the lower part of a reed when a shuttle remains in the warp, thus relieving it, for the time being, of its function of beating up the weft. On the release of a reed from the motion of the slay a dagger stops the loom. Temples must keep a fabric distended to the breadth of

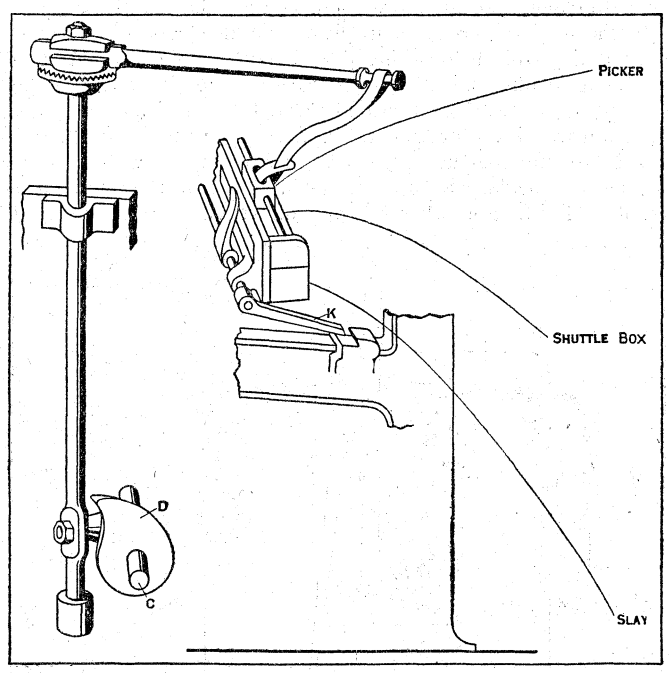


FIG. 29.—PICKING PARTS OF POWER LOOM
The illustration shows the cone overpick motion, the type generally used on the cotton looms of Lancashire and the jute looms of Dundee

the warp in the reed, and be self-adjusting. This is usually accomplished by small rollers whose surfaces are covered with fine, closely set points. The rollers are placed near the selvages of a web which is prevented from contracting widthwise by being drawn tightly over the points.

Looms are varied in details to suit different kinds of work, but as a rule fabrics figured with small patterns are provided with healds for shedding as at L, while those with large patterns are provided with the Jacquard and its harness. Healds may be operated either by tappets or dobbies, but the range of usefulness in tappets is generally reached with 12 shafts of healds and with patterns having 16 picks to a repeat; where they are unsuitable for heald shedding a dobby is used. A dobby may resemble, in construction and action, a small Jacquard; if so the selection of healds that rise and fall for any pick is made by cards. In other types of dobbies the selection is frequently made by lags, into which pegs are inserted to pattern in the same manner that cards

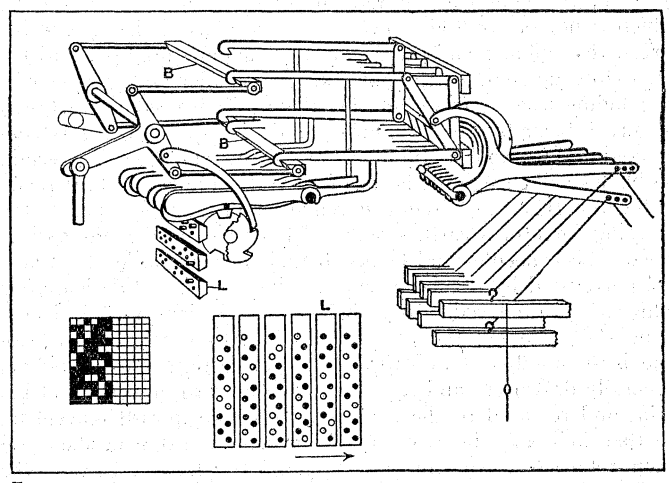


FIG. 30.—DOBBY SHEDDING MOTION, WIDELY USED FOR LIGHT CLOTHS REQUIRING SMALL PATTERNS, AS STRIPED SHIRTINGS AND DRESS FABRICS

are perforated. A dobby of this type is illustrated in fig. 30, which shows detached the pegging of the pattern lags for a small design, filled in circles representing pegs. The pattern lags, L, act on levers which lower hooks into contact with the oscillating griff bars B, and these lift the required heald shafts. The figure shows a double acting dobby, one lag, with two rows of pegs, serving for two picks. Some dobbies are made single acting and some have rollers instead of pegs to form a pattern. When multiple shuttles are required for power looms one of two types is selected, namely, drop or rotating boxes; the former are applicable to either light or heavy looms, but the latter are chiefly confined to light looms. As previously stated, Robert Kay invented drop boxes in 1760, but they were not successfully applied to the power-loom until 1845, when Squire Diggle patented a simple device for operating them automatically. Since his time many other methods have been introduced, the most successful of these being operated indirectly from the shedding motion. Revolving boxes were patented in 1843 by Luke Smith.

Many devices have been added to power looms with a view to reduce stoppages, among which those for the automatic supply of weft are probably the most important. These efforts originated with Charles Parker, who in 1840 obtained the first patent, but no marked success was achieved until 1894, when J. H. Northrop patented a cop changer. By his plan a cylindrical magazine, placed over one shuttle box, is charged with cops or pirns. When fresh weft becomes necessary the lowest cop in the hopper is pressed into a shuttle from above, the spent one is pressed out from beneath and the new weft is led into the shuttle eye, while the loom is moving at its normal speed. The mechanism is controlled by the weft fork, or by a feeler which acts when only a predetermined quantity of weft remains inside a shuttle. Many inventions are designed to eject an empty shuttle and introduce a full one; others change a cop, but differ in construction and action from the Northrop. By relieving a weaver of the labour of withdrawing, filling, threading and inserting shuttles it was seen that a large increase might be made in the number of looms allotted to one weaver, provided suitable mechanism could be devised for stopping a loom on the failure of a warp thread and for automatically maintaining a constant tension on the warp. With these devices as many as 100 looms have been supervised by one weaver.

Warp stop motions date from 1786, when Dr. Cartwright suspended an independent detector from each warp thread until a fracture occurred, at which time a detector fell into the path of a vibrator and the loom was stopped. The demand for warp stop

motions was, however, small until automatic weft supply mechanisms were introduced, and the majority of those devices now in use are constructed upon similar lines to the invention of Dr. Cartwright.

Smallware Looms.—A loom, which was for a long period operated manually, but to which mechanical power could be applied, was brought into use more than a century before Dr. Cartwright's invention. It was known as the Dutch engine loom, and was designed to weave from eight to upwards of 40 tapes or ribbons simultaneously. This machine may be regarded as a series of looms mounted in one frame, each having a complete set of parts, and as the first practical effort to connect and control all the motions of weaving from one centre. The place and date of its invention are uncertain, but it is known that in some districts its use was entirely prohibited, that in others it was strictly limited, and that it was worked in Holland about 1620. In England the first patent was obtained by John Kay and John Snell, in 1745, for additions which enabled it to be worked by hand, by water, or other force, and in 1760 John Snell appears to have added the draw harness for weaving flowered ribbons. In 1765 a factory in Manchester was filled with ribbon looms which were either invented by M. Vaucanson, or Kay and Snell, but one weaver could only attend to one machine. When worked by hand it was known as the bar-loom, because the weaver oscillated by hand a horizontal bar that set in motion all parts of the machine. The shuttles and reeds are actuated from the batten, the former originally by pegs, but later by a rack and pinion arrangement, which in action shoots the shuttles simultaneously across a web, to the right and left alternately, each into the place vacated by its next neighbour. One small warp beam is required for each web, but tappets, dobbies, or Jacquards are available for dividing the threads. Where differently coloured wefts are needed in one web the shuttles are mounted in tiers and all raised or lowered at once to bring the proper colour in line with the shed.

In *Swivel weaving*, shuttles, similar to those described above, are added to the battens of broad looms in order to diaper small figure effects, in different colours or materials, over the surface of broad webs. Weft from an ordinary shuttle forms the ground texture with the warp, and after the passage of this shuttle the small swivel shuttles place the figuring weft where required on the surface of the fabric.

Pile Weaving.—Looms for weaving piled fabrics differ in certain important respects from those employed for ordinary weaving; they are also made to differ from each other to suit the type of fabric to be manufactured, as, for example, double and single, plain and figured, textures. In *Double pile looms* the special features are those that control the pile threads and those that sever the vertical lines of pile. Two ground warps are required, and unless they are kept a uniform distance apart the piled effects will be irregular. For plain goods the pile threads are wound upon two or more beams, and as they move from web to web cloth-covered rollers deliver them in fixed lengths. Meanwhile, a shuttle passes twice in succession through each ground warp, and the pile threads in moving above or beneath the wefts are bound securely. Both fabrics are furnished with taking-up rollers which draw the pieces apart and so stretch the uniting pile in front of a knife, which severs it, thus forming two pieces at once.

The chief feature which renders most *single pile looms* dissimilar from others is the mechanism by which wires are woven upon, and withdrawn automatically from, a ground texture. Wires are of two kinds, namely, without and with knives. The former, being flattened and somewhat pointed, are woven above the weft of a ground texture, but beneath the pile, so that by withdrawing them looped pile is formed. A wire terminating in a knife with a sloping blade, on being withdrawn, cuts the pile and produces a brush-like surface. The mechanism for operating the wires is placed at one end of a loom and consists of an arm which moves in and out; at each inward movement a wire is inserted, and at each outward movement one is withdrawn. In weaving tapestry carpets, and certain other fabrics, a wire and a shuttle move simultaneously, but the shuttle passes through the ground warp, while the wire passes beneath the pile. After several wires have been woven upon the ground texture the one first inserted is withdrawn by the vibrating arm, and at the next inward movement the same wire enters the warp near the reed, where it is beaten up with the weft, and from this point the operation is continuous. Tapestry carpets require three warps, one for the ground texture, a second, or stuffing warp, to give bulk and elasticity to the tread, and a third to form the pile. The last named is printed upon a large drum, thread by thread to the colour-scheme of the design, then, when the colours have been fixed and the threads accurately placed, they are wound upon a beam, and all the warps are operated by healds. For figured velvets, and Brussels and Wilton carpets, the pile warp beam is replaced by a creel, in order that each thread of pile may be wound upon a bobbin and separately tensioned. This is essential, because, in the weaving of a design, it is probable that no two threads of pile will be required in equal lengths. Creels are made in sections called frames, each of which usually carries as many bobbins as there are loops of pile across a web, and the number of sections is the same as the number of colours. In weaving these fabrics healds are used to govern the ground warp, but a Jacquard is needed for the pile. It must form two sheds, the lower one to receive a shuttle, the upper one to make a selection of threads beneath which the wire is to pass.

Terry looms for weaving piled textures, of the Turkish towel type, have the reed placed under the control of parts that prevent it from advancing its full distance for two picks out of every series that separate one line of loops from another. At such times the weft is not beaten home but a broad crack is formed. So soon as the reed again moves through its normal space three picks of weft are simultaneously driven home, thus closing the gap and causing part of the pile to loop upward, the remainder downward. The system is available for plain and figured effects.

Gauze textures are woven in looms having a modified shedding harness, which, at predetermined intervals, draws certain warp threads crosswise beneath others and lifts them while crossed. There is also a tensioning device to slacken the crossed threads and thus prevent breakages due to excessive strain. At other times the shedding is normal.

Lappet looms have a series of needles fixed upright in laths, and placed in a groove cut in the slay, in front of the reed. Each needle carries a thread which does not pass through the reed. The needles are lifted for each pick and lowered after the passage of the shuttle, which is guided, not by the reed but by a series of pins in front of the needles and lifted and lowered along with the latter. After being lowered the needles are moved sideways the width of the figure and again lifted for the next pick. The edges of the figure are bound in this way to the ground texture by the weft.

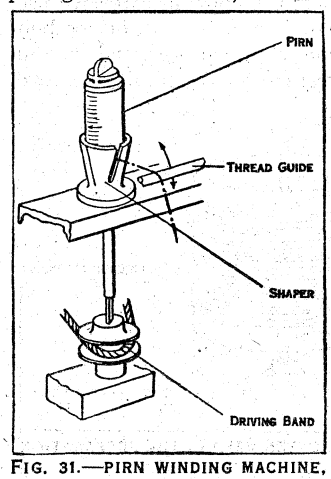


FIG. 31.—PIRN WINDING MACHINE, FOR WINDING COLOURED, AND SOMETIMES GREY, WEFT YARNS ON PIRNS FOR THE LOOM SHUTTLE

Preparing Warp and Weft for Weaving.—The power loom is only one of a series of machines which revolutionized weaving. Although early inventors of the power loom did much to perfect its various movements, the commercial results were disappointing, chiefly because means had not been devised for preparing warp and weft in a suitable manner for such a machine. William Radcliffe, of Stockport, perceived these shortcomings, and concluded that, by division of labour, weaving could be brought into line with spinning machinery, then recently invented. He therefore set himself the task of solving the problems involved, and by inventing the beam warper, the dressing sizing machine, the shuttle tongue, and the pin cop, he enabled the power loom to become a factor in the textile industry.

Weft yarns invariably receive simpler treatment than warp

yarns; in many cases none at all. Cops and ring spools pass direct to the loom unless their dimensions are unsuited to the shuttles, in which case they, together with wefts bleached or dyed in hanks or used in a saturated condition, require winding upon pirns, or into cops of suitable sizes. Weft for use with automatic weft supply mechanism is frequently re-wound on to pirns, which hold much more than the cops or ring spools. This reduces the number of changes, lengthens the life of the changing mechanism and makes less work for the magazine fillers.

Pirn winders differ greatly in construction but a common type is illustrated in fig. 31. The spindles are driven at constant speed and the pirn is built up by the accumulation of yarn inside the shaper cup. The rubbing of the yarn against the cup is a disadvantage, and many winders have shapers which reduce rubbing to a minimum. These machines generally have horizontal spindles, running at constant speed, but often the speed is varied to keep constant rate of winding on to the varying diameter of the pirn.

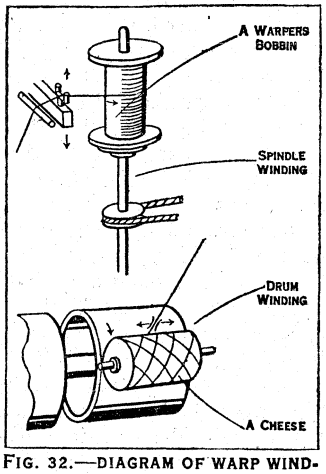


FIG. 32.—DIAGRAM OF WARP WINDING PROCESS

Warp winding consists in transferring yarn from cops, ring spools or hanks, either to warpers, bobbins or cheeses. Machines for this purpose are of two kinds, which are known respectively as spindle and drum winders (fig. 32). In the former each bobbin is placed upon a vertical spindle and rotated by frictional contact; a yarn guider meanwhile rises and falls far enough to lay the threads in even coils between the bobbin flanges. In the latter each bobbin, or tube, is laid upon a rotating drum and a thread guide moves laterally to and fro, slowly for a bobbin but quickly for a tube.

Warping.—Number of longitudinal threads in a web varies according to their closeness and its breadth. It is the function of a warper to provide a sufficient number of parallel threads for a web, all of equal length, and to retain their parallelism. Warpers are of three types, viz., mill, beam and sectional.

Mill warping (fig. 33) is the oldest type now in extensive use. A mill warper has a creel in which from 50 to upwards of 300 bobbins or cheeses are supported horizontally upon pegs, and the mill has a vertical axis which carries a reel from 5 to upwards of 20yd.

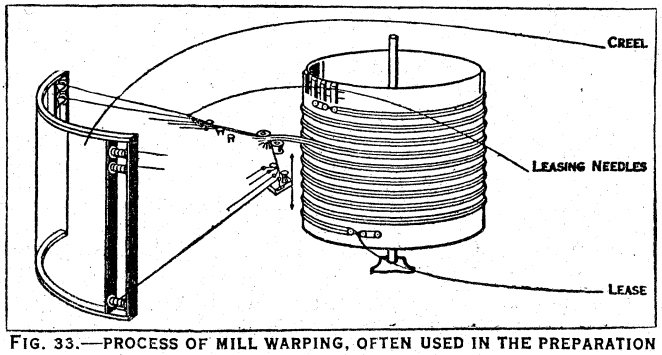


FIG. 33.—PROCESS OF MILL WARPING, OFTEN USED IN THE PREPARATION OF STRIPED COLOURED WARPS

in circumference. The threads from the creel are threaded in succession through leasing needles, then passed in groups of four to 20 threads between runners, and finally fastened by a peg to the mill staves. The needles are mounted alternately in two frames which may be lifted separately, one to elevate odd threads, the other even ones, and both separations thus formed are retained upon separate pegs; this is the lease which enables a weaver to fix readily the position of a broken thread. As the mill rotates the threads form a tape about 1in. wide, and the leasing apparatus slides down a post to coil the threads spirally upon the reel. When the full length of warp has been made the mill is stopped, a lease known as a half-beer lease is picked by hand from the divisions formed by the runners and is also retained upon pegs. The mill next reverses its direction of rotation, and as the leasing apparatus ascends the threads are folded back upon themselves. Hence, if a reel is 20yd. in circumference, and 200 threads are in use to make a warp 600yd. long, and containing 2,000 threads, the reel will

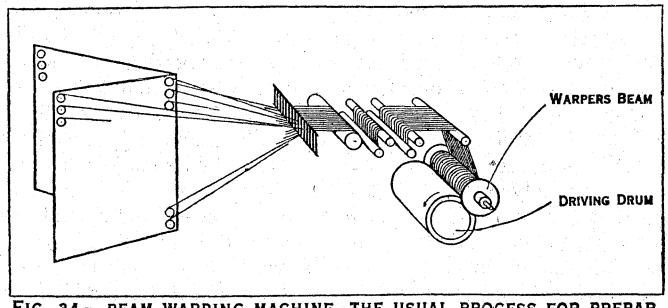


FIG. 34.—BEAM WARPING MACHINE, THE USUAL PROCESS FOR PREPARING THE WARP YARN FOR THE SLACKER SIZING MACHINE

make 30 revolutions ($600 \div 20 = 30$) and ten reversals, for at each reversal 200 additional threads will be added ($2{,}000 \div 200 = 10$).

Beam warping is the system most extensively used in the cotton trade. The creels for these machines have an average capacity of about 600 bobbins, and are often V-shaped in plan. In each leg of the V the bobbins are arranged in tiers of 16 to 20, and row behind row. The threads are drawn separately between the dents of an adjustable reed, then under and over a series of rollers; from here they are dropped amongst the teeth of an adjustable comb and led down to a warper's beam, which rests upon the surface of a drum. As the drum rotates the threads are drawn from the bobbins and wrapped in even coils upon the beam. On most of these machines mechanism is attached for arresting motion on the breaking of a thread, and also for accurately measuring and recording the lengths of warp made. When full, a warpers beam holds threads of much greater length than are needed for any warp, but they are insufficient in number. Thus, if 500 threads are in use, and warps of the above-named particulars are required, four similar beams must be filled ($2{,}000 \div 500 = 4$) and the threads from all are subsequently united. The chief parts of a beam warper may be used as a substitute for a mill warper, provided that mechanism be employed to contract the threads to the form of a loose rope and coil them into a cylindrical ball, which will be subsequently treated as a mill warp. Or, one of these warpers may be furnished with parts which link the roped threads loosely into a chain.

Sectional warping is chiefly employed for coloured threads and its outstanding features consist in contracting the threads to form a ribbon of from 3in. to 12in. wide. This ribbon is coiled upon a block placed between flanges, and when completed is set aside until a sufficient number of similar sections have been made; after which they are slipped upon a shaft and by endlong pressure converted into a compact mass. All the threads are then collected and transferred in the form of a sheet to a loom beam, each section contributing its own width to that of the warp. Sectional warps are also made upon horizontal mills by superposing the coils of a ribbon of yarn upon a portion of the staves. When the first section is formed a second is wound against it, and the operation continued until all the sections have been made; after which the yarn is run upon a loom beam.

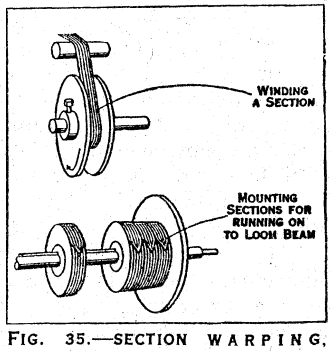


FIG. 35.—SECTION WARPING, SHOWING WARP YARN WOUND INTO SECTIONS (TOP), AND SECTIONS MOUNTED SIDE BY SIDE TO RUN YARN OFF ON LOOM BEAM (BOTTOM)

Yorkshire Dressing and Scotch Dressing.—These systems are used to make striped warps from balled warps which have been dyed in different colours. The operation of Yorkshire dress-

ing is as follows: The requisite number of threads of any colour is split from a uniformly dyed ball and set aside until warps of the remaining colours have been similarly treated. The split sections from the several balls collectively contain as many threads as are needed for a warp, but those threads have still to be placed in their proper sequence. This is done by drawing them in groups of two or four between the dents of a reed to a predetermined colour-scheme, then all are attached to a loom beam which is supported in a frame. The beam is rotated and winds the threads upon itself, but in order to hold the threads taut they are passed between weighted rollers and deflected by bars arranged ladder-wise, whilst in passing from one part of the machine to another they are gradually opened out to the width of the beam. Scotch dressing is an alternative system of making striped warps from dyed balled warps. Here, instead of being taken direct to the dressing frame, the required number of threads of each colour are first wound on to a beam. The threads from these differently coloured beams are then combined at the dressing frame and wound on to the loom beam according to the colour pattern, the yarn being wound on under considerable tension and the beam consolidated by a presser roller. This method gives a firmer beam than Yorkshire dressing, and the system is well suited to the preparation of several similar loom beams which can all be run from one set of coloured beams.

Sizing.—In cases where single yarns are made from short fibrous materials, smooth surfaces are obtained by laying outstanding ends of fibres upon the thread and fastening the fibres together to impart sufficient strength to resist the strains of weaving. This is accomplished either by coating the threads or by saturating them with an adhesive paste. In hand-loom days the paste was applied by brushes to successive stretches of warp while in a loom. But with the advent of mechanical weaving it was found necessary to size a warp before placing it in a loom. Two systems were evolved. One, invented by William Radcliffe, sizes, dries and beams a warp in one operation, the yarn being made to pass in the form of a sheet between a pair of rollers, the lower one being partly immersed in warm size. This roller carries upon its surface a film of size which it deposits upon the threads, while, by pressure, the upper roller distributes the size evenly. Brushes, acting automatically, smooth down the loose fibres and complete the distribution of size. As the yarn advances it is separated by reeds and lease rods, so that in passing over steam-chests and fans the moisture contained in the threads may be quickly evaporated. This machine is a duplex one, for the warpers beams are divided into two sets and placed at opposite ends of the machine, both sets receiving similar treatment as they move to the centre, where the loom beam is placed.

While efforts were being made to perfect Radcliffe's dressing machine a system of sizing ball warps was being gradually evolved and this system is still largely employed. The machine consists of a long trough, inside which a series of rollers are fitted, either in one horizontal plane or alternately in two horizontal planes, whilst over the front of the trough a pair of squeezing rollers are mounted. The trough contains size, which is maintained at a boiling temperature and in sufficient quantity to submerge the rollers. Two warps, in the form of loose tapes, may be simultaneously led over, under and between the rollers. As the warps advance, the threads become saturated with size, and the squeezing rollers press out all but a predetermined percentage, the latter being regulated by varying the pressure of the upper roller upon the lower one. If more size be required than can be put into the threads during one passage through the machine, they may be similarly treated a second time. This process does not lay all the loose fibres, but the threads remain elastic. After sizing, the warps are passed round a set of steam-heated cylinders by which the moisture contained in the threads is evaporated; they are next either reballed or wound upon a loom beam.

For sizing cotton yarns Radcliffe's dressing machine has to a large extent been displaced by the slasher, but in some branches of the textile industry it is still retained under various modifications. In a slasher the threads from a number of warping beams are first combined into one sheet, then plunged into a trough filled with size which is kept at a boiling temperature by perforated steam pipes. The threads are next squeezed between two pairs of rollers mounted in the trough. The under surfaces of the sizing rollers are in the size, and the upper squeezing rollers, which are covered with flannel, rest by gravitation upon the lower ones. On leaving the size trough the sheet of yarn almost encircles two steam-heated cylinders which quickly expel moisture

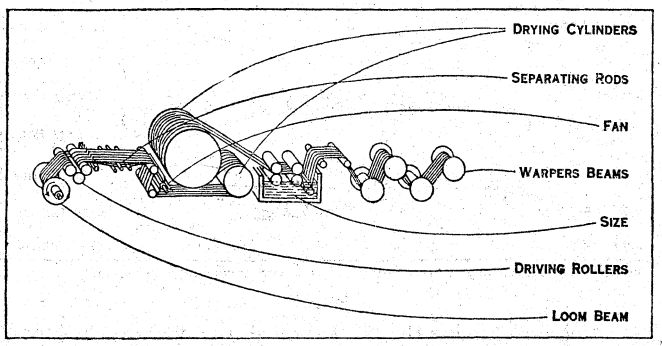


FIG. 36.—SLASHER SIZING MACHINE, FOR APPLYING SIZE TO THE WARP YARN AND FOR WINDING IT ON THE LOOM BEAM, ESPECIALLY IF CLOTH IS TO BE GREY OR ALL OF ONE COLOUR

from the yarn, but so much heat is retained that fans have to be employed to throw cool air amongst the threads. The yarn is next measured, passed above and below rods which separate threads that have been fastened together by size, smeared with piece marks, and coiled upon a loom beam.

Hank sizing is chiefly, but not exclusively, employed for bleached and coloured yarns. Machines for doing this work consist of a tank which contains size, flanged revolving rollers and two hooks. One hook is made to rotate a definite number of times in one direction, then an equal number the reverse way; the other has a weight suspended from its outer end and can be made to slide in and out. Size in the tank is kept at the required temperature by steam pipes, and "doles" of hanks are suspended from the rollers with about one-third their length immersed in size. As the hanks rotate all parts of the yarn enter the size, and when sufficiently treated they are removed from the rollers to the hooks where they are twisted to cause the size to penetrate the yarn and to wring out excess size. If sufficient size has not been added by one treatment, the wrung-out hanks are passed to a similar machine containing paste of greater density than the first and are treated a second time; if necessary this may be followed by a third passage. On the completion of sizing the hanks are removed either to a drying stove or a drying machine.

Drawing-in, or *entering,* is the operation of passing warp threads through the eyes of a shedding harness, in a sequence determined by the nature of the pattern to be produced, and the order of lifting the several parts. It is effected by passing a hook through each harness eye in succession, and each time a thread is placed in the hook by an attendant it is drawn into an eye by the withdrawal of the hook. The operation is generally done by hand, but for the simpler cloths, and particularly for repetition work, mechanical drawing-in is often used.

Twisting consists in twisting, between the finger and thumb, the ends of a new warp separately upon those of an old one, the remains of which are still in the eyes of the shedding harness. The twisted portions adhere sufficiently to permit of all being drawn through the eyes simultaneously.

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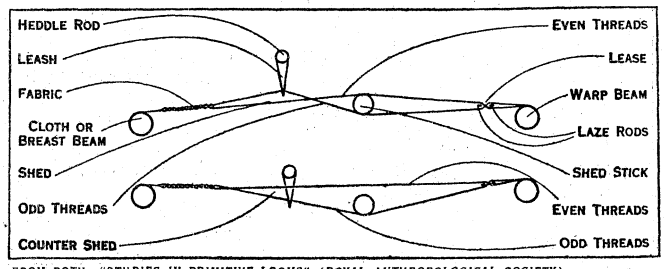
PRIMITIVE

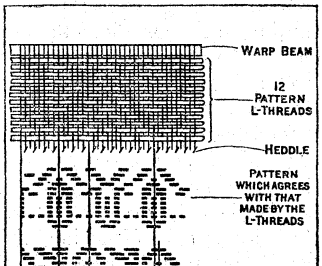
True weaving consists "of the interlacing at right angles by one series of filaments or threads, known as the *weft* or *woof*, of another series known as the *warp*, both being in the same plane." The *warp* threads are stretched from a *cloth-* or *breast-beam* to another beam known as the *warp-beam*. The process of weaving is then carried out by raising the odd threads, leaving the even ones



FROM ROTH, "STUDIES IN PRIMITIVE LOOMS" (ROYAL ANTHROPOLOGICAL SOCIETY)

FIG. 37

in position and passing the *woof* through the opening thus made. The odd threads are then lowered, the even ones raised, and the woof again passed between them. This is continued until the warp is full. The space between the odd and even threads when the former are raised is known as a *shed*, when the latter are raised as a *counter-shed*. The passing of the woof through either is termed *making a pick*. After each *pick* is made the woof is pressed home into position by a *beater-in* or *sword* usually a flat slat of wood. In some primitive looms the odd and even threads are laboriously raised by hand, but more commonly a *heddle* and *shed stick* are used. The simplest heddle consists of a bar of wood to which the odd warp threads are attached—this, the *rod heddle*, is always worked by hand. The *frame heddle* is composed of two parallel rods connected by a number of thin bars or strands, each with an eye or loop in the centre through which the odd warp threads pass (fig. 37). In Africa and Indo-China this is worked with the feet by means of treadles. The *shed stick* is a rod, usually of some thickness, which passes over the odd and under the even threads. When the heddle is not raised the thickness and weight of the shed-stick depresses the odd threads and so makes the *counter-shed* (fig. 38). A more efficient form of shed-stick is a lath which is set on edge to form the counter-shed. To prevent the warp threads from becoming entangled, either two slender laths are passed close to the warp-beam, one over the even and under the odd, the other over the odd and under the even threads; this prevents the warp threads from moving laterally or a *warp-spacer* is employed, *i.e.*, two parallel rods united by a number of rigid bars between which the warp-threads are passed in varying quantities. In many Indonesian and some African looms this is placed on the cloth-beam side of the heddles and serves as a *beater-in* as well. It is similar to the *reed* of a European hand-loom. An appliance which is sometimes used is the *temple*, usually a slender rod with a point at either end, inserted in the fabric horizontally close to the portion under construction, serving to keep the width of the web even. Except where the weft threads are discontinuous, as in the raffia looms of West Africa, the weft is wound upon a *spool*. The arrangement is either as on a European bobbin or the threads may pass lengthwise as on a netting needle. Where the former method is employed, the bobbin is usually encased in a shuttle, but among primitive peoples the latter is the more common. In Indonesia and Indo-China the material used in weaving is generally cotton, and this is also



FROM ROTH, "STUDIES IN PRIMITIVE LOOMS" (ROYAL ANTHROPOLOGICAL SOCIETY)

FIG. 38

widely used in Africa; but here and in the west Pacific vegetable fibre and the filaments of shredded leaves are utilized.

Variants.—Outside Africa the *horizontal loom* is most common. In this the warp beam is fixed a short distance off the ground. The cloth-beam is then either similarly fixed (as in the African specimens) or to it is fastened a girdle which passes behind the back of the weaver as she sits at work. By adjusting the position of her body she is able to regulate the tension on the warp threads. The looms of ancient Mexico and modern West Africa differ from other horizontal looms in that they lack a warp beam; instead the warp-threads are bunched together and anchored to a pole or to the ground.

The *vertical loom* is now found among primitive peoples in Africa, India and parts of North America. It was used in ancient Egypt and a special variety, with weights instead of a warp beam, in classical Greece. The African vertical loom has two varieties, that for weaving cotton and that for working raffia. They are probably related historically, possibly to the ancient Egyptian form. In them the warp-beam is the upper, the cloth-beam the lower; that is, the weaver begins his work at the bottom. A sloping loom is used by the Bushongo, wherein the warp is stretched at an angle of about 60° and the weaver sits underneath it, working from the bottom upwards.

Distribution.—The art of weaving occurs sporadically among primitive peoples. The vertical loom is found in Africa, India and among the Zuni, Navaho and kindred tribes of North America. The horizontal loom with fixed cloth-beam is mainly African; that with a back-strap is found in Farther India, Indo-China, in parts of Indonesia, Micronesia and north, central and south America, among the Ainu of Japan and in a few islands of Melanesia. In this last area its presence is almost undoubtedly due to Micronesian influence. In some islands, such as the Banks group and Santo (New Hebrides), it appears to have become a lost art, since there is evidence of its having been practised there formerly.

Sociological and Religious Aspect of Weaving.—Weaving is often the prerogative of one or other of the sexes. In Africa all the weavers are men, and though women may spin they are often prohibited from touching a loom. With the exception of Oceania the horizontal loom with the back-strap is worked mainly by women. Weaving may be restricted to villages or families, and among the Tangkhul Nagas of Assam, if a woman of a weaving village marries and goes to live elsewhere, she usually ceases to ply her craft. Even certain designs may be owned. In olden days in Ashanti the king appeared to hold "copyright" of all new designs, which were treated as a "tartan." Among the Sema Nagas a woman may not weave while her husband is away hunting, trading or fighting. The Ashanti hold it wrong to break or burn any part of a loom, and they therefore throw those which are past service into a stream. If a man weaver commits adultery with the wife of a weaver a sheep must be sacrificed in atonement to the loom as well as to the ancestral stools.

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WEBB, SIR ASTON (1849–1930), British architect, son of Edward Webb, engraver and painter, was born in London on May 22, 1849 and elected president of the Architectural Association in 1884, and of the Royal Institute of British Architects in 1902. He restored the beautiful church, St. Bartholomew's, Smithfield, London. He was knighted in 1904 and made K.C.V.O. in 1914. He designed the new front of Buckingham Palace, and the architectural settings for the Queen Victoria Memorial there, as also

the Admiralty Arch at the other end of the Mall, London. He completed the Victoria and Albert Museum, the Royal College of Science and other institutions at South Kensington as well as many private houses, among them Yeaton-Peverey, Shrewsbury. New buildings for the Army and Navy Co-operative Society are among his latest work in London. In Jan. 1919 he was elected president of the Royal Academy. He resigned in 1925, and was made G.C.V.O. He died, Aug. 21, 1930.

WEBB, MATTHEW (1848–1883), English swimmer, generally known as "Captain Webb," was born at Dawley, Shropshire on June 18, 1848, the son of a doctor. While still a boy he saved one of his brothers from drowning in the Severn, and, while serving on board the training ship in the Mersey, he again distinguished himself by saving a drowning comrade. He served his apprenticeship in the East India and China trade, shipped as second mate for several owners, and in 1874 was awarded the first Stanhope gold medal by the Royal Humane Society for an attempt to save a seaman who had fallen overboard from the Cunard steamship "Russia." In 1875 Captain Webb became a professional swimmer. On July 3 he swam from Blackwall Pier to Gravesend, a distance of 20 m. in $4\frac{3}{4}$ hours, a record which remained unbeaten until 1899. In the same year, after one unsuccessful attempt, he swam the English Channel, on Aug. 24, from Dover to Calais in $21\frac{3}{4}$ hours. He lost his life on July 24, 1883, in an attempt to swim the rapids and whirlpool at Niagara.

WEBB, PHILIP SPEAKMAN (1831–1915), British architect, was born at Oxford on Jan. 12, 1831. He was educated at Aynho, Northants, and after being articled to a Reading firm, entered the office of G. E. Street, Oxford, where he met William Morris. In 1856 he set up for himself in London, and after the establishment of the firm founded by Morris (Morris, Marshall, Faulkner and Co.), produced for them many designs for the most varied purposes, house decoration, tiles, jewellery, furniture, etc.

Webb designed many fine houses, and one church, at Brampton, Cumberland (1875). His first house was built for William Morris (Red House, Upton, 1859). He also made additions to old houses, for example Berkeley Castle and Pusey House, Berkshire. Webb was the inventor of a method by which old buildings were strengthened by filling the interior of the walls with new material. This procedure was often used by the Society for the Protection of Ancient Buildings, which Webb and Morris jointly organized and founded in 1877. He died at Worth, Sussex, on April 17, 1915.

WEBB, SIDNEY (1859–), English statesman and author, was born in London on July 13, 1859. He was educated at private schools in London and Switzerland, at the Birkbeck Institute and the City of London College. He entered the civil service by open competition as a clerk in the War Office in 1878, became surveyor of taxes in 1879, and in 1881 entered the colonial office, where he remained until 1891. In 1885 he was called to the bar at Gray's Inn. Webb was one of the early members of the Fabian Society, contributing to *Fabian Essays* (1889). He entered the London County Council in 1892 as member for Deptford, and was returned at the head of the poll in the successive elections of 1895, 1898, 1901 and 1904. He resigned from the civil service in 1891 to give his whole time to the work of the Council (where he was chairman of the Technical Education Board) and to the study of economics. He served from 1903 to 1906 on the Royal Commission on Trade Union Law and on other important commissions. He married in 1892 Beatrice Potter, herself a writer on economics and sociology, the author of *The Co-operative Movement in Great Britain* (1891) and a contributor to Charles Booth's *Life and Labour of the People* (1891–1903). Mrs. Webb was a member of the Royal Commission on the Poor Law, and she and her husband were responsible for the Minority Report (*see* POOR LAW) and for starting the widespread movement in its favour.

From 1909 onward, the Webbs played an increasingly important part in moulding the opinion of British Labour and supplying it with an intellectual armoury. They were concerned in the founding of the weekly *New Statesman* in 1913, and for some time before that had been busily promoting the development of the London School of Economics and Political Science, a department of the University of London where Mr. Webb was professor of public administration. In 1915–25, he was a member of the executive of the Labour party. In 1922 he was returned as M.P. for Seaham Harbour. In 1919, Webb was a member of the royal commission on coal mines, and put before it a complete plan for the nationalisation of the industry. His inclusion in the first Labour Government was a matter of course; but his presidency of the Board of Trade (1922–23) was not marked by any striking innovations. In the MacDonald cabinet of 1929 he became secretary for the colonies and dominions, and was elevated to the peerage as Baron Passfield. He resigned in 1931.

Mr. and Mrs. Webb have published three standard works, *The History of Trade Unionism* (1894, rev. ed. 1920), *Industrial Democracy* (1897, new ed. 1902) and *English Local Government,* which reached its seventh volume in 1927; also *The Manor and the Borough* (1908); *The Break-up of the Poor Law* and *The Public Organization of the Labour Market* (1909); *English Poor Law Policy* (1910); *A Constitution for the Socialist Commonwealth of Great Britain* (1920); *The Consumers' Co-operative Movement* (1921); *The Decay of Capitalist Civilization* (1921); *English Poor Law History* (3 vols., 1927–29); *Soviet Communism: A New Civilization?* (1935, 2nd ed. 1937).

WEBB CITY, a city of Missouri, U.S.A. Pop. (1920), 7,807, 97% native white, and 7,033 in 1940 by the federal census. Adjoining it on the east is Carterville, with a population in 1940 of 1,582. The two cities are the centre of rich lead and zinc mines, which were at their peak of production about 1910, when the combined population reached 16,356. Webb City has large powder works. Lead was discovered there in 1873 on the farm of John C. Webb. Systematic mining began in 1877.

WEBER, CARL MARIA FRIEDRICH ERNEST VON (1786–1826), German composer, was born at Eutin, near Lübeck, on the 18th of December 1786, of a family long devoted to art. His father, Baron Franz Anton von Weber, a military officer in the service of the palgrave Karl Theodor, was an excellent violinist, and his mother once sang on the stage. In 1778 Franz Anton was appointed director of the opera at Lübeck. In 1779 the prince bishop of Eutin made him his kapellmeister, and five years later he went to Vienna, placed two of his sons under Michael Haydn, and in 1785 married the young Viennese singer Genovefa von Brenner. In the following year Carl Maria von Weber was born—a delicate child, afflicted with congenital disease of the hip-joint.

Carl Maria von Weber became familiarized with the stage from his earliest infancy. Franz Anton hoped to see him develop into an infant prodigy, like his cousin Mozart. The child was taught to sing and place his fingers upon the pianoforte almost as soon as he could speak, though he was unable to walk until he was four years old. Happily his powers of observation and aptitude for general learning were so precocious that he seems, in spite of all these disadvantages, to have instinctively educated himself. In 1798 Michael Haydn taught him gratuitously at Salzburg. In April the family visited Vienna, removing in the autumn to Munich. Here the child's first composition—a set of "Six Fughettas"—was published, with a pompous dedication to his half-brother Edmund; and here also he took lessons in singing and in composition. Soon afterwards he began to play successfully in public, and his father compelled him to write incessantly. Among the compositions of this period were a mass and an opera—*Die Macht der Liebe und des Weins*—now destroyed. A set of "Variations for the Pianoforte," composed a little later, was lithographed by Carl Maria himself, under the guidance of Alois Senefelder, the inventor of the process.

In 1800 the family removed to Freiburg, where the Ritter von Steinsberg gave Carl Maria the libretto of an opera called *Das Waldmädchen,* which the boy, though not yet fourteen years old, at once set to music, and produced in the following November at Freiburg.

Carl Maria returned with his father to Salzburg in 1801, resuming his studies under Michael Haydn. Here he composed his second opera, *Peter Schmoll und seine Nachbarn,* which was unsuccessfully produced at Nuremberg in 1803. In that year he again visited Vienna, where, though Joseph Haydn and Al-

brechtsberger were both receiving pupils, his father preferred placing him under Abt Vogler. Through Vogler's instrumentality Carl Maria was appointed conductor of the opera at Breslau, before he had completed his eighteenth year. He began a new opera called *Rübezahl*, the libretto of which was "romantic" to the last degree, and Weber worked at it enthusiastically, but it was never completed, and little of it has been preserved beyond a quintet and the masterly overture, which was re-written in 1811 under the title of *Der Beherrscher der Geister*. Quitting Breslau in 1806, Weber removed in the following year to Stuttgart, where he had been offered the post of private secretary to Duke Ludwig, brother of Frederick, king of Württemberg. He worked hard, and in 1809 remodelled *Das Waldmädchen*, under the title of *Sylvana*. Weber removed to Darmstadt in order to be near his old master Abt Vogler, and his fellow-pupils Meyerbeer and Gänsbacher. On Sept. 16, 1810, he reproduced *Sylvana* at Frankfort, but with very doubtful success. His new comic opera *Abu Hassan* was completed at Darmstadt in January 1811, after many interruptions, one of which (his attraction to the story of *Der Freischütz—see* below) exercised a memorable influence upon his later career.

Weber started in February 1811 on an extended artistic tour, during which he made many influential friends, and on the 4th of June brought out *Abu Hassan* with marked success at Munich. His father died at Mannheim in 1812. In 1813 Carl Weber's wanderings were brought to an end by the unexpected offer of an appointment as kapellmeister at Prague, coupled with the duty of entirely remodelling the performances at the opera-house. He retained this post till 1816. He composed no new operas, but he had already written much of his best pianoforte music, and played it with never-failing success, while the disturbed state of Europe inspired him with some of the finest patriotic melodies in existence. First among these stand ten songs from Körner's *Leyer und Schwerdt*, including "Vater, ich rufe dich," and "Lützow's wilde Jagd"; and in no respect inferior to these are the splendid choruses in his cantata *Kampf und Sieg*, which was first performed at Prague, on Dec. 22, 1815.

Weber resigned his office at Prague on Sept. 30, 1816, and on Dec. 21, Frederick Augustus, king of Saxony, appointed him kapellmeister at the German opera at Dresden. Weber had previously meditated turning *Der Freischütz* into an opera, and, with the assistance of Friedrich Kind, he produced an admirable libretto, under the title of *Des Jägers Braut*. He had dealt with the supernatural in *Rübezahl*, and in *Sylvana* with the pomp and circumstance of chivalry; but the shadowy impersonations in *Rübezahl* are scarcely less human than the heroine who invokes them; and the music of *Sylvana* might easily have been adapted to a story of the 19th century. But Weber now knew better than to let the fiend in *Der Freischütz* sing; with three soft strokes of a drum below an unchanging dismal chord he brings him straight to us from the nether world.

Weber wrote the first note of the music of *Der Freischütz* on July 2—beginning with the duet which opens the second act. But nearly three years elapsed before the piece was completed. In the meantime the performances at the opera-house were no less successfully remodelled at Dresden than they had already been at Prague, though the work of reformation was far more difficult. Having, after much difficulty, broken off his *liaison* with Margarethe Land, Weber married the singer Carolina Brandt, a consummate artist. The new opera was completed on May 13, 1820. He had engaged to compose the music to Wolff's Gipsy drama, *Preciosa*. Two months later this also was finished, and both pieces ready for the stage.

It had been arranged that both *Preciosa* and *Der Freischütz*—no longer known by its original title, *Des Jägers Braut*—should be produced at Berlin. *Preciosa* was produced with great success at the old Berlin opera-house on June 14, 1821. On June 18, the anniversary of the battle of Waterloo, the opening of the new "Schauspielhaus" was celebrated by the production of *Der Freischütz*. The success of the piece was triumphant. The work was received with equal enthusiasm at Vienna on Oct. 3, and at Dresden on Jan. 26, 1822. Yet Weber's position as kapellmeister was not much improved by his success.

For his next opera Weber accepted a libretto based, by Frau Wilhelmine von Chezy, on the story of *Euryanthe*, as originally told in the 13th century, in Gilbert de Montreuil's *Roman de la Violette*, and repeated with alterations in the *Decamerone*, in Shakespeare's *Cymbeline*, and in several later forms. The work was produced at the Kärntnerthor theatre in Vienna, on Oct. 25, 1823, and received with enthusiasm.

Weber's third and last dramatic masterpiece was an English opera, written for Covent Garden theatre, upon a libretto adapted by Planché from Wieland's *Oberon*. It was disfigured by the spoken dialogue abandoned in *Euryanthe;* but in musical beauty it is quite equal to it, while its fairies and mermaids are as vividly real as the spectres in *Der Freischütz*. Though already far gone in consumption, Weber began to compose the music on Jan. 23, 1825. Charles Kemble had offered him £1,000 for the work, and he could not afford to rest. He finished the overture in London, at the house of Sir George Smart, soon after his arrival, in March 1826; and on April 12, the work was produced with triumphant success. Weber grew daily perceptibly weaker, and, notwithstanding the care of his kind host, Sir George Smart, and his family, he was found dead in his bed on the morning of June 5, 1826. For eighteen years his remains rested in a temporary grave in Moorfields chapel; but in 1844 they were removed and placed in the family vault at Dresden, Wagner making an eloquent speech

Besides his three great dramatic masterpieces and the other works already mentioned, Weber wrote two masses, two symphonies, eight cantatas, and a large number of songs, orchestral and pianoforte pieces, and music of other kinds, amounting altogether to more than 250 compositions.

Weber's style rises, in his three greatest works, to heights which show his kinship with the great classics and the great moderns. His intellect was quick and clear; but yet finer was the force of character with which he overcame the disadvantages of his feeble health, desultory education and the mistakes of his youth. With such gifts of intellect and character, every moment of his short life was precious to the world; and it is impossible not to regret the placing of his training in the hands of Abt Vogler. Weber's master was an amiable charlatan, whose weakness as a teacher was thoroughly exposed, in perfect innocence, by his two illustrious pupils. Meyerbeer wished to be famous as the maker of a new epoch in opera. Weber could not help being so in reality. But all his determination could not quite repair the defects of his purely musical training, and though his weaknesses are not of glaring effect in opera, still there are moments when even the stage cannot explain them away. Thus the finale of *Der Freischütz* breaks down so obviously that no one thinks of it as anything but a perfunctory winding-up of the story, though it really might have made quite a fine subject for musical treatment. In *Euryanthe* Weber attained his full power, and his inspiration did not leave him in the lurch where this work needed large musical designs. But the libretto was full of absurdities; especially in the last act, which not even nine remodellings under Weber's direction could redeem. Yet it is easy to see why it fascinated him, for, whatever may be said against it from the standpoints of probability and literary merit, its emotional contrasts are highly musical. Indeed it is through them that the defects invite criticism.

WEBER, JOSEPH: *see* WEBER AND FIELDS.

WEBER, MAX (1864–1920), German economist, was born at Erfurt on April 21, 1864, and died in Munich on June 14, 1920. He was professor at Berlin (1893), Freiburg (1894) and at Munich (1918). Weber's first important work was *Die römische Agrargeschichte in ihrer Bedeutung für das Staats-und Privatrecht* (1891). Later he occupied himself principally with sociology and social philosophy, as in *Die sozialen Gründe des Untergangs der antiken Kultur* (1895).

Other works are *The rural Community*, lecture delivered before the international Congress in St. Louis (1904); *Russlands Uebergang zum Scheinkonstitutionalismus* (1906). The following works were published

after his death: *Gesammelte Aufsätze zur Religionssoziologie* (1920, 1921); *Gesammelte politische Schriften,* and *Gesammelte Aufsätze zur Wissenschaftslehre* (1922); *Wirtschaft und Gesellschaft* (1921); *Wirtschaftsgeschichte* (1923); *Gesammelte Aufsätze zur Soziologie und Wirtschafts Geschichte* (1924); *Gesammelte Aufsätze zur Soziologie und Sozialpolitik* (1924).

WEBER, WILHELM EDUARD (1804–1891), German physicist, was born at Wittenberg on Oct. 24, 1804, and was a younger brother of Ernst Heinrich Weber, the author of Weber's Law. He studied at Halle, and at Göttingen, was one of the seven professors who were expelled for protesting against the action of the king of Hanover (duke of Cumberland) in suspending the constitution. In 1849, he returned to Göttingen, where he died on June 23, 1891.

There was no system either of stating or measuring electrical quantities; but he showed, as his colleague K. F. Gauss did for magnetic quantities, that it is both theoretically and practically possible to define them, not merely by reference to other arbitrary quantities of the same kind, but in terms in which the units of length, time and mass are involved. Weber's theory of electricity was founded on the views of Fechner who considered that positive and negative charges move in a conductor with equal and opposite velocities. From this he worked out the law of forces between charges. Weber's work on electricity did much to stimulate mathematical physicists. He also carried on extensive researches in the theory of magnetism, and developed Faraday's ideas regarding his explanation of diamagnetic phenomena. In his observations in terrestrial magnetism he not only employed an early form of mirror galvanometer, but, about 1833, devised a system of electromagnetic telegraphy, by which a distance of some 9,000 ft. was worked over. In conjunction with his elder brother he published in 1825 a well-known treatise on waves, *Die Wellenlehre auf Experimente gegründet;* and in 1833 he collaborated with his younger brother, the physiologist Eduard Friedrich Weber (1806–1871), in an investigation into the mechanism of walking.

WEBER AND FIELDS, U.S. comedians. Joseph M. Weber was born Aug. 11, 1867, and Lewis Maurice Fields was born Jan. 1, 1867, both in New York city. They were educated there and made their first stage appearance together in juvenile sketches at Turner Hall on the city's east side. They continued together in "knockabout" sketches in small variety theatres until 1885, when they formed their own company. In 1895 they became joint managers of the Broadway Music Hall, which was thereafter generally known as "the Weber and Fields," enacting there a series of burlesques which added continually to their fame. In 1904 Fields withdrew and formed a partnership with Hamlin and Mitchell, but continued to appear at Weber's theatre. In 1912 they re-united in "Hokey-Pokey" at the Broadway theatre, and their names were long associated in popular sketches in New York theatres. Fields died July 20, 1941; Weber on May 10, 1942.

WEBERN, ANTON VON (1883–1945), Austrian composer, was born in Vienna on Dec. 3, 1883. He studied at Vienna university, taking the degree of Ph.D. in musicology, and was one of the first disciples of Schönberg, whose principles he adopted in his own works. In concentration and intensity he even exceeds Schönberg, and the fragmentariness and almost complete absence of tangible melody or effective rhythm in his later compositions deprives them of any but an intellectual appeal. A characteristic feature is his use of pianissimo. Webern died in Sept. 1945.

His works include: A two string quartet op. 5 and 9; Pieces for violin and piano op. 7; Passacaglia and five Pieces, op. 5, for orchestra; *Geistliche Lieder* for soprano with 5 instr., op. 16; and miscellaneous chamber music. *See* Paul Stefan, *Neue Musik und Wien.*

WEBER'S LAW, in psychology, the name given to a principle first enunciated by the German scientist, Ernst Heinrich Weber (1795–1878), who became professor at Leipzig (of anatomy, 1818, of physiology, 1840). He was specially famous for his researches into aural and cutaneous sensations. His law, the purport of which is that the increase of stimulus necessary to produce an increase of sensation in any sense is not an absolute quantity but depends on the proportion which the increase bears to the immediately preceding stimulus, is the principal generalization of that branch of scientific investigation which has come to be known as psycho-physics (*q.v.*).

According to Gustav Fechner (*q.v.*), who has done most to prosecute these inquiries and to consolidate them under a separate name, "psycho-physics is an exact doctrine of the relation of function or dependence between body and soul." In other words, it is throughout an attempt to submit to definite measurement the relation of physical stimuli to the resulting psychical or mental facts, and forms an important department of experimental psychology. It deals with the quantitative aspects of mental facts—their intensity or quantity proper and their duration. Physical science enables us, at least in the case of some of the senses, to measure with accuracy the objective amount of the stimulus, and introspection enables us to state the nature of the subjective result. Thus we are able to say whether a stimulus produces *any* psychical result, and can fix in that way the *minimum sensibile* or "threshold of consciousness" for each of the senses. In like manner (though with less accuracy, owing to the disturbing nature of the conditions) we can fix the sensational maximum, or upper limit of sensibility, in the different senses, that is to say, the point beyond which no increase of stimulus produces any appreciable increase of sensation. We thus determine, as Wundt puts it, the limit-values between which changes of intensity in the stimulus are accompanied by changes in sensation. But the central inquiry of psycho-physics remains behind. Between the quantitative minimum and the quantitative maximum thus fixed can we discover any definite relation between changes in the objective intensity of the stimuli and changes in the intensity of the sensations as estimated by consciousness.

As we have no means of subjectively measuring the absolute intensity of our sensations, it is necessary to depend upon the mental estimate or comparison of two or more sensations. Comparison enables us to say whether they are equal in intensity, or if unequal which is the greater and which is the less. But as they approach equality in this respect it becomes more and more difficult to detect the difference. By a series of experiments, therefore, it will be possible, in the case of any particular individual, to determine the just observable difference in intensity between two sensations of any particular sense. This least observable difference is called by Fechner the *Unterschiedsschwelle* or "difference-threshold," that is to say, the limit of the discriminative sensibility of the sense in question. That such a "threshold," or least observable difference, exists is plain from very simple examples. Very small increases may be made in the objective amount of light, sound or pressure—that is, in the physical stimuli applied to these senses—without the subject on whom the experiment is made detecting any change. It is further evident that, by means of this just observable difference, it is possible to compare the discriminative sensibility of different individuals, or of different senses, or (as in the case of the skin) of different parts of the same sense organ: the smaller the difference observable the finer the discriminative sensibility. Thus the discrimination of the muscular sense is much more delicate than that of the sense of touch or pressure, and the discriminative sensibility of the skin and the retina varies very much according to the parts of the surface affected. Various methods have been adopted with a view to determine these *minima* of discriminative sensibility with an approach to scientific precision. The first is that employed by Weber himself, and has been named the method of just observable differences. It consists either in gradually adding to a given stimulus small amounts which at first cause no perceptible difference in sensation but at a certain point do cause a difference to emerge in consciousness, or, vice versa, in gradually decreasing the amount of additional stimulus, till the difference originally perceived becomes imperceptible. By taking the average of a number of such results, the minimum may be determined with tolerable accuracy. The second method is called by Fechner the method of right and wrong cases. When two stimuli, A and B, are very nearly equal the subject will often fail to recognize which is the greater, saying sometimes that A is greater, sometimes that B is greater. When in a large number of trials the right and wrong guesses exactly balance one another we may conclude that the difference between the two stimuli is not appreciable by the

sense. On the other hand, as soon as the number of correct guesses definitely exceeds half of the total number of cases, it may be inferred that there is a certain subjective appreciation of difference. This method was first employed by Vierordt. The third method, that of average errors, is very similar to the one just explained. Here a certain weight (to take a concrete example) is laid upon the hand of the person experimented upon, and he is asked, by the aid of subjective impression alone, to fix upon a second weight exactly equal to the first. It is found that the second weight sometimes slightly exceeds the first, sometimes slightly falls below it. Whether above or below is of no consequence to the method, which depends solely on the amount of the error. After a number of experiments, the different errors are added together, and the result being divided by the number of experiments gives us the average error which the subject may be calculated upon to make. This marks the amount of stimulus which is just below the difference-threshold for him. This method was first employed by Fechner and Volkmann. Another method, known as the "method of mean gradation," was first introduced by Plateau. It consists in getting the subject to find or select a stimulus that shall be, or at least appears to him to be, midway between two given stimuli. The different methods were first named, and the theory of their application developed by Fechner in his *Elemente der Psychophysik* (1860).

A number of experimental variations have since been devised by Wundt and others, but they are all reducible to the two types of the "gradation" and "error" methods. These methods have been chiefly applied to determine the relation of the difference-threshold to the absolute magnitude of the stimuli employed. For a very little observation tells us that the smallest perceivable difference is not an amount whose absolute intensity is constant even within the same sense. It varies with the intensity of the stimuli employed. We are unable, for example, to recognize slight differences in weight when the weights compared are heavy, though we should be perfectly able to make the distinction if the weights compared were both light. Ordinary observation would lead us, therefore, to the conclusion that the greater the intensity of the original stimulus at work the greater must be the increase of stimulus in order that there may be a perceptible difference in the resulting sensation. Weber was the first (after a prolonged series of experiments) to clothe this generality with scientific precision by formulating the law which has since gone by his name. He showed that the smallest perceptible difference is not absolutely the same, but remains relatively the same, that is, it remains the same fraction of the preceding stimulus. For example, if we can distinguish 16 oz. and 17 oz., we shall be able to distinguish 32 oz. and 34 oz., but not 32 oz. and 33 oz., the addition being in each case $\frac{1}{16}$ of the preceding stimulus. This fraction (supposing it to be the difference-threshold of the muscular sense) remains a constant, however light or however heavy the weights compared. The law may be formulated thus:—The difference between any two stimuli is experienced as of equal magnitude, in case the mathematical relation of these stimuli remains unaltered. Or, otherwise expressed, in order that the intensity of a sensation may increase in arithmetical progression the stimulus must increase in geometrical progression.

It is also expressed by Fechner in the form: The sensation increases as the logarithm of the stimulus.

VARIOUS INTERPRETATIONS

The law has been variously interpreted. Fechner himself designated it the psycho-physical law, and treated it as the fundamental formula of the relation between body and mind, thus assigning to it an ontological dignity and significance. But in this "psychophysical" interpretation of his results he has not had a numerous following. Wundt interprets the law in a purely "psychological" sense, making it a special instance of the general law of relativity which governs our mental states. Introspection can give us no information as to the absolute intensity of the stimulus; for a stimulus is known in consciousness only through its sensational resultant. Hence, he argues, we can only compare one psychical state with another, and our standard of measurement is therefore necessarily a relative one; it depends directly upon the preceding state with which we compare the present. Others (*e.g.*, G. E. Müller) have attempted to give the law a purely physical or "physiological" explanation. Instead of holding with Fechner that the law expresses a recondite relation between the material and the spiritual world, they prefer to regard the quantitative relation between the last physical antecedent in the brain and the resultant mental change as prima facie one of simple proportion, and to treat Weber's law as holding between the initial physical stimulus and the final action of the nerve-centres. According to this interpretation, the law would be altogether due to the nature of nervous action. As a nerve, says Sully, after a temporary degree of stimulation temporarily loses its sensibility, so the greater the previous stimulation of a nerve the greater is the additional stimulus required to produce an appreciable amount of sensation.

Weber's law, it must be added, holds only within certain limits. In the "chemical" senses of taste and smell experiments are almost impossible. It is not practicable to limit the amount of the stimulus with the necessary exactitude, and the results are further vitiated by the long continuance of the physiological effects. The same considerations apply with still more force to the organic sensations, and the results in the case of temperature sensations are completely uncertain. The law is approximately true in the case of sight, hearing, pressure, and the muscular sense—most exactly in the case of sound. As this is the sense which affords the greatest facilities for measuring the precise amount of the stimulus, it may perhaps be inferred that, if we could attain the same exactitude in the other senses, with the elimination of the numerous disturbing extraneous influences at work, the law would vindicate itself with the same exactitude and certainty. It is further to be noted, however, that even in those senses in which it has been approximately verified, the law holds with stringency only within certain limits. The results are most exact in the middle regions of the sensory scale; when we approach the upper or lower limit of sensibility they become quite uncertain.

BIBLIOGRAPHY.—Weber's investigations were published as "Der Tastsinn und das Gemeingefühl," in Wagner's *Handwörterbuch der Physiologie,* iii. (1846). Fechner's *Elemente der Psychophysik* (1860) contains an elaborate exposition of the whole subject. He replied to his critics in two later works, *In Sachen der Psychophysik* (1877) and *Revision der Hauptpunkte der Psychophysik* (1882). Delboeuf's *Étude psychophysique* (1873), *Examen critique de la loi psychophysique* (1883), and *Éléments de psychophysique générale et spéciale* (1883), and G. E. Müller's *Zur Grundlegung der Psychophysik* (1878) are also important documents; and the subject is fully treated in Wundt's *Grundzüge der physiologischen Psychologie* (ed. 1902–1903), and "Über die Methode d. Minimaländerungen," in *Philos. Stud.* (Leipzig, 1883), or, more popularly, in his *Human and Animal Psychology* (2nd ed., 1892), Lectures 2, 3, 4. *See* also Ladd's *Physiological Psychology* (1887), which is based upon Wundt; Meinong, in *Zeitschr. für Psychologie,* xi. (1896); Ziehen, *Leitfaden der physiologischen Psychologie* (7th ed., Jena, 1906); E. B. Titchener, *Experimental Psychology* (ii., 1905); Professor James Ward's "Attempt to Interpret Fechner's Law," in *Mind,* i. 452 *sqq.;* and generally textbooks of psychology, *e.g.* G. F. Stout's *Manual of Psychology,* bk. ii. ch. 7 (following Meinong); James's *Principles of Psychology,* ch. 13; Külpe's *Outlines of Psychology,* part i. chap. 1 and 3. *See* PSYCHOLOGY, HISTORY OF. (A. S. P.-P.)

WEBSTER, DANIEL (1782–1852), American statesman and lawyer, was born in Salisbury (N.H.), Jan. 18, 1782. His parents were rugged New England farming people. Daniel was the delicate one of the family, and not particularly inclined to farm work. From childhood, however, he loved out-of-door life, was exceedingly fond of hunting and fishing, and unusually skilful at them, and this taste, which became strong in his youth, clung to him through all his long career.

His early schooling was primitive. But he had a passion for books of all sorts. Bits of the poets and illustrations from the great historians were always ready to his hand when he needed them and came out with singular appropriateness in later years. It has been urged that he was indolent. So was Sir Walter Scott. But Scott could do more work in a day than other men in a week; and so could Webster. His mind seized the essence of things.

These intellectual gifts were so manifest that Webster's father made great sacrifices to send the boy to Phillips academy, Exeter, and then to Dartmouth college. His college record was good, but not remarkable; like many men of genius, he preferred other things to the appointed task. It is said that in early days he was reluctant to speak in public, but toward the end of his college career he was known as something of an orator and debater, and when he was 18, a year before his graduation in 1801, he was invited to deliver the Fourth of July address for the town of Hanover. Some of these early speeches have been preserved, and while crude, they suggest what was to come.

With a mind like Webster's the law seemed the inevitable vocation, and the little teaching he did was merely a means to an end. As was the custom in those days, he went into the office of a practising lawyer in Boston, and the invaluable training of Christopher Gore no doubt went far in making his pupil the great lawyer that he afterwards became. He was admitted to the bar in 1805, and in 1807 settled himself to practise in Portsmouth. His reputation in law is quite as great as, perhaps more unclouded than, in statesmanship. His clear, massive, gorgeous, overwhelming eloquence carried juries with him as well as parliaments, and no estimate of his eloquence is complete that does not allow for the superb personality that gave it weight and vigour. He was a notable presence, even to those who passed him unknown in the street. The dignity of his solid figure, the rich and varied music of his voice, above all the penetrating splendour of his eyes, gave his spoken words a glory which we cannot recover, effective as his speeches often are in print. Of his jury triumphs the best known is that in the White murder case. His most celebrated plea before the Supreme Court in Washington is that for Dartmouth college, in 1818, when the personal touches, notably, "It is, as I have said, a small college, and yet there are those who love it," so affected all present that it was said of Chief Justice Marshall that "the deep furrows of his cheek expanded with emotion and his eyes suffused with tears."

Party passions, together with the power of his tongue, naturally took Webster into politics. It is said that even in childhood he began to study the Constitution as printed on a cotton handkerchief. From 1813 to 1817 he was a member of the House of Representatives. New England at that time was bitterly opposed to the Madison Administration, to the Democratic Party, and especially to the war with England, and Webster's eloquence was used unsparingly to express these New England prejudices, though he cannot be connected with the more or less disloyal Hartford Convention. At this early period, in curious contrast to his later views and arguments, he was hostile to a protective tariff, feeling that it would complete the ruin of the New England shipping interests, already sufficiently imperilled by the cost of the war.

While he was out of politics, from 1817 to 1823, Webster devoted himself energetically and profitably to the practise of law. During these years he was making his great reputation as a historical orator. In 1820 he delivered the bi-centennial speech at Plymouth, celebrating the landing of the Pilgrims, and it is probable that in the line of general eloquence he never reached a greater height than this. The significance of America, the political, social and religious principles that America stood for, and the splendid development and prospects of the Anglo-Saxon race, were portrayed with a dignity and amplitude which good judges consider worthy to be compared with Demosthenes or Burke. Webster's impressive delivery, his intense, magnetic hold upon his audience, were never more fully manifested than upon this occasion. Ticknor, who was present, gives a vivid account of his own experience: "I was never so excited by public speaking before in my life. Three or four times I thought my temples would burst with the gush of blood. . . . When I came out I was almost afraid to come near to him. It seemed to me as if he was like the mount that might not be touched and that burned with fire. I was beside myself, and am so still." The address delivered on the anniversary of the battle of Bunker Hill, in 1825, was another of these historical tributes, equally successful and well known. On Aug. 2, 1826, Webster gave, in Faneuil hall, Boston, the eulogy on John Adams and Thomas Jefferson, who had both died on the Fourth of July previous. This speech contains the famous words, attributed to John Adams, "Sink or swim, live or die," etc., which have probably been repeated in school declamations as often as any piece of rhetoric in the English language. In 1823 Webster again appeared in the House of Representatives, and in 1827 in the Senate, in which he was to play so great a part for many years. The Missouri Compromise (*q.v.*) of 1820 had for the time apparently settled the question of slavery, but in reality the rift between the two sections of the country had been opened, and it was not ever really to be closed again until after the Civil War.

Webster's position with regard to slavery was taken at this time, and in spite of his conduct in later years, it cannot be said that his theoretical attitude was ever altered. He believed, as did so many good men and leaders, both North and South, that slavery was an evil, disastrous to the white race as much as to the black. The earlier great men of the South in the main held this view, and it was left for Calhoun and Jefferson Davis, under the controlling influence of cotton, to discover that the enslavement of the blacks was ordained by God for the benefit of everybody. But Webster believed first of all in the Constitution. The Constitution recognized slavery, and therefore it was impossible to meddle with it, except to see that its increase and spread were discouraged by every means that the Constitution would permit.

On the other sectional issue, that of the tariff, which some persons consider even more vital than slavery, inasmuch as it meant the growing triumph of the industrial North over the agricultural South, Webster was more aggressive, and distinctly advocated the high protection which the Southern leaders felt to be fatal to their prosperity. But above all Webster ranged himself on the side of those who opposed sectional division and disunion tendencies altogether. In 1830 a comparatively minor debate as to the public lands brought on the Southern attack upon New England, and Webster, in defending his native state, replied to Hayne with the glorification of the Union, which probably did more to unify the country than any single utterance of any man. Hayne and his followers often had the technical interpretation of the Constitution on their side, but Webster had common sense behind him, he was himself the incarnation of common sense, and he gave the common sense of a united country a superb, an enduring dignity of expression which has never been forgotten and never can be. In his arguments with Calhoun over nullification, in 1833, there is the same striking contrast. Calhoun was perhaps more sound as regards mere technical logic, but Webster had the weight and the enduring substance of human truth.

In this nullification quarrel with South Carolina Webster heartily supported Andrew Jackson. But there was no sympathy between the two. Webster was an aristocratic Whig of the old school, Jackson an aggressive Democrat of the America to come, and over the bank and other things they came into violent conflict. It should be added that Webster's most serious contributions to political thought are to be found in his discussion of strictly financial matters. Moreover, when Jackson went out, in 1836, Webster would have liked to come in, and this was one of the acute crises in the fever of his presidential desires. It is amusing to see how many of his biographers deny his ambition. He wanted to serve his country, they say; he wanted to be where he could be of the greatest use. It is the old story, and no one has ever yet succeeded in disentangling the personal from the patriotic motive in these matters. The Presidency is the final seal of success in American politics, and no man who has given his life to those politics has ever been willing to see the Presidency slip from him without a sigh of despair. "I would rather be right than be President," said Henry Clay. But Clay and Webster and many another have persuaded themselves that the road to being President was the road to being right. Where will you find a more ingenuous avowal of ambition than in Webster's words to his friend Plumer: "I have done absolutely nothing. At 30 Alexander had conquered the world; and I am 40."

But Van Buren was elected, and Webster passed by, and for a time he turned his thoughts to private life. His affairs needed more attention than he could give them. He had been twice married, first in 1808, to Grace Fletcher, a love-match; second in 1829, to Caroline Le Roy. He had an expensive family, and his own tastes were expensive. He liked social life of all sorts, and social life was

costly. He liked eating and drinking, especially the latter. He was happy on his great farms, in Franklin and at Marshfield.

But the farms and the country life were almost as ruinous as dissipation, perhaps more so. And the trouble was aggravated by Webster's business habits, or lack of them. He was a master of theoretical finance, but he could not keep his own private accounts, did not even try to keep them systematically. In consequence, he was always in trouble, always borrowing and renewing. When such business methods get mixed up with politics, there may not be corruption, but there is terrible danger of it. Webster's biographers insist that he was never personally dishonest. But there is a profound remark of Webster himself, which is worth remembering: "There are means of influence not generally esteemed positively corrupt, which are competent to produce great effects."

With the failure of his immediate political ambitions, Webster turned his attention to more general matters, and grew anxious to see something of Europe. The embassy to England had always tempted him, and it was even said that he had manoeuvred to get his friend Everett out of the position so as to succeed him. This came to nothing, but in 1839 Webster arranged a trip across the water and he was received by his English friends with every possible attention and courtesy. He wrote rather extensive letters home, but it is curious to note, with these, as with all his correspondence, the singular lack of intimate personal revelation. In reading these lengthy epistles, we may be driven to wonder whether Webster's external life was so active and varied that it left the inner life somewhat jejune and bare.

Returning from abroad, Webster found the election of 1840 impending, but his own hopes and aspirations were completely submerged in the spectacular success of Harrison, with the log-cabin and hard cider and Tippecanoe campaign furore. Again it was evident that, widely as Webster was esteemed and respected, he had not the faculty of personal leadership. Men praised him, but they did not vote for him. Instead of the Presidency, he was forced to put up with the secretaryship of State, which was given him by Harrison, and at first continued by Harrison's successor, Vice-president Tyler. Tyler soon got into trouble with his Whig cabinet, and they all left him but Webster, who incurred some odium by remaining. His plea was that he wished to complete the negotiation with England about the north-eastern boundary. This was settled with Lord Ashburton by the treaty of 1842, an arrangement which was entirely satisfactory to neither party, and was therefore probably as fair a compromise as could have been devised. This is notable as being almost the only great constructive achievement of Webster's career. With all his intellectual and oratorical powers, the working of circumstances was such that he was almost always in opposition, and had no opportunity to show how well he could build for permanence, though the sure logical action of his genius would seem to have adapted him peculiarly for such work.

After the treaty was disposed of, Webster retired from the cabinet and for a time again disappeared into private life. The clouds seemed to be gathering about him in many ways. The deaths of his children, culminating in that of his daughter Julia, were a terrible grief to him. His money complications increased, and though his earning power was as great as ever, his gift for spending more than kept pace with it.

When he returned to the Senate in 1845, the political world was as dark as his own surroundings. He was personally attacked by Ingersoll, with charges of dishonesty during his secretaryship. Congressional investigation cleared him of all but carelessness, yet men always spoke of him with a slur or an apology from the financial point of view. The menace of the Mexican War was confusing everything, and making the issue of slavery more threatening and more difficult to deal with. Webster, like Clay and Calhoun, opposed the war, but he sent his son to fight and die, as did Clay also.

The vast accession of territory that resulted from the defeat of Mexico brought all sorts of slavery complications with it. Webster took an active part in these, being in the main anxious to have slavery repressed and limited, so far as this was compatible with the Constitution. But when, in 1850, Clay brought forward his compromise measures, in the desperate attempt to avert actual civil conflict, Webster joined him, and the combined influence of the two, after months of heated debate, prevailed to have the compromise accepted. Webster's course was abused with the utmost violence by the anti-slavery section of the North, and Whittier's wail over Ichabod gave the abuse literary dignity and permanence. The senator was accused of having betrayed every high principle, in the vain hope of getting the South to support him for the Presidency. Recent historians have come more and more to reject this view. They argue that without the compromise, the Civil War would have been precipitated at that time, and that by postponing it for ten years, until the North was strengthened by the immense accession of the growing West, the whole course of American history was changed. In this view Webster became, not the destroyer but the saviour of his country, and it must at least be believed that such salvation was mainly what he aimed at.

Under Fillmore, he had to be content with the secretaryship of State, and he filled this office until the condition of his health became so critical that work of any kind was out of the question. Perhaps the most notable of his later official acts was his sharp correspondence with the Austrian *chargé* Hülsemann in regard to the affairs of Hungary. Webster died on Oct. 24, 1852.

The details of Webster's death have been recorded with curious minuteness by his biographer, Curtis. The dying statesman first delivered a senatorial oration on religious matters, perhaps, like most of his talk on such subjects, more eloquent than convincing. The exhaustion of this prostrated him for the moment. When he again came to himself, his words were: "Have I—wife, son, doctor, friends, are you all here?—have I, on this occasion, said anything unworthy of Daniel Webster?" And the audience unanimously answered, "no." It would be hard to find a more fitting final utterance for a man who had lived for 50 years in the statuesque pose.

Yet it is fair also to remember that Webster's last preoccupation on the less personal side was with his country, and he directed that the American flag should be kept flying at the masthead of his little yacht, with a light cast upon it at night, so that he could see it as long as he could see anything.

Webster's writings are best studied in the complete edition, 18 vols., 1903. This includes the two volumes of correspondence published earlier by his son. A large amount of further correspondence was published by Van Tyne in 1902. The two-volume *Life*, by Curtis (1869), is a storehouse of material, but is eminently partial to the subject. H. C. Lodge's "Life," in the *American Statesman* series, is brilliantly written, but under strong Republican and anti-slavery prejudices. *The True Daniel Webster*, by Fisher (1911) is sympathetic, and defends Webster where he most needs it. The *Life* by Ogg (1914), is critical and dispassionate. The *Reminiscences* of Lanman and Harvey are suggestive, but not always reliable. The writer of this article, whose grandfather was Webster's law partner, possesses a desk and a dispatch box which belonged to Webster. In the desk are a number of unpublished documents tending to support the statements made above as to Webster's financial habits. *See* also Allan L. Benson, *Daniel Webster* (1929). (G. B.)

WEBSTER, JOHN (fl. 1602–1624), one of the greatest tragic writers in English literature. Of his life almost nothing is known. It is said that he was the son of a London tailor; and we learn from his own Preface to the pageant called *Monuments of Honour* that he was a member of the Merchant Taylors' Company and "born free" of it. But this does not prove that either he or his father ever actually plied the needle. It might be gathered from the ambiguous classical knowledge exhibited in his writings that he was educated at some school of repute; but his close association with so good a scholar as Heywood gave him many opportunities of picking up the scraps of Martial and Horace which adorn his pages. Reasons have been given for placing his birth about 1580; and, as we hear nothing of him after 1625, he may have died in that year. These uncertainties are intensified by the fact that several persons of that time are known to have borne his name.

At what date he "commenced playwright" is uncertain. We learn from Henslowe's diary that he collaborated with Drayton and others in *Caesar's Fate*, 1602, and with Chettle, Dekker and Heywood in *Christmas comes but once a year*. Somewhat later his name appears with that of Dekker as part-author of *Westward Hoe* and *Northward Hoe* and in 1604 he contributed the induction to Marston's *Malcontent*. In 1607 "Mr. Dickers and Mr. Webster" appear on the title-page of *The Famous History of Sir*

Thomas Wyat, a play which had no fewer than five authors and at least two titles (it is an abridgment of *Lady Jane*).

This habit of collaboration perplexes the critic who endeavours to appraise merit or mark progress in style. One collaborator may easily fall into the manner of the other, and it is not impossible that the authors themselves, after a few years, would be unable to name their own portions. Unerringly to trace the hand of Webster through Elizabethan drama is now impossible, though students still essay the task. Mr. Sykes thinks he had a share in *Anything for a Quiet Life,* usually ascribed to Middleton, and in the *Fair Maid of the Inn,* perhaps by Massinger and Ford but printed as Beaumont and Fletcher's. Mr. Sykes may be right, and has the weighty support of Mr. Lucas; but it is certain that others have been wrong. Thus in 1661 *A Cure for a Cuckold* and *A Thracian Wonder* were ascribed by the publisher Kirkman, probably without the slightest traditional justification, to Webster and Rowley. The former, as a whole, seems to bear rather the mark of Heywood than of either of the assigned authors; but there is in it an episode easily detachable from the rest and of some merit, which Gosse and Spring Rice, in 1885, printed separately under the title of *Love's Graduate,* with the wish rather than the assurance that it might be "a piece of silver-work by the sculptor whose other groups are all of bronze." As *The Guise* and *The Late Murther of the Sonne upon the Mother* (this latter partially by Ford) are alike lost, conjecture may here disport itself without danger either of proof or of confutation.

The case of *Appius and Virginia* is more important, for on the decision as to its genuineness must rest our idea of the width and range of Webster's genius. Except for a few remarkable passages, this excellent play differs in every way from Webster's certain work. The only external evidence is the statement of an unknown publisher in 1654, repeated by Humphrey Moseley in 1659; but Webster's authorship was never doubted till in 1911 Rupert Brooke submitted the play to a careful analysis and finally, on grounds of style and vocabulary, ascribed it to Heywood. The present writer, after carefully considering Brooke's arguments, and comparing the play with Heywood's undoubted works (especially with the *Rape of Lucrece*) is inclined to believe that Brooke has made out his case. If so, we are, in forming our judgment on Webster's powers, limited to the three undoubtedly genuine works, *The White Devil,* the *Duchess of Malfy,* and the *Devil's Law Case.*

The last, though considerably the latest of the three—it is dated 1619 or 1620—may be taken first, and can be easily dismissed. It is a clumsy, involved, inartistic tragicomedy, in which the happy ending is brought about by the violation of all probability. With many reminiscences of the older and better time, it marks the transition to the later and worse fashion of the Caroline drama. Its chief merits lie in occasional flashes of Webster's characteristic murky imagery and daemonic forcefulness of phrase. There are also some touches of a shrewd satirical observation which, though not always dramatic, is in itself exceedingly striking.

But it is on the two great tragedies that Webster's fame must always rest. *The White Devil,* based on actual events of then recent date, was published in 1612, with a preface that interests by its tersely-worded appreciations of contemporary writers; and, as we know that Webster was a very slow worker, may be dated 1610. *The Duchess of Malfy,* founded ultimately on a novel of Bandello's, cannot be later than 1614; for the researches of Charles Wallace have shown that William Osteler, who acted in it, died that year. The two plays, therefore, were written with the combined daring of youth and solid strength of manhood. They have been said to belong to the "Tragedy of Blood," and they certainly have much in common with Kyd's *Spanish Tragedy* on the one hand and with *Hamlet* on the other. But perhaps it would be better—if classify we must—to regard them as a fusion of the Blood-Tragedy with the "Machiavellian" type of which *Othello* is the supreme example—that type in which further use is made of the Elizabethan conception of a contemporary Italy, rich in all the resources of culture, and permeated with all the vices of decadence. In it the essential element is the villain, endowed with matchless cunning, a hatred of good for its own sake, and a plentiful lack of conscience. To the exhibition of this conception Webster brought a certain Juvenalian *indignatio* which informs the work from beginning to end. The dramatic technique, coldly considered, is often lamentable; whole scenes are irrelevant, characters start up at random, and description too often takes the place of action. With every allowance for the fact that the plays were greatly shortened for the stage, these defects are serious, and go far to explain the repugnance of such critics as William Archer. But they are far outweighed by stupendous merits—in fact by the irresistible power of genius, often it is true "sufflaminandus," but conquering every obstacle like a rushing torrent. There is nothing of the icily regular about Webster. He dares all, and either vanquishes or fails. The main secret of his lasting appeal (an appeal perhaps stronger than ever to-day, to a generation that has supped full of the horrors of war) is his accumulation of catastrophe on catastrophe, his sense of the ghastly in little things, his power of symbolic hinting, and what we may call his sublimation of the pathetic into the portentous. To convey all this he has, when at white heat, a gift of brief expression, charged with the fullest meaning, unmatched except in Shakespeare. The famous "Cover her face, mine eyes dazzle, she died young," is only a supreme instance out of scores. In the face of this, criticism has to hold its peace; or, if it speaks at all, takes the form of such imitation as Shelley gives us in the *Cenci.*

Webster's works were edited by Dyce (4 vols., 1830) and inaccurately; W. C. Hazlitt (4 vols., 1857), but all previous editions are superseded by that of F. L. Lucas (4 vols., 1927, bibliog. in vol. I.). *The White Devil* and *the Duchess,* Symonds (1888) and Sampson (1904).

Criticism, Lamb, *Specimens* (1808); Swinburne, *Age of Shakespeare* (1908); Sidney Lee, *Dict. Nat. Biog.* (1899) (needs correction as to facts); Gosse, *Seventeenth Cent. Studies* (1883); Symonds, *Italian By-ways* (1883). On the story of Vittoria Accoramboni, *see* Trollope in *All the Year Round,* 1860.

The most important recent works are E. E. Stole, *John Webster* (1905); Rupert Brooke, *John Webster and the Elizabethan Drama* (1913) (valuable as the appreciation of a poet by a poet), and for its bibliog. and Lucas's introductions (especially on Webster's so-called plagiarisms from Sidney, Montaigne, etc.). (E. E. K.)

WEBSTER, NOAH (1758–1843), American lexicographer and journalist, was born at West Hartford, Conn. on Oct. 16, 1758. He was descended from John Webster, of Hartford, governor of Connecticut in 1656–57, and on his mother's side from Governor William Bradford, of Plymouth. He worked on his father's farm while preparing for Yale, graduated in 1778, taught in village schools, studied law, and was admitted to the bar at Hartford in 1781. In 1783–85 he published at Hartford *A Grammatical Institute of the English Language* in three parts, a spelling-book, a grammar and a reader. This was the pioneer American work in its field and because of its useful simplification of English spelling and its patriotic nature it soon found a place in most of the schools of the United States. During the 20 years in which Webster was preparing his dictionary, his income from the spelling-book was the chief source for the support of his family; and before 1861 the sale reached more than a million copies a year. He did some political writing, and himself regarded his *Sketches of American Policy* (1785) as the first distinct proposal for a U.S. constitution. In 1788 he started in New York the *American Magazine,* but it failed at the end of a year, and he resumed the practice of law at Hartford, where he enjoyed the congenial companionship of the "Hartford wits." In 1793, in order to support Washington's administration and oppose the designs of Genet, he established a daily paper, the *Minerva* (afterwards the *Commercial Advertiser*), in New York and in connection with it a semi-weekly paper, the *Herald* (afterwards the *New York Spectator*). The remainder of his life was spent in New Haven, Conn., and Amherst, Mass., in both places holding various public posts, including membership in the Connecticut House of Representatives and a county judgeship, but he devoted himself primarily to linguistic studies. In 1806 he brought out *A Compendious Dictionary of the English Language* which contained much encyclopaedic information, and in 1807, *A Philosophical and Practical Grammar of the English Language.* He began his great dictionary the same year. In 1824–25 he worked on this in France and

England, finishing his manuscript at the University of Cambridge. *The American Dictionary* came out in 1828 in two volumes. It contained 12,000 words and from 30,000 to 40,000 definitions that had not appeared in any earlier dictionary. An English edition soon followed. In 1840 appeared the second edition, corrected and enlarged. Webster completed the revision of an appendix a few days before his death, which occurred in New Haven on May 28, 1843. Many revisions and abridgments have since appeared. Amongst Webster's other works may be mentioned *Dissertations on the English Language* (1789); *The Rights of Neutral Nations in Time of War* (1802) and *A Collection of Papers on Political, Literary, and Moral Subjects* (1843) and Governor John Winthrop's *Journal* in 1790.

See *Memoir of Noah Webster* by his son-in-law, Prof. Chauncey A. Goodrich, in the quarto editions of the *Dictionary; Noah Webster* (1881), by H. E. Scudder, in "American Men of Letters"; and *Notes on the Life of Noah Webster* by a grand-daughter, Emily E. F. Ford (1912), which contains many letters.

WEBSTER, a town of Massachusetts, U.S.A., on the Maanexit river. Pop. 12,992 in 1930 and 13,186 in 1940 federal census. Within the town's area is beautiful Lake Chaubunagungamaug (2 sq.mi.). Manufactures of textiles, boots, etc., had a value in 1937 of $10,040,783. Webster was founded by Samuel Slater (1768–1835) who established cotton mills there in 1812 and woollen mills in 1815. The town was named after Daniel Webster.

WEBSTER GROVES, a city of St. Louis county, Missouri, U.S.A. Pop. (1920) 9,474 (89% native white) and 18,394 in 1940 by federal census. It is the seat of Webster college (Roman Catholic; 1916) and of German Evangelical Missouri college (1850).

WEDDING, the ceremony or festivities attending marriage. See MARRIAGE. The chief anniversaries and the kind of gift appropriate to such anniversaries are: fifth year, wood; tenth year, tin; fifteenth year, crystal; twentieth year, china; twenty-fifth year, silver; fiftieth year, gold; sixtieth year in Great Britain, diamond; seventy-fifth year in America, diamond.

WEDEKIND, FRANK (1864–1918), German dramatist, was born in Hanover on July 24, 1864. In 1883 he took up journalism. Afterwards he became an advertising manager and then, in 1890, secretary of a circus. In 1897 he set up as an actor and producer acting in his own dramas. His dramatic works include: *Frühlings Erwachen* (1891), *Erdgeist* (1895), *Der Marquis von Keith* and *Die Kammersänger* (1900), *Die Büchse der Pandora* (1903), *Schloss Wetterstein* (1910) and *Franziska* (1911). Wedekind's plays are written in a difficult symbolic style. Their preoccupation with erotic themes awoke much opposition, and he served a term of imprisonment in Munich for *lèse-majesté*. Wedekind also wrote poetry (*Die Vier Jahreszeiten*), novels, *Mine-Haha* (1906), etc., and essays. He died in Munich on March 9, 1918. *See* A. Kutscher, *Frank Wedekind* (1922–24).

His *Works* were published in 8 vols., 1912–19. Certain plays were translated into English by S. A. Eliot, Jr., New York.

WEDGWOOD, JOSIAH (1730–1795), was born on July 12, 1730, and died on Jan. 3, 1795. He was the youngest child of Thomas Wedgwood, a potter, of Burslem, and came of a family of which many members had been notable potters in Staffordshire in the 17th century. Soon after the death of his father in 1739 Josiah learned, and became extraordinarily skilful in, the art of shaping pottery on the wheel.

In 1744 he was apprenticed to his eldest brother, and in 1752 became manager of a small pottery at Stoke-upon-Trent, known as Alder's. Within a year or two he became junior partner with Thomas Whieldon of Fenton, then the cleverest master-potter in Staffordshire, many of whose apprentices afterwards became noted potters. In 1759 he began work on his own account at the Ivy House pottery in Burslem. Salt-glaze and green and yellow glaze seem to have been his first staples. In 1762 he also leased the Brick House, alias "Bell" works, at Burslem. The fine white English earthenware was just reaching perfection, and Wedgwood became one of its best-known makers. He was most active in his efforts for the improvement of turnpike roads, the construction of a canal (the Trent and Mersey) and the founding of schools and chapels. He presented a service of his improved cream-coloured earthenware (to which he gave the name of Queen's Ware) to Queen Charlotte in 1762, and was appointed potter to the queen and afterwards to the king. Next he turned his attention to artistic pottery and found his inspiration in the European renaissance of classic art, fostered by the discovery of Pompeii and the recovery of Greek painted vases from the ancient graves in Campania and other parts of Italy. Wedgwood was particularly successful in this direction, for his "dry" bodies —some of which, like the black and cane bodies, had long been known in the district, while others, such as the famous Jasper bodies, he invented after years of laborious effort—lent themselves particularly well to the reproduction of designs based on the later phases of Greek art. The most famous of Wedgwood's artists was John Flaxman. His works at Hanley were called "Etruria" where his descendants have carried on the business and established a Wedgwood museum of great interest. (*See* CERAMICS.)

BIBLIOGRAPHY.—For detailed accounts of his life *see* Eliza Metyeard, *Life of Wedgwood* (1865–66); L. Jewitt, *Life of Wedgwood* (1865); F. Rathbone, *Old Wedgwood* (1893); A. H. Church, *Josiah Wedgwood: Master-Potter* (1894; new ed., 1903); W. Burton, *History and Description of English Earthenware and Stoneware* (1904); J. C. Wedgwood, *A History of the Wedgwood Family* (1909); F. J. Wedgwood, *The Personal Life of Josiah Wedgwood* (1915).

WEDNESBURY, municipal borough of Staffordshire, England, 8 mi. N.W. of Birmingham. Pop. (est. 1938) 33,370. Area 3.2 sq.mi. An electric tramway connects with Walsall. The church of St. Bartholomew, a fine Perpendicular building, is supposed to occupy the site of a place of the worship of Woden or Odin—hence Wednesbury (Wodensborough). There are iron and steel works, producing every kind of heavy goods. Similar industries, with brick-making, are practised at Darlaston, an urban district (pop. est. 1938, 20,290), within the parliamentary borough.

Here Ethelfleda in 916 constructed a castle. The place is not mentioned in Domesday. After the Conquest it became a demesne of the crown, and was bestowed by Henry II on the Heronvilles. It became a parliamentary borough in 1867, an independent borough in 1885, returning one member, and a municipal borough in 1886. A town planning scheme was prepared during World War II.

WEED, THURLOW (1797–1882), American journalist and politician, was born in Cairo, N.Y., on Nov. 25, 1797. Weed was in 1824 elected to the New York assembly on the John Quincy Adams ticket, serving for a single session (1825). During the excitement over the disappearance of William Morgan (*see* ANTI-MASONIC PARTY), he retired from the *Telegraph* and threw himself with enthusiasm into the attack on the Masonic order, editing for a time the *Anti-Masonic Enquirer*. In 1830 he established and became editor of the *Albany Evening Journal*, which he controlled for 35 years. Supporting the Whigs and later the Republicans, it was one of the most influential anti-slavery papers in the north-east. He died in New York on Nov 22, 1882.

See *The Life of Thurlow Weed* (vol. i., Autobiography, edited by his daughter, Harriet A. Weed; vol. ii., Memoir, by his grandson, Thurlow Weed Barnes, Boston and New York, 1884). The Memoir is especially full for the period 1850–67.

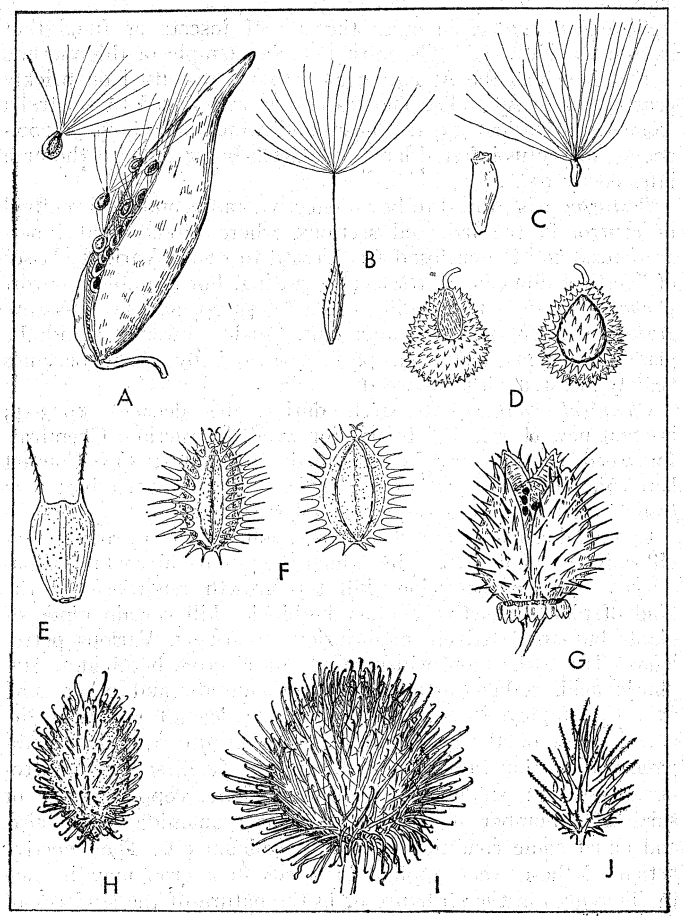
WEEDS. There are no species of weeds. Whether a plant of a given species is a weed depends not only on its characteristics and habits but also on its relation to other plants and to man. Weeds have been defined as plants whose virtues have not yet been discovered or plants growing where they are not wanted. The same species may be considered a weed or not a weed depending upon where it grows.

Characteristics.—Weeds possess certain harmful or objectionable habits or characteristics which enable them to grow where they are not wanted, especially where it is desired to grow other plants. They are not as exacting in the conditions required for growth as are most crop plants. Many weeds, especially perennials, regenerate lost parts and spread vegetatively by creeping rootstocks or roots. Others have reduced leaves, or modified stems, or underground storage organs enabling them to grow under adverse conditions and to win in competition with crop plants.

Many weeds produce enormous numbers of seeds per plant. Single plants of some common weeds matured the following numbers of seeds in one season: tumbling mustard (*Sisymbrium altissimum*) 511,208; black mustard (*Brassica nigra*) 58,363; tumble-

weed (*Amaranthus graecizans*) 180,220; pigweed (*Amaranthus retroflexus*) 196,405; fleabane (*Erigeron canadensis*) 243,375; nightshade (*Solanum nigrum*) 178,000; purslane (*Portulaca oleracea*) 193,213.

Some weed seeds may remain alive for many years, especially if buried in the soil. Seeds of the following weeds were still capable of germinating after they had been buried in soil for 50 years: black mustard (*Brassica nigra*), curled dock (*Rumex crispus*), evening primrose (*Oenothera biennis*) and moth mullein (*Verbascum blattaria*). Seeds of many of the most noxious weeds of arable land will retain their viability in soil for at least 20 years. The seeds of velvet-leaf (*Abutilon theophrasti*) will germinate well after having been stored dry for 70 years.



FROM "WEEDS" BY W. C. MUENSCHER COPYRIGHT 1936. THE MACMILLAN CO.

FRUITS AND SEEDS OF WEEDS SHOWING MODIFICATIONS FOR DISSEMINATION

A, Common Milkweed; B, Dandelion; C, Canada Thistle; D, Hounds-Tongue; E, Beggar-Ticks; F, Wild Carrot; G, Jimson-Weed; H, Cocklebur; I, Burdock; J, Sandbur

The seeds or fruits of many weeds are modified for dispersal by special agents. Many compositae, such as the thistles and dandelions, have a pappus that aids in wind dissemination. Other weeds like cocklebur, burdocks, beggar-ticks and sandburs bear hooks or spines by which they cling to the fur of animals. Tumbleweeds break off at the ground level and are blown over the ground, scattering seeds along their path.

Many weeds ripen their seeds about the same time as the crop among which they grow is mature. Such seeds are frequently similar in size, shape or weight to crop seeds and, because of the difficulty of separation, are carried by and sown with the crop seed. This accounts for the frequent association of narrow-leaved plantain (*Plantago lanceolata*) and night-blooming catchfly (*Silene noctiflora*) with red clover and of sheep sorrel and witch grass with white clover.

Dissemination.—Most weeds are successful travellers. This is largely due to the action of various forces or agents by which they are transported or scattered about—man, wind, water and animals. These agents have been so effective that many weeds are so widely scattered that they appear wherever conditions for growth are favourable.

Man himself has been one of the most important agents in weed dissemination. He has frequently carried their seeds across natural barriers such as the deserts, oceans or mountains. Some species have been introduced into new regions as ornamentals and then allowed to escape; others are carried about as impurities in agricultural seeds, with hay and feedstuffs and in packing materials. Seeds of many weeds are scattered from farm to farm with manure or by seeding and cultivating implements or harvesting machinery.

The most noxious and widespread weeds of temperate regions have been spread from Europe, or through Europe from Asia, by importations of agricultural seeds. In this group belong such pests as European bindweed, perennial sow-thistle, Russian knapweed, perennial peppergrass, Canada thistle, Russian thistle, sheep sorrel, quack grass, crab grass, narrow-leaved plantain, wild carrot and dandelion.

Injurious Effects.—Weeds reduce the yield of crops, increase the cost of operations connected with the production of crops, and produce injuries to certain crops and livestock. Weeds growing among crop plants compete with them for water, mineral nutrients and sunlight. They are often better adapted than crop plants to win out in the struggle for water, nutrients and light. Unless the weeds are eradicated or controlled the crop plants are "crowded out" or their yield is much reduced.

Tillage operations necessary to control weeds frequently require an expenditure of labour equal to from 10% to 30% of the value of the crop produced. Numerous weeds are susceptible to fungi, bacteria and viruses which are transferred to crop plant hosts. The presence of such weeds makes it difficult to control diseases of crops caused by such organisms. Many insect pests of crops spend certain stages of their life cycle on weeds or live on weeds until crop plants are available. Several common weeds are poisonous when eaten by stock; others produce sharp spines or awns that cause mechanical injury to animals.

Although weeds are usually condemned because of the harm they do, some are useful in that they supply forage and seeds for food for domestic animals and particularly for wild animals. Weeds are often very effective in preventing erosion. They are among the pioneers to heal over the scars made on the earth's surface by man, and they first cover over the denuded areas made by him until more desirable plants take their place. (W. C. M.)

Weed Control.—The destruction of weeds becomes an economic necessity, because weeds are plants which compete with crops for water, light and mineral nutrients, increase the cost of labour and equipment, impair the quality of farm products, harbour insect and fungous pests that attack crop plants, reduce yields, cause depreciation of land values, in some cases result in the death of livestock, and not infrequently impair the health of human beings. The total annual loss from weeds in the United States is estimated to be about $3,000,000,000. Weeds are of concern to the large land owner, the small farmer, home gardener, orchardist, vineyardist, to highway, railroad and irrigation engineers, and keepers of parks, golf courses and cemeteries.

Basic considerations in weed control are recognition of the methods by which weed seeds are transported, and prevention of new infestations. Weed seeds, and sometimes other parts of the plant, are disseminated by wind, water, animals, and especially by man. They are transported in shipments of agricultural seeds, in screenings, hay, feedstuffs, nursery stock, in dirt, sand and gravel, in soil adhering to cultivating implements, in threshing machines, hay balers and portable seed cleaners.

The life history of weeds is related to methods of their control. Annual weeds live but one year; they reproduce by seed only. All methods of controlling annuals have one purpose: the prevention of seeding. This may be attained in different ways: hand pulling, hoeing and spudding, tillage, mowing, burning and chemical treatment. The younger the weed the more easily and cheaply is it killed.

Biennial weeds live two years. The first season's growth is

vegetative, the top growth usually being a rosette of leaves which, with the roots, lives over the winter; in the second season seed is formed, after which the plant dies. Biennial weeds are controlled like annuals, preferably the first season.

Perennial weeds live for three or more years. Of these, the creeping perennials, such as wild morning-glory (European bindweed), Canada thistle, perennial sow thistle, quack grass, etc., are the most difficult to destroy. They propagate both by seeds and by roots and rootstocks. Therefore, top growth may be destroyed and seed production prevented, but new shoots come up repeatedly from underground organs. Methods of controlling perennial weeds include chiefly tillage, cropping and competition, smothering, chemical treatment, and combinations of the foregoing. Methods of weed control may be classified as follows: (1) mechanical methods, including hand pulling, hoeing and spudding, tillage, mowing, flooding, burning and smothering with non-living materials; (2) cropping and competition methods; (3) biological methods, involving the use of parasites, and pasturing; and (4) chemical methods.

Hand pulling of individual weeds is a practical method of eliminating weeds in home gardens and within the rows and hills of certain cultivated crops. The method is usually confined to annuals and biennials. It has long been a practice to pull objectionable weeds in grain fields, in case there are relatively few scattered plants.

Hand hoeing of weeds is an indispensable practice in garden culture and as a supplement to tillage in all kinds of row crops. Scattered weeds in pastures and meadows are usually more cheaply destroyed by hoeing than by any other method.

Tillage alone, or in combination with cropping methods, usually is the most economical method of controlling weeds of all classes: annuals, biennials, perennials. The principal function of tillage in crop production is weed extermination rather than its effect on the physical properties and the chemical and biological activities of the soil.

Tillage destroys top growth and prevents seeding; thus, it is effective in destroying annuals and biennials; also, it creates conditions that encourage the germination of weed seeds in the soil; and, if timely tillage follows, the seedlings are destroyed.

With deep-rooted perennials, the object of tillage is to exhaust food reserves in roots and rootstocks by repeated destruction of top growth. In the western United States, large acreages of land have been successfully cleared of wild morning glory by tillage alone. By a study of the seasonal trend of root reserves in this perennial weed in relation to frequency of cultivation and time of beginning cultivation, it has been demonstrated that the time interval between cultivations may be lengthened with no disadvantage and with distinct benefit. Whereas the older recommendation was to cut the weeds below the ground level every 7 days, it is now the practice to cultivate from 6 to 12 days after new shoots emerge. Two weeks is becoming the standard interval between cultivation in Great Plains states.

With most deep-rooted perennials, one or more seasons of tillage, with the proper interval between successive operations, may bring about sufficient reduction in the weed population such that crops may be grown with success.

Mowing is chiefly employed to prevent weed seed production along roadsides, in waste places, and in meadows and pastures. Other methods are more effective in combatting perennials.

Flooding is successful in controlling certain perennial weeds. The infested area is first plowed, then surrounded by dikes, and covered with 6 to 10 in. of water for several weeks in the summer. It is important to have complete and continuous coverage during the period of submergence, inasmuch as flooding kills plants by excluding air.

Burning is used to destroy matured weeds or those killed by spraying or mowing. Burning, however, is not particularly effective as a weed control measure. Even seeds on the soil surface are not all destroyed. Weed burners of various types using gaseous and liquid fuels are available. In certain western states the channels and banks of irrigation ditches and drainage canals are periodically burned to keep the water flow normal.

Smothering weeds with non-living material, such as straw, hay, manure and paper is sometimes practiced. As a rule, other methods are more efficient. On sugar and pineapple plantations in the Hawaiian Islands, however, paper mulching is effective and economical.

Competition methods of weed control refer to the use of competitive or "smother crops," such as millet, Sudan grass, sweet clover, alfalfa, sunflower, rape, barley, rye, sorghum, buckwheat, soybeans, cowpeas, clovers, hemp and ensilage corn, which successfully compete with weeds for water, light and mineral nutrients. Particularly encouraging has been a combination of competitive crops and tillage in the control of deep-rooted perennials.

Biological control involves the use of insects or fungi that live on specific weeds. The most notable example of this method is that in which the Argentine moth borer was used on prickly pear cactus in Australia. The insect was introduced to Australia from Argentina in 1925. In Queensland, which had about 50,000,000 ac. of cactus-infested lands, the moth borer reduced the area infested by 95%.

Pasturing has proved to be an effective and economical method of control in the irrigated sections, where ditches and canals are fenced and the enclosed area grazed to sheep. Various classes of livestock differ in their selective grazing. For example, ragwort (*Senecio jacobaea*) is readily eaten by sheep, and in a pasture grazed by them is seldom abundant. Cattle, however, avoid the plant, and consequently a pasture grazed by them becomes heavily infested with this weed.

Chemical control.—Research during the decades 1923–43 brought new chemicals into use for weed destruction. Chemicals for weed control may be classified as follows: (1) Contact herbicides including (a) nonselective and (b) selective; (2) translocated herbicides; and (3) soil sterilants.

Contact herbicides are chemicals, applied to top growth, that kill only the plant parts with which they come in contact. Nonselective contact herbicides kill top growth regardless of the kind of plant. Selective contact herbicides kill certain kinds of plants but are relatively noninjurious to others. Various petroleum oils are the most widely used nonselective herbicides. Sulphuric acid, sodium arsenite, sodium chlorate and other salts are also employed; a spreader (wetting agent) enhances the effectiveness of these. Selective sprays in use are nitro compounds of various aromatic hydrocarbons (*e.g.*, sodium dinitro-orthocresylate), sulphuric acid, iron sulphate, copper nitrate or sulphate, a number of dry dusts such as cyanamide and kainite, and under some conditions certain petroleum oils. The selective action of these when applied to weeds in a crop may be due to differences in the structure or in the nature of the surfaces of the plants; for example, cereals and other grasses, flax, onions, garlic, peas and other legumes are tolerant of sodium dinitro-orthocresylate, but broad-leaved annual weeds are killed. Or, the selective action may be due to differences in physiological tolerance; for example, carrots, celery and other members of the carrot family, and guayule (a rubber plant) are tolerant of stove-top oil (37.6° to 38.7° gravity), whereas most weeds, including grasses, are killed.

Translocated herbicides are used to kill deep-rooted perennials. They include chemicals which, when applied as a spray to the tops of weeds, not only kill the tissues contacted but enter the conducting tubes of the plant and are carried deep into the roots. The principal translocated herbicides are sodium arsenite, arsenic acid, arsenic trichloride and sodium chlorate. The "jar" or "dipping" method is a modification of the arsenical spray and is useful in killing individual weeds like wild morning-glory in gardens. The tops of the plant are forced into a glass jar or tin can, containing a 1% sodium arsenite solution. The arsenic is drawn into the plant, and penetrates deep into the roots. Adjacent plants are uninjured, and the small residue of arsenic in the soil is harmless. Soil sterilants are chemicals which destroy weeds through direct contact with the roots. The principal ones are carbon bisulphide, sodium chlorate, chloropicrin, borax and

borate ores, sodium arsenite and arsenic trioxide. Carbon bisulphide, a volatile liquid, is injected into the ground, where it diffuses, killing all root tissues with which it comes in contact. It is used extensively to combat deep-rooted perennials. After several weeks the area may be cropped. Sodium chlorate is applied as a spray, or dry. Sufficient rainfall or irrigation water must be available to carry the chemical to the root zone.

Crops cannot be grown on the treated area until the chemical is leached out. Chloropicrin, a colourless liquid, is injected into the soil. It kills weed seeds as well as the roots. But its high cost has limited its use to small infestations.

Borax and borate ores, sodium arsenite and arsenic trioxide are fairly permanent soil sterilants. They find use around fences, along ditches and roads, in parking areas, mill yards, about sign boards, airports, telephone and power-line poles, and other places where no weed growth is desired and where cropping is not intended.

The method of attack on a specific weed problem is determined by several factors: species and habit of weed, type and location of the infestation, relation of the weeds to crop plants of the area, farm practices, soil and climate, and value of the land and crops raised upon it. Tillage and cropping plus good farming are basic in weed control; herbicides have a place but should not be used without consideration of other methods, costs, effect upon the soil, and danger to animals and human beings.

Special machinery has been developed for applying herbicides. These include hand- and power-operated spray equipment, applicators for injecting carbon bisulphide and other liquids into the soil, and applicators for dry chemicals. In the grain sections of the west use is made of tractor-drawn spray rigs with a boom 40 ft. or more long, capable of spraying 120 ac. or more per day. Special types of knives and tillage tools and various kinds of burners are available for weed control. Certain herbicides are also applied by aeroplane. (W. W. Rs.)

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WEEHAWKEN, a township of New Jersey, U.S.A. Pop. 1930 federal census, 14,807; 1940, 14,363. It is a narrow strip along the Hudson, at the southern extremity of the Palisades. On a ledge below the crest of the Palisades is the famous duelling ground which was the scene of the encounter between Hamilton and Burr. Weehawken was incorporated in 1859. The name is an Indian word, said to mean "maize land."

WEEK, the name given to periods of time, varying in length in different parts of the world, but shorter than a "month" (from A.S. *wicu,* Germanic *wikôn,* probably "change," "turn"). The month may be divided in two ways: a fractional part may be taken (decad or pentad), as in east Africa or ancient Egypt (moon-week), or the week may be settled without regard to the length of the month (market-week, etc.). The seven-day week (*see* CALENDAR) originated in west Asia, spread to Europe and later to north Africa (Mohammedan). In other parts of Africa three, four (especially in the Congo), five, six and eight (double four) day weeks are found, and always in association with the market.

In ancient Scandinavia a five-day period was in use, but markets were probably unknown. That the recurrence of the market determined the length of the week seems clear from the Wajagga custom of naming the days after the markets they visit, as well as from the fact that on the Congo the word for week is the same as the word for market. Among agricultural tribes in Africa one day of the week, which varies from place to place, is often a rest-day, visiting the market being the only work allowed.

WEEKS, JOHN WINGATE (1860–1926), American public official, was born at Lancaster, N.H., on April 11, 1860. He graduated from the U.S. Naval Academy in 1881, and became assistant land commissioner of the Florida Southern railroad. In 1886 he helped to organize the banking and brokerage firm of Hornblower and Weeks, Boston, Massachusetts, of which he was a member until 1912. In 1890 he joined the Massachusetts naval brigade, and he served in the Spanish-American War. During 1905–13 he took an active part in framing the Aldrich-Vreeland Currency bill. In 1913 he entered the U.S. Senate, but was defeated for re-election in 1919. In 1921 he entered the cabinet of President Harding as Secretary of War, serving also in the same post under President Coolidge. He died at Lancaster, N.H., on July 12, 1926.

WEELKES, THOMAS (d. 1623), English madrigal composer. His name first appears in connection with the publication of his first book of madrigals for three, four, five and six voices in 1597; and as he alludes in 1598 to his "yeeres yet unripened" in a volume of *Balletts and Madrigals,* dedicated to Edward Darcye, groom of the privy chamber, his birth may be placed somewhere between 1570 and 1580. He was at one time organist of Winchester college, and on July 16, 1602, took his degree of Mus. B. from New college, Oxford. An appointment as cathedral organist at Chichester followed, and the rest of his life was probably spent in that city. There is a six-part madrigal, "As Vesta was from Latmos," in the *Triumphs of Oriana* (1601), a famous collection by Thomas Morley, to whose memory Weelkes paid a tribute in his "a Remembrance of his Friend Thomas Morley" in *Ayeres or Phantastique Spirites* (1608). Weelkes's will was made on Nov. 30, 1623, and he probably died on that day, as his burial took place on Dec. 1, 1623, at St. Bride's, Fleet Street, London. In 1923 tercentenary tablets were placed in that Church, at Winchester, and at Chichester.

In addition to the above-mentioned publications, Weelkes brought out a set of five-part and another of six-part madrigals in 1600. In the latter part of his life he wrote a great quantity of church music, of which very little has been printed. This includes 32 anthems, and six services. His first book of madrigals was reprinted in 1843 by the Musical Antiquarian Society. "Grace, my lovely one" was edited by W. Barclay Squire from the ms. in the British Museum. The *Balletts and Madrigals* (1598) and the *Ayeres or Phantastique Spirites* (1608) were published in Arkwright's *Old English Edition* (1889–1902). Weelkes also wrote a few pieces for viols.

WEENIX, JAN BAPTIST (1621–1660), Dutch painter, the son of an architect, was born in Amsterdam, and studied first under Jan Micker, then at Utrecht under A. Bloemaert, and at Amsterdam under Moijaert, and finally, between 1643 and 1647, in Rome. In that city he acquired a great name and worked for Pope Innocent and Cardinal Pamphili. He returned to Holland in 1649, in which year he became master of the gild of St. Luke at Utrecht, where he died in 1660. He was a very productive and versatile painter, his favourite subjects being landscapes with ruins and large figures, seaports, and, later in life, large still-life pictures. His son Jan, Berchem, and Hondecoeter were his pupils.

His son, JAN WEENIX (1640–1719), was born at Amsterdam and was a member of the Utrecht gild of painters in 1664 and 1668. His fame is chiefly due to his paintings of game and of hunting scenes, and many of the pictures of this genre, formerly ascribed to the elder Weenix, are now generally considered to be the works of his son, who even at the age of 20 rivalled, and subsequently surpassed, his father in breadth of handling and richness of colour. At Amsterdam he was frequently employed to decorate private houses with wall-paintings on canvas; and between 1702 and 1712 he painted an important series of large hunting pictures for the Prince Palatine Johann Wilhelm's castle of Bensberg, near Cologne. Some of these pictures are now at Munich. He died at Amsterdam in 1719. Many of his best works are to be found in English private collections, though the National Gallery has but one example, a painting of dead game and a dog.

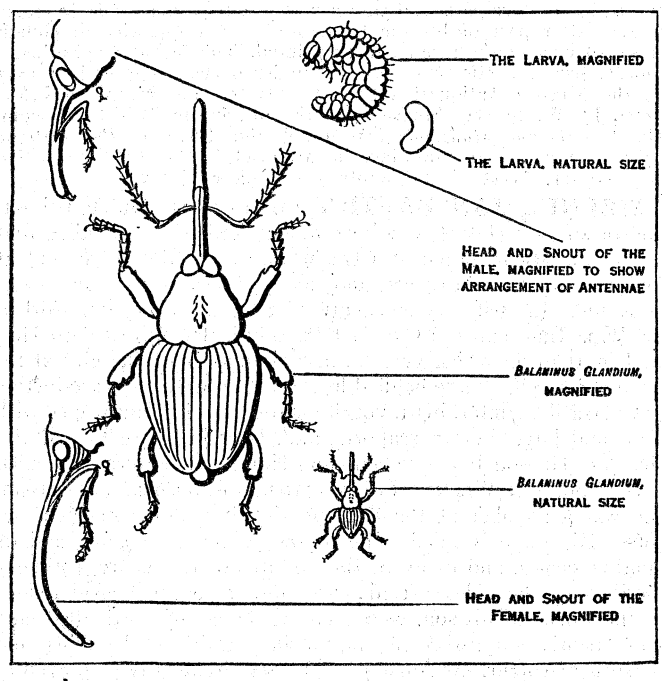
WEEVER, or WEAVER. The weevers (*Trachinus*) are small marine fishes common on the coasts of Europe. They belong to a family of spiny-rayed fishes (Trachinidae), and are distinguished by a long low body with two dorsal fins, the anterior of which is composed of six or seven spines only, the posterior being long and many-rayed. The ventral fins are placed in advance of the pectorals. The upper surface of the head is bony, without skin.

Several species are known, but two only occur on the British coasts, viz., the Greater Weever (*Trachinus draco*) and the Lesser Weever (*T. vipera*); the former is frequently found of a length of 12 in., while the latter grows only to about half that length. The coloration of both is plain, but the short first dorsal fin is always deep black. The weevers are bottom fish, burying and hiding themselves in the sand or shingle—the lesser species living close inshore and the greater preferring deeper water. They inflict wounds by their dorsal and opercular spines. The spines are deeply grooved, and the poisonous fluid lodged in the grooves is secreted by glands at their base. The flesh is not bad eating.

See Jordan, *Guide to the Study of Fishes.*

WEEVIL, the name applied to beetles of the division Rhynchophora of the order Coleoptera. They are characterized by the prolongation of the head into a rostrum or snout which bears the mouth-parts at the apex. The antennae are usually elbowed and clubbed, with the basal portion frequently lodged in a depression on each side of the rostrum. The tarsi have four evident segments and there is a single median or gular suture beneath the head. Their larvae are usually white, curved, fleshy grubs, generally without legs; the head is darker and well developed, with strong jaws; eyes are absent or very rudimentary. Both the adults and the larvae are exclusively vegetable feeders.

The true weevils or Curculionidae form the largest natural family in the animal kingdom and include over 35,000 known species, but probably several times that number still await discovery. More than 400 species occur in the British Isles, and upwards of 2,500 species inhabit America N. of Mexico. Their most characteristic organ is the rostrum: its function in the female is often that of a boring instrument, a hole being drilled by it for placing the eggs, but its significance in the male is not understood. As a rule the rostrum is better developed in the female than in the male, a feature that is well seen in the nut weevils. The majority of weevils are sombrely coloured but others are attractive objects. In the brilliant green *Phyllobius* and *Polydrusus,* so common among herbage in Britain, the colour lies in the covering scales. The Papuan *Eupholus* is sky blue, and the diamond-beetles (*Entimus*) of Brazil are probably the most resplendent of all. In their larval stages weevils may feed upon any part of a plant from the roots to the seed: the vast majority are internal or subterranean feeders, but some feed openly and a few live in tunnels formed of rolled leaves. A large number of species are highly injurious either as larvae or as adults also. The granary weevil (*Sitophilus granarius*) destroys the grains of corn (maize), wheat and barley, and has become widely distributed through commerce. The cosmopolitan rice-weevil (*S. oryza*) affects, besides rice, a great variety of other dry food products. The cotton-boll weevil (*Anthonomus grandis*) is the most serious enemy of the American cotton crop, causing immense damage to the bolls. The allied apple-blossom weevil (*A. pomorum*) is very destructive to unopened blossom buds in England and other parts of Europe. The palm-weevil (*Rhynchophorus ferrugineus*) affects toddy and coco-nut palms, and the pine-weevil (*Hylobius abietis*) is a European enemy of young conifers. The alfalfa-weevil (*Phytonomus posticus*) entered the U.S. from Europe in 1904 and is a serious enemy of alfalfa and clovers. Mention must be made of the North American plum curculio (*Conotrachelus nenuphar*), a most destructive pest of stone fruits, of the nut-weevils (*Balaninus*) and of species of *Sitona* which attack leguminous crops.



ACORN-WEEVIL (BALANINUS GLANDIUM), ADULT AND LARVA

A nut-weevil closely allied to the common nut-weevil (Balaninus nucum) of Great Britain. The female of the various species drills holes in green hazel-nuts, acorns or similar nuts and deposits eggs singly within the kernels upon which the larvae later feed

In addition to the Curculionidae, the Rhynchophora include the families Scolytidae, Platypodidae, Anthribidae and Brentidae. (*See* BOLL WEEVIL, COTTON; ALFALFA WEEVIL; PLUM CURCULIO; PINE-BEETLE; ENTOMOLOGY: *Economic*; COLEOPTERA: *Rhynchophora*). (A. D. I.; R. L. WL.)

WEFT: *see* WARP AND WEFT.

WEIERSTRASS, KARL (1815–1897), German mathematician, was born at Ostenfelde on Oct. 31, 1815. He studied jurisprudence at Bonn, and later went to Münster to study under Gudermann, who was interested in the theory of functions. Weierstrass wrote a paper on the development of modular functions for his teacher's examination, and so started the work in mathematics with which his name is associated. He became a teacher of mathematics at the "gymnasium" at Deutsche-Crone (1842–48) and then at the Collegium Hoseanum in Braunsberg (1848–56). In 1856 he was appointed extraordinary professor of mathematics at Berlin and lecturer at the school of technology. He was appointed ordinary professor in 1864. He died in Berlin on Feb. 19, 1897.

Weierstrass' work in mathematics was mainly on the theory of functions; his was the most notable work on this subject since that of Abel and Jacobi. He published very little himself, but embodied his works in his lectures. These were taken down by the students and afterwards collected in *Gesammelte Abhandlungen;* vols. i., ii. and iii. (1894–95 and 1903) contained his lectures, vol. iv. (1902) on Abelian functions, vols. v. and vi. (1915) on elliptic functions, vol. vii. on the calculus of variations, and vol. viii. on analytic functions. He worked on the functions of real variables, devised tests for the convergence of series, and dealt with converging infinite products. He also dealt with the theory of bilinear and quadratic forms. Weierstrass developed the theory of functions of a complex variable to such an extent that he put this subject on a fresh basis. He also made notable contributions to the theory of periodic functions, elliptic functions, Abelian functions and the calculus of variations. Although his work was on pure mathematics, he was interested in its applications, and influenced a number of his students to work on applied mathematics. He edited Steiner's *Gesammelte Werke* (2 vols., 1881–82), and was co-editor with Kummer of *Crelle's Journal.*

WEIGALL, ARTHUR EDWARD PEARSE BROME (1880–1934), British Egyptologist and author, was born on Nov. 20, 1880, and educated at Hillside school, Malvern, and at Wellington college. After a short time at New College, Oxford (1900), he joined the Egypt Exploration fund as assistant to Prof. Flinders Petrie, and later (1905) was appointed inspector general of antiquities under the Egyptian Government. He retired in 1914, but continued to write on archaeological subjects. He received several foreign decorations for his archaeological work.

His many publications include *A Report on the Antiquities of Lower Nubia* (1907); *Travels in the Upper Egyptian Deserts* (1909); *The Life of Akhnaton, Pharaoh of Egypt* (1910, revised 1922); *The Life of Cleopatra, Queen of Egypt* (1914, revised

1924); *Egypt from 1798 to 1914* (1915); *Ancient Egyptian Works of Art* (1924); *A History of the Pharaohs* (vol. i. 1925, vol. ii. 1926); *Wanderings in Roman Britain* (1926); *The Grand Tour of Norman England* (1927).

WEIGHING MACHINES. This article deals with mechanisms used for weighing goods and commodities, or used for technical purposes other than those for which the fine balance is constructed. The latter instrument is fully dealt with in the article BALANCE, and to that article the reader is also referred for a discussion of the principles which underlie the construction of the balance beam and determine its accuracy, sensitivity, period of vibration and so forth. The beam-scale, or simple balance is, however, used for commercial as well as for scientific purposes; hence a brief account of the principal forms is here given.

The Beam Scale: Its History.—It seems certain that the balance originated in pre-dynastic Egypt, and in the opinion of some Egyptologists its invention dates back to over 5,000 years before the Christian era.

The earliest balances of which we have knowledge were of the cord-pivot type, the beam being suspended at its centre by a cord attached to a fixed support and the scale pans similarly suspended from the ends of the beam. At first, to effect these attachments, holes were drilled diametrically through the beam, but at a period which may be as early as 2000 B.C., a great improvement was initiated which enabled balances of considerable precision to be constructed. The end-pivot was formed by drilling a hole into the upper surface of the beam and connecting it with one drilled longitudinally into the end. The suspension cord issuing from the latter and secured above the former hole was always held by the weight of the scale-pan in definite contact with the end of the beam. Any inequality of arm-length could be quickly corrected. The central pivot, or fulcrum, was either constructed by drilling diametrically through the beam, or by wrapping the suspension cord round the beam, or by attaching the cord to a metal ring secured to the upper surface of the beam. The better type of Egyptian balance, as early as 1500 B.C., and possibly much earlier, was always suspended from a bracket projecting from a substantial standard. From this bracket a plumb-line was hung, the heart-shaped plumb-bob of which was placed immediately below the tip of a downward-depending tongue ("finger" or pointer) of triangular shape, secured to the beam at its centre.

At a later date, and for ordinary commercial purposes, a more portable type of beam was used, like that depicted on the *kylix* of Arcesilas, a Spartan vase dating from about 550 B.C. The lotus-shaped ends of the beam are here retained, but the beam is depicted as hung, by a simple sailors' device, from the lowered yard of the ship, on the deck of which the king is seated superintending the weighing and loading of a cargo of silphium. This balance is neither equipped with tongue nor plummet. The ancient method of constructing the cord-pivot beam has survived in India and China to the present day.

The balance used in classical times was often constructed on Egyptian lines, but those examples which have survived are almost entirely of bronze, and are of a quite different type which possibly originated at Alexandria in Ptolemaic times. The pivots in these instruments may best be described as hole- or ring-pivots, and were formed by linking hooks or rings through holes pierced through the beam. These ring-pivot instruments stand for a gain in portability and convenience, but for a retrograde step in accuracy of weighing.

At first no fork ("gallows," "shears," or "cheeks") was used, as this device had not been invented. In its place a metal hook or loop of cord was attached to a ring linked through a central hole.

Later, probably about the commencement of the Christian era —but the date is quite uncertain—the fork was invented, and, being itself suspended, enabled an upward-pointing tongue to be fitted. In all these classical balances the middle, or fulcrum pin, was apparently never secured to the beam, but to the fork. The beam turned loosely on a pin attached to the fork.

It is a remarkable fact that in the case of the steelyard in some surviving examples (of which one is now in the British Museum) we find a fixed fulcrum pin secured between lugs shaped in the body of the beam. It would appear that it was not till towards the close of the middle ages that such a pin, approximating to the modern knife-edge, was used in equal-armed balances.

Bullion Balances.—The finest type of large balance constructed in 1929 is used for weighing gold and silver. It is really a large precision balance and the principles of its construction need not here be detailed. Very great care in design is necessary owing to the magnitude of the stresses to which the parts are subjected. In particular, the design of the relieving cam and the whole of its connected parts demands technical skill of a high order.

In the modern form of bullion balance care is taken to preserve the structural rigidity of the beam by causing the continuous plane bearing-piece to pass through an aperture in the framework of the open trussed beam, and thus give support to the continuous fulcrum knife-edge. This means that the bearing-piece has to bridge over a space between two supporting columns, and, in order to ensure freedom from distortion under load, very great transverse rigidity is necessary.

For ordinary commercial purposes, box-end, Dutch-end, and "brass-agate" beams are still often used, but the continuous knife-edge with continuous bearing is gradually displacing less accurate forms of pivot.

Counter Machines, or Small Linked Mechanisms.—It is convenient for most commercial purposes to use scales in which the scale-pans are placed above the beam. In the United States such machines are known as "counter trip scales." To effect this end, linked mechanisms have had to be devised which maintain the pans always in a horizontal position, and give accurate weighing irrespective of the position thereon of the load and weights. This means that each pan must be supported so that a load, wherever

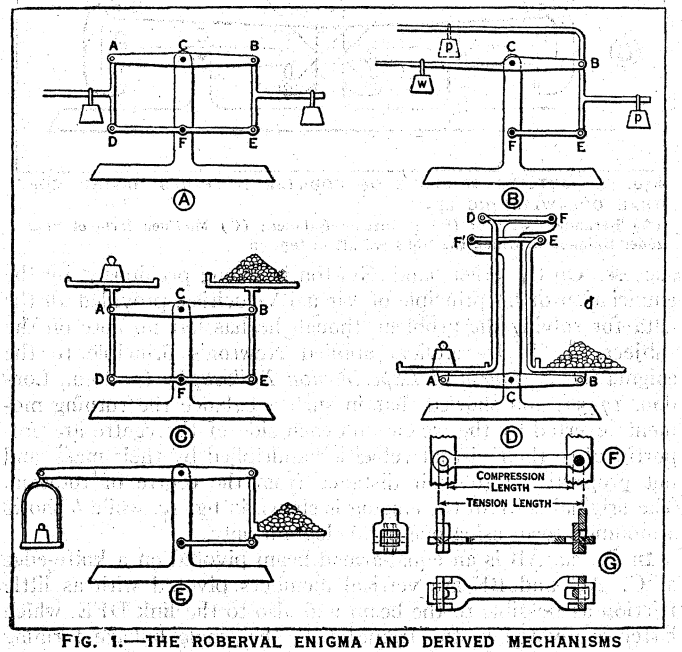


FIG. 1.—THE ROBERVAL ENIGMA AND DERIVED MECHANISMS
(A) The Roberval Enigma; (B) Modified form; (C) Ordinary Roberval Counter Machine; (D) Inverted type of Roberval Balance; (E) Balance designed to avoid reversal of stress in stay; (F) Diagram showing change in stay length due to reversal of stress; (G) French stay designed to maintain constant length in tension or compression

it is placed, will exert the same turning moment round the centre of oscillation of the main beam. This may be effected in various ways, the object in all cases being to give to every part of a pan or platform the same virtual velocity.

Two chief groups of mechanisms may be recognized, viz.: (1) Those directly derived from the *énigme statique* (fig. 1*a*) of the French mathematician, Gilles Personne de Roberval, and (2) those consisting of a combination of load-carrying levers adapted to support the scale-pans in such a manner as to comply with the specified conditions (fig. 2). Roberval invented his static enigma

in 1669, but no completely satisfactory explanation of its action appears to have been formulated until Poinsot published the 3rd edition of his *Élémens de Statique* in 1821. His explanation is based on the theory of couples, and has the advantage of being immediate and self-contained.

D'Alembert, in his article on the lever in the *Encyclopédie* of 1750, had attempted a similar type of solution without complete

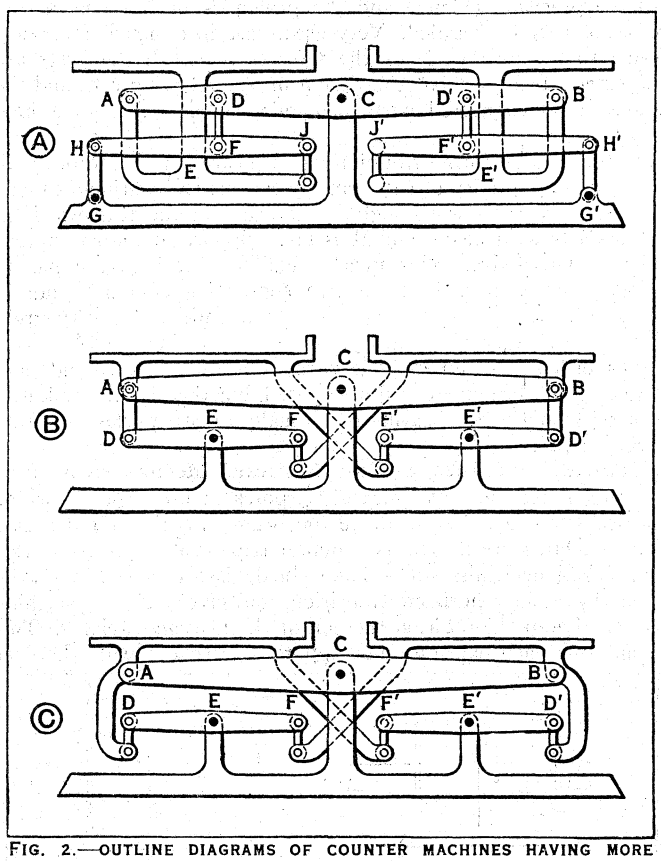


FIG. 2.—OUTLINE DIAGRAMS OF COUNTER MACHINES HAVING MORE THAN ONE WEIGHING LEVEL
(A) Beranger Balance; (B) Phanzeder Balance; (C) Modified form of Phanzeder Balance in which the links are all in tension

success. On the other hand, Newton had long previously, by the enunciation of his principle of Virtual Velocities, provided all the data for solving the problem, though he has left no note on the subject. J. T. Desaguliers applied Newton's principle to the enigma in his *Course of Experimental Philosophy* (2nd ed., London, 1745), and showed that in such a balance the turning moments exerted by the weights on each side of the centre are proportional to their virtual velocities multiplied by their mass, and not proportional to their distance from the centre of rotation. The original form of the enigma is shown in fig. 1*a*, while *b* shows a modified form using one parallelogram only.

In fig. 2*a*, AB is an equal-armed beam pivoted on a knife-edge at C. AD and BE are vertical members pivoted with as little friction as possible to the beam and also to the link DFE, which latter is pivoted to the frame at F, the whole linkage forming two parallelograms. To the vertical legs are rigidly secured two bars from which equal weights are adapted to hang. These bars need not be fastened to the middle of the legs, nor need they project horizontally. If the parallelograms are truly equal, the balance will remain in equilibrium no matter what the position of the equal weights on the bars. It is obvious that, since the legs rise and fall vertically, the virtual velocities of the weights for any given change of inclination of the beam AB are independent of the distance of the weights from C, and are equal to each other; and it can be shown that, this being so, the balance of the system must remain undisturbed when the positions of the weights are changed. Considering the problem in the light of the principle of work, it is clear that, for a given inclination of the beam the vertical displacement of the weights is irrespective of their distance from the fulcrum C of the beam. Under such conditions equilibrium is not disturbed by moving the weights along the bars.

Any divergence of the linkage from perfect parallelism destroys the characteristics of the balance; and it is important to observe that the susceptibility to derangement through lack of equality in the lengths of the parallel members is much greater as regards the vertical legs than as regards the horizontal lever-arms and links.

Fig. 1*b* shows a form of the device in which both weights may be placed spatially on the same side of C, though kinematically *p* is on the opposite side to *w*. A balance based on this form was made by Phitzer of Oschatz. The two principal counter machines which have been constructed on the basis of the Roberval enigma are indicated in outline in figs. 1*c* and 1*d*, and do not require detailed description. Type 1*d*—the "inverted Roberval"— is the better form, as the long vertical legs reduce the magnitude of the alternating tensional and compressive stresses in the "stays" or links DF and EF′.

In order to ensure that the parallelograms retain their true shape under load it is important that the attachment of the leg to the scale-pan supports should be very rigid. In fact, good weighing with this type of balance depends on thoroughly sound design and construction.

Reference has been made to the alternation of stress in the stays or "checks" due to varying positions of the load or weights. Unless a special type of pivot be employed, providing line-contact on one and the same line irrespective of whether the stay is in tension or compression, a reversal of stress will always be accompanied by a change in the effective length of the stay, and, consequently, by a distortion of the parallelogram in question. This is shown in fig. 1*f*. The beautiful kinematic pivot by which this distortion is prevented is shown diagrammatically in fig. 1*g*. Such stays require to be made with great accuracy to give satisfactory service in modern self-indicating balances, where any minute differences of load-effect due to variation in the position of the load are directly visible on the chart. To avoid reversal of stress in the stays the form of balance shown in fig. 1*e* has been devised and occasionally manufactured. Other forms have been constructed. In American practice, round hardened steel pins are generally used as pivots for the stays or "checks"—a cheaper form of construction. American counter machines are also generally equipped with a graduated steelyard, called a side-beam, placed parallel to the scale-beam and carrying a suitable poise. By moving this poise to the appropriate notch a balance may be obtained without the use of small fractional weights. A 16-lb. capacity scale would have a side-beam of 1 lb. capacity graduated in $\frac{1}{4}$-oz. sub-divisions. The use in retail trade of such counter scales is not allowed in England.

Of counter machines in which more than one load-carrying lever is employed to keep a scale-pan always parallel to itself throughout its permitted range of movement, the most typical is probably that of Beranger, a French scale manufacturer, who patented his device in the United Kingdom in 1849. This beautiful linkage is represented diagrammatically in fig. 2*a*, where ACB is the main beam, of which, as in all these diagrams, only one of the two side members is shown. At D and D′ are pivots equally spaced from the fulcrum C. To the links DF and D′F′ are suspended the subsidiary levers HFJ and H′F′J′, anchored to the base plate respectively by links HG and H′G′, and serving to support, by means of the links hanging from J and J′, the "cradles" E and E′, which latter are also suspended from pivots A and B of the main beam. By pillars rigidly attached to the cradles the scale-pans are conveniently supported above the levers. Considering the left half of the beam, the short arm DC bears the same ratio to the long arm AC, as the short arm HF of the subsidiary lever HFJ does to the long arm HJ of the same. Hence it follows that, when the balance vibrates, if D falls 1 in. and A 2 in., J will also fall 2 in.; consequently, the cradle E, together with its scale-pan, will move parallel to itself, and the load, or any part thereof, will produce the same turning moment about C whether it be transmitted directly to the main beam through A or indirectly

through J, F and D. Precisely the same considerations hold in respect of the other half of the mechanism.

Another type of balance, very similar in principle to the Beranger, and much used in European countries, is the Phanzeder. In fig. 2*b* the earlier type, using compression links AD and BD′, is shown. The subsidiary levers DEF and D′E′F′ are equal-armed, and it will be observed that each scale-pan has one leg supported by a pivot, A or B, of the main beam, and the other leg supported by a link from a pivot of the subsidiary lever on the opposite side of the fulcrum.

Obviously, to avoid friction, since the arcs described by A and D, or B and D′ are of different radii, AD and BD′ must be pivoted links, and not rigid projections from the scale-pans. Obviously, too, they are in compression. British practice, as also American, is generally opposed to the use of such compression links, which, nevertheless, when correctly designed and constructed, are quite reliable. A form of the Phanzeder balance in which only links in tension are used is shown in fig. 2*c*.

The Steelyard.—This instrument, designed as a portable weighing device dispensing with the necessity for using a large number of weights, must be regarded as in all respects of a secondary or derivative nature when compared with the balance. The English word has probably nothing whatever to do with either "steel" or "yard," being derived from the M.L.German word *stâlhof*, sample courtyard, the name for the London depôt of the Hanseatic merchants, where they displayed samples of their goods, and where numbers of such instruments were in use. In America, and in the British dominions, steelyards, especially when suspended from a tripod, are often known as "Weighmaster beams."

The principle of operation of the modern or Roman steelyard may be gathered from the diagram, fig. 3. AB is the steelyard freely suspended by its fulcrum knife-edge C from the fixed support D. E is the load knife-edge, and *p* the poise, shown suspended at a point F, such that the turning moments about the

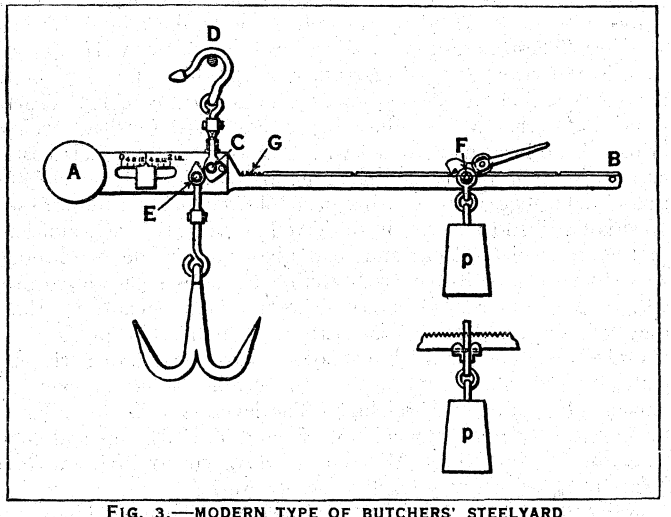


FIG. 3.—MODERN TYPE OF BUTCHERS' STEELYARD
A more primitive method of suspending the poise from the graduated yard is also shown

pivot C due to the weight of the steelyard and its parts, together with those due to the poise and the load (not shown), are of equal magnitude on each side of C. Under these conditions the yard is in equilibrium. Supposing, now, that, with the poise in zero graduation G, and no load except the shackle and its parts depending from E, the instrument be in equilibrium, then it is clear that the centre of gravity of the unloaded steelyard is under the suspension knife-edge C. The weight of the steelyard and its parts, under such conditions, exerts no turning moment about C. If, now, a load L be suspended from E, it will exert a turning moment L×CE, and obviously this can only be balanced by moving the poise *p* away from the centre until, at a point F, the turning moment *p*×CF=L×CE. Since CE and *p* are constants the load varies directly as CF. Hence the graduations of the steelyard will be of equal magnitude for equal increments of load. It is desirable that steelyards should be constructed so that the unloaded beam is in balance when the poise is in zero graduation.

The Roman steelyard is an Italian invention, and probably originated about 200 B.C. in Campania, or in Magna Graecia. It was apparently unknown to Aristotle, who, in his "Mechanics," describes the so-called Danish steelyard, which we now know preceded the Roman type in classical antiquity, as also throughout the greater part of Europe and western Asia. The "Danish" steelyard consisted of a beam heavily weighted at one end, and provided at the other with a hook or pivot to which the load could be suspended. A loop of cord generally constituted the fulcrum, the graduated beam being moved through the loop until the load was balanced. The graduations were not equal, but formed a harmonic series. The Shetland *bismar*, the Indian *dhari*, and other instruments found throughout the East, conform to this type. The device was probably a Wiro invention, and was carried by those invaders into western and southern Europe, just as by the Aryans proper it was taken into India.

The modern "Roman" steelyard, still largely used by butchers, is a reliable and accurate instrument. The best makes are provided with devices to prevent undue wear of the graduation notches, and the yard proper, or blade, is made of a non-corrosive steel. The notches are cut by a specially-constructed dividing engine to a degree of accuracy quite unattainable by other means.

Compound Lever Platform Machine.—Practically all heavy loads are to-day weighed on some form of platform machine. Before John Wyatt's brilliant invention of the compound lever, about the year 1744, it was necessary to use immensely heavy and inconvenient steelyards for the weighing of loaded carts, and the operation, even in the case of a small two-wheeled hay cart, was a very laborious one. Wyatt was a master carpenter or

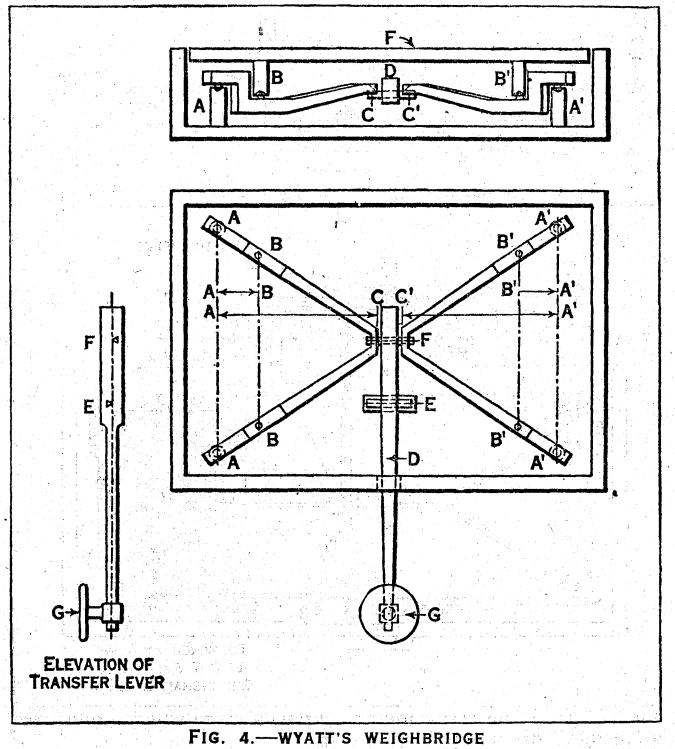


FIG. 4.—WYATT'S WEIGHBRIDGE
This first compound lever platform machine (about 1744) was the brilliant invention of John Wyatt of Birmingham

mechanic. Apparently most of his weighbridges were built when he was in the employ of the great Matthew Boulton. He died in 1766. Fig. 4 is a drawing, necessarily somewhat diagrammatic and lacking in detail, which probably represents correctly the original "bob-up" form of Wyatt's mechanism. It has been constructed from early descriptions and illustrations. (*See* the 3rd edition of the *Ency. Brit.* [1797], under STEELYARD; *John Wyatt, Master Carpenter and Inventor* [1885, published anonymously, but compiled by the late Henry Pooley, of Liverpool], and the Wyatt mss. in the Birmingham reference library.)

The two triangular levers are pivoted at A and A′, and receive the load transmitted by the stool legs of the platform F on pivots B and B′. The arms AB and A′B′ are equal, as are also the arms AC and A′C′. The pivots C and C′ transmit the load to the first order transfer lever D at the same distance FE from its fulcrum E. G is a table for weights to counterbalance the load. Such a combination of levers—crude as it is in construction, being devoid of links and originally having conical points instead of knife-edges—ensures the transmission to the counterpoising lever or steelyard of the same load effect by the same load, irrespective of its position on the platform. Before the close of the 18th century English builders were making machines of which the transfer levers pulled down on the ends of first order steelyards, very much in the modern manner. Whether the Fairbanks brothers of Vermont, U.S.A., were the first to make small platform machines in which no separate transfer lever was used, but in which the upper triangular lever was provided with an extension arm connected to a steelyard, is difficult to ascertain at the present time; but their platform machines, dating from the year 1831, undoubtedly marked an advance in construction and convenience of operation, and had a far-reaching effect on the development of platform machines throughout the world.

Henry Pooley and Son were the first in Great Britain to build such machines for general use on railways. A modern compound lever platform machine for light loads consists of two triangular bottom levers, link-suspended from the framework, and connected together by a central link, the upper lever having an

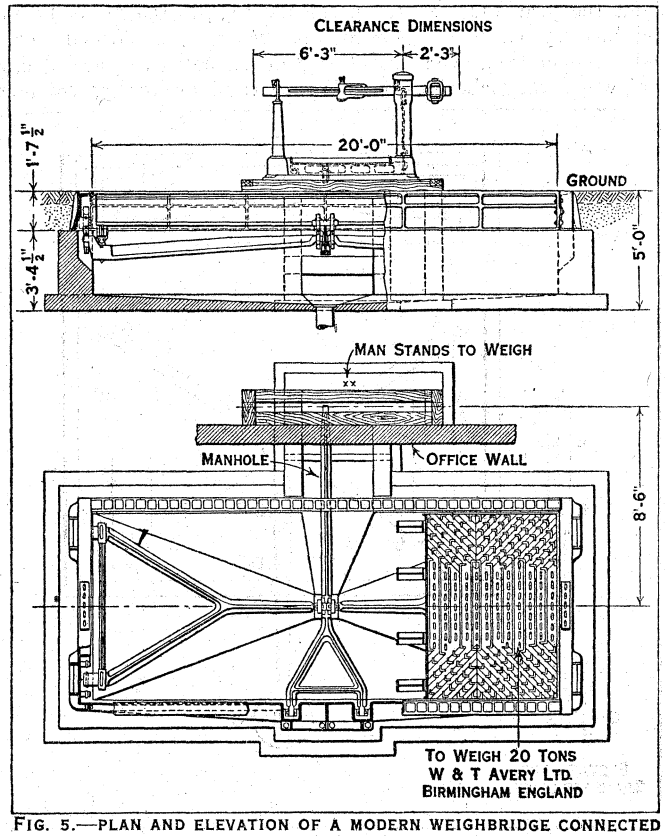


FIG. 5.—PLAN AND ELEVATION OF A MODERN WEIGHBRIDGE CONNECTED TO A "NO-LOOSE-WEIGHT" STEELYARD

These bridges are sometimes connected to automatic dials, the lead capacity of which can be multiplied several times by the use of counterpoise weights

extension arm at the end of which is a knife-edge connected by a rod to the counter-balancing and indicating device—a steelyard or automatic dial. If a steelyard is employed, it is designed to be operated without the use of any loose weights, a balance being obtained by means of one large and one small sliding poise. Fig. 5 shows the construction of a modern weighbridge, characterized by having, among other new features, "oil baths," or rather, grease receptacles, fitted round the bottom-lever pivots. American practice differs in many respects from British, as, for instance, in a general preference for fixed levers—that is, triangular or "bottom" levers having their fulcra resting on fixed stools or brackets, whereas the leading British makers prefer to suspend their levers, especially in the case of high-capacity bridges, from links depending from brackets secured to the massive "box-beds" constructed of cast-iron or steel girders which are a distinguishing feature of British practice.

On the Continent of Europe railway track scales are generally equipped with means for putting the portion of the track constituting the platform into relief—that is completely disconnecting it from the weighing mechanism—while the engine or other vehicle is taking up a position thereon. In Britain and the United States track weighbridges, at the present time, are seldom fitted with relieving apparatus, but are made sufficiently strong to resist the shocks due to rolling loads moving at a reasonable speed. A very large amount of loaded rolling stock is weighed while moving at speeds varying from 1 to 3 m. per hour. Platforms supported so as to be free to swing with a restricted movement in all directions are in general use. While in Great Britain and in Europe triangular bottom levers are most frequently employed, in America four transverse "straight" levers, connecting directly with two longitudinal extension levers, constitute customary practice, especially for bridges intended to weigh motor road traffic. The extension levers are, in turn, linked directly to the steelyard, or to the intermediate lever of a self-indicating mechanism.

The steelyards are often equipped with ticket-printing devices, the types being brought into position by a mechanical connection between the type-carrying bars or wheels and the poises by the movement of which a balance of the load is effected.

The accuracy and reliability of high-class modern weighbridges are rather remarkable. A bridge loaded with from 50 to 100 tons will indicate the addition of from 4 to 7 lb. when properly adjusted. In fact, its order of sensitivity is not very different from that of a chemical balance in customary laboratory use.

Plate Pivot Machines.—Of recent years there has been developed, in the United States, a type of weighbridge in which knife-edges are replaced by thin plates or laminae used in compression. These are all derived from the work of A. H. Emery, who, in the year 1875, successfully applied this type of pivot to the construction of a remarkably fine testing machine. There is no doubt that a few admirably reliable and sensitive weighbridges have been constructed with plate-fulcra; but their costliness at present prevents their general adoption. It is claimed that weighbridges built on this principle remain in accurate and sensitive adjustment even if subjected to very severe conditions of use. The plate-fulcra and load pivots are made of chrome-vanadium steel, and their cross sectional area is sufficient to provide an ample margin of safety. The amount of flexure to which they are subjected in use is extremely small. The platform is restrained from horizontal movements by the tension of horizontal plates or rods sufficiently flexible to permit the minute vertical movement required for weighing. The lever system is similar to that of knife-edge lever machines. E. and T. Fairbanks and company, of St. Johnsbury, Vermont, U.S.A., constructed the first "plate-fulcrum" railway track scale in 1915.

Self-indicating Weighing Machines.—The most important developments in the science of weighing instruments in recent years have, unquestionably, been associated with the evolution of the modern visible weigher, or self-indicating machine. All such weighing machines—except one class of automatic or semi-automatic weight-depositing instruments, not yet fully developed—depend on a variable resistant against which the load, or a fractional portion thereof, automatically balances itself when deposited on the scale.

The first self-indicating scales appear to have been invented by Leonardo da Vinci (1452–1519). They are described and drawn in one of his note-books preserved at Paris. (The mss. are in the Bibliothèque de l'Institut. See *Les Manuscrits de Léonard de Vinci, publiés en fac-simile,* etc., par C. Ravaisson Mollien. [6 vols., 1881–91]. *See* also *The Mechanical Inventions of Leonardo da Vinci,* by Dr. Hart [1923].) His description appears to make it certain that he had actually constructed one of these instruments. A semi-circular dial, suitably weighted, is suspended, at

the middle of its diameter, on a pivot from which also hangs a plumb-line, situated so as to serve as an indicator. A scale-pan hangs from one end of the diameter. The design has a remarkable characteristic not shared by many modern instruments, viz., that the accuracy of the indications is not affected by any divergence from horizontality of the surface on which the instrument is placed.

A pendulum or bent-lever resistant does not give equal chart divisions on a circular or segmental chart unless a cam or other equivalent device is used in the application of the load to the resistant, so as to counteract what has been called "the circular error" of the pendulum.

As the pendulous mass is raised by the fall of the load, its resistance increases as the sine of the angle of displacement from the vertical. At the same time, unless the load has been applied by a strap passing round a circular arc concentric with the centre of rotation, the effective length of the arm to which the load is applied will vary. Supposing, in the most simple case, that when the instrument is unloaded the load arm is horizontal and the centre of gravity of the pendulous mass vertically beneath its pivot, then the application of a load will deflect the system until a position of equilibrium is attained. During this movement the effective load arm will become shorter in the ratio of the cosine of the angle of deflection, and the resistant arm will increase from zero in the ratio of the sine of the angle. Hence, the load in all balanced positions will vary as the tangent of the angle of deflection, and a pointer attached to the pendulum will not indicate equal chart graduations for equal load increments. Generally, if the load arm makes an angle ϕ with the horizontal, and the pendulum an angle θ with the vertical, the applied load being L, the following relationship will hold:

$$L \propto \frac{\sin\theta}{\cos\phi}.$$

Obviously, with a small angle of deflection the graduations will be approximately equal to each other, for the arc traversed will be nearly proportional to the trigonometrical function of its angle. Weighing machines have been constructed using such small angles of rotation in order to get virtual equality of sub-divisions, as is required by the regulations of the various national weights and measures authorities. Where a machine is permanently and securely positioned, and extreme sensitivity is not required, little exception can be taken to this method of construction, which has the great advantage of extreme simplicity and robustness of design.

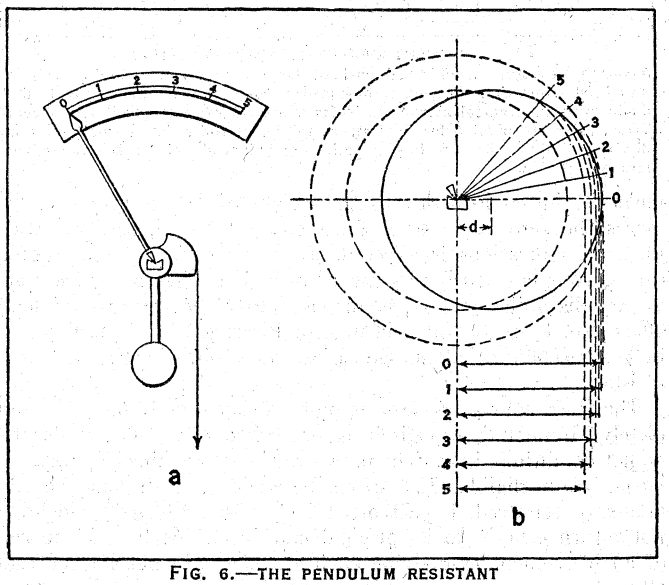


FIG. 6.—THE PENDULUM RESISTANT
(a) Diagram of the mechanism of the Fan Scale used for weighing small quantities in retail shops; (b) Diagram showing how the arm-lengths of the cam vary with the angle through which the pendulum moves

The sensitivity of a pendulum resistant is, however, within limits imposed by technical considerations, a function of the amplitude of the angle of rotation; and furthermore, the larger the angle the less the derangement that will result from such minute differences of level as may supervene after installation. Hence has arisen a multitude of designs for utilizing a considerable angle of rotation, as 55° for instance, while still obtaining equality of sub-divisions. Various parallel-motion and tangent-bar devices have been constructed, but the most generally em-

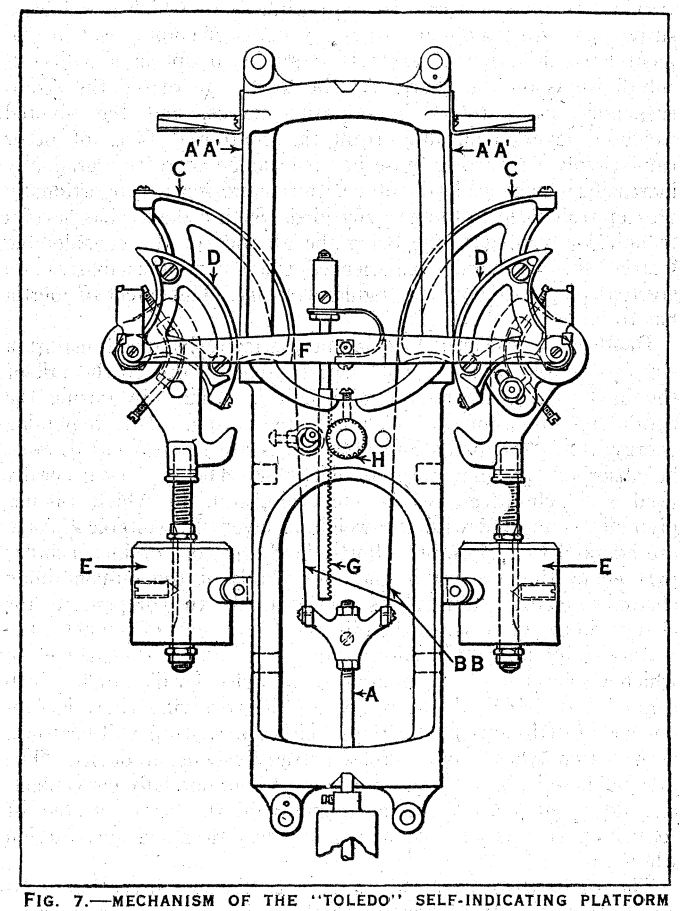


FIG. 7.—MECHANISM OF THE "TOLEDO" SELF-INDICATING PLATFORM MACHINE
(A) Connecting rod attached to weighing levers. Yoke connected by steel straps (BB) to the cams (CC), which are attached to segments (DD) and to pendulums (EE). Segments are suspended from the frame by straps (A'A'). The bar (F) sensitively pivoted to the centres of the circular segments (DD) is raised together with the elastically supported rack (G) which rotates the pinion (H)

ployed method makes use of a cam formed by eccentrically displacing a circular arc in respect of the axis of rotation. To the periphery of this cam the load is applied by means of a flexible metallic strap. (*See* fig. 6, *a* and *b*.) A close approximation to absolute equality of sub-divisions is possible if the best geometrical configuration is adopted. Fig. 6 *a* is a diagram of the mechanism of the well known fan type of self-indicating counter machine. The combined counterbalancing and indicating unit is pivoted on a knife-edge housed in V-shaped bearings. Fig. 6 *b* is a diagram designed to show that the rate of change of the products of the "circular cam" arm-lengths and their respective loads closely approximates to the rate of change of the pendulum moment-arms, which latter, as has been stated above, conform to a sine law. The two rates of change are made to counteract each other in just the measure necessary to permit of the use of equally divided charts. The dimension *d* indicates the linear displacement of the cam circle from the centre of oscillation.

The well known cylindrical computing scale embodies a resistant of this type, the cylinder itself being carried on anti-friction wheels, and rotated by a pinion engaging with a vertically moving rack connected pivotally with the weighing lever. Some types of dial mechanism employ a resistant consisting of two pendulums rotating in opposite senses, thus eliminating the effects of out-of-level disturbances. In a well known American

type of mechanism, knife-edges are dispensed with, the cams, with their attached pendulums, rolling on vertical straps anchored to the framework, and being rotated by other straps attached to a yoke to which the pull transmitted from the weighing levers is centrally applied. (*See* fig. 7.)

A more modern type of resistant, the most highly-developed form of which is illustrated in fig. 8, depends for its effect on the varying leverage of a cam to the periphery of which a weight is suspended. No pendulum is employed. In a commercial instrument a combination of cams is required to obtain equality of sub-divisions on the chart. As the load is increased the strap-suspended cams rotate in opposite senses, and the pivoted weighted levers depending from the contoured faces of other cams rigidly attached to those just mentioned act with a gradually increasing mechanical advantage, thus opposing a proportionally greater resistance to the growing load. Such a device has several technical advantages, one being the absence of the considerable inertia effects generally experienced when pendulous masses are given a comparatively high angular velocity. This effect of inertia has to be provided for.

Dash-pots.—When a load is automatically balanced against a simple variable resistant, only half the energy due to the fall of the load to a position of equilibrium is utilized in raising the pendulous mass, or in extending the spring. The remaining energy, if violent oscillations and shocks are to be avoided, must be absorbed by some form of dash-pot. The devices generally used are cylindrical vessels containing oil, in which pistons pivotally connected with the weighing levers by suitable linkage are adapted to reciprocate. Ports, in the piston, or in a tubular part connecting the upper and lower ends of the oil-containing chamber, enable adjustments to be made to compensate for changes in the viscosity of the oil due to variations of temperature.

Anti-friction Devices.—In those self-indicating machines in which a pointer has to be rotated round a circular dial, or in which a moving dial is used, the weight of the revolving chart is supported on "frictionless" bearings—either miniature ball-bearings, anti-friction wheels, or a crossed-strap suspension device. The first of these is, in many cases, the most commercially convenient, but does not permit the attainment of the same degree of sensitivity that is possible with really well-designed anti-friction wheels.

The *Crossed-strap Device,* a recent "Avery" invention, constitutes the most frictionless method yet discovered of supporting and rotating a large indicating unit. No rack and pinion is necessary. A rotational angle of about 300° is possible. The weight of the spindle carrying the rotating chart is entirely supported by two pairs of thin steel bands. These pairs are secured to, and wrapped in opposed senses about, a small drum attached to the said spindle. Their upper ends are attached to the opposite ends of an inverted weighted pendulous segment, pivoted on a knife-edge working in V-shaped agate bearings. This segment constitutes the variable resistant, and carries a cam or displaced circular arc so disposed eccentrically to the fulcrum as to give equal chart sub-divisions for equal fractions of the total load. The load-effect or "pull" is transmitted from the main weighing lever to this cam by means of a long flexible steel strap. As the segment rotates on its knife-edge it unwinds one pair of straps and winds up the other pair at exactly the same rate, thus rotating the drum mounted on the floating chart-carrying spindle, while maintaining it in exactly the same position.

Other resistants beside the bent-lever or pendulum have been and are used in weighing mechanisms. Of these the chief is the *spring.* The most commonly used form is the spiral spring. For some purposes its employment is quite legitimate; nevertheless, the chief constructors of self-indicating weighers throughout the world have, with few exceptions, abandoned it as a resistant in entirely automatic weighing mechanisms. It has three outstanding defects, two of which are due to its susceptibility to changes of external temperature. The substance of all steel springs expands or contracts in length with variations of temperature, and this generally affects the zero indication of the balance. It can be shown that, in the case of a properly-proportioned spiral spring in the unloaded state, the change in length of the wire due to temperature change makes practically no difference in the actual length of the spiral; but in a weighing instrument such a condition of no-load never occurs in practice. Temperature also affects the specific elasticity of springs. When a spring is warm it extends more under a given load than when cold. Hence, even if the scale-pan is empty, the greater extension of the spring

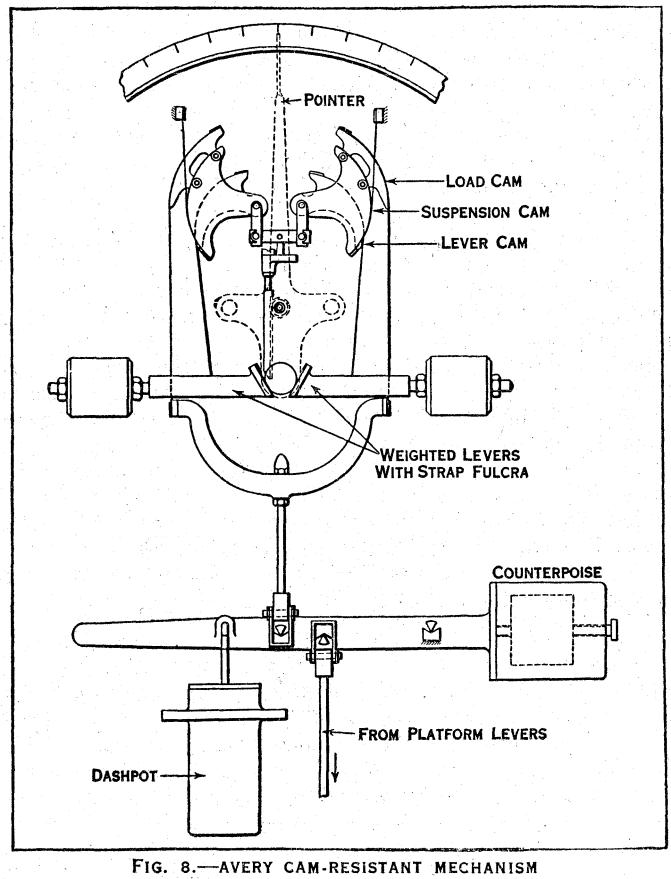


FIG. 8.—AVERY CAM-RESISTANT MECHANISM

A variable resistant is obtained without the use of pendulums, two sets of suspended triple cam contours so designed as to give to an increasing load a diminishing mechanical advantage in its efforts to raise the weighted levers. These latter are pivoted by steel straps to the periphery of a small circular disc round which they are free to roll. The balanced pointer is operated by rack and pinion

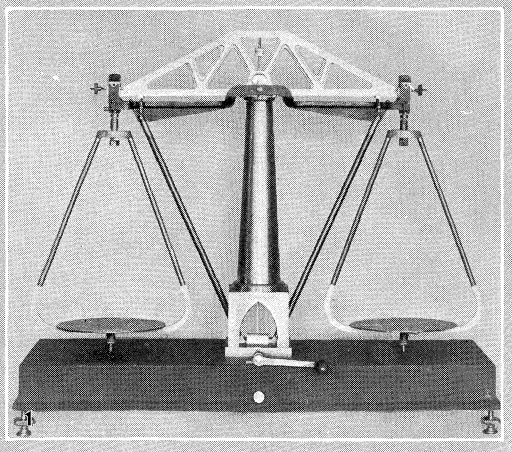
under its initial load due to the weight of necessary parts, displaces the zero indication. To a still greater extent the whole range of indications is affected. In a large measure this defect can be compensated for by means of a thermostatic device made of two dissimilar metals, so disposed that the transmitted load-effect can, by means of a change of leverage, be given a greater or less mechanical advantage before its application to the spring resistant.

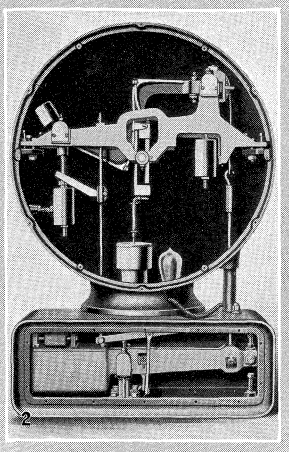
The third source of error is more serious and cannot be completely eliminated, though it is proper to note that, under the actual conditions in which many weighing machines operate, its effects are negligible. If a spring be loaded and the load be very gradually removed, it will often be found that the spring does not return exactly to its original conformation; hence, the zero of an instrument embodying such a spring will not be constant. Other derangements due to this hysteresis of the elastic material of the spring have been noted. In practice, the very gradual and shockless deposition or removal of loads referred to seldom takes place, and vibration—such as that due to neighbouring traffic or machinery—appears generally to eliminate this trouble in the case of well-designed spring-operated machines.

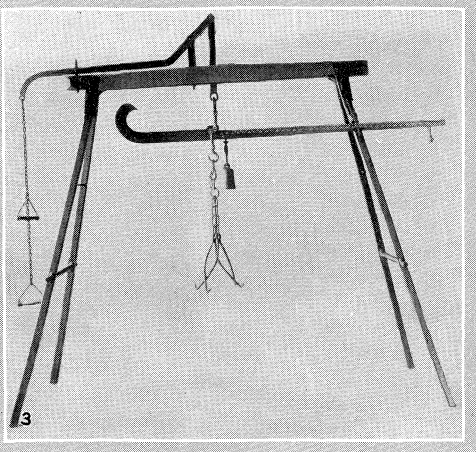
Against these drawbacks the spring has the great advantage of conforming exactly, for all practical purposes, to Hooke's law; that is to say, it gives equal chart sub-divisions. Moreover, it is intrinsically a more sensitive resistant than the pendulum.

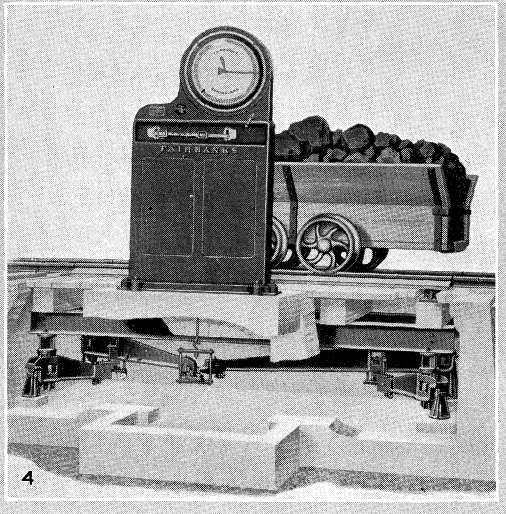
The "hydrostatic resistant" has been made in various forms.

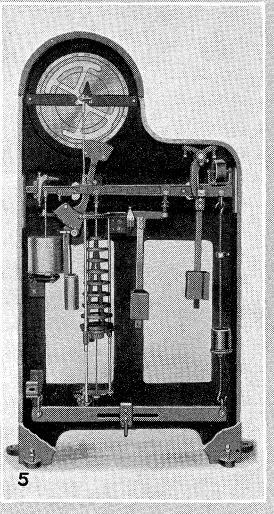
WEIGHING MACHINES

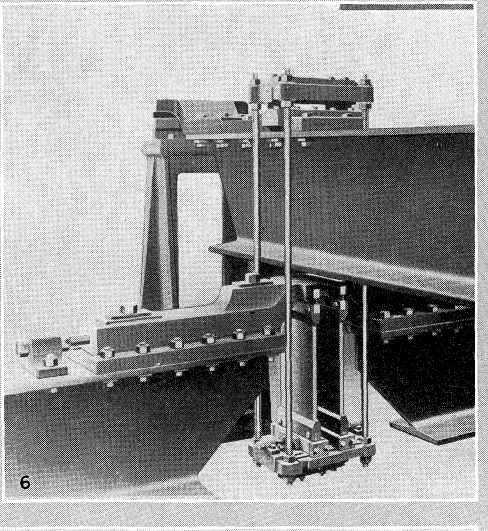


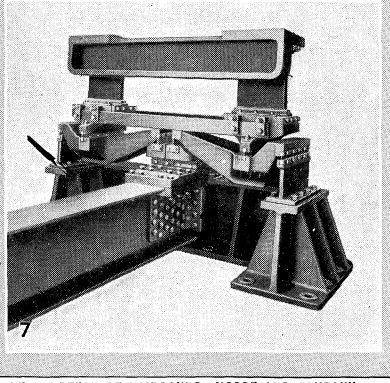


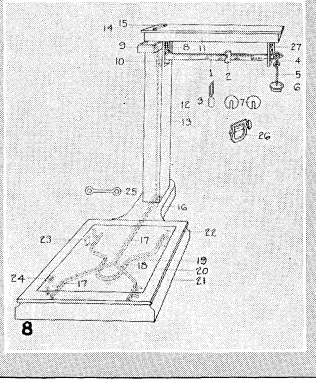


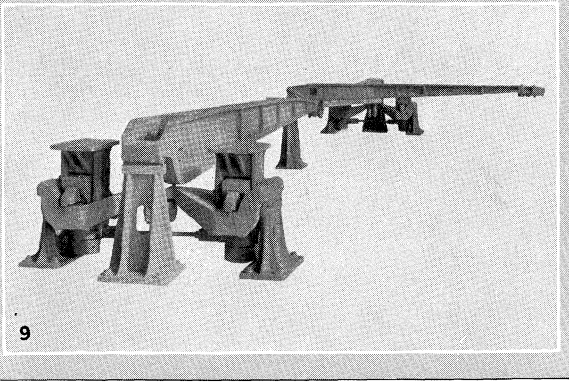










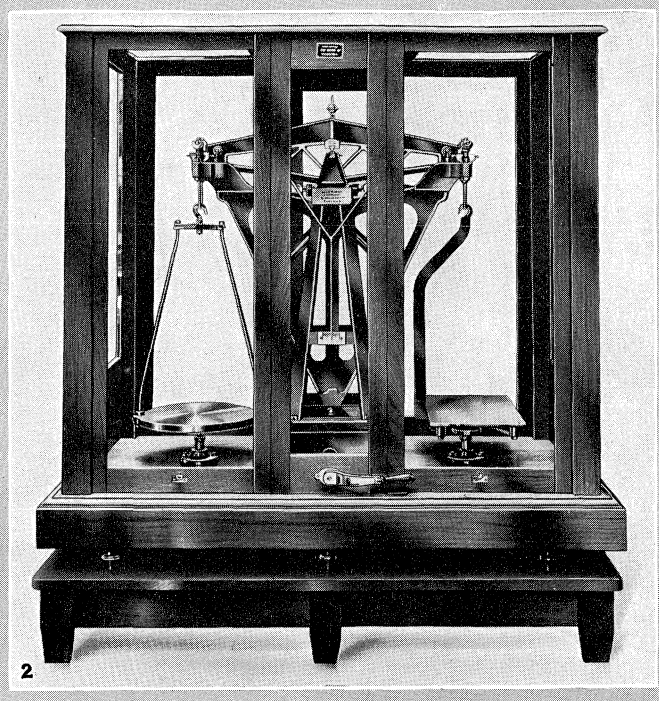


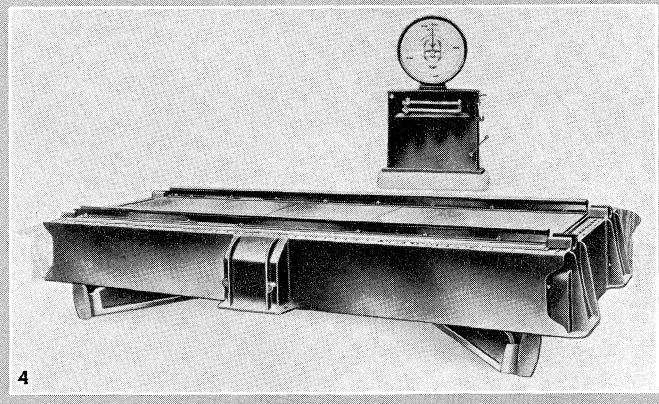
BY COURTESY OF FAIRBANKS, MORSE AND COMPANY

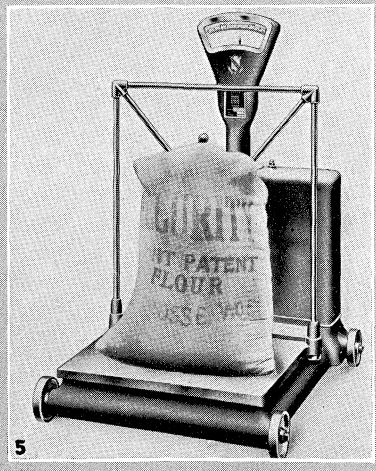
VARIOUS TYPES OF WEIGHING MACHINES

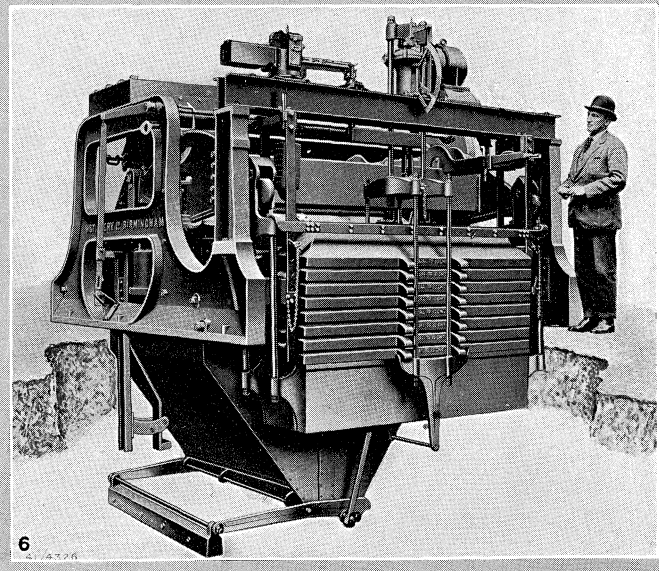
1. Bullion and testing balance, a sensitive beam weighing machine used for precious stones and metal
2. Self-indicating scale with part of back removed to show dial mechanism by means of which weights are indicated on a circular disc for convenience in reading
3. Weighmaster beam, or Roman steelyard, used where absolute accuracy is not required, and valuable for its simplicity and ruggedness
4. Railway track scale used in weighing loaded rolling stock in motion.
5. Platform scale without the compensating cam sometimes used for obtaining equality of sub-divisions on dial
6. Plate fulcrum track scale showing end and transverse lever connections
7. Plate fulcrum track scale showing movable end section
8. Phantom view of compound lever platform machine, showing separate parts: 1, beam; 2, poise; 3, bush poise; 4, counterpoise loop; 5, counterpoise stem; 6, counterpoise cup; 7, weights; 8, fulcrum loop; 9, fulcrum lever beam hook; 10, balance ball; 11, cap; 12, beam rod; 13, pillar; 14, strap washer; 15, pillar rod nuts; 16, nose iron; 17, long lever; 18, short lever; 19, platform board; 20, platform; 21, frame; 22, corner links; 23, bearing steel; 24, screw and block; 25, check rod; 26, trig loop; 27, cap loop
9. Assembly of modern heavy two-section track scale

WEIGHING MACHINES









1. Computing counter scale. The chart revolves almost without friction. 2. Bullion balance. Capacity 50 lb. Intended for weighing precious metals with great accuracy. 3. Automatic portable platform machine embodying the new type of cam-resistant indicator unit described in text. 4. Avery multi-unit weight-depositing self-indicating weighbridge. The dial mechanism is of the cam-resistant type, fitted with large capacity tare bars. A handle on the cabinet permits the successive deposition of weights, each of which is equal in load-balancing effect to the capacity of the dial. By its means also the appropriate figures appear on the dial. 5. Pre-determined load portable-platform machine. The load is balanced by means of steel yard poises in the cabinet. A small divergence from the true weight is clearly indicated on the dial. 6. Automatic grain weigher of 4 tons capacity. Its construction is illustrated and described in the text

It depends on the buoyancy of a float and its resistance to vertical displacement. A mercury resistant embodying the same principle has also been extensively used.

Computing Scales. — Entirely automatic self-indicating counter scales are very generally adapted to indicate, not only the weight of the goods, but the particular value of the said weight corresponding to a large number of different unitary prices. Collinear with each weight graduation is a series of price indications —the respective unitary prices, as, for instance, prices per pound avoirdupois being marked either on the pointer, if the dial be of the stationary type, or on the revolving chart itself.

Automatic Feed Scales.—This name is given to a large class of mechanisms by means of which granular and liquid materials may be automatically weighed off in pre-determined amounts. It is now possible to weigh in this manner practically all materials which can be induced to flow through a port or valve of reasonable dimensions. Thus modifications of the same general type of scale will weigh flour and the most finely ground cement, while others will weigh coal and ores broken up in lumps not exceeding say 2 or 3 in. in diameter. In general terms such a machine—one form of which is illustrated in fig. 9—may be defined as consisting of a hopper I, or box terminating a feeding spout, and equipped at its lower end with a pivoted gate D, or gates, adapted, when opened, to permit a flow of material into a scale-hopper C, placed immediately beneath it. This receptacle depends from one end of an equal-armed balance beam A, the other end of which carries a weight box B. When the scale is empty the weighted end of the beam causes the hopper end to rise, and by contacting with a part pivotally connected by links to the above mentioned gate or gates, forces them to open, thus causing the rapid filling of the

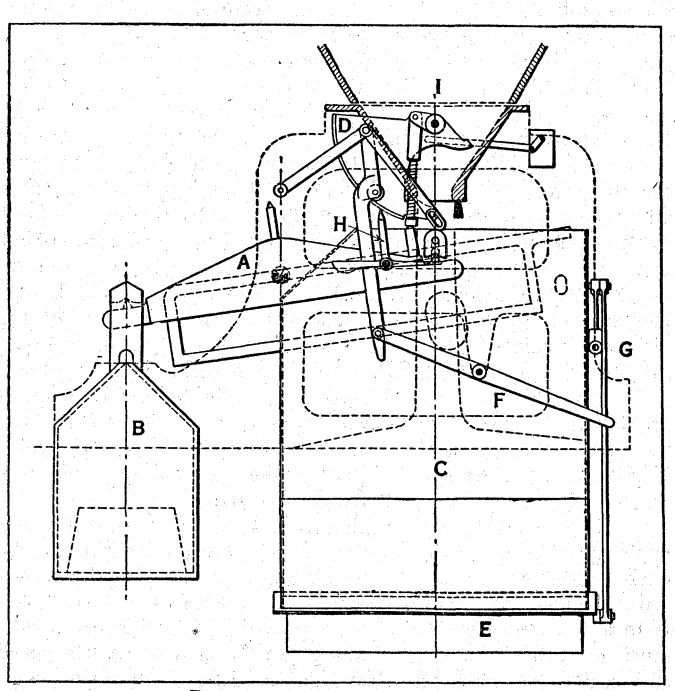


FIG. 9—AUTOMATIC FEED SCALE

A diagram of a grain weigher for automatically weighing wheat and other grains. The material is stored in the hopper I, the gate D being opened by the upward pressure of the empty receptacle C due to the weights in the scale-pan B. When the load in the receptacle balances the weights the receptacle falls, closes the supply gate and opens the discharge-valve E

receptacle with the material being weighed. The bottom of the scale-hopper is closed by a large discharge valve E, to which is connected linkage so designed that, when this door is closed, the linkage forms a locked dead-centre. This device, often called a toggle, is indicated at the right of the receptacle in the illustration. Other and different devices, as detent mechanisms, are sometimes used to keep the bottom door securely fastened until the receptacle has received its proper load.

As a state of equilibrium is approached, the weights no longer hold up the receptacle forcibly against the device which controls the opening of the hopper valve. Consequently, this valve gradually closes, and the final cut-off is arranged to take place just when a balance has been obtained. In some types of this mechanism the balanced beam, in falling away from the gate-opening mechanism, causes contact to be made between a lug or peg attached to the framework, and the linkage or detent-system controlling the discharge valve; or, alternatively, as in fig. 9, a part connected with the feed gate is adapted to "break" the dead centre or toggle mechanism of the discharge valve linkage at the moment when the hopper valve has completely closed. A very small force, properly applied, suffices to effect this release. The moment this takes place the discharge valve E opens, and the weighed material falls into another receptacle, generally connected with a conveyor or elevator.

Such, in brief outline, is the principle on which practically all automatic feed weighers act. Many refinements are, however, necessary in practice, and to the chief of these some reference must be made. At the moment when the receptacle has received its true weight of material, and the beam is moving to the balanced position, there is a considerable weight of material in the act of falling from the closed feed-port to the receptacle. To compensate for this amount, which would otherwise overload the balance, a "compensating lever" is employed. This lever is shown outlined in the illustration as lying parallel to the scale-beam. It is pivoted to the frame, and adapted by means of an adjustable poise, not shown, to press upon the load-receptacle, or some connected part, while the said receptacle is being filled. Consequently, the receptacle tends to fall to the balanced position before it has obtained its full load, thus closing the feed-port. The weight of material in the air at the moment of cut-off exactly compensates for this deficiency. If desired, the accuracy of the weighing can be immediately checked by raising the compensating lever before the hopper has had time to fall sufficiently far to cause discharge to ensue, or by preventing discharge in some other convenient manner. If the adjustments have been properly made, the beam will be found in perfect balance. In order to render the cut-off still more precise, in practically all large weighers a small valve called a "dribble" valve is used in addition to the main valve or valves. The main valves are closed before the weighing is complete, but the dribble port continues open until closed by the release of a detent, or, in some mechanisms—as in the grain weigher illustrated in fig. 9—by the continued movement of the main valve. In some makes of machine, especially those used for weighing grain, the edge of the feed valve port is rimmed with a brush in close proximity to which the closing valve moves very smoothly and without risk of jamming.

The action of the particular type of weigher illustrated may now be followed in a little greater detail. F is a lever connected to the feed valve linkage. When this valve is nearly closed, the little wheel shown on the vertical link is resting on the steel pin H, attached to a pivoted counterbalanced lever. Later, when the loaded receptacle falls to the balanced position, a pin contacts with the counterbalanced lever and throws H over to the right. The valve then closes completely, and the free end of the lever F rises and contacts with the pin G, thus breaking the dead centre and causing the discharge valve E to open.

Small automatic feed weighers, used for filling packets with standard quantities of material, are often operated electrically, as this enables very great accuracy to be attained. In such devices, the instantaneous and energetic shutting of the feed port is accomplished by an electro-magnet, the circuit of which is completed by the fall of the loaded weigh-beam.

Liquid weighers operate on the same general principles as those already described for weighing granular materials.

Conveyor Weighers.—Of recent years various conveyor weighers have been developed, and have filled a useful place in the bulk weighing of materials where no great accuracy is required. The principle of operation of one form is here briefly outlined:

If a conveyor belt be made to pass over rollers supported by a system of weighing levers, which system is in turn suitably connected to a variable resistant, the resistant will respond to the varying weight of material on the belt. If this weighing device,

as regards its load indications, be connected with a device responding to the velocity of linear movement of the conveyor belt in such a manner that the one numerical magnitude is multiplied by the other, it is obvious the product may be evaluated to represent the weight of material passing along the conveyor in a given time. Various methods, some mechanical and some electrical, have been designed to effect this multiplication.

Totalizer.—This weighing machine is of the automatic moving poise type, and is generally used for the automatic weighing and recording of the total of the separate loads contained in a series of receptacles or trucks placed successively on the weighing platform. As each load is imposed an electrically-propelled poise moves out along a steelyard connected to the weighing machine, and effects a balance, at the same time operating a counting device which records and adds on to the total of previous weighments the weight of the newly imposed load. Such mechanisms are capable of very accurate and reliable adjustment. The divergence of the weight indications of the mechanical counters, when such a machine is working under reasonably good conditions, from the true weight of the total loads should not exceed about one-fifth of 1%. About the same standard of accuracy is often attainable with high-class automatic feed weighers.

Weighing as a Means of Counting.—A great extension of this convenient method of counting things of uniform weight has taken place in recent years. Immense numbers of small parts and finished articles are produced by modern methods of machining and fabrication under conditions which ensure that the weight of each piece will be approximately the same. Hence, if a balanced system of linked levers be constructed having two receptacles connected therewith, one large and one small, at points at which the mechanical advantage of a weight deposited in the small pan is a hundred times greater than that of the same weight if deposited in the larger pan, it is obvious that equilibrium can only be obtained by placing 100 such weights in the large pan for every one deposited in the small pan. Hence if, for instance, it is desired to count bolts of uniform pattern in hundreds, one bolt is placed in the small pan and a quantity in the other, the number being rapidly adjusted until a balance is obtained.

A large variety of these instruments are available to-day, adapted to suit particular requirements, but, except in some recently-designed instruments equipped with dials and pointers for counting odd numbers of articles, the principle of operation is the same in all cases.

The future of weighing as a science and industry would seem to lie in the further evolution of self-indicating weighers and automatic feed and packeting machines. In particular, attention will be given to the production of more perfect, convenient, and fraud-proof printing mechanisms. It is already possible to convey to a distant point the weight-indications of a weighing machine, but such devices cannot yet be said to have been made into commercially successful instruments free from liability to error arising from faulty manipulation. As regards self-indicating instruments of large capacity, the most promising line of development would seem to lie in the perfecting of weight-depositing instruments, automatically or semi-automatically controlled, and operated by mechanical or electrical means. While steelyard instruments having mechanically or electrically-propelled poises will, no doubt, attain a high degree of perfection, the automatic deposition of weights on one and the same knife-edge to balance the major portion of a load the fractional portion of which is balanced against a variable resistant, is more completely in accordance with the essential principles of a perfect weighing instrument.

In conclusion, it may be confidently asserted that the rapidity and accuracy of automatic weighing, with its almost complete elimination of the fallible human element, make it certain that a very great extension of this method of weighing may be looked for in the immediate future.

BIBLIOGRAPHY.—For the early history of weighing *see* Hippolyte Ducros, *Études sur les Balances égyptiennes* (Annales du Service des Antiquités de l'Égypte, tomes ix. and x.); the article "Libra" in the *Dictionnaire des Antiquités grecques et romaines,* by Daremberg and Saglio; J. A. Kingdon, *The Strife of the Scales* (1904); Sheppard and Musham, *Money Scales and Weights* (1923); Benton, "The History of the Evolution of Weighing Instruments" in the *Transactions of the G.W.R., Swindon Engineering Society* (1926–27). For the principles and construction of weighing machines *see* Ernst Brauer, *Die Konstruktion der Wage,* 3rd ed., edit. by Fr. Lawackzeck (Leipzig, 1906), and the Eng. trans. by Walters (Incorporated Society of Inspectors of Weights and Measures, 1909); Airy, "Weighing Machines," *Proc. Inst. Civ. Eng.,* vol. 108; Owen, *A Treatise on Weighing Machines* (London, 1922); Wade, *Scales and Weighing, their Industrial Applications* (New York, 1924); Benton, "Weighing in the Chemical Industries," *Journ. Soc. of Chem. Industry* (1927); Malan and Robinson, *The Weighing and Measuring of Chemical Substances* (1922). The theory of articulated systems, as embodied in counter machines, has been fully discussed by J. A. Bonneau, "Vérificateur des Poids et Mesures" in *Instruments de Pesage à Systèmes Articulés, Première Partie Balances Roberval* (Paris, 1908), and *Inst. de Pesage Théorie Générale* (1913).

(W. A. BN.)

WEIGHTS AND MEASURES: *see* MEASURES AND WEIGHTS.

WEIGHT THROWING. The art of throwing a 56 lb. weight to the greatest height or distance. Lifting and hurling weights of different kinds have been popular pastimes from time immemorial. Slinging the "half-hundredweight" for distance approximates most closely, perhaps, to the earliest competitive weight throwing. This was the *roth cleas,* or wheel feat, at the Tailtin Games of Ireland, held as far back as 1829 B.C. It appears that the sport was initiated in Ireland and it is still in Ireland that it enjoys the greatest popularity. In that country the various championship forms of slinging the 56 lb. weight, together with records, are as follows:—Without run or follow, J. Mangan, 27ft. 4½in.; between legs with follow, J. Mangan, 32ft. 5in.; with unlimited run and follow, T. F. Kiely, 38ft. 11in.; from 9ft. circle, J. J. Flanagan, 39ft. 2½in. In other countries, where the throwing takes place from a 7ft. circle for distance only, the records are as follows:—World and Canada, M. McGrath, U.S.A., 40ft. 6⅜in.; Scottish, S. Smith, 33ft. 3in.; English, J. Barrett, 32ft.; U.S.A., P. J. McDonald, 38ft. 9⅞in.; Sweden, E. Stromberg, 35ft. 1in.; World and U.S.A. for height, P. Donovan, 16ft. 11¼in. Slinging the 56 lb. weight was once a common event in Great Britain at all important athletic sports meetings. It has, however, been given championship status upon only three occasions, and has but twice appeared in the Olympic programme, *i.e.,* St. Louis, 1904 (Desmarteau, Canada, 34ft. 4in.), and Antwerp, 1920 (P. J. McDonald, U.S.A., 36ft. 1⅛in.). The American championship for distance was instituted in 1878 and is still continued, the best performance being that of P. J. McDonald, who, in 1911, threw 38ft. 9⅞in. Prior to 1888, the ordinary, slightly conical half-hundredweight was used and thrown by the ring attached to the top; the ring, however, was awkward to grip and a larger triangular handle was afterwards substituted, while the conical weight was replaced by a spherical head. *See* PUTTING THE SHOT.

To throw for height the athlete places himself beside the pole vault uprights and endeavours to heave the half-hundredweight over a cross-bar placed at increasing heights between the standards. The general championship style of throwing for distance from a 7ft. circle, without follow, provides the spectator with a much more lively and entertaining exhibition of strength, speed and skill. The modern 56 lb. weight used for competition comprises a spherical head of moulded lead, or a brass shell filled with lead, having embedded in it a forged steel eye as a means of attaching the handle. The handle is made of round iron, or steel, ½in. in diameter, bent in a triangular form so that no side measures more than 7¼in. The weight is not less than 56 lb., and the length over all not more than 16in. The throwing takes place from a 7ft. circle marked upon the ground, which the thrower must not quit until his throw has been marked.

Method of Throwing.—At the back edge of the rear half of the circle the thrower takes his stance, with feet well separated and the implement resting upon the ground between them. His back is turned towards the direction in which the throw is to be made. He grasps the handle with both hands, the palms turned towards his body, and the cross-piece being against the middle joints of his fingers. He raises the weight from the ground and

swings it round outside his right leg, so that the backs of his hands are turned towards him. As the compensating swing forward starts he gives the weight more speed, swings it once round his head and, as it is coming down at his right side again, he begins to pivot on the left foot in the manner of the hammer thrower (*see* HAMMER THROWING). All the time he is turning he takes care to keep his arms out straight and his body travelling well ahead of the weight, otherwise he will lose control, the weight will drag him round and he will have neither length of swing nor the right position from which to produce a powerful delivery at the end of his one, two or three turns. At the end of the turning movement both feet are on the ground and the athlete's back is facing the direction in which the throw is to be made. Although his feet remain firmly planted, his body takes up and continues the turning movement as he heaves the weight away over his left shoulder. In the finishing position, in which the arms follow up and right through, the body is at full stretch, the legs crossed at the thighs and the left shoulder is pointing in the direction of the flight of the 56 lb. weight. An instant after the release of the weight the thrower's feet are quickly reversed in a compensating movement which enables him to remain inside the circle. The rules require that he shall not quit the circle until his throw has been marked and that he shall go out by the rear half of the circle.

One of the few really good 56 lb. weight throwers that England has produced was the late H. A. Leeke, who won the championship in 1911. Both Leeke and his father were Cambridge Blues and English champions in shot putting and also hammer throwing. H. A. Leeke was, however, not heavy enough for the 56 lb. weight event. Matt McGrath, the world's record holder, stood 6 ft. in height and weighed 17 st. 10 lb. (248 lb.) in his prime.

See Silfverstrand and Rasmussen, *Text Book of Athletics* (1926).

(F. A. M. W.)

WEI-HAI-WEI, former naval and coaling station on the northeast coast of the Chinese province of Shantung, leased (together with much of the neighbouring territory and waters and the island of Liu Kung) by Great Britain, through a convention with the Chinese government in 1898. The previous Chinese port had been captured by Japan in 1895, and occupied by their troops until 1898, when it was given over to Great Britain.

The harbour is formed by the island (Liu Kung) which runs east and west across the mouth of a small bay, leaving an entrance at each end. The best anchorage is under the lee of the island. The old city is walled and has a population of about 2,000. The chief port and seat of government was Port Edward. The leased area comprised, besides the harbour and island, a belt of mainland 10 English miles wide, skirting the whole length of the bay. The coast line of the bay is some 10 mi. and the total area of the leased district was 256 sq.mi.; its pop. est. (1921) was 154,416, including 600 on the island of Liu Kung. Within this area Britain had exclusive jurisdiction, her military rights extending to 121° 40′ E. Pop. for territory (1937) 222,247.

The leased territory comprised fertile valleys among the finger-like projections of the Shantung peninsula. The mild climate made it an important summer resort. Cereals, vegetables and fruits are grown, and some silk is produced. The people are fishers and farmers. The region contains a few metals, but not of workable value. The imports included bean-cake, candles, cigarettes, coal, raw cotton and yarn, ground-nuts, kerosene, maize, paper, rice, sugar and timber, and the exports were mainly raw cotton and yarn, fish, ground-nuts (kernels and oil), eggs, sugar and salt. A customs station was established here on Oct. 1, 1930.

History.—The territory of Wei-hai-wei was leased to Great Britain under a convention of July 1, 1898, "for so long a period as Port Arthur shall remain in the occupation of Russia." Since Jan. 1895, prior to which it had been one of China's naval stations, Wei-hai-wei had been held by Japan pending the payment of the indemnity which she had imposed on China after defeating her in war. The Japanese were still in occupation when the lease of the territory to Great Britain was arranged, the idea of the lease having originated with the Chinese, who had just agreed to Germany's possession of Kiaochow. Lord Salisbury at first rejected the Chinese suggestion but, on reconsideration, instructed Sir Claude MacDonald to obtain the lease in order to restore the local balance of power. Wei-hai-wei thus served as a sanatorium for the British squadron on the China station, and under British rule it developed considerably. On Feb. 1, 1922, however, at the Washington Conference, Mr. Balfour announced that the British Government was willing to surrender the lease under conditions similar to those agreed upon regarding the leased area of Kiaochow. After prolonged negotiations rendition took place on Oct. 1, 1930 and a special administrative area was established. In 1938 Japan occupied the port.

WEILBURG, a town in Hesse-Nassau, Germany, on the Lahn. Pop. (1933) 3,590. In the 11th century it belonged to the bishops of Worms, from whom it passed to the house of Nassau. The old town, built on and around a hill almost encircled by the river, contains a 16th century castle, formerly the residence of the dukes of Nassau-Weilburg and later of the grand-dukes of Luxemburg. In the neighbourhood are the ruins of the castles of Merenberg and Freienfels.

WEIMAR, a city of Germany, being the chief town of the *Land* of Thuringia. Pop. (1939) 65,989. It existed in the 9th century. Till 1140 it belonged to the counts of Orlamünde; it then fell to Albert the Bear. In 1247 Otto III. founded a separate Weimar line of counts. In 1345 it became a fief of the landgraves of Thuringia, to whom it escheated in 1385. At the partition of Saxony in 1485 Weimar, with Thuringia, fell to the elder, Ernestine, branch of the Saxon house of Wettin, and was the continuous residence of the senior branch of the dukes of this line since 1572. Under Charles Augustus (1775–1828) and his successors, Weimar became a centre of Liberalism as well as of German art. It was at Weimar, in July 1919, that the constitution of the new German Republic was adopted by the National Assembly.

Weimar still retains much of its mediaeval character owing to the narrow winding streets of the older part of the town, the market-place surrounded by houses with high-pitched gables and roofs and the fragments of the walls, which still survive. Of the churches the *Stadtkirche* is a Gothic building dating from about 1400, but much altered in detail under "classical" influences. The altar-piece is a triptych, the centre-piece representing the Crucifixion; beside the cross Luther is represented, with the open Bible in his hand, while the blood from the pierced side of the Saviour pours on to his head. The other church, the *Jakobs-* or *Hofkirche* (court church) is also ancient. The most important building in Weimar is the former palace, erected (1789–1803) under the superintendence of Goethe, on the site of one burned down in 1774. A remnant of the old palace, with a tower, survives. The interior is very fine, and in one of the wings is a series of rooms dedicated to the poets Goethe, Schiller, Herder and Wieland. Of more interest, however, is the house in which Goethe himself lived from 1782 to 1832. It is a complete example of a German nobleman's house at the beginning of the 19th century. Of more pathetic interest is the *Schillerhaus,* in the *Schillerstrasse,* containing the humble rooms in which Schiller lived and died. The theatre, built under Goethe's superintendence in 1825, memorable in the history of art not only for its associations with the golden age of German drama, but as having witnessed the first performances of many of Wagner's operas, was pulled down and replaced by a new building in 1907. The most beautiful monument of Goethe's genius in the town is, however, the park. Just outside the borders of the park, beyond the Ilm, is the "garden house," a simple wooden cottage with a high-pitched roof in which Goethe used to pass the greater part of the summer. Finally, in the cemetery is the grand ducal family vault, in which Goethe and Schiller also lie, side by side.

Among the other prominent buildings in Weimar are the *Grünes Schloss* (18th century), containing a library and a valuable collection of portraits, etc.; the old ducal dower-house (*Wittumspalais*); and the museum. In 1896 the Goethe-Schiller Archiv, on the wooded height above the Ilm, containing mss. by Goethe, Schiller, Herder, Wieland, Immermann, Fritz Reuter, Mörike, Otto Ludwig and others, was opened. Weimar possesses also archaeological, ethnographical and natural science collections. About 2 m. S. from the town is the château of Belvedere, with the open-air

theatre, of interest because of its use in Goethe's day.

See Kuhn, *Weimar in Wort und Bild* (Jena, 1905, etc.); Francke, *Weimar und Umgebungen* (Weimar, 1900, etc.).

WEINER, LEO (1885–), Hungarian musical composer, was born in Budapest April 16, 1885, and studied in his native city, becoming a professor at the School of Music there in 1907. His works include orchestral works: *Serenade* (1906, awarded the Budapest Lipótvárosi Kaszinó Prize), *Carnival, Scherzo* and accompanying music to a play by Michel Vörösmartz entitled *Csongor ēs Tünde;* chamber music: two string quartets (the second of which gained the Coolidge Prize in America, 1922), two sonatas for violin and pianoforte, and a ballad for clarinet and pianoforte (also for orchestra). Weiner's style is classical and he ignores both the romantics and the ultra-modern school.

WEINHEIM, a town of Germany, in the *Land* of Baden, pleasantly situated on the Bergstrasse at the foot of the Odenwald, 11 m. N. of Heidelberg by the railway to Frankfort-on-Main. Pop. (1939) 18,598. It is still in part surrounded by the ruins of its ancient walls. The Gothic town hall, the ruins of the castle of Windeck and the modern castle of the counts of Berckheim, the house of the Teutonic Order, and three churches are the principal buildings. The town has various manufactures, notably leather, machinery and soap, and cultivates fruit and wine. It is a favourite climatic health resort and a great tourist centre for excursions in the Odenwald range. Weinheim is mentioned in chronicles as early as the 8th century, when it was a fief of the abbey of Lorsch, and it was fortified in the 14th century. In the Thirty Years' War it was several times taken and plundered, and its fortifications dismantled.

See Ackermann, *Führer durch Weinheim und Umgebung* (Weinheim, 1895); and Zinkgräf, *Bilder aus der Geschichte der Stadt Weinheim* (Weinheim, 1904).

WEINSBERG, a small town of Germany, in the *Land* of Württemberg, situated on the Sulm, 5 m. E. from Heilbronn by the railway to Crailsheim. Pop. (1933) 4,081. Conrad III. defeated Welf VI. of Bavaria near Weinsberg in Dec. 1140, and took the town, which later became a free imperial city. In 1331 it joined the league of the Swabian cities, but was taken by the nobles in 1440 and sold to the elector palatine, thus losing its liberties. It was burnt in 1525 as a punishment for the atrocities committed by the revolted peasants. It has an ancient Romanesque church and a school of viticulture, which is the chief occupation of the inhabitants. On the Schlossberg above the town lie the ruins of the castle of Weibertreu. The famous legend of Weibertreu is connected with the siege of 1140, when Conrad III. is said to have allowed the women to leave the town with whatever they could carry, whereupon they came out with their husbands on their backs.

WEIR, ROBERT WALTER (1803–1889), American portrait and historical painter, was born at New Rochelle, New York, on the 18th of June 1803. He was a pupil of Jarvis, was elected to the National Academy of Design in 1829, and was teacher of drawing at the United States Military Academy at West Point in 1834–1846, and professor of drawing there in 1846–1876. He died in New York City on the 1st of May 1889. Among his better-known works are: "The Embarkation of the Pilgrims" (in the rotunda of the United States Capitol at Washington, D.C.); "Landing of Hendrik Hudson"; "Evening of the Crucifixion"; "Columbus before the Council of Salamanca"; "Our Lord on the Mount of Olives"; "Virgil and Dante crossing the Styx," and several portraits, now at West Point, and "Peace and War" in the Chapel there.

His son, JOHN FERGUSON WEIR (1841–1926), painter and sculptor, became a Member of the National Academy of Design in 1866, and was made director of the Yale University Art School in 1868. Another son, JULIAN ALDEN WEIR (1852–1919), studied under his father, and under J. L. Gérôme, and became a distinguished portrait, figure and landscape painter.

WEIR, WILLIAM DOUGLAS WEIR 1ST VISCOUNT (1877–), British politician and business man, was born May 12, 1877, the son of James Weir of Over Courance, Dumfriesshire. He was successively Scottish director of munitions (1915), member of the Air Board (1917), Air minister (1918), and chairman of the advisory committee on civil aviation. His firm of G. & J. Weir, Ltd., Glasgow, constructed the "Weir" steel houses which caused controversy in 1925. He was knighted 1917, sworn P.C. and created a baron 1918, created G.C.B. 1934 and a viscount 1938.

WEIR, a barrier placed across a river or canal for raising or diverting or regulating the water for navigation, irrigation, power and other purposes. A weir, as distinguished from a dam employed for purposes of water storage, connotes the discharge of water over its crest or through wide openings made for the purpose. River weirs are not infrequently termed dams, and the French term *barrage* is often applied to weirs provided with sluice openings. In the United States a barrier placed across a river for any purpose is called a dam, the term weir being used to denote the movable wickets or gates forming part of it and employed for regulating the flow and level of the water. (*See* WATER SUPPLY; IRRIGATION; DAMS and HYDRAULICS.)

Rough weirs, formed of stakes and brushwood, were erected across English rivers in Saxon times for holding up the water and catching fish. Fish traps, with iron-wire meshes and eel-baskets, are still used sometimes at weirs. Weirs exhibit the greatest variety of form and construction in connection with the canalisation of rivers. Navigation becomes impracticable at the shoals in many rivers during periods of low water. In early times boats had to be kept at such places until the discharge of storm-water raised the river sufficiently to carry them over the shallows. An early method of remedying this trouble consisted in building low weirs to increase the depth of water. Openings formed in them could be temporarily closed by stanches usually consisting of planks supported by movable wooden beams. By removing these beams suddenly and thus releasing the stanch an artificial flood was produced which carried any boat waiting above the weir through the opening and over the shoals below. This process was called flashing. It remained in use on some rivers in England and France until well on in the 19th century.

There are four principal classes of weirs, namely: (1) solid or overfall weirs; (2) movable weirs which retain the water above them for navigation or irrigation during the low stage of the river and can be lowered so as to leave the channel quite open in flood-time; (3) draw-door weirs, in which doors or gates closing openings are lifted by means of machinery carried on a permanent overhead structure; and (4) other lifting weirs of various forms operated by overhead gear.

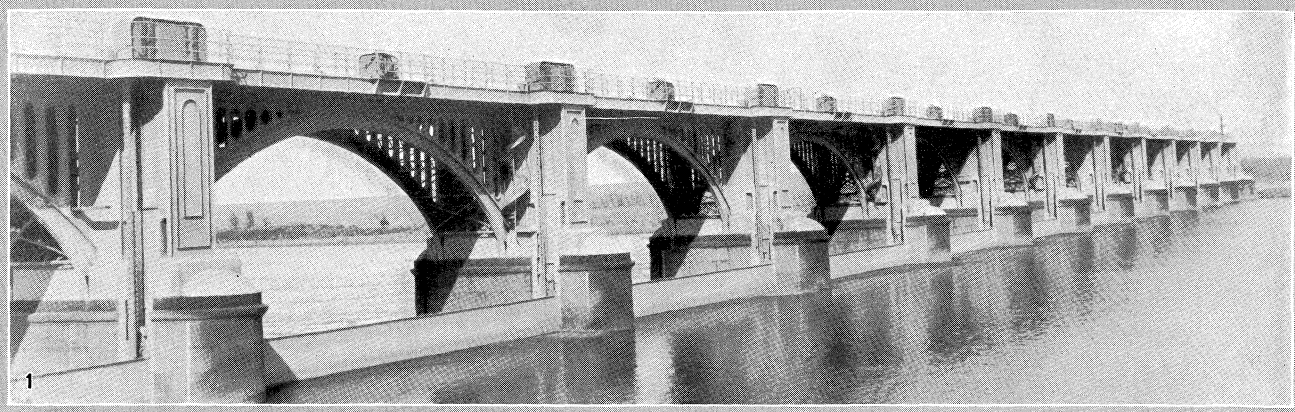
1. SOLID WEIRS

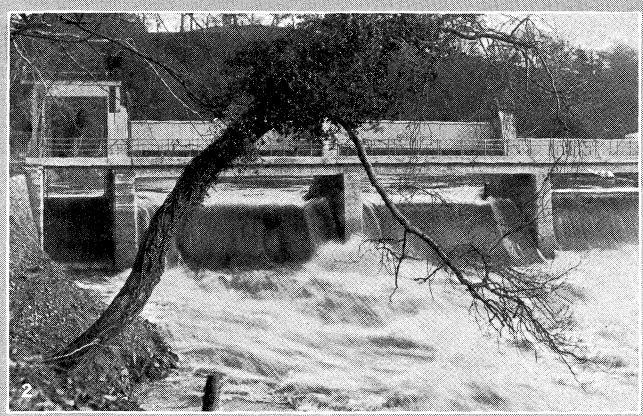
The simplest form of weir on an alluvial or erodible foundation is a dam of earthwork or rubble-stone faced with stone pitching, or masonry, or fascine mattresses weighted with stone, or with timber cribs filled with rubble. Many solid weirs were formerly constructed in North America of log-timber or stone-filled cribs. Large modern weirs on alluvial soil are now frequently built of concrete on piled foundations. When solid weirs are founded on rock, concrete or masonry construction is usually employed. It is frequently desirable to maintain a pool of water, by building a small dam below the weir against the down stream face of the weir to act as a water-cushion for the overflow.

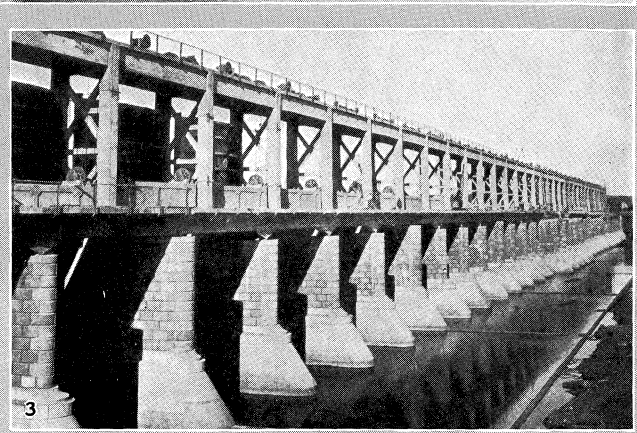
Weirs founded on alluvial deposits are specially liable to undermining, and the consequent washing out of the foundation, and to the scouring action of the water down stream. Undermining is prevented by impeding the percolation of the water under the weir by means of a cut-off, either in the form of a deep curtain-wall of masonry or concrete or of steel interlocked sheet-piling. Scour below the weir can be prevented by constructing a suitable apron of rubble-stone or cribwork of sufficient width. Frequently cut-off walls are formed both under the crest of the weir and under the apron. In many Indian rivers weirs have been built with cut-off walls formed of brick or concrete wells. The weirs across the Damietta and Rosetta branches of the Nile below the Grand Barrage at the head of the delta (1899–1901) have cut-off walls of cement-grouted rubble in a dredged trench.

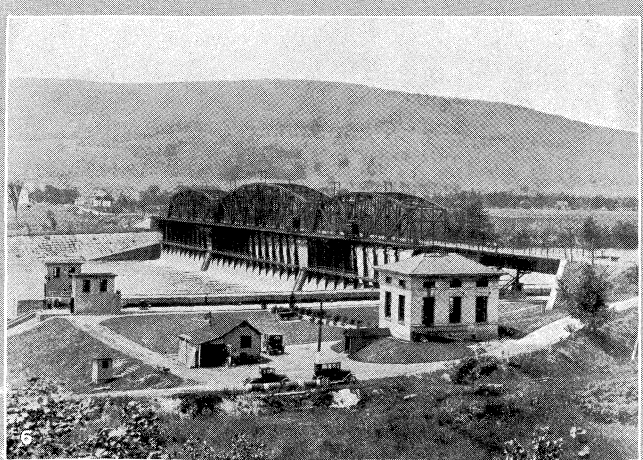
Solid weirs, if properly constructed, possess the advantage of simplicity, strength and durability, and require no attendance.

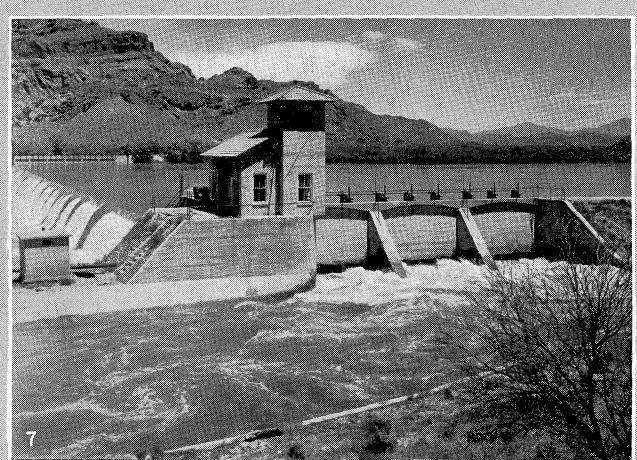
WEIR











BY COURTESY OF (1, 2) RANSOMES AND RAPIER, LTD., (3, 4, 5) GLENFIELD AND KENNEDY, LTD., (6) CHIEF ENGINEER, NEW YORK STATE BARGE CANALS, (7) BUREAU OF RECLAMATION, U.S. DEPARTMENT OF THE INTERIOR

1. Stoney Gates at Neuquen Barrage, Argentina, 65′ 7″ span and 13′ 1″ deep. The counterbalance weights are housed in the bridge piers. 2. Stonebyres Weir, River Clyde, Scotland, 38 ft. span and 8 ft. effective depth. The crestgates are automatic. 3. Thirty-six Stoney roller gates, at Vaal River Barrage, South Africa. 4. Hinged steel shutters forming movable crest weir at Mockes Dam, Modder River, South Africa. On release of the first shutter operated by hand, the remaining shutters fall automatically. View shows shutters falling in succession. 5. Stoney roller gate 70 ft. long and 7 ft. deep on River Irvine, Scotland. One man can raise the gate 13 ft. in 2 minutes. 6. Bridge-suspended weir at Rotterdam, New York. This is one of eight similar weirs on the Mohawk River. The bridge also carries a roadway. 7. Gates of the Granite Reef diversion dam of the Salt River project, Arizona

They, however, block up the river channel to the extent of their height, and consequently raise the flood-level above them. This defect of solid weirs, when the riparian lands are liable to be injured by inundations, can be slightly mitigated by keeping down the crest of the weir a little below the required level, and then raising the water level at the low stage of the river by placing planks, called flash-boards, a few feet high along the top of the weir. The capacity of a solid weir is increased by building it obliquely across the river, *e.g.*, some of the Severn weirs; or curved in plan, with the convex face up-stream.

2. MOVABLE WEIRS

Movable weirs are barriers capable of being lowered so as to present no obstruction to the flow of water in flood time. They are constructed either upon a foundation or sill having its surface approximately level with that of the river bed or on the crest of a solid weir structure raised above the river bed.

Needle Weirs.—A simple form of needle weir was employed in France about the end of the 18th century. Small wooden spars called *aiguilles* (needles), which bore on the bottom against a masonry sill and at the top against wooden beams supported on masonry piers, formed the barrier. This type, however, only provided a series of small openings between the piers. Poirée, a French engineer, devised in 1834 the movable frame weir which bears his name and can be lowered so as to leave the whole width of the river free from obstruction. In its ordinary form the Poirée needle weir consists of a series of iron frames placed across a river, end on to the current, 3 to 4 ft. apart, hinged to a masonry apron on the bed of the river and carrying a foot-way across the top, from which the actual barrier, resting against the frames and cross bars at the top and a sill at the bottom, is put into place or removed for closing or opening the weir. A winch is used to handle the frames.

A needle weir built in 1891–97 across the Big Sandy river at Louisa, Ky., was the first constructed in the United States and is higher than any in Europe.

Boulé Gates.—A modification of the Poirée needle weir is the Boulé gate introduced in 1874 in which panels of boards or sheet-iron set in tiers one above another are used instead of needles to form the barrier between the frames. The panels are set and removed by a small derrick crane travelling on top of the footbridge. The system has the advantage of forming a tighter dam which can be more easily although less rapidly manoeuvred than needles. Boulé gates have been used to a considerable extent in France and on the Moskowa and other rivers in Russia.

Curtain Weirs.—The curtain weir, invented by Caméré, was first introduced in 1876–80 at Port Villez on the lower Seine. In it wooden curtains that can be rolled up from the bottom were substituted for the needles in the Poirée weir. The curtains are raised and removed, and the frames lowered by winches travelling over the service bridge. The manoeuvring of the frames and curtains is a troublesome operation and all the curtain weirs subsequently constructed have been designed for suspension from a fixed over-head bridge (*vide infra.*).

Shutter Weirs.—The earliest practical application of falling shutters to overfall weirs was made on the river Orb in France in the latter part of the 18th century. A gate or shutter turning on a horizontal axis at the bottom was supported by a prop when raised against the stream and fell flat on the apron when the prop was drawn aside. The difficulty experienced in raising such a shutter against a head of water was overcome by Thénard about 1837 who placed a second row of shutters (counter-shutters) on the up-stream side of the weir which, rising with the stream, were retained in an upright position by chains and stopped the flow of water while the lower shutters were being raised and propped.

Shutters of modified and improved forms, some of them automatic in action, are in use at many irrigation weirs in India and other countries.

Chanoine Weirs.—The inconveniences attending the use of counter-shutters of the Thénard type were overcome by Chanoine, another French engineer, who, in 1857, at the Conflans weir on the Seine, employed shutters turning on a horizontal axis a little above their centre of pressure. The axis rests on an iron trestle at the back of each shutter, which is hinged to the apron of the weir and is supported when raised by an iron prop resting against a shoe fastened on the apron. The weir is opened by releasing the props from their shoes, either by a sideways pull of a tripping bar with projecting teeth laid on the apron and worked from the bank, or by pulling the props clear of their shoes by chains. The weir is raised again by pulling up the shutters to a horizontal position by their bottom chains from a special boat or from a foot-bridge on movable frames, together with their trestles and the props which are replaced in their shoes. The discharge at the weir whilst it is raised is usually effected by partially tipping some of the shutters by chains from a foot-bridge. Occasionally the balance is so arranged that the shutters tip automatically when the water level in the upper pool reaches a certain height.

The addition of a foot-bridge facilitates the raising and lowering of these weirs and the regulation of the discharge, but it makes the weir more costly than the ordinary needle weir. Moreover, where large quantities of drift come down with sudden floods, the frames of the bridge are liable to be carried away and therefore boats must be relied on for working the weir as on the upper reaches of the Ohio river. In the United States the type is known as the Chanoine wicket. The Chanoine shutter is adapted for use both on overfalls and in navigable passes.

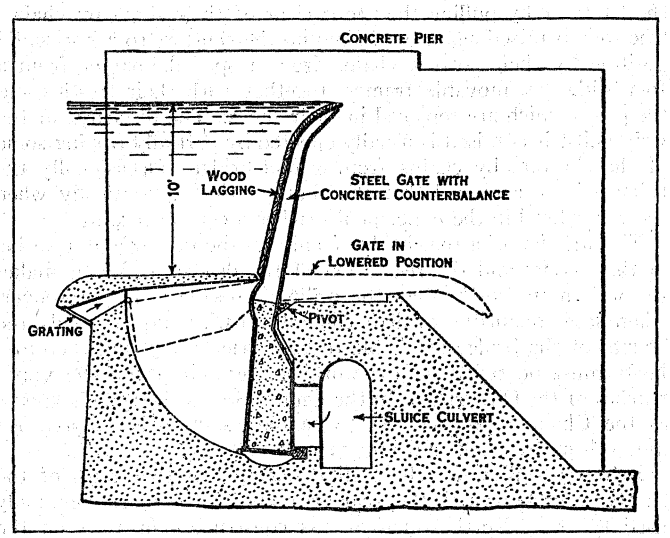
Bear-trap Weirs.—The earliest example of that form of the shutter weir known as the bear-trap, one of the most commonly used types in North America, was constructed in 1818 on the Lehigh river (Pa.). It consists of two timber—or, in recent types, steel—gates, each hinged on a horizontal axis, inclined towards one another and abutting together at an angle in the centre when the weir is raised. The up-stream leaf or gate serves as the weir and the down-stream one forms its support. Both gates fall flat on the sill floor when the weir is opened. The weir is raised by admitting water beneath the gates through culverts in connection with the upper pool and controlled by valves, and is lowered by letting the water under the gates escape into the lower pool. In its original form the bear-trap was open to several important objections such as the twisting or warping of a wide gate in raising or lowering, the friction between the leaves, and lodgement of driftwood or stones under them. Since about 1896 many improvements in the design of bear-traps have been made and there are numerous examples on North American rivers with leaves over 120 ft., wide, and with lifts up to about 17 ft.

Drum-weirs and Sector Gates.—The drum-weirs invented by Desfontaines and erected on the river Marne between 1857–67 comprise a series of upper and under wrought-iron paddles or blades which can make a quarter of a revolution round a central axis laid along the sill of the weir. By means of valves the pressure of the water due to the head of the upper pool can be applied to either side of the lower and larger paddle, which is contained in a masonry chamber, or drum, below the weir apron, and thus the upper paddle can be raised against a head of water or lowered as required. The disadvantage of the arrangement is the high cost of constructing the deep chambers below the weir sill, and its use is generally restricted to over-fall weirs. Several examples of the type in modified forms and on a large scale have, however, been erected in Germany, one at Charlottenberg having an upper paddle 33 ft. long and $9\frac{1}{4}$ ft. high.

A form of drum-weir invented by an American engineer, H. M. Chittenden, has been used in the United States. An early example was erected about 1895 in a weir on the Osage river near its confluence with the Missouri where a hollow, wooden sector of a cylinder having a radius of 9 ft. rotates on a horizontal axis and is housed when lowered in a drum chamber below the weir sill. The weir is raised by admitting water from the upper pool into a wedge-shaped space left below the sector when it is lowered. Provision is also made for rendering the sector buoyant by forcing air into it so that it can be raised when the head of water in the upper pool is insufficient to lift it.

The sector-gate applied to weirs may be said to be a development of the Chittenden drum-weir. Two large gates, each 100 ft.

long and about 16 ft. high, have been constructed across the Genesee river near Rochester, N.Y. The gates are, when lowered, housed in concrete chambers formed between the abutments below the level of the fixed-weir crest. The steel sector-frame which forms the gate is hinged on its axial line, and the plating fixed to the cylindrical face forms the water barrier when the sector is raised. The gate is operated by admitting water from



BY COURTESY OF RANSOMES & RAPIERS

FIG. 1.—MODERN DRUM-WEIR MANGAHOO, NEW ZEALAND, WITH GATES 53½ FT. SPAN

the higher pool under the sector by means of culverts and valves. Somewhat similar gates are in use on the river Drac in France; on the Weser at Bremen; on the Chicago drainage canal; in Norway, where one gate is 163 ft. long; and in Perak.

Automatic Crest Gates or Weirs.—Several forms of gates or shutters which operate automatically have been devised, particularly in recent years, for use on the crests of solid weirs to give increased height. The common feature of these devices is the automatic lowering of the gate as soon as the water rises to a certain level. When the water falls below this level, the gate rises again to its normal position as a barrier.

The Stickney crest gate consists of two leaves joined together at about right angles and hinged to a masonry base on a horizontal axis. Under the lower leaf is a quadrant-shaped chamber formed in the concrete or masonry of the weir which is in communication by means of water openings with the up-stream pool. The areas of the leaves are so proportioned that the pressure against the under side of the lower leaf preponderates until the water rises above its normal level when the gate falls. These gates have been made in sections of over 100 ft. in length and for heights of about 8 ft. For long weirs several crest gates, separated by piers, may be used. Several are in use on the New York State barge canal system.

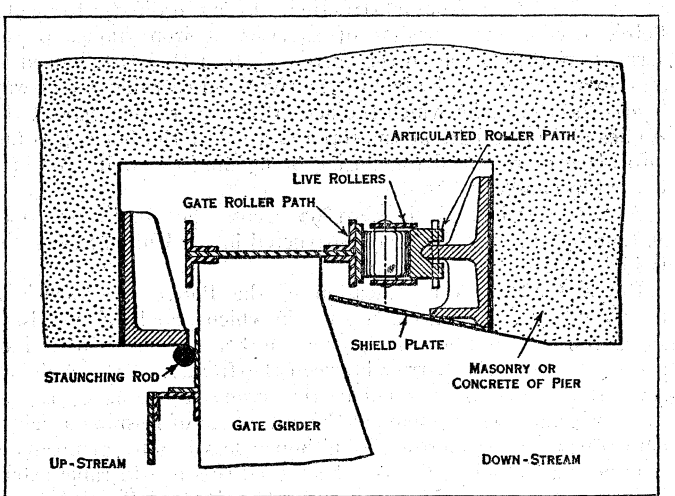
Another form of automatic gate consists of single leaves hinged horizontally at the crest level of the solid weir and balanced by counter-weights carried by pivoted levers or by chains and pulleys on piers raised above the weir at intervals of about 50 ft., the spans between the piers being occupied by the hinged gates. Various ingenious devices at the fulcrum of the lever or in connection with the pulley wheels are employed to vary automatically the balance as the gate rises and falls.

3. DRAW-DOOR WEIRS

The water discharge at a weir can be regulated and considerably increased in flood time by introducing a series of openings in a solid weir, with sluice gates or panels which slide in grooves at the sides of upright frames or masonry or concrete piers erected at convenient intervals apart. The sluice gates can be raised or lowered as desired from an overbridge. Ordinary draw-doors of moderate size and raised against a small head of water can be readily worked in spite of the friction of the sides of the doors against their supports; but with large draw-doors and a considerable head, the friction of the surfaces in contact offers a serious impediment in raising them. To overcome this difficulty F. G. M. Stoney about 1875 introduced roller sluice gates.

Stoney Gates.—In the Stoney sluice gate two frames, containing a number of free, or live, rollers, are interposed between the fixed framework and the moving face of the gate, so that, instead of a sliding friction, which in very large sluices might amount to over 300 tons, a rolling friction only has to be overcome, which is insignificant in amount. The working is facilitated by counterpoising the gates and roller trains. By these arrangements the friction is so reduced that gates subjected to a water pressure of over 400 tons can be easily moved by hand-operated gearing. Water-tight joints are obtained by means of suspended iron rods or tubes or by rubber strips which are jammed by the water-pressure against the small apertures between the gates and the fixed framework (fig. 2).

Stoney gates have been used for openings up to 80 ft. in width and for depths exceeding 35 ft. The first example constructed in the United Kingdom was at Belleek in 1883 in connection with the Lough Erne drainage works. A well-known example is the weir across the Thames at Richmond with three spans of 66 ft. each closed by doors 12 ft. high (1892–94). In order that the doors when raised may not impede the view of the river under the arches, the doors are rotated automatically at the top by



BY COURTESY OF RANSOMES & RAPIERS

FIG. 2.—STONEY GATE SECTIONAL PLAN OF VERTICAL ROLLER PATHS
The articulated grooved roller-path can rock freely so as to be self adjusting and is easily renewable

grooves at the sides of the piers, so as to assume a horizontal position and pass out of sight in the central space between the overhead footways.

4. OTHER LIFTING WEIRS

Bridge-suspended Weirs.—The difficulty of operating the Caméré curtains in conjunction with movable frames hinged at the sill of a solid weir or apron led to the construction, as a part of the Poses weir on the lower Seine (completed in 1885), of a fixed overhead-bridge from which the frames and curtains are suspended. The suspended frames are hinged to the under side of the bridge and rest against a sill at the bottom when the weir is in operation. The rolling curtains are raised when necessary and the hinged-frames lifted to a horizontal position under the bridge by means of travelling winches and chains. This system, which has been employed for several weirs on the Seine, on the Moldau in Bohemia, and on the Danube canal near Vienna, has the merit of raising all the movable parts of the weir out of the water, in flood time, into a position where they are not subjected to the risk of damage, and rendering the working of the weir safe and easy. On the other hand it involves the expense of wide and high river piers and a substantial over-bridge.

A bridge-suspended weir with Caméré curtains at the St. Andrew's rapids on the Red river, Manitoba, was the first of its

kind to be built in America (1908–11). The bridge is of 6 spans of 120 ft. each and also carries a roadway.

The Mohawk river, forming a part of the New York State barge canal system, has been canalized by the construction of a number of dams, 8 of which are of the suspended weir type. At each of these weirs the river is crossed by a steel-truss bridge, usually of three spans, carried upon masonry and concrete piers. The clear spans vary in width from 120 ft. to 240 ft. Some of the bridges carry roadways as well as the weir-operating machinery. The only fixed structure in the river other than the bridge piers is a concrete sill level with the river bed. Against this sill bear vertical steel beams suspended from the over-bridge at intervals of 15 feet. Steel doors which are 30 ft. wide and mounted on rollers and arranged in two tiers can be moved up on and down on the up-stream faces of the hanging beams by means of travelling electric winches carried by the bridge. During the navigation season the hanging beams are kept lowered and are only raised partly or entirely in cases of extreme freshets. The discharge of ordinary floods is provided for by raising the roller doors. At the close of the navigation season the hanging beams with their doors are raised to a horizontal position under the bridge floor to permit the free passage of ice.

Taintor Gates.—The Taintor gate is a form of sector gate but it differs from the type described in section 2 p. 489 in being raised, by means of hand-operated gearing and counterweights, in order to open the waterway. Many of these gates have been constructed in recent years, particularly on the New York State barge canal system. Some of the larger gates are 50 ft. wide with a water depth of 20 ft. In common with some other forms of lifting gates they possess the advantage over lowering weirs of all working parts being accessible from above water.

Rolling Dams.—A form of movable weir consisting essentially of a rolling gate was first employed on a tributary of the river Main near Schweinfurt, Bavaria, in 1901. It consists of a steel drum or pipe, usually cylindrical and sometimes with a protruding rib to increase the retaining height, which closes the opening in a fixed weir when required and which, when the weir is to be opened, can be rolled by mechanical means up inclines at the abutments, leaving a clear opening underneath. Several of these weirs have been built in Germany, Bohemia, France, Italy and the United States. They have been made up to 115 ft. in length and with closing heights up to 20 ft.

One of the longest weirs on the Ohio river is a navigable pass, 1,200 ft. long, closed by Chanoine wickets, an overfall weir of Chanoine wickets 700 ft. in length, three bear-traps occupying 325 ft. and a fixed weir of 715 ft. making a total of 2,940 feet.

An example of a long weir with over-bridge is the Lloyd barrage on the Indus at Sukkur in Scinde (1929) which has 66 Stoney gates each of 60 ft. span and 18½ ft. in height. The total length of the weir, including the piers, is 4,620 feet.

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(N. G. G.)

WEISMANN, AUGUST (1834–1914), German biologist, was born at Frankfort-on-Main, on Jan. 17, 1834. In 1863 he went to Giessen to study biology under Leuckart, and in 1866 he was appointed extraordinary professor of zoology at Freiburg, becoming ordinary professor a few years later. His earlier work was largely concerned with purely zoological investigations, one of his earliest works dealing with the development of the Diptera. Microscopical work, however, became impossible to him owing to impaired eyesight, and he turned his attention to wider problems of biological inquiry. Between 1868 and 1876 he published a series of papers attacking the question of the variability of organisms; these were published in an English translation under the title *Studies in the Theories of Descent* (1882), Darwin himself contributing a preface in which the importance of the nature and cause of variability in individuals was emphasized. Weismann's name is best known as the author of the germ-plasm theory of heredity, with its accompanying denial of the transmission of acquired characters—a theory which on its publication met with considerable opposition, especially in England, from orthodox Darwinism. His views on the permanence of the germ-plasm and his rejection of the inheritance of acquired characters are not without their theological implications. A series of essays in which this theory is expressed and in which Weismann declared that there must be a reduction division for the chromosome—a prophecy verified a few years later by Platner and others—was collected and published in an English translation (*Essays upon Heredity and Kindred Biological Problems,* vol. i. 1889, vol. ii. 1892). Weismann published many other works devoted to the exposition of his biological views. He died at Freiburg in Baden on Nov. 6, 1914. His latest publications were an estimate of Darwin's work, and *Die Selektionstheorie.*

For an account of his doctrines the reader is referred to the articles on HEREDITY, REGENERATION IN ANIMALS and CYTOLOGY. *See* also E. Gaupp, *August Weismann* (1917).

WEISSENBURG: *see* WISSEMBOURG.

WEISSENBURG-AM-SAND, a town of Germany, in the Bavarian district of Middle Franconia, situated at the western foot of the Franconian Jura, and 33 mi. by rail S.W. of Nürnberg by the railway to Munich. Pop. (1939) 8,894. Weissenburg dates from the 8th century, and in the 14th was made a free imperial town. It passed to Bavaria in 1806. It is still surrounded by old walls and towers and has two Gothic churches and a Gothic town hall. The town has a mineral spring and remains of a Roman castle have been discovered. The old fortalice of Wülzburg (2,060 ft.) overlooks the town.

WEISSENFELS, in the Prussian province of Saxony, Germany. Population (1939) 42,220. It is a place of considerable antiquity, and from 1656 till 1746 it was the capital of the small duchy of Saxe-Weissenfels. The body of Gustavus Adolphus was embalmed at Weissenfels after the battle of Lützen. The former palace, called the Augustusburg, built in 1664–1690, lies on an eminence near the town. Weissenfels manufactures cardboard, rubber, boots, machinery, ironware, paper and other goods. In the neighbourhood are large deposits of sandstone and lignite.

WEKA-RAIL, a flightless bird of New Zealand.

WELD (*Reseda luteola*), an herbaceous plant of the mignonette family (Resedaceae) formerly cultivated in France, Germany and Austria. It is the oldest European dyestuff known, and appears to have been used by the Gauls in the time of Julius Caesar. Of all the natural yellow colouring matters, it yields the purest and fastest shades, but owing to the small amount of dye which it contains, and its bulky nature, it has almost disappeared from the market. Weld contains the yellow colouring matter luteolin, $C_{15}H_{10}O_6$, which crystallizes in yellow needles ($+1\frac{1}{2}H_2O$) and melts at 320° C. (*See* ANTHOCYANINS.) (A. G. P.)

WELDING. Not until comparatively recently was the value of welding as a standard method of joining metal pieces fully appreciated. It was during World War I that the various welding processes came into their own because speed of production in every metal-using and metal-fabricating industry became a vital factor.

At first welding was limited to small or less important parts. Welding (1940) is employed for an almost limitless number of applications including ships, structures, and trains. The subject of welding may be divided into the five following processes: (1) forge welding; (2) arc welding; (3) gas welding; (4) resistance welding; (5) thermit welding.

Forge Welding.—Until about 1890 this was the only available method of welding and it had been in use to some extent for centuries.

After properly shaping the two surfaces to be joined, the parts are heated to welding temperature in a forge or furnace and then hammered, rolled or pressed together, usually with the aid of some fluxing material.

The numerous applications of this method are well known and its limitations are fairly obvious.

Arc Welding may be divided as follows:
(1) metal arc welding with bare electrodes;
(2) metal arc welding with covered electrodes;
(3) atomic hydrogen arc welding;
(4) carbon arc welding;
(5) electronic tornado welding;
(6) automatic arc welding. Several of these divisions may be further sub-divided as to whether the current is direct or alternating and whether the operation is manual, semi-automatic, or automatic.

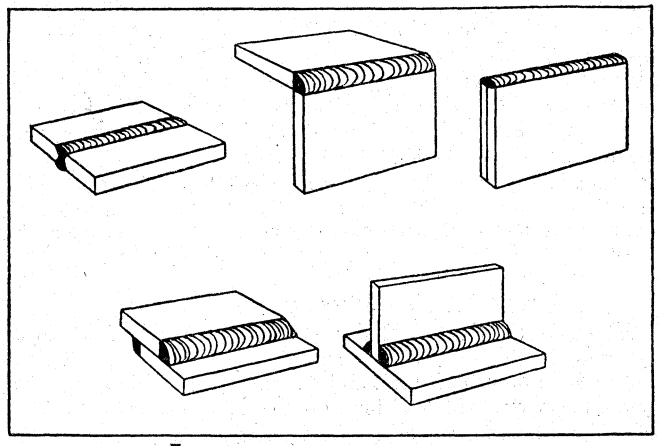


FIG. 1.—TYPES OF WELDED JOINTS

Metal Arc Welding.—An arc is struck between the electrode, a wire or rod of suitable composition, generally coated with a heavy cellulose or mineral coating, and the parts to be welded. These should be properly shaped and are usually bevelled on both edges when plates are to be joined in the same plane by a "butt" weld. The metal is fused at both ends of the arc and the fused electrode deposited in the joint in a series of layers until it is properly filled. After each layer the protective slag formed by the melting of the coating should be removed by chipping or peening. The arc should be as short as possible, particularly with bare wire welding, in order to avoid oxidation of the metal, the inclusion of harmful gases, and to secure the proper penetration.

Welding may be done with direct or alternating current. The alternating current is usually supplied by a suitable transformer provided with taps to adjust the current. Several types of direct current arc welding equipment are available. An arc welding outfit consists of a welding generator or transformer, a control panel for varying the current, a voltmeter and ammeter, proper lengths of cable, an electrode holder and a suitable shield or helmet for protecting the eyes of the operator.

The Welding Arc.—When direct current is used, one terminal remains positive and the greater portion of the total heat is liberated at this terminal. When alternating current is used, the terminals are alternately positive and negative so that approximately the same amount of heat is liberated at each terminal. Usually the piece of metal to be welded is considerably larger and has more mass than the electrode so that its loss of heat will be the greater due to conduction into the body of the metal and hence is made the positive side.

In case, however, very thin metal is being welded, it is frequently advisable to reverse the polarity to prevent the arc burning through the metal.

Coated Electrodes have been used in some form almost since the beginning of arc welding. In general the coatings serve as a fluxing or deoxidizing medium, or provide a protective vapour around the arc or a vehicle for transmitting desirable alloys in the deposited metal. Some coated or "shielded arc" electrodes, as they are generally called, operate best with "reversed" polarity.

Atomic Hydrogen Arc Welding.—A fine jet of hydrogen is forced through an arc formed between two tungsten electrodes. The high temperature of the arc breaks up the hydrogen molecules into hydrogen atoms, which recombine into molecules after passing through the arc, giving up the heat absorbed during dissociation in the arc. The result is a jet flame of hydrogen burning in a hydrogen atmosphere at a temperature higher than that of any other known flame, but lower than that of the arc itself. The welding wire is fused in this flame and deposited in the joint. The intensely reducing character of this hydrogen flame results in a nearly perfect weld practically as good as the parent metal. *Carbon Arc Welding* was first invented in 1881. An arc is struck between a carbon (or graphite) electrode and the parts to be welded. The welding wire is then fed into the arc and fused into the joint. In some cases the welding rod is laid in the joint groove and the carbon arc passed slowly along the joint until the fusion is complete.

Electronic Tornado Welding uses a magnetically controlled carbon arc in which is introduced a suitable flux or "shielding" medium. This produces welds with good ductility. Oxidation is largely prevented in this process. Great speeds are possible although the application is limited to "downward" welding.

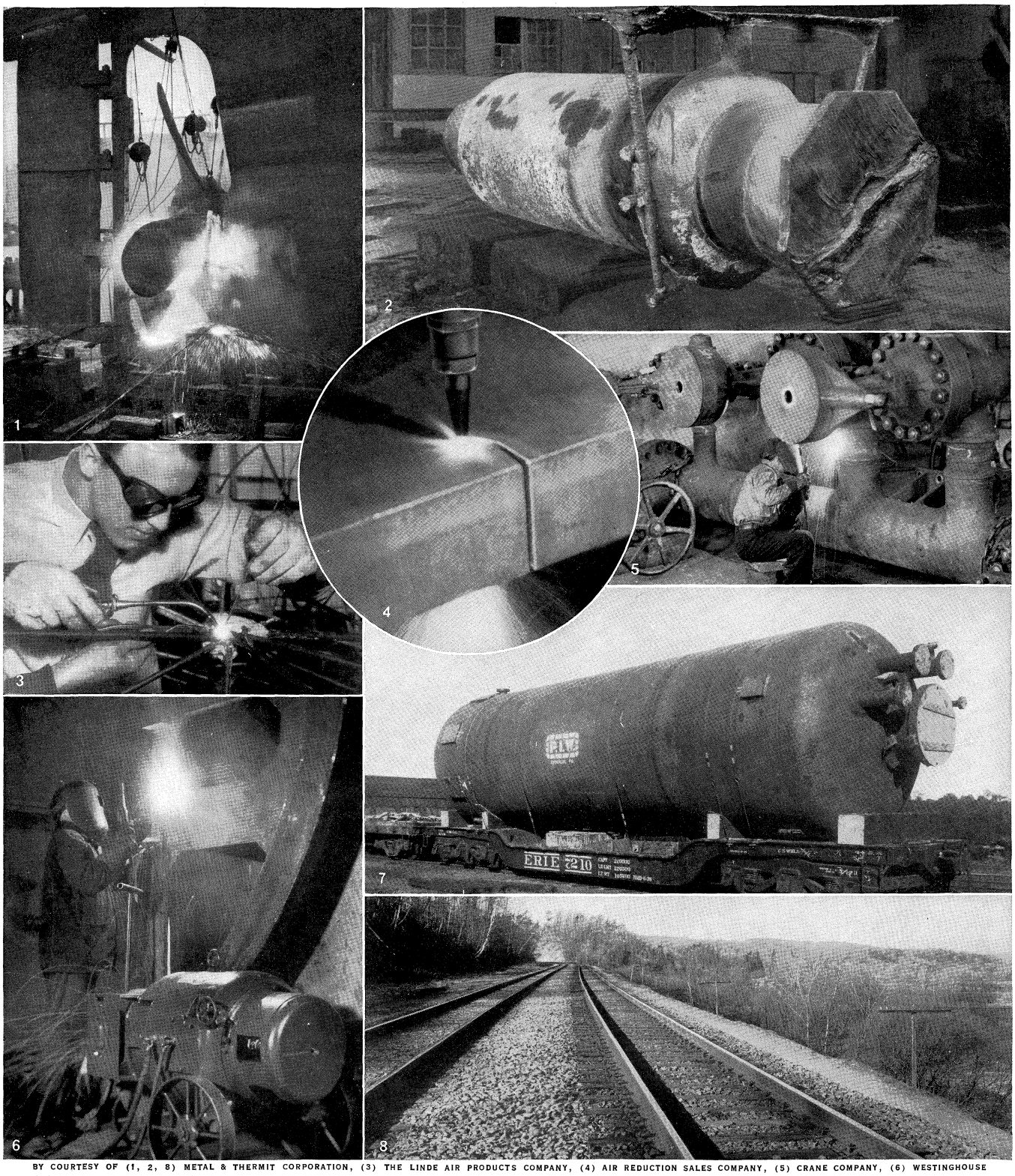
Automatic Arc Welding.—The great advantage of the automatic welder is that the arc length and other variables are much more accurately controllable and constant than with the most skillful hand operator. It is also a great labour saver and the speed of welding can be greatly increased. There are also semi-automatic arc welding machines in which the feed of the electrode and the arc length are under automatic control, but the "travel" or movement of the arc along the seam is under hand control. This largely eliminates the demand for great skill on the part of the operator and is at the same time applicable to a number of situations where the full automatic machine could not be used.

Gas Welding.—This process of fusion welding is generally carried out by the heat produced by the burning of acetylene in the presence of commercially pure oxygen, the flame temperature so attained being probably about 5,500° F, which, in view of the concentrated flame, is high enough to melt any metal locally, and so allows pieces to be easily fused together. It is necessary, when welding thick materials, to bevel the edges to be joined so they form a "v," which is filled up by melting into it a rod of suitable composition, the weld metal also being fused to the base metal. The joint, well made, is clean and sound, free from injurious defects, and usually as strong or stronger than the parts joined.

Torches.—Any oxy-acetylene welding torch is an instrument that thoroughly mixes the two gases, oxygen and acetylene, in the proper amounts and that permits easy adjustment and regulation of the flame. A small flame and little heat are required for welding thin gauge metals and a large flame and much heat when welding heavy sections. This is the reason for the interchangeable tips furnished by the torch manufacturers. Broadly speaking, there are two types of torches—pressure and low pressure. In the pressure type of torch, both acetylene and oxygen are supplied to the torch under appreciable pressures, the pressures being increased for each larger size of tip used. In the low pressure or injector type of torch, the oxygen only is under pressure. The mixing chamber is made on the same principle as an ordinary steam water injector so that the volume of acetylene going into the mixture is dependent upon the velocity, and not the volume of oxygen.

Flame Adjustment and Manipulation.—It is generally desirable that the welding flame be neutral, that is, that there be no excess of acetylene or oxygen. When there is an excess of acetylene the hot inner cone is ragged and poorly defined. When there is an excess of oxygen the inner cone is short and has a pale violet colour. The inner welding flame should not play directly on the welding rod but around it in a semi-circular fashion, the rod being melted by the radiating heat of the flame. The heat should be evenly distributed on each side of the joint in order to melt down the walls and to secure thorough penetration and union of the adding material and parent metal. It is also essential that the torch oscillations be regular, otherwise fusion will be more thorough on one side of the joint than on the other.

WELDING



BY COURTESY OF (1, 2, 8) METAL & THERMIT CORPORATION, (3) THE LINDE AIR PRODUCTS COMPANY, (4) AIR REDUCTION SALES COMPANY, (5) CRANE COMPANY, (6) WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, (7) PETROLEUM IRON WORKS COMPANY

TYPES OF WELDING

1. The Thermit reaction—pouring of two welds simultaneously in the repair of the stern frame of a large ship
2. Typical of repairs to steel mill equipment is the roll with a new, oversize end welded on by means of Thermit. The gates and risers of weld metal are later cut away and the new end machined to the dimensions of the original end
3. Gas welding aircraft tubing
4. Gas cutting of heavy steel
5. Welding of cast steel gate valves for a super power station
6. Portable welders used for fabricating big machine frames
7. Arc welded coking drum, 12ft. in inside diameter, 50ft. in over-all length
8. Thermit welding of railroad rails into continuous lengths to reduce track maintenance

Reinforcement.—As the weld proceeds, the rod metal should be added until the surface of the joint is built up a little above the edge of the plates. This reinforcement is customary in all welding on steel plate. The small amount of oxide that forms during welding and impurities remain on the surface as a scale and can be easily removed when cold, by grinding or machining.

Fluxes.—Except in the welding of wrought iron and steels, fluxes are usually required for satisfactory results. Impurities

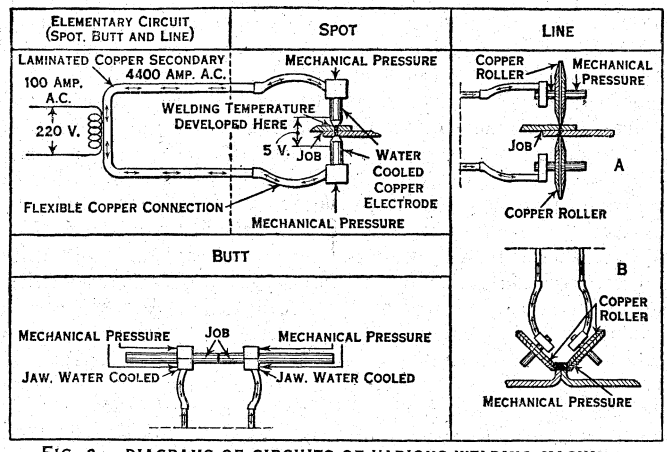


FIG. 2.—DIAGRAMS OF CIRCUITS OF VARIOUS WELDING MACHINES

on the surface of the metal or impurities contained in the metal find their way into the weld and must be floated out as slag to prevent damage to the weld. The combination of a suitable flux with these impurities produces the slag. *Cutting of Metals by Torch.*—The cutting torch differs from the welding torch in that in addition to having the oxy-acetylene heating flame it also has another gas stream of pure oxygen under high pressure which does the cutting after the metal is raised to the ignition point by the heating flame. The iron and oxygen combine to form iron oxide, thus burning a narrow slit or "kerf" in the steel. It is a chemical process and should not be confused with melting. Sometimes hydrogen is used in welding and cutting operations instead of acetylene. Other fuel gases are sometimes used in conjunction with oxygen for cutting. The cutting torch may also be used for the bevelling of plates and for machining operations.

Resistance Welding.—In this method, invented about 50 years ago by Elihu Thomson, the parts to be joined, after proper shaping, are pressed together. A large current is then passed through the joint until it has reached welding temperature, when further pressure is applied, upsetting the joint and completing the weld. As the electrical resistance of the contact surface is much greater than that of the solid metal, most of the heat is generated at the joint surface where it is desired.

The voltage required is so low and the current so high that the only convenient source is an alternating-current transformer built into the welder and as close as possible to the jaws which hold the parts and transmit the current to them. For work of any considerable size, these machines are not readily portable, *i.e.*, the work must ordinarily be brought to the machine. The simple type of resistance welding described is known as *butt welding*, and has been applied to join sections of widely varying shapes up to 36 sq.in. in a section. *Flash Butt Welding.*—Parts to be welded are clamped, the primary circuit closed and the ends of parts brought together slowly. When these ends touch they will "flash," that is, minute particles of molten metal will fly off; this flashing is continued until the entire faces of the abutting ends have reached a welding heat when heavy pressure is applied, forcing the ends together and completing the weld.

Spot Welding.—Where air-tightness is not required, a lap seam may be welded in spots by clamping the seam overlap between two electrodes and passing the necessary current between them and through the overlapping edges of the plates. As the electrical resistance of the surface contact is least in the region under pressure, most of the current and therefore the weld is confined to a spot of about the same area as that of the electrodes. For relatively thin metal this method is much more rapid and economical than any other known method of making a joint where mechanical strength alone is the chief consideration. The mechanical strength obviously depends upon the number and size of the spots. Sometimes the spots are localized by raising one of the surfaces to be joined at convenient points or "projections." Several spot welds may be made at one time by having one of the electrodes flat. This is called "projection" welding. *Seam Welding.*—The overlapping edges of sheet metal are passed between two narrow roller electrodes, the speed, current and pressure being so adjusted as to produce a continuous seam or a series of overlapping spots. This method is usually limited to relatively thin sheets, but is readily applicable to straight seams or to circular seams. The process is widely used in the manufacture of barrels, small transformer tanks, and numerous other similar containers.

Alumino-Thermic (Thermit) Welding.—Thermit is a trade name for a mixture of finely divided aluminium and iron oxide, which when ignited reacts to produce a superheated liquid steel at 5,000° F. The underlying principle of the thermit process is the high chemical affinity of aluminium for oxygen. Up to a temperature of 2,800° F thermit is an inert mixture. At that temperature, however, the aluminium unites with the oxygen of the iron oxide, and the iron is set free and becomes a highly superheated liquid steel. It is obvious that if steel at this temperature is poured around the sections to be united, especially if the sections have previously been preheated to a bright red heat, it will melt those sections and amalgamate with them so that the whole will cool to form a single homogeneous mass, or in other words a fusion weld.

Making a Thermit Weld.—In making a thermit weld, the parts to be united are first lined up with a space between the ends to be welded, the extent of which depends upon the size of the sections to be welded. The adjacent ends are then thoroughly cleaned by a sand blast or other suitable means. A wax pattern is then formed around the ends to be united of the exact shape of the thermit steel to be cast. A sand mould is next rammed around the wax pattern and inside a sheet iron box provided with pouring gates, heating gates and risers. A basin on the top of the mould serves to catch the slag when the pour is made.

The flame of a compressed air liquid fuel (gasolene or kerosene) heater, directed into the heating gate melts the wax pattern and leaves a space for the thermit steel. The heat is continued until the parts to be united have been brought to a good, red, workable heat. By that time the mould will have become dried out. In the meantime the charge of thermit is placed in a conical shaped

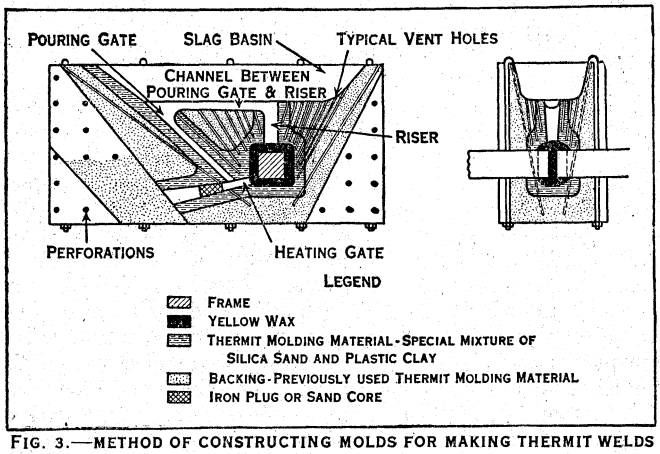


FIG. 3.—METHOD OF CONSTRUCTING MOLDS FOR MAKING THERMIT WELDS

crucible supported over the pouring gate of the mould. When the sections are red hot and the mould dried, the application of heat is discontinued, the heating gate plugged up and the thermit charge in the crucible ignited. In 25 to 35 seconds the thermit reaction is completed and the thermit steel tapped from the bottom of the crucible into the mould where it flows around and between the sections to be welded, uniting them into one homogeneous mass.

(WM. SP.)

WELF or **GUELPH,** a princely family of Germany, descended from Count Warin of Altorf (8th century), whose son Isenbrand is said to have named his family *Welfen, i.e.,* whelps. From his son Welf I. (d. 824) were descended the kings of upper Burgundy and the elder German line of Welf. Welf III. (d. 1055) obtained the duchy of Carinthia and the March of Verona. With him the elder line became extinct, but his grandson in the female line, Welf IV. (as duke, Welf I.), founded the younger line, and became duke of Bavaria in 1070. Henry the Black (d. 1126), by his marriage with a daughter of Magnus, duke of Saxony, obtained half of the latter's hereditary possessions, including Lüneburg, and his son Henry the Proud (*q.v.*) inherited by marriage the emperor Lothair's lands in Brunswick, etc., and received the duchy of Saxony. The power which the family thus acquired, and the consequent rivalry with the house of Hohenstaufen, occasioned the strife of Guelphs and Ghibellines (*q.v.*) in Italy. Henry the Lion lost the duchies of Bavaria and Saxony by his rebellion in 1180, and Welf VI. (d. 1191) left his hereditary lands in Swabia and his Italian possessions to the emperor Henry VI. Thus, although one of the Welfs reigned as the emperor Otto IV., there remained to the family nothing but the lands inherited from the emperor Lothair, which were made into the duchy of Brunswick in 1235. Of the many branches of the house of Brunswick that of Wolfenbüttel became extinct in 1884, and that of Lüneburg received the electoral dignity of Hanover in 1692, and founded the Hanoverian dynasty of Great Britain and Ireland in 1714. For its further history *see* HANOVER.

See Sir A. Halliday, *History of the House of Guelph* (1821); R. D. Lloyd, *Historical Chart and notes on the origin of the British Victorian Monarchy* (cover title, *Origin of the Guelphs*) (1892); F. Schmidt, *Die Anfänge des welfischen Geschlechts* (Hanover, 1900).

WELFARE WORK. This term, as applied to industry, has been well defined by Dr. Royal Meeker as "anything for the comfort and improvement, intellectual or social, of the employees, over and above wages paid, which is not a necessity of the industry, nor required by law." *See* INDUSTRIAL RELATIONS; OFFICE MANAGEMENT.

Welfare Work in Great Britain.—Of course, ever since there have been employers some of them have done their utmost to promote the welfare of their employees, but so long as industry was conducted in small units, no organized welfare work was required. It was only with the introduction of the factory system that the personal links between master and man were gradually broken, and with the development of joint stock limited liability companies, business became increasingly impersonal. As a rule, unfortunately, in the early days of large scale manufacture, the attention of the employing class was devoted almost exclusively to the financial and mechanical aspects of business; and the workers were regarded merely as instruments of production, not as men, women and children whose individual well-being was a matter of importance. It is significant that they were generally called "hands," while their employer was tacitly assumed to represent the controlling will and brain. Gradually, however, a sense of responsibility for the welfare of these "hands" developed. It was due, in Great Britain, to many causes, partly to the activities of the trade unions, partly to the development of education, which tended to break down class divisions, and to make employers and workers better acquainted with each other, and partly to the various factory acts. These compelled every factory to adopt certain precautions and safeguards, and drew the attention of the general public to a side of industry which had been neglected.

But although the attitude of the employing class to the workers was gradually changing for the better throughout the 19th century, organised welfare work has only been undertaken on an extensive scale since 1914. As recently as 1913, a careful investigation into the facts showed that only about 30 employers in Great Britain were definitely engaged in welfare work. Fifteen years later the number had grown to over a thousand.

This great increase in so short a time was due to two causes. The first was the revolutionary change in the relations between capital and labour for which the World War was largely responsible. No one acquainted with industry can doubt that the war developed a more liberal spirit among employers.

The second cause is the great prominence given by the British Government during the war to welfare in munition factories. First, a committee was appointed to investigate and report upon all questions affecting the health of munition workers. It considered such matters as hours of work, canteen facilities, sanitation and protection against poisons; and it issued a number of valuable reports, which formed the basis of Government regulations. But another step was taken—namely, the creation within the Ministry of Munitions, of a welfare department concerned solely with the development of welfare conditions in the thousands of munition factories controlled by the State. This department had a staff of inspectors, who visited the factories and arranged for the introduction of various welfare measures, and for the appointment of large numbers of welfare supervisors, whose duty it was to deal with all matters affecting the health and comfort of the workers. In these ways, the Government gave to the whole country a striking object-lesson in organised welfare work, and we can hardly wonder that such work is now a definite and important factor in British industry. Two British societies, one actively presided over by the duke of York, are engaged in developing the movement. One of these works primarily with and through "welfare supervisors," as the officers engaged in organised welfare are often termed; the other is concerned with encouraging firms to undertake organised welfare work, and advising them as to the best and wisest modes of procedure.

Forms of Welfare Work.—Welfare work takes many forms: they are briefly indicated in the following summary, drawn up by the (British) Industrial Welfare Society—

Employment: Interview, Preliminary selection, Waiting list, Records and progress, Lost time and absentees, Transfers and promotion, Dismissal, Transport.

Co-operation: Suggestions and Complaints, Works and Welfare Committees, Works Magazine.

Education: Technical instruction, Continuation Classes, Lectures.

Health: Protective Clothing, Rest and Cloak Rooms, First-aid and Ambulance, Medical Service, Records and Research, Dental Service, Optical Service, Sick Visiting, Convalescence, Rest Pauses, Canteen, Heating, Lighting, Ventilation, Sanitation.

Thrift: Sick and Benevolent Societies, Superannuation and Pension Funds, Holiday Funds, Tool Funds, etc., Saving Schemes, Protective Devices.

Accident Prevention: Accident Prevention Campaigns, Safety Instructions, Inspections, Records, Fire Drill.

Leisure: Outdoor Activities, Indoor Games and Hobbies, Co-operation with Local Agencies, Lodgings Register, Institute and Hostel Management, Camps and Holiday Schemes.

Economics of Welfare Work.—It is not, of course, suggested that all the above activities find a place in every factory which has definitely undertaken welfare work; but the tendency is certainly to advance from one activity to another. The perusal of the somewhat formidable list may suggest two questions which must be answered in any careful appreciation of welfare work. The first is:—"Are all these measures really necessary or even desirable?" and the second is "Does it pay?" The answer which those who believe in welfare work would give to the first question would be along the following lines. Industry is the life-blood of the modern nation. Most people, during a greater or less part of their lives spend at least half their waking hours at work, and if society as a whole is to be healthy, cultured, and prosperous, no employer can afford to ignore what may be termed his social obligations towards the workers within his own factory. In a well organised community, it should be possible for men and women to live full, healthy lives all the while. Work should not be regarded as an inevitable deduction from the happiness of life, but as an integral part of that happiness. Therefore, just as much consideration should be shown towards members of the community while at work, as during their leisure hours. The State, through its factory acts, demands a steadily rising minimum standard in working conditions, but this is necessarily a soulless and unsatisfying standard. A factory which complied strictly with all legal requirements might yet be an appalling place in which to spend nearly half one's waking life.

Welfare work seeks to remedy this deficiency, and so far as it is possible, to carry out social ideals in the factory. It regards the

workers, therefore, as ends in themselves, not merely as a means to an end. All welfare questions should be handled by persons carefully selected for their intelligent human sympathy. It must be recognised that the care of the workers is a more expert business than even the care of the most intricate and delicate machinery. It cannot be handed over to men who have not the necessary experience and special qualities. In a large factory the recognition of this fact will involve the organisation of a carefully staffed labour department, while in a small one, it may only mean the handing over of all labour questions to a qualified officer who has other duties. In either case, if the employment manager or the welfare supervisor be wise, he will soon learn to avoid the spirit of paternalism, which was somewhat too characteristic of many early experiments in welfare work. He must enlist the help of the workers to achieve the desired ends. This will lead to a better mutual understanding between employer and employed—and probably to the establishment of works councils, where an ever growing list of subjects of joint interest will be discussed by management and men. The welfare supervisor is really the liaison officer between capital and labour.

Although, in the definition of welfare work given at the beginning of this article, the question of wages was excluded, the welfare spirit, out of which welfare work springs, cannot disregard that question. It is not for the welfare officer to dictate the scale of wages, but if the management is not paying a living wage, it is quite within his sphere to call their attention to the fact.

There can be no true welfare unless reasonable living wages are paid, or, if this is temporarily out of the question, unless every effort is being made to raise the efficiency of the organisation to the point at which their payment becomes possible.

The second question referred to above "Does welfare work pay?" has in part been already answered. Of course, it is not possible to draw up a profit and loss account showing the precise cost of welfare work on the one hand and the precise gain derived from it on the other. What, for instance, is the value, in pounds or dollars, of a spirit of co-operation between capital and labour? What is the value of a higher standard of health, due to an efficient works medical department? These questions defy strict analysis.

It can, however, be said without a shadow of doubt that welfare work pays whenever it is the natural outcome of a belief on the part of the management that the welfare of all engaged with them in their enterprise is a matter of real moment—that industry is fundamentally a human activity, whose success or failure is eventually to be measured by its effect on human society. Any welfare scheme undertaken merely to "make the beggars work" or to swell the dividends of the shareholders will never succeed.

Some of the finest welfare work is done in little factories, where the profits earned are not high, but where the employer has real sympathy with his workers, and does his best to surround them with the kind of environment he would desire for his own children. The items to enter on the debit side of his welfare account might not to any high degree interest the works auditor. But there are also factories where very large sums are paid for welfare work. There are costly pension schemes, medical departments and provisions for education, and recreation. Do these pay? Probably the return on the expenditure varies from factory to factory. It will depend on the spirit in the factory, and the intelligence with which the expenditure is incurred. But a few observations may suggest the angle from which this matter should be considered. Take, for instance, a pension fund. It absorbs a given sum per annum, and all workers retire at pension age. The cost of that fund may appear to be high—but how much are many organisations paying yearly through their wage rolls to men who ought to be on pension? Again, a factory medical or dental service may cost a considerable sum, but there is also a considerable difference between the value, say, of a purchasing agent who has a headache, or toothache, and one who is perfectly fit. We must strike a ratio between the cost of the medical service and the total wage and salary bill. The former is unlikely to amount to as much as one half of one per cent of the latter.

Incidentally, reference may be made to a striking example of the British Government's appreciation of the value of welfare work. Under the Mining Industry Act of 1920, power was given to raise a levy of a penny on every ton of coal raised to create a fund, known as the miners' welfare fund. Up to 1927 over five million pounds was thus raised, of which £2,726,000 was spent on recreation and £1,696,000 on hospitals, convalescent homes and other health services. The fund is administered by a central committee consisting of owners, miners and other persons appointed by the Board of Trade, and by a number of district committees consisting of owners and miners. Under a more recent act (the Mining Industry Act of 1925) the royalties welfare levy is producing more funds, available for pit-head baths.

In conclusion, there are three ideas of welfare work. The first is merely that it is a fad, or a hobby: the second that it is good because it pays; the third that it is an essential condition of good management, and an inevitable outcome of modern ideas regarding the relationship of industry to society and the responsibilities of industrial management. The last idea is the right one.

For the American aspects, *see* EMPLOYEES, TRAINING OF.

See John Lee, *The Principles of Industrial Welfare* (1924); B. S. Rowntree, *The Human Factor in Business* (1925); Edgar L. Collis and Major Greenwood, *The Health of the Industrial Worker* (1921); L. P. Lockhart, *A Short Manual of Industrial Hygiene* (1927); Chas. F. Lloyd (ed.), *The Factory, Truck and Shops Acts*, by the late Alexander Redgrave (13th ed., 1924). (B. S. R.)

WELHAVEN, JOHANN SEBASTIAN CAMMERMEYER (1807–1873), Norwegian poet and critic, was born at Bergen. He first studied theology, but from 1828 onwards devoted himself to literature. In 1840 he became reader and subsequently professor of philosophy at Christiania, and delivered a series of impressive lectures on literary subjects. In 1836 he visited France and Germany; and in 1858 he went to Italy to study archaeology. Welhaven made his name as the representative of conservatism in Norwegian literature. He represented clearness and moderation against the extravagances of Wergeland. He gave an admirable practical exposition of his aesthetic creed in the sonnet cycle *Norges Daemring* (1834). He published a volume of *Digte* in 1839; and in 1845 *Nyere Digte*. His descriptive poetry is admirable, but his best work was inspired by his poems on old Norse subjects, in which he gives himself unreservedly to patriotic enthusiasm.

His critical work includes *Ewald og de norske Digtere* (1863), *On Ludwig Holberg* (1854). Welhaven's *Samlede Skrifter* were published in 8 vols. at Copenhagen (1867–69).

WELL. An artificial excavation or boring that derives some fluid, usually water, from the interstices of the rocks or soil which it penetrates. Wells are classified mainly according to the method of sinking, the depth, character or geologic horizon of the bed that yields the water, capacity or head of water. Thus, according to the method of sinking are wells distinguished from borings, the former being divided into ordinary shallow or surface wells as distinguished from deep, or sometimes erroneously termed artesian, wells. Such wells are generally circular excavations ranging from 3 or 4 ft. to 15 ft. or more in diameter, usually lined with brickwork, concrete or cast iron for some depth down from the surface, and may be either dug or drilled by special tools.

The term borings is applied to sinkings of smaller size, ordinarily up to 36 in. in diameter, excavated by means of a drill, either percussion or rotary, which operates either by cutting or by abrasion, and in which the débris is brought up to the surface by means of a shell-pump, hollow drill-tool, or by a hydraulic or self-clearing method. Borings of this kind are usually lined with steel tubes through unstable materials, the tubes being perforated where in contact with water-bearing strata. In addition there is the driven well, which is sunk by driving a casing at the end of which is a conical point, water being admitted for supply through the point or through perforations in the casing immediately above it. Frequently, however, a well may consist of a combination of a well and boring, the boring being sunk through the bottom of the well; or adits or headings may be driven horizontally from the bottom of a well in different directions into the water-bearing stratum.

The shallow well is sunk into water-bearing strata at or near the surface, and in populous or cultivated districts the water is apt

to be contaminated by sewage or other surface sources of pollution. Deep wells, if lined to some depth from the surface, draw upon deeper zones, and usually afford larger and purer supplies.

The term *artesian* as popularly applied to wells is ambiguous. Strictly, artesian water is water which is confined under pressure beneath an impervious stratum, and, rising up through the penetrating well or boring, overflows the surface of the ground above the normal ground-water surface of the district.

Thus in fig. 1 there are shown two water-bearing formations A and C separated by an impervious stratum B of shales and

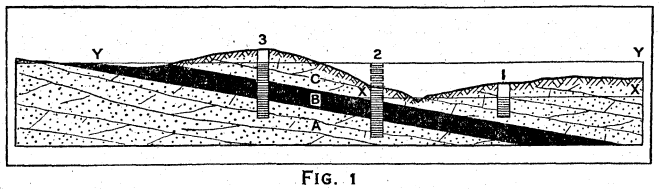


FIG. 1

clays. The surface of the ground-water, or saturation level, YY in the bed A stands at a higher level than that of XX in the bed C, being held down by the impervious bed B. The well 1 in the shallow surface bed is a shallow surface or dug well, which taps the immediately underlying ground-water, the level of which is below the surface of the well. The well 2 is a true artesian or artesian-flowing well. The well 3, in which artesian water from a lower stratum is tapped but does not overflow, is known as a non-flowing or sub-artesian well.

The function of a well is to tap the underground or ground-water which may occur in the pores of the water-bearing formations, or if in solid rocks, the water in the fissures, joints, faults, bedding planes and other openings. Water from porous strata is most freely and directly obtained from superficial beds of gravels and sands of alluvial or glacial origin. In hard rocks such as sandstones, chalk and conglomerates which are exceedingly porous, wells are capable of affording copious yields only when the ground-water is directly tapped in open cavities, such as bedding planes, fissures and the like, the water in these openings being fed and maintained by slow seepage from the pores of the rock from a vast area. Wells in formations such as the chalk, for example, may be practically dry if sunk in the mass of the rock itself without penetrating any fissure or other natural channel with water.

The most successful wells derive their supplies from rocks of later age than the Palaeozoic formations. With the exception of a few of the higher strata, such as the Permian limestones and sandstones and the Millstone Grits of the Carboniferous, the older rocks in general are highly consolidated by pressure and their pores cemented by minerals, hence they are incapable of affording large supplies of ground-water. The sandstones of the Trias, the limestones of the Jurassic and the chalk and sands of the Cretaceous have yielded the most copious underground supplies in Britain and the Continent, and generally the world over the Secondary and later formations are the most prolific. In Britain the glacial and alluvial gravels and sands of the Post-Tertiary are thin and not so extensive as elsewhere and in consequence afford only relatively small supplies, but in many other parts of the world copious yields are obtained from these later deposits. The water bearing properties of the crystalline or igneous rocks are similar to those of the older formations, and underground supplies from them are dependent upon the presence of fissures or joints, hence the yields are almost universally small.

Hydraulics of Wells.—Fig. 2 illustrates an ordinary well KH sunk through a water-bearing stratum to H the surface of an impervious bed at the level GHJ. Normally the surface of the ground-water lies below the ground at a level AE which is known as the surface of saturation, water-table, ground-water level, or, in relation to wells, rest-level. The effect of pumping water from the well is to lower the water in the well to a level F known as the working- or pumping-level, which varies according to the rate of pumping, becoming increasingly lower as the rate of pumping is increased. Outside the well the effect of pumping is to draw in radially the surrounding water to the well, and the surface of saturation in the vicinity assumes the form of an inverted cone or bell. This figure BFD is known as the cone of depression, which dies out along a line theoretically forming a circle around the well, and known as the circle of influence of radius BC or CD in fig. 2.

In actual practice the circle of influence may be far from a true circle, forming a figure which extends irregularly in different directions according to geological circumstances; for only in absolutely uniform and homogeneous sand or gravel, not found in nature, could the theoretical conditions be obtained. The slopes of the cone are theoretically sub-logarithmic curves, and although irregular in actual practice often approximate to theory, especially in deposits of sands and gravels.

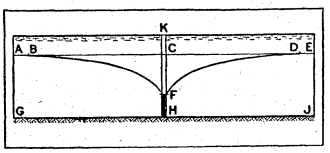


FIG. 2

In solid rocks again, while borings in the vicinity of a well indicate there is a local depression, it is doubtful if the surrounding water-levels indicate more than the water-levels in the actual fissures and other openings penetrated.

The radius of the circle of influence is dependent mainly on two factors, viz., the transmitting capacity of the water-bearing medium and the rate of pumping, or alternatively the lowering C.F. at the well; but a third factor of influence is the natural slope of the water-table in the vicinity.

Theory and practice have established that, except when excessive, lowering of the water-level in a well in porous media is approximately proportional to the rate of pumping, and that at a given rate of pumping, provided that is not greater than the maximum yield of the well, the water will fall to a definite level and, subject to seasonal fluctuations, remain stationary at that level. A further principle of importance has also been established both by theory and practice, viz., that the effect of size or diameter of a well is of less importance than might be assumed, borings of only a few feet in diameter affording copious yields not greatly less than those of wells of large diameter.

Testing of Wells.—The yields of small wells or borings are usually tested by pumping continuously over a period ranging from a few days to a fortnight until a permanent working-level is maintained. For large public wells, however, much longer periods are required, and it may be a year or more before a final state of equilibrium is obtained.

The term *specific capacity* is frequently used in relation to testing, and is a numerical expression of the readiness with which a well furnishes water to the pumps. It depends on the transmission capacity of the water-bearing stratum, the resistance of the strainer when present, the thickness of water-bearing stratum penetrated, and to some extent on the diameter of the well. This factor is merely the yield per foot of lowering of the water in a well, or the gross yield divided by the working head. Successful public wells in sands similar to the Lower Greensand have a mean specific capacity of about 500 gal. per hour, Triassic wells 500 to 800, and Chalk wells about 1,800 gal. per hour, but the figures are extremely variable, maximum values being as much as double these figures. In the case of wells with headings, however, it is doubtful if the specific capacity is of any value as an index.

Wells in Sands.—Wells in sands, especially where the deposits are fine-grained, may be lined wells of large diameter, the lining extending to the full depth of the well. The water is obtained either by upward percolation from the bottom of the well only, or by means of perforations, with or without fine wire-gauze strainers, in the sides of the lining. Where borings are sunk into such material the lower portion of the lining tubes may be perforated with small holes, which may or may not be covered with a straining material. Frequently a series of such borings in close proximity are placed at right angles to the direction of natural flow of the ground-water and connected to a common suction-pipe.

Records of Actual Wells.—In Britain wells or borings in the New Red Sandstone have afforded permanent yields up to a maximum of 4 or 5 million gallons per diem, and the Chalk up to 7 million gallons per diem; but the supplies of large public wells in these formations usually vary between a few hundred thousand to one or two million gallons per day. In the Oolite yields up to 3 million gallons per day have been obtained, but these are quite

exceptional. Wells in Millstone Grit and Coal Measures rarely afford more than 500,000 gallons per day, and other geologic formations only relatively small supplies. The effect of pumping in large public wells in Britain does not appear to extend more than about two miles in the New Red Sandstone and about one mile in the Chalk. In California, however, a test of pumping at rates between 8 and 20 million gallons per day in alluvial deposits proved the consequent lowering to extend to five miles.

Of wells of record yield in other countries may be mentioned a well at St. Augustine stated by Slichter (1902) to yield 10 million gallons a day, and another in South Dakota reported to yield as much as 11½ million gallons a day.

The deepest boring sunk for water is probably that at Putnam Heights, Connecticut, which reached a depth of over 6,000 ft. in crystalline rock without obtaining a significant supply. In Australia many artesian borings are sunk to depths of over 4,000 ft. and obtain supplies ranging from 100,000 to 1,400,000 gal. per day. The deepest borings in the world sunk for either oil or water are the Olinda well, Orange County, Calif., and the Ligonier deep well near Latrobe, Pa. The former is 8,201 feet deep and the latter 7,756 feet deep. In general, except where there are true artesian conditions on a vast scale, it is little use to sink below 1,500 feet.

The effect of pumping excessive quantities of water from underground sources has frequently been to lower the general water-level of the district, and this has taken place under London, Birmingham and Liverpool in Britain, and around Chicago, Memphis, Savannah, the Dakota basin and other districts in the U.S.A.

Artesian Basins.—The chief artesian areas in Europe are around London and Paris. In the United States the basins of Dakota, New Mexico, Potsdam and the Atlantic coastal plain are the most remarkable. In Queensland, New South Wales and South Australia deep seated artesian water is found in vast quantities, while in Africa the artesian areas of Cape Colony and the Sahara desert are of special note.

The London and Paris basins derive their supplies from deep seated Chalk and Tertiary strata, the former affording supplies amounting in all to many million gallons per day to hundreds of wells beneath London.

The Dakota basin which underlies large areas in South Dakota, Colorado, Nebraska and Kansas, is of special interest, thousands of borings deriving artesian supplies from the Dakota Sandstone, which outcrops in the mountains to the west of the area and passes beneath the basin at depths of 1,000 ft. or more and reappears in the east at a distance of 200 m. or more from the western outcrop. The yield of the whole basin is about 125 million gallons per day.

The Roswell area in south-eastern New Mexico derives its artesian supply chiefly from creviced and cavernous limestone. The total annual yield from more than 1,400 wells is about 200,000 acre-feet which is used chiefly for the irrigation of approximately 60,000 acres of farm land. The largest flowing well in the area yields over 8,000,000 gallons a day. The Atlantic Coastal Plain extends from Long island in the north to Texas in the south.

The Australian artesian areas, and especially that of Queensland, afford remarkable yields. The Queensland basin is estimated to supply a total of over 350 million gallons per day. Over 1,000 borings have been sunk, some exceeding 4,000 ft. in depth. The New South Wales and South Australia basins are of considerably less importance. The three basins all derive their supplies from the Cretaceous rocks.

The Cape Colony area derives its supplies from the Karoo beds of triassic age at shallow depths. Nearly 3,000 boreholes have been sunk, but the individual yields are small.

The Sahara basin in the vicinity of Algeria is noteworthy, in that the artesian water is derived from beds of Pliocene sands which outcrop in the Atlas mountains about 300 miles distant. The underground water has been found to follow definite open channels, and small fish, river-crabs and fresh-water molluscs are brought up in quantities in some of the borings, which vary from 150 to 800 ft. in depth. Over 100 million gallons per day is obtained from this basin.

BIBLIOGRAPHY.—Numerous Water Supply and Irrigation Papers of the United States Geological Survey, in particular No. 67 by C. S. Slichter (1902), and the 19th Annual Report of the U.S. Geological Survey, Slichter and King (1897–98), where full references are given to previous investigators, pp. 381–384; W. S. P. 494, "Outline of Ground-water Hydrology" by O. E. Meinzer (1923); W. S. P. 439, "Occurrence of Ground-water in the United States" by O. E. Meinzer (1923). Baldwin Wiseman, Min. Proc. Inst. C.E., vol. CLXV. (1905–06), Pt. III, on "The Flow of Underground Water," where numerous further references are given. (H. LA.)

WELLAND CANAL: *see* NIAGARA RIVER.

WELLES, GIDEON (1802–1878), American political leader, was born at Glastonbury (Conn.), on July 1, 1802. He studied for a time at Norwich University, Vt., but did not graduate. From 1826 to 1837 he edited the Hartford *Times*, making it the official organ of the Jacksonian democracy in southern New England. He left the Democratic Party on the Kansas-Nebraska issue, assisted in the formation of the Republican Party in the state of Connecticut, and was its candidate for the office of governor in 1856.

On the inauguration of President Lincoln in 1861 he was appointed secretary of the Navy, a position which he held until the close of President Andrew Johnson's administration in 1869. Although deficient in technical training, he handled with great skill the difficult problems which were presented by the Civil War. The number of naval ships was increased between 1861 and 1865 from 90 to 670, the officers from 1,300 to 6,700, the seamen from 7,500 to 51,500, and the annual expenditure from $12,000,000 to $123,000,000; important changes were made in the art of naval construction, and the blockade of the Confederate ports was effectively maintained. Welles supported President Johnson in his quarrel with Congress, took part in the Liberal Republican movement of 1872, and returning to the Democratic Party, warmly advocated the election of Samuel J. Tilden in 1876. He died at Hartford (Conn.), on Feb. 11, 1878.

While Welles was in President Lincoln's Cabinet, he kept a diary of the stirring events happening daily. This manuscript, though greatly amended by Welles in later years, is a valuable historical source. But the published diary is unreliable because it makes no distinction between the entries that were contemporaneous and those that Welles made in his old age.

In 1874 Welles published *Lincoln and Seward*, in which he refutes the charge that Seward dominated the Administration during the Civil War. His *Diary* was published in the *Atlantic Monthly* (1909–10).

See Albert Welles, *History of the Welles Family* (New York, 1876); also "Is the Printed Diary of Gideon Welles Reliable?", *Amer. Hist. Rev.* vol. xxx.

WELLESLEY, RICHARD COLLEY WESLEY (or WELLESLEY), MARQUESS (1760–1842), eldest son of the 1st earl of Mornington, an Irish peer, and brother of the famous duke of Wellington, was born on June 20, 1760. He was sent to Eton, and to Christ Church, Oxford. By his father's death in 1781 he became earl of Mornington, taking his seat in the Irish House of Peers. In 1784 he entered the English House of Commons as member for Beeralston. Soon afterwards he was appointed a lord of the treasury by Pitt. In 1793 he became a member of the board of control over Indian affairs and in 1797 accepted the office of governor-general of India. Wellesley seems to have caught Pitt's large political spirit during his intercourse with him from 1793 to 1797. That both had consciously formed the design of acquiring empire in India is not proved; but the rivalry with France made Wellesley's rule in India an epoch of enormous and rapid extension of English power. Clive won and Warren Hastings consolidated the British ascendancy in India, but Wellesley extended it into an empire. For the details of Wellesley's Indian policy *see* INDIA: *India under the Company.*

He found the East India Company a trading body, he left it an imperial power. He was an excellent administrator, and sought to provide, by the foundation of the college of Fort William, for the training of a class of men adequate to the great work of governing India. A firm free trader, like Pitt, he endeavoured to remove some of the restrictions on the trade between England and India. Both the commercial policy of Wellesley and his educational projects brought him into hostility with the court of directors, and he more than once tendered his resignation, which,

however, public necessities led him to postpone till the autumn of 1805. He reached England just in time to see his friend Pitt before his death. He had been created an English peer in 1797, and in 1799 an Irish marquess.

On the fall of the coalition ministry in 1807 Wellesley was invited by George III. to join the duke of Portland's cabinet, but he declined, pending the discussion in parliament of certain charges brought against him in respect of his Indian administration. Resolutions condemning him for the abuse of power were moved in both the Lords and Commons, but defeated by large majorities. In 1809 Wellesley was appointed ambassador to Spain. He landed at Cadiz just after the battle of Talavera, and endeavoured, but without success, to bring the Spanish government into effective co-operation with his brother in Portugal. A few months later Wellesley became foreign secretary in Perceval's cabinet. He retired in February 1812, partly from dissatisfaction at the inadequate support given to Wellington by the ministry, but also because he was convinced that the question of Catholic emancipation was urgent. With the claim of the Irish Catholics to justice he henceforward identified himself.

On Perceval's assassination he refused to join Lord Liverpool's administration, and he remained out of office till 1821, criticizing with severity the proceedings of the congress of Vienna and the European settlement of 1814. He was one of the peers who signed the protest against the enactment of the Corn Laws in 1815. In 1821 he was appointed lord-lieutenant of Ireland. Wellesley's acceptance of the vice-royalty was believed in Ireland to herald the immediate settlement of the Catholic claims. But the hope of the Catholics still remained unfulfilled. On the assumption of office by Wellington, who was opposed to Catholic emancipation, his brother resigned the lord-lieutenancy. He had, however, the satisfaction of seeing the Catholic claims settled in the next year by the very statesmen who had declared against them. In 1833 he resumed the office of lord-lieutenant under Earl Grey's brief ministry. He died on Sept. 26, 1842.

See Montgomery Martin, *Despatches of the Marquess Wellesley* (1840); W. M. Torrens, *The Marquess Wellesley* (1880); W. H. Hutton, *Lord Wellesley* ("Rulers of India" series, 1893); and G. B. Malleson, *Wellesley* ("Statesmen" series, 1895); *The Wellesley Papers: Life and Correspondence of Richard Colley Wellesley* by the editor of "The Windham Papers" (2 vols., 1914).

WELLESLEY, a beautiful residential town of Massachusetts, U.S.A. Pop. (1930) 11,439; 1940 federal census 15,127. On Lake Waban are the grounds of Wellesley college (*q.v.*) and opposite it is the Hunnewell estate, with its famous Italian gardens, the first in the United States. The Babson institute and the Babson statistical centre are in Wellesley and there are four private schools for girls. Wellesley was settled about 1640 and incorporated in 1881.

WELLESLEY COLLEGE, an institution for the higher education of women situated in Wellesley, Mass. It was founded by Henry Fowle Durant, a Boston lawyer, with the announced purpose "of giving to young women opportunities for education equivalent to those usually provided in colleges for young men." The first charter was granted by the Commonwealth of Massachusetts on March 17, 1870, under the name of Wellesley Female seminary. This name was changed to Wellesley college by act of legislature, March 7, 1873. In accordance with the spirit of the founder, the college is undenominational but distinctively Christian in its influence and instruction. The college grants the degrees of B.A., M.A., M.A. in education, and M.S. in hygiene and physical education.

Wellesley college opened in Sept. 1875, with a curriculum remarkably in advance of its period. For example, Wellesley was the first women's college to open scientific laboratories for student experimentation. In fact, such work was offered at Wellesley earlier than at any other institution in the United States for either men or women with the exception of Harvard and the Massachusetts Institute of Technology.

The campus of more than 300 ac., the gift of the founder, the buildings, and fixed equipment, were valued in the treasurer's report, on June 30, 1942, at $11,234,802, and the trust funds at $10,674,808, of which $9,150,016 was for permanent endowment. The buildings numbered 72, of which 19 were halls of residence. In addition to the library, some of the most important buildings are Green hall, containing the administrative offices; Founders hall, containing lecture rooms and department offices for the liberal arts; the Farnsworth Art museum; Billings hall for the department of music; Whitin observatory for the department of astronomy; Mary Hemenway hall containing the gymnasium; the Recreation building; the Memorial chapel; Alumnae hall; Sage hall for the departments of botany and zoology; Pendleton hall for the departments of chemistry, physics and psychology. There were in 1942–43, 1,511 students, 45 registered for the master's degree and 1,455 for the bachelor's degree. The official staff numbered 273, of whom 195 formed the instructing body. Presidents of the college: Ada L. Howard, Litt.D. (1875–82); Alice E. Freeman (Mrs. George H. Palmer), B.A., Ph.D., L.H.D., LL.D. (1882–87); Helen A. Shafer, M.A., LL.D (1888–94); Julia J. Irvine, M.A., L.H.D., LL.D. (1895–99); Caroline Hazard, A.M., Litt.D., LL.D. (1899–1910); Ellen F. Pendleton, M.A., Litt.D., LL.D. (1911–36); Mildred H. McAfee, M.A., LL.D. (1936–).

(M. H. McA.)

WELLHAUSEN, JULIUS (1844–1918), German biblical scholar and Orientalist, was born at Hameln on the Weser, Westphalia, on May 17, 1844. Having studied theology at the university of Göttingen under Heinrich Ewald, he established himself there in 1870 as *Privatdozent* for Old Testament history. In 1872 he was appointed professor ordinarius of theology in Greifswald. Resigning in 1882 owing to conscientious scruples, he became professor extraordinarius of oriental languages in the faculty of philology at Halle, was elected professor ordinarius at Marburg in 1885, and was transferred to Göttingen in 1892. Wellhausen made his name famous by his critical investigations into Old Testament history and the composition of the Hexateuch, the uncompromising scientific attitude he adopted in testing its problems bringing him into antagonism with the older school of biblical interpreters. He died at Göttingen on Jan. 7, 1918.

The best known of his works are *De gentibus et familiis Judaeis* (Göttingen, 1870); *Der Text der Bücher Samuelis untersucht* (Göttingen, 1871); *Die Pharisäer und Sadducäer* (Greifswald, 1874); *Prolegomena zur Geschichte Israels* (Berlin, 1882; Eng. trans., 1885; 5th German edition, 1899; first published in 1878 as *Geschichte Israels*); *Muhammed in Medina* (Berlin, 1882); *Die Komposition des Hexateuchs und der historischen Bücher des Alten Testaments* (1889, 3rd ed. 1899); *Israelitische und jüdische Geschichte* (1894, 4th ed. 1901); *Reste arabischen Heidentums* (1897); *Das arabische Reich und sein Sturz* (1902); *Skizzen und Vorarbeiten* (1884–99); and new and revised editions of F. Bleek's *Einleitung in das Alte Testament* (4–6, 1878–93). In 1906 appeared *Die christliche Religion, mit Einschluss der israelitisch-jüdischen Religion,* in collaboration with A. Jülicher, A. Harnack and others. He also did useful and interesting work as a New Testament commentator. He published *Das Evangelium Marci, übersetzt und erklärt* in 1903, *Das Evangelium Matthäi* and *Das Evangelium Lucae* in 1904, and *Einleitung in die drei ersten Evangelien* in 1905.

WELLINGBOROUGH, a town of Northamptonshire, England. Pop. of urban district (est. 1938) 26,210. Area 13.6 sq.mi. In 1935 the area was extended to include the late urban district of Finedon and other lands. In 948 Edred gave the church at Wellingborough to Crowland abbey, and the grant was confirmed by King Edgar in 966. The town received the grant of a market in 1201. It was formerly famed for the chalybeate springs to which it owes its name. After a disastrous fire in 1738 the town was built on its present site on the hill. St. Luke's church has Norman and Early English portions, but is mainly Decorated. Wellingborough school, founded in 1595, was endowed with the revenues of a suppressed guild. The town is a centre of agricultural trade; but the staple industry is in leather. The manufacture of shoe uppers began here, and forms the principal part of the town's boot and shoe business. Other manufactories are ready-made clothing and cardboard boxes, while the raising and smelting of iron and metal working are carried on.

WELLINGTON, ARTHUR WELLESLEY, 1ST DUKE OF (1769–1852), was the fourth son of Garrett (1735–1781) Wellesley or Wesley, 2nd baron and 1st earl of Mornington, now remembered only as a musician. He was descended from the family of Colley or Cowley, which had been settled in Ireland for two

centuries. The duke's grandfather, Richard Colley, 1st Baron Mornington (d. 1758), assumed the name of Wesley on succeeding to the estates of Garrett Wesley, a distant relative of the famous divine. In Wellington's early letters the family name is spelt Wesley; the change to Wellesley seems to have been made about 1790. Arthur (born in Ireland in 1769[1]) was sent to Eton, and subsequently to a military college at Angers. He entered the army as ensign in the 73rd Highlanders in 1787, passed rapidly through the lower ranks (in five different regiments), became major of the 33rd (now the duke of Wellington's Regt.) and purchased the lieutenant-colonelcy of that regiment in 1793 with money advanced to him by his eldest brother. But in all these changes he did little regimental duty, for he was aide-de-camp to the lord-lieutenant of Ireland for practically the whole of these years. Before reaching full age he was returned to the Irish parliament by the family borough of Trim.

His first experience of active service was in the campaign of 1794–95, when the British force under the duke of York was driven out of Holland by Pichegru. In 1796 he was sent with his regiment to India, being promoted colonel by brevet about the same time. It was thus as a commanding officer that he learnt for the first time the details of regimental duty. He mastered them thoroughly—it was to the completeness of his practical knowledge that Wellington ascribed in great part his later success. It is probable, moreover, that he at this time made a serious study of the science of war. As soon as he landed in India he began to devote fixed hours to study, giving up cards and the violin. This study was directed chiefly to the political situation of India, and when on his advice his eldest brother, Lord Mornington, afterwards Marquess Wellesley, accepted the governor-generalship of India, he became his trusted though unofficial adviser. In the war with Tippoo Sahib the 33rd was attached to the Nizam's contingent, and Colonel Wellesley commanded this division in the army of General Harris. Though his military services in this short campaign were not of a striking character, he was appointed by his brother to the supreme military and political command in Mysore, in spite of the claims of his senior, Sir David Baird.

His great faculties now for the first time found opportunity for their exercise. In the settlement and administration of the conquered territory he rapidly acquired the habits and experience of a statesman, while his military operations against Doondiah, a robber chief, were conducted with extraordinary energy and success. When pressed in Mysore, Doondiah moved into Mahratta territory, whither Wellesley followed him. Here, negotiating and bargaining with the Mahratta chiefs, Wellesley acquired a knowledge of their affairs and an influence over them such as no other Englishman possessed. Simple and honourable himself, he was shrewd and penetrating in his judgment of Orientals; and, unlike his great predecessor Clive, he rigidly adhered to the rule of good faith in his own actions, however depraved and however exasperating the conduct of those with whom he had to deal. The result of Wellesley's singular personal ascendancy among the Mahrattas came into full view when the Mahratta War broke out. In the meantime, however, his Indian career seemed likely to be sacrificed to the calls of warfare in another quarter. Wellesley was ordered with a body of troops to Egypt. But at Bombay he was attacked by fever, and prevented from going on. The troop-ship in which he was to have sailed went down with all on board.

He returned in May 1801 to Mysore, where he remained until the Mahratta War broke out. Wellesley, now a major-general, was placed in command of a division of the army charged with the task of restoring the Peshwa, overthrown by his rival, to power. Starting from Seringapatam, he crossed the frontier on March 12, 1803, and moved on Poona. The march was one unbroken success, thanks to Wellesley's forethought and sagacity in dealing with the physical conditions and his personal and diplomatic ascendancy among the chieftains of the district. A march of 600 m. was conducted without even a skirmish. The Peshwa was restored.

Sindhia and Holkar, with the raja of Berar, maintained a doubtful but threatening aspect farther north. It was uncertain whether or not a confederacy of the northern Mahrattas had been formed against the British Government. Wellesley was charged with "the general direction and control of military and political affairs in the territories of the Nizam, the Peshwa and the Mahratta states and chiefs." Armed with these powers, he required Sindhia, as a proof of good faith, to withdraw to the north of the Nerbudda. Sindhia not doing so, war was declared on Aug. 6, 1803, and Wellesley moved against the enemy. A second division was to converge from the east, but on Sept. 23 Wellesley suddenly found that the combined forces of Sindhia and the raja of Berar were close in front of him at Assaye. Weighing the dangers of delay, of retreat and of an attack with his single division of 4,500 men, supported only by 5,000 native levies of doubtful quality, Wellesley convinced himself that an immediate attack, though against greatly superior forces (30,000 horse, 10,000 European-drilled infantry and 100 well-served guns) in a strong position, was the wisest course. He threw himself upon the Mahratta host, and, carrying out a bold manoeuvre under an intense fire, ultimately gained a complete victory, though with heavy loss. In comparison with the battle of Assaye, all fighting that had hitherto taken place in India was child's play. Wellesley brought the war to a close by a second victory at Argaum on Nov. 29 and the storming of Gawilghur on Dec. 15. The treaties with Sindhia and the raja of Berar, which marked the downfall of the Mahratta power, were negotiated and signed by Wellesley—not yet 35 years old.

His ambitions now led him back to Europe, and in the spring of 1805 he quitted India. After being sent on the abortive expedition to Hanover, he was elected M.P. for Rye, in order to defend his brother in the House, and in the following year he was Irish secretary for a few months. He was then employed in the expedition against Copenhagen, in which he defeated the Danes in the action of Kjoge (Oct. 29). In 1808, however, began the war (*see* PENINSULAR WAR) in which his military renown was fully established. In April he was promoted lieutenant-general and placed in command of a division of the troops destined to operate against the French in Spain or Portugal. He landed at Mondego bay in the first week of August, moved southwards, and on the 21st won the battle of Vimeiro. In the midst of this engagement, however, Sir Harry Burrard landed, and took over the command. Burrard was in turn superseded by Sir Hew Dalrymple, and the campaign ended with the convention of Cintra, which provided for the evacuation of Portugal by the French, but gave Junot's troops a free return to France. So great was the public displeasure in England at the escape of the enemy that a court of inquiry was held. After the battle of Corunna, Wellesley, who had in the meantime resumed his duties as Irish secretary, returned to the Peninsula as chief in command. He drove the French out of Oporto, and then prepared to march against Madrid. He had the support of a Spanish army, but his movements were delayed by the neglect of the Spanish Government, and Soult was able to collect a large force for the purpose of falling upon the English line of communication. Wellesley, unconscious of Soult's presence on his flank, advanced against Madrid, and defeated his immediate opponent, King Joseph, at Talavera de la Reina (*q.v.*) on July 27–28. But within the next few days Soult's approach on the line of communication was discovered, and Wellesley, disgusted with his Spanish allies, had no choice but to withdraw into Portugal.

A peerage was conferred upon him for Talavera. He was also made marshal-general of the Portuguese army and a Spanish captain-general. But his conduct after the battle was sharply criticized in England, and its negative results were used as a weapon against the ministry. Even on the defensive, Wellington's task was exceedingly difficult. Austria having made peace, Napoleon was at liberty to throw heavy forces into the Peninsula. Wellington, foreseeing that Portugal would now be invaded by a very powerful army, began the fortification of the celebrated lines of Torres Vedras. (*See* FORTIFICATION AND SIEGECRAFT.) As summer approached Masséna moved against Portugal with 70,000 men. Wellington, unable to save Ciudad Rodrigo, retreated down the valley of the Mondego, devastating the country, and

[1] At 24 Upper Merrion Street, Dublin, or at Dungan castle, Meath, on April 29 or on May 1; but both place and date are uncertain.

pausing to inflict a check on the French at Bussaco (*q.v.*). Masséna continued to press forward but was held up definitely in front of the lines. It was with the utmost difficulty that he could keep his army from starving. At length, when the country was exhausted, he fell back to Santarem. In the spring of 1811 Wellington received reinforcements and moved forward. Masséna retreated, but such were the sufferings of his army, both in the invasion and in the retreat, that the French, when they re-entered Spain, had lost 30,000 men. Public opinion in England, lately so hostile, now became confident, and Wellington, whose rewards for Talavera had been opposed in both Houses, began to be a hero.

In the meantime Soult, who was besieging Cadiz, had moved to support Masséna. But after capturing Badajoz, Soult learnt that Masséna was in retreat, and in consequence returned to the south. Wellington, freed from pressure on this side, and believing Masséna to be thoroughly disabled, considered that the time had come for an advance into Spain. The fortresses of Almeida, Ciudad Rodrigo and Badajoz barred the roads. Almeida was besieged, and Wellington was preparing to attack Badajoz when Masséna again took the field, and marched to the relief of Almeida. The battle of Fuentes d'Onoro followed, in which Wellington was only able to extricate the army from a dangerous predicament which "if Boney had been there" would have been a disaster. His attack on Badajoz and Ciudad Rodrigo failed.

Wellington had from the first seen that, whatever number of men Napoleon might send against him, it was impossible, owing to the poverty of the country, that any great mass of troops could long be held together, and that the French, used to "making war support war," would fare worse in such conditions than his own troops with their organized supply service. It was so at the end of 1811. Soult had to move southwards to live, and the English were again more than a match for the enemy in front of them. Wellington resumed the offensive early in 1812, took by storm Ciudad Rodrigo and Badajoz, although with terrible loss, and then advanced into Spain. Marmont, who had succeeded Masséna, fell back to the Douro, but there turned upon his assailant, and, by superior swiftness, threatened to cut the English off from Portugal. Wellington retreated as far as Salamanca (*q.v.*), and there extricated himself from his peril by a brilliant victory (July 22). Instead of immediately following the French, Wellington thought it wise to advance upon the Spanish capital. King Joseph retired, and the English entered Madrid in triumph. The political effect was great, but the delay gave the French northern army time to rally. "The vigorous following of a beaten enemy was not a prominent characteristic of Lord Wellington's warfare," as Napier says. Moreover, Soult, raising the siege of Cadiz, pressed towards Madrid. Wellington was compelled once more to retire into Portugal. During this retreat he announced in general orders that the demoralization and misconduct of the British army surpassed anything that he had ever witnessed. Such wholesale criticism was bitterly resented, but indeed throughout his career Wellington, cold and punctilious, never secured to himself the affections of officers and men as Marlborough or Napoleon did. He subjugated his army and gave it brilliant victories, but he inspired few disciples except the members of his own staff. For Salamanca his rewards included a marquessate.

He was now invested with the supreme command of the Spanish armies, and, after busying himself with preparations, in May 1813 the hour for his final and victorious advance arrived. The Russian disasters had compelled Napoleon to withdraw some of his best troops from the Peninsula. Against a weakened and discouraged adversary Wellington took the field with greatly increased numbers and with the utmost confidence. Position after position was evacuated by the French, until Wellington came up with the retreating enemy at Vittoria, and won an overwhelming victory (June 21). Soult's combats in the Pyrenees, and the desperate resistance of St. Sebastian, prolonged the struggle through the autumn, and cost the English thousands of men. But at length the frontier was passed, and Soult forced back into his entrenched camp at Bayonne. Both armies now rested for some weeks, during which interval Wellington gained the confidence of the inhabitants by his unsparing repression of marauding, his business-like payment for supplies, and the excellent discipline which he maintained. In Feb. 1814 the advance was renewed. The Adour was crossed, and Soult was defeated at Orthes. At Toulouse, after the allies had entered Paris, but before the abdication of Napoleon had become known, the last battle of the war was fought. Peace being proclaimed, Wellington took leave of his army at Bordeaux, and returned to England, where he was created duke of Wellington.

After the Treaty of Paris (May 30) Wellington was appointed British ambassador at the French capital. During the autumn and winter of 1814 he reported the mistakes of the restored Bourbon dynasty, and warned his Government of the growing hostility to it. His insight, however, did not extend beyond the circumstances immediately before and around him, and he failed to realize that the great mass of the French nation was still with Napoleon at heart. He remained in France until Feb. 1815, when he took part in the congress of Vienna. His imperfect acquaintance with French feeling was strikingly proved in the despatch which he sent home on learning of Napoleon's escape from Elba. "He has acted," he wrote, "upon false or no information, and the king (Louis XVIII.) will destroy him without difficulty and in a short time." Almost before Wellington's unfortunate prediction could reach London, Louis had fled, and France was at Napoleon's feet. The ban of the congress, however, went out against the common enemy, and the presence of Wellington at Vienna enabled the allies at once to decide upon their plans for the campaign. To Wellington and Blücher were committed the invasion of France from the north, while the Russians and Austrians entered it from the east. But Napoleon outstripped the preparations of his adversaries, concentrated his main army on the northern frontier, and on June 14 crossed the Sambre. The four days' campaign that followed, and the crowning victory of June 18, are described in the article WATERLOO CAMPAIGN. Wellington's reward was a fresh grant of £200,000 from parliament—he had already received £500,000 for the Peninsular War, the title of prince of Waterloo and great estates from the king of Holland, and the order of the Saint-Esprit from Louis XVIII.

Not only the prestige of his victories, but the chance circumstances of the moment, now made Wellington the most influential personality in Europe. The emperors of Russia and Austria were still far away at the time of Napoleon's second abdication, and it was with Wellington that the commissioners of the provisional Government opened negotiations preliminary to the surrender of Paris. The duke well knew the peril of delaying the decision as to the Government of France. The emperor Alexander was hostile to Louis XVIII. and the Bourbons generally; the emperor Francis might have been tempted to support the cause of Napoleon's son and his own grandson, who had been proclaimed in Paris as Napoleon II.; and if the restoration of Louis—which Wellington believed would alone restore permanent peace to France and to Europe—was to be effected, the allies must be confronted on their arrival in Paris with the accomplished fact. He settled the affair in his usual downright manner, telling the commissioners bluntly that they must take back their legitimate king, and refusing—perhaps with more questionable wisdom—to allow the retention of the tricolour flag, which to him was a "symbol of rebellion."

Further, it was mainly owing to the influence of Wellington, in conjunction with Castlereagh, that France escaped the dismemberment for which the German powers clamoured, and which was advocated for a while by the majority of the British cabinet. Wellington realized the necessity, in the interests not only of France but of Europe, of maintaining the prestige of the restored monarchy, which such a dismemberment would have irretrievably damaged. In the same spirit he carried out the trust imposed upon him by the allies when they placed him in command of the international army by which France was to be occupied, under the terms of the second peace of Paris, for five years. By the terms of his commission he was empowered to act, in case of emergency, without waiting for orders; he was, moreover, to be kept informed by the French cabinet of the whole course of business. If he had no sympathy with revolutionary disturbers

of the peace, he had even less with the fatuous extravagances of the comte d'Artois and his reactionary *entourage,* and his immense powerful influence was thrown into the scale of the moderate constitutional policy of which Richelieu and Decazes were the most conspicuous exponents. Besides the complex administrative duties connected with the army of occupation his work included the reconstruction of the military frontier of the Netherlands, and the conduct of the financial negotiations with Messrs. Baring, by which the French Government was able to pay off the indemnities due from it, and thus render it possible for the powers to reduce the occupation from five years to three.

The events of the next few months considerably modified his opinions in this matter. The new chambers proved their trustworthy quality by passing the budget, and the army of occupation was reduced by 30,000 men. Wellington now pressed for the total evacuation of France, pointing out that popular irritation had grown to such a pitch that, if the occupation were to be prolonged, he must concentrate the army between the Scheldt and the Meuse, as the forces, stretched in a thin line across France, were no longer safe in the event of a popular rising. At the congress at Aix-la-Chapelle in the autumn of 1818, which settled the question, it was owing to his common-sense criticism that the proposal of Prussia, supported by the emperor Alexander and Metternich, to establish an "army of observation" at Brussels, was nipped in the bud. The definitive financial settlement between France and the allies was left entirely to him.

On Wellington's first entry into Paris he had been received with popular enthusiasm, but he had soon become intensely unpopular. He was held responsible not only for the occupation itself, but for every untoward incident to which it gave rise; even Blücher's attempt to blow up the Pont de Jéna, which he had prevented, was laid to his charge. His characteristically British temperament was wholly unsympathetic to the French, whose sensibility was irritated by his cold and slightly contemptuous justice. Two attempts were made to assassinate him. His work in Paris, however, was now finished, and on Oct. 30 he took leave of the international troops under his command. On Oct. 23, while still at Aix, he had received an offer from Lord Liverpool of the office of master-general of the ordnance, with a seat in the cabinet. He accepted, though with some reluctance.

He organized the military forces held in case of a Radical rising. It was his influence with George IV. that led to the readmittance of Canning to the cabinet after the affair of the royal divorce had been settled. It was only in 1822, however, that the tragic death of his friend Londonderry (Castlereagh) brought him once more into international prominence. Londonderry had been on the eve of starting for the conference at Vienna—later adjourned to Verona—and the instructions which he had drawn up for his own guidance were handed over by Canning, the new foreign secretary, to Wellington, whose official part at the congress is outlined elsewhere. (*See* VERONA, CONGRESS OF.) Unofficially, he pointed out to the French plenipotentiaries, arguing from Napoleon's experience, the extreme danger of an invasion of Spain, but at the same time explained, for the benefit of the duke of Angoulême, the best way to conduct a campaign in the Peninsula.

Wellington disliked Canning's aggressive attitude towards the autocratic powers, and viewed with some apprehension his determination to break with the European concert. He realized, however, that in the matter of Spain and the Spanish colonies the British Government had no choice, and in this question he was in complete harmony with Canning. This was also at first the case in respect to the policy to be pursued in the Eastern Question raised by the war of Greek independence. Both Canning and Wellington were anxious to preserve the integrity of Turkey, and therefore to prevent any isolated intervention of Russia; and Wellington seemed to Canning the most suitable instrument for the purpose of securing an arrangement between Great Britain and Russia on the Greek question, through which it was hoped to assure peace in the East. In Feb. 1826, accordingly, the duke was sent to St. Petersburg (Leningrad), ostensibly to congratulate the emperor Nicholas I. on his accession, but more especially—to use Wellington's own words—"to induce the emperor of Russia to put himself in our hands." In this object he signally failed. As a diplomatist the "Iron Duke"—whom Nicholas, writing to his brother Constantine, described as "old and broken (*cassé*)"—was no match for the "Iron Tsar." As for the Greeks, the emperor said bluntly that he took no interest in *ces messieurs,* whom he regarded as "rebels"; his own particular quarrel with Turkey was the concern of Russia alone. Under stress of the imminence of the peril, which Nicholas was at no pains to conceal, the duke was driven from concession to concession, until at last the tsar, having gained all he wanted, condescended to come to an arrangement with Great Britain on the Greek question. On April 4 was signed the Protocol of St. Petersburg, an instrument which—as events were to prove—fettered the free initiative not of Russia, but of Great Britain. (*See* TURKEY: *History;* GREECE: *History.*)

After the death of the duke of York on January 5, 1827, the post of commander-in-chief was conferred upon Wellington. His relations with Canning had, however, become increasingly strained, and when, in consequence of Lord Liverpool's illness, Canning in April 1827 was called to the head of the administration, the duke refused to serve under him. The effect of his withdrawal was momentous in its bearing upon Eastern affairs. Canning, freed from Wellington's restraint, carried his intervention on behalf of Greece a step further, and concluded the Treaty of London, whereby France, England and Russia bound themselves to put an end to the conflict in the East and to enforce the conditions of the St. Petersburg protocol upon the belligerents. Against this treaty Wellington protested, on the ground that it involved war. The battle of Navarino followed.

Canning died on Aug. 8, 1827, and was succeeded as premier by Lord Goderich. The duke was at once again offered the post of commander-in-chief, which he accepted on Aug. 17. On the fall of Lord Goderich's cabinet five months later Wellington became prime minister (Jan. 9, 1828). He had declared some time before that it would be an act of madness for him to take this post; but his sense of public duty led him to accept it when it was pressed upon him by the king. His cabinet included at first Huskisson, Palmerston and other followers of Canning. The repeal of the Test and Corporation Acts having been carried in the House of Commons in the session of 1828, Wellington, to the great disappointment of Tories like Lord Eldon, recommended the House of Lords not to offer further resistance, and the measure was accordingly carried through. In May Huskisson and Palmerston voted against the Government in the East Retford question; Huskisson resigned, and the other liberal members of the ministry followed suit. It was now hoped by the so-called Protestant party that Wellington, at the head of a more united cabinet, would offer a steady resistance to Catholic emancipation. Never were men more bitterly disappointed. The Clare election and the progress of the Catholic Association convinced both Wellington and Peel that the time had come when Catholic emancipation must be granted; and, submitting when further resistance would have led to civil war, the ministry itself brought in at the beginning of the session of 1829 a bill for the relief of the Catholics in the face of opposition from the king and from Wellington's own supporters. Wellington, who had hitherto always opposed Catholic emancipation, explained and justified his change of front in simple and impressive language. He had, however, to challenge the Earl of Winchelsea to a bloodless duel. No mischief resulted from the encounter.

As soon as Catholic emancipation was carried, the demand for parliamentary reform and extension of the franchise agitated Great Britain from end to end. The duke was ill informed as to the real spirit of the nation. He conceived the agitation for reform to be a purely fictitious one, worked up by partisans and men of disorder in their own interest. Wholly unaware of the strength of the forces which he was provoking, the duke, at the opening of the parliament which met after the death of George IV., declared against any parliamentary reform whatever. This declaration led to the immediate fall of his Government. Lord Grey, the chief of the new ministry, brought in the Reform bill, which was resisted by Wellington as long as anything was to be gained by resistance. When the creation of new peers was known

to be imminent, however, Wellington was among those who counselled the abandonment of a hopeless struggle. His opposition to reform made him for a while unpopular. He was hooted by the mob on the anniversary of Waterloo, and considered it necessary to protect the windows of Apsley House with iron shutters.

For the next two years the duke was in opposition. On the removal of Lord Althorp to the House of Lords in 1834, William IV unexpectedly dismissed the Whig ministry and requested Wellington to form a cabinet. The duke, however, recommended that Peel should be at the head of the government, and served under him, during the few months that his ministry lasted, as foreign secretary. On Peel's later return to power in 1841 Wellington was again in the cabinet, but without departmental office beyond that of commander-in-chief. He supported Peel in his Corn-Law legislation, and throughout all this later period of his life, whether in office or in opposition, gained the admiration of discerning men, and excited the wonder of zealots, by his habitual subordination of party spirit and party connection to whatever appeared to him the real interest of the nation. On Peel's defeat in 1846 the duke retired from active public life. He was now nearly 80. His organization of the military force in London against the Chartists in April 1848, and his letter to Sir John Burgoyne on the defenses of the country, proved that the old man had still something of his youth about him. But the general character of Wellington's last years was rather that of the old age of a great man idealized. To the unbroken splendours of his military career, to his honourable and conscientious labours as a parliamentary statesman, life unusually prolonged added an evening of impressive beauty and calm. The passions excited during the stormy epoch of the Reform bill had long passed away. Death came to him at last in its gentlest form. He passed away on Sept. 14, 1852, and was buried under the dome of St. Paul's.

BIBLIOGRAPHY.—The *Wellington Despatches,* edited by Gurwood; *Supplementary Despatches;* and *Wellington Despatches, New Series,* edited by the second duke of Wellington. Unlike Napoleon's despatches and correspondence, everything from Wellington's pen is absolutely trustworthy: not a word is written for effect, and no fact is misrepresented. Almost all the political memoirs of the period 1830–50 contain more or less about Wellington in his later life. Those of Greville and Croker have perhaps most of interest. A good deal of information, from the unpublished Russian archives, is given in F. F. de Martens' *Recueil des traités conclus par la Russie. See* also Sir Herbert Maxwell, *Life of Wellington* (2 vols., 1900); J. W. Fortescue, *Wellington* (1925); and the literature of the Peninsular War (*q.v.*), Waterloo Campaign (*q.v.*).

WELLINGTON, a market town and urban district of Somersetshire, England, at the foot of the Blackdown hills, and near the river Tone, 151 mi. S.W. of London by the G.W.R. Pop. (1938) 6,628. Area 3.6 sq.mi. The church of St. John has a fine Perpendicular tower and chancel, while the clerestoried nave is Early English. A tower on top of the Blackdowns, 2½ mi. S., was erected in honour of the duke of Wellington. The town is well known for its public school, founded 1839.

WELLINGTON, capital of New Zealand, on the south-western shore of the North Island, on the inner shore of Port Nicholson. Pop. (1936) 115,705 (149,971 with suburbs). A deep harbour is walled in by abrupt hills, and the original flat shore, reclaimed for a considerable distance, provides the site for the chief business part of the city. The residential suburbs extend over the surrounding hills and terraces and out to the seaside bays, also across the harbour to Day's bay. The Hutt valley has developed rapidly as an industrial and residential area, Lower Hutt (8 mi. N.E. of Wellington) having been proclaimed a city in 1941. Main railway lines link the town with Auckland and Napier, and from Rongatai are regular air services to points in both North and South Islands. There is a fast overnight steamer-ferry service to Lyttelton, the port of Christchurch. The principal public buildings include the houses of parliament, town hall, railway station (completed in 1937), many large, modern structures housing government departments, and the National Art gallery and Dominion museum. Among the city's many fine educational institutions is Victoria University college, one of the constituent colleges of the University of New Zealand. Several public parks and recreation grounds adorn the city. Wellington's electric supply is from the Mangahao hydroelectric plant near Shannon, 80 mi. north. As a chief port Wellington vies with Auckland. The city was founded in 1840, being the first settlement of New Zealand colonists. The capital of the country was transferred to Wellington from Auckland in 1865.

See A. E. Mulgan, *The City of the Strait* (1939).

WELLS, CHARLES JEREMIAH (1798?–1879), English poet, was born in London, probably in the year 1798. He was educated at Cowden Clarke's school at Edmonton, with Tom Keats, the younger brother of the poet, and with R. H. Horne. He met John Keats, but later quarrelled with him.

In 1822 he published *Stories after Nature,* and in 1823, under the pseudonym of H. L. Howard, *Joseph and his Brethren.* For the next three years Wells saw Hazlitt, as he said, "every night," but in 1827 the two men were estranged. Wells was now practising as a solicitor in London, but he went to live in the country, first in South Wales and then at Broxbourne, Herts., on account of his health. In 1840 he left England for good. He settled at Quimper, in Brittany, where he lived for some years. A story called *Claribel* appeared in 1845, and one or two slight sketches later, but several tragedies and a great deal of miscellaneous verse belonging to these years are lost. Wells stated in a letter to Horne (November 1877) that he had composed eight or ten volumes of poetry during his life, but that, having in vain attempted to find a publisher for any of them, he burned the whole mass of mss. at his wife's death in 1874. The only work he had retained was a revised form of *Joseph and his Brethren,* which was praised in 1838 by Wade, and again, with great warmth, by Horne, in his *New Spirit of the Age,* in 1844. The drama was then once more forgotten, until in 1863 it was read and vehemently praised by D. G. Rossetti. The tide turned at last; *Joseph and his Brethren* became a kind of shibboleth—a rite of initiation into the true poetic culture—but still the world at large remained indifferent. Swinburne wrote an eloquent study of it in the *Fortnightly Review* in 1875, and the drama itself was reprinted in 1876. Between 1876 and 1878 Wells added various scenes, which are in the possession of Buxton Forman, who published one of them in 1895. After leaving Quimper, Wells went to reside at Marseilles, where he held a professorial chair. He died on Feb. 17, 1879.

The famous *Joseph and his Brethren,* concerning which criticism has recovered its self-possession, is an overgrown specimen of the pseudo-Jacobean drama in verse which was popular in ultra-poetical circles between 1820 and 1830. Its merits are those of rich versification, a rather florid and voluble eloquence and a subtle trick of reserve, akin to that displayed by Webster and Cyril Tourneur in moments of impassioned dialogue.

In 1909 a reprint was published of *Joseph and his Brethren,* with Swinburne's essay, and reminiscences by T. Watts-Dunton.

WELLS, DAVID AMES (1828–1898), American economist, was born in Springfield, Mass., on June 17, 1828. He graduated at Williams college in 1847 and at the Lawrence Scientific school, becoming assistant professor, in 1851. In 1850–65 he published with George Bliss an *Annual of Scientific Discovery.* His essay on the national debt, *Our Burden and Our Strength* (1864), secured him the appointment in 1865 as chairman of the national revenue commission, which laid the basis of scientific taxation in the United States. In 1866–70 he was special commissioner of revenue and published important annual reports; during these years he became an advocate of free trade. The creation of a federal bureau of statistics in the department of the treasury was largely due to his influence. In 1871 he was chairman of the New York State commission on local taxation. He did good work in the reorganization of the Erie and the Alabama and Chattanooga railroads and on the board of arbitration for railroads. In 1877 he was president of the American Social Science association. He died in Norwich, Conn., on Nov. 5, 1898. He edited many scientific textbooks, and wrote *Robinson Crusoe's Money* (1876), *Our Merchant Marine* (1882), *A Primer of Tariff Reform* (1884), *Practical Economics* (1885), *Recent Economic Changes* (1889), *The Relation of the Tariff to Wages* (1888) and *The Theory and Practice of Taxation* (1900), edited by W. C. Ford.

See the tribute by W. C. Ford in *Harper's Weekly* (vol. xlii., Nov. 19, 1898) and one in the *Journal of Political Economy* (vol. vii., Dec. 1898).

WELLS, HERBERT GEORGE (1866–), English novelist, sociologist, historian and Utopian, was born at Bromley, Kent, on Sept. 21, 1866. His father, Joseph Wells, was a professional cricketer; the young Wells had acquaintance with those straits, compromises and vicissitudes of the Victorian "lower middle class," which he was afterwards to describe, in several of his most famous novels, with such poignant sympathy and rich humour. Grants and scholarships took him to the Royal College of Science, at South Kensington; and in 1888 he graduated, with first-class honours, as B.Sc. of London University. He taught science for some years, as schoolmaster and private coach; but in 1893 turned to journalism, and in 1895 published his first book, *Select Conversations with an Uncle*, and began his astonishing career as a novelist with the short but vivid and powerful romance, *The Time Machine*. At this stage, Mr. Wells was one of the brilliant group known to the 'nineties as "Henley's young men." But already he had adopted his own line. He was to clothe scientific speculation in the form of fiction. *The Wonderful Visit* and *The Stolen Bacillus and Other Stories* appeared and in 1896 followed the grim *Island of Doctor Moreau*, and *The Wheels of Chance*. In this latter novel, Mr. Wells treats the romantic aspirations of the awkward and the shabby; and that strain was, later, developed more fully in *Love and Mr. Lewisham, Kipps* and *The History of Mr. Polly*. In 1897 came *The Plattner Story*, a collection of tales, and *The Invisible Man*—another scientific romance. In *The War of the Worlds* (1898) and *When the Sleeper Wakes* (1899) (subsequently revised, and re-published under the title *The Sleeper Awakes*, in 1911), there is again the double interest. Mr. Wells set himself to ask, not merely what might be, but what ought to be: and the enthusiasm of the reformer was manifested. *Tales of Space and Time*, a collection of short stories, appeared in 1899; and *Love and Mr. Lewisham* in 1900. In *Anticipations*, Mr. Wells presented his prophecies, as solid essays in constructive sociology. More essays followed in *Mankind in the Making* (1903). To the same period belong *The First Men in the Moon* (1901), *The Sea Lady* (1902), and *Twelve Stories and a Dream* (1903). *The Food of the Gods* (1904) is again scientific-sociologic romance: in *A Modern Utopia* (1905) the thought was summed up. The author was at this time preoccupied with the idea of an order of "Samurai," self-chosen and self-dedicated aristocrats, in some degree comparable with the Guardians in Plato's *Republic*. In this same year, 1905, came *Kipps: the Story of a Simple Soul*, a straightforward novel of contemporary life, which is still by many considered its author's masterpiece. 1906 saw *In the Days of the Comet* and *The Future in America*, as well as Mr. Wells's first incursion into active politics. He had been a member of the Fabian Society since 1903, but in 1906 came forward with criticisms of its methods. With these activities are connected *This Misery of Boots* (1907), and *Socialism and Marriage* (1908) —both Fabian tracts. In *New Worlds for Old* (1908) and *First and Last Things* (revised, 1917) Mr. Wells explained his Socialism. *The War in the Air* (1908) was a further scientific romance. *Tono-Bungay* (1909) inaugurated that series of novels in which Mr. Wells dealt with contemporary history. *Ann Veronica*, also published in 1909, dealt with the revolt of "emancipated" young women; and *The History of Mr. Polly* (1910), is a reversion to the simple, jolly, pathetic type of *Kipps*. In the series inaugurated by *Tono-Bungay* may be placed *The New Machiavelli* (1911), *Marriage* (1912), *The Passionate Friends* (1913), *The Wife of Sir Isaac Harman* (1914) and *The Research Magnificent* (1915). In 1914 appeared *An Englishman Looks at the World* and *The World Set Free*. *Bealby* (1915) seems a mere holiday from serious labours, and so does the satirical *Boon* (1915). Mr. Wells has written on World War I. In *Mr. Britling Sees it Through* (1916), he gave a picture of the "home-front." The titles of *What is Coming?* (1916) and *In the Fourth Year* (1918) speak for themselves; 1917 saw another philosophical work, *God the Invisible King*, and in the same year the author attempted to embody his philosophical ideas in fiction, with *The Soul of a Bishop*. In *Joan and Peter* (1918), three familiar strands are interwoven: history of a nation at war, destructive criticism of contemporary social method and constructive educational ideals. Various commentaries on post-war trends were: e.g., *Russia in the Shadows* (1920), *The Salvaging of Civilisation* (1921), *Washington and the Hope of Peace* (1922). Obviously, the most important post-war work by Mr. Wells is *The Outline of History* (1920). He has also written a much briefer work of the same scope—*A Short History of the World* (1922). In the general elections of 1922 and 1923 he stood unsuccessfully as Labour candidate for the University of London. *The Undying Fire* (1919), *Men Like Gods* (1923), and *The Dream* (1924), are propagandist discussion; *Christina Alberta's Father* (1925), is an indictment of the Lunacy Laws; *Meanwhile* (1927), in fiction form, gives an account of the General Strike; and *Mr. Blettsworthy on Rampole Island* (1928) uses the vagaries of abnormal psychology, and the familiar Wellsian creation of strange tribes and monsters, to produce a satire on the civilisations that lead to war. We next have the intimate and sensitive "Introduction" to a collection of stories and poems by Catherine Wells who died in 1927. *The Book of Catherine Wells* was published in 1928. Mr. Wells himself regards *The Open Conspiracy* (1928) as stating "the essential ideas of my life, the perspective of my world." Of *William Clissold*, it was urged that the author confused fact with fiction. Other books: *The Science of Life* (with J. Huxley and G. P. Wells) (1929); *The Work, Wealth and Happiness of Mankind* (1932); *Experiment in Autobiography* (1934).

Mr. Wells's qualities have their defects: rapidity of judgment implies impatience towards slow democratic developments, his strength of personal conviction entails impatience towards the convictions of others. But he has exercised an unquestionable influence upon his generation. (G. Go.)

WELLS, HORACE (1815–1848), American dental surgeon, was born at Hartford, Vt., Jan. 21, 1815. He studied dentistry in Boston, 1834, and began practice in Hartford, Conn. In 1840 he first expressed the idea that teeth might be extracted painlessly by the application of nitrous oxide gas. He tested the efficacy of the gas in this operation on his own person in 1844 and afterwards frequently used it in his practice. He was long thought to have been the first to use an anaesthetic in any operation, and, though it is now known that he was preceded by Dr. Crawford Long (*q.v.*), he deserves the credit of an independent discovery, which through him was first brought to the world's attention. He died in New York city Jan. 24, 1848.

WELLS, SIR THOMAS SPENCER, 1ST BART. (1818–1897), English surgeon, was born at St. Albans on Feb. 3, 1818. He was a member of Council of the Royal College of Surgeons, Hunterian professor of surgery and pathology (1878), president (1882) and Hunterian orator (1883). In 1883 he was made a baronet. He died on Jan. 31, 1897. Sir Thomas is famed for his successful and safe revival of the operation of ovariotomy, the principles of the operation now being applied to the other abdominal viscera. His chief writings are *Diseases of the Ovaries* (1865–1872), *Notebook for Cases of Ovarian and other Abdominal Tumors* (1865) and *On Ovarian and Uterine Tumors* (1882).

WELLS [*Theorodunum, Fonticuli, Tidington, Welliae, Welle*], a city of Somerset, England. Pop. (1938) 5,250. Area 2 sq.mi. It lies below the Mendip Hills and derived its name from St. Andrew's Wells, which during the middle ages were thought to have curative properties. There was a Roman settlement here. During Saxon times Wells was one of the most important towns of Wessex. King Ine founded a religious house here in 704. In 905 Wells was made the seat of a bishopric by Edward the Elder. About 1092 Bishop John de Villula removed the see to Bath. After struggles between the secular clergy of Wells and the regulars of Bath, it was arranged about 1246 that the bishop should take the title of "Bath and Wells," and should be elected by representatives of the monks of Bath and of the canons of Wells who were secular canons of St. Augustine. Wells became a borough owned by the bishops before 1160, when Bishop Robert granted the first charter. Wells was represented in parliament from 1295 to 1868, but is now in the Wells division of the county.

The beautiful cathedral was executed principally by Bishops Reginald Fitz-Jocelyn (1171–1191), Savaricus (1192–1205) and Jocelyn (1206–1242). The western part of the nave, with the beautiful series of statues on the façade, is attributed to Bishop Jocelyn. With him was associated a famous architect in Elias de Derham, who was his steward in 1236, and died in 1245. The upper half of the two western towers has never been built. The central tower, 160 ft. high, was built early in the 14th century; the beautiful octagonal chapter-house on the north side, and the lady chapel at the extreme east, were the next important additions in the same century. The whole church is covered with stone groining of various dates, from the Early English of the choir to the fan vaulting of the central tower. Its plan consists of a nave (161 ft. in length and 82 in breadth) and aisles, with two short transepts, each with a western aisle and two eastern chapels. The choir and its aisles are of unusual length (103 ft.), and behind the high altar are two smaller transepts, beyond which is the very rich Decorated lady chapel, with an eastern semi-octagonal apse. On the north of the choir is the octagonal chapter-house, the vaulting of which springs from a slender central shaft. The cloister, 160 by 150 ft., extends along the whole southern wall of the nave. The extreme length of the church from east to west is 383 ft. The oak stalls and bishop's throne in the choir are magnificent examples of 15th-century woodwork.

On the south side of the cathedral stands the bishop's palace, a moated building, originally built in the form of a quadrangle by Bishop Jocelyn, and surrounded by a lofty circuit wall. The hall and chapel are beautiful structures, mostly of the 14th century.

Fine remains of the vicars' college, dating from the 15th century, and other residences of the clergy stand within and near the cathedral close; some of these are beautiful examples of mediaeval domestic architecture.

The church of St. Cuthbert has a fine tower with spire at the west end. It was originally an Early English cruciform building, but was much altered during the Perpendicular period.

Fairs were granted before 1160. But Wells is now ecclesiastical. The theological college is well known. The diocese covers all Somerset except Bedminster, Abbots-Leigh and Brislington.

WELLSTON, a city of Ohio, U.S.A. Pop. (1940) 5,537. Its industrial activity is built around coal, clay and limestone deposits. Mining equipment, sheet steel products and clothing are manufactured. To the north is Lake Alma state park. Wellston, founded in 1871 by Harvey Wells, was chartered in 1876.

WELLSVILLE, a city of Ohio, U.S.A. Pop. (1930) 7,956; in 1940, 7,672. The region is rich in clay, coal, oil and gas, and the manufactures include yellow and white pottery, sewer pipe, terra cotta, sheet iron, iron castings and machinery. In 1795 James Clark, of Washington county, Pa., bought a tract of 304 acres here, transferring it to his son-in-law, William Wells, after whom the town was named. It was chartered as a city in 1890.

WELSH LANGUAGE AND LITERATURE. Welsh is the Celtic language of Wales. Old Welsh (800–1100), is known to us almost entirely by means of isolated words or glosses. The term *"cymro"* or "fellow-countryman" dates from the 7th century. It has been therefore impossible to record the phonetic system or the grammatical structure of the oldest forms in any detail. The Middle Welsh period (1100–1500) is better known through a greater supply of valuable material. The symbol *ll* to denote a voiceless *l* appears in middle Welsh. But *rh* (voiceless r) *dd* (= Eng. *th* in "thou") and f=v become regular in the modern period. As compared with Old Irish the inflectional system has become simple. There are only faint traces of case forms, the dual and the neuter gender. The infixation of pronominal objects, between the verbal participle and the verb itself continues in use to the present day. Four dialectical groups are known, two Northern—(Powys and Gwynedd), spoken in Anglesea, Carmarthen and Merioneth, and two Southern, (Dyfed and Gwent), spoken in Cardigan, Carnarvon and Glamorgan.

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WELSH LITERATURE

The earliest literature of the Cymry is preserved in about half a dozen mss., written, with one exception, after the close of the 12th century. The most important of these, the so-called *Four Ancient Books of Wales*[1], are anthologies or collections of pieces both traditional and contemporary.

Up to the end of the 6th century, before Northumbrian and Mercian aggression had confined the Welsh nation to its present boundaries, the whole of the district west of a line drawn roughly from the Firth of Forth to the mouth of the Exe was still Celtic territory, and, with the exception of certain districts to be described later, spoke the British tongue, from which Welsh has developed, just as Italian has developed from Latin.

Traditional Literature, 550–1150.—It is now generally agreed that up to the 7th century the dominant language in Gwynedd and Dyved (the north-western and south-western corners of Wales) was Irish. These Irish districts were the homes of the most important portion of the early prose literature, which, in all its variety, is known as the *Mabinogion.* Still stronger proof of the Goedelic origin of the early romances is to be found in the correspondence between the characters and incidents of the *Mabinogion* and those of the tales of Ireland, more particularly of the earlier cycle known as the Ultonian.

The northern portion of this ancient Wales, comprising roughly the districts included between the Wirral peninsula and the Clyde valley, was called in Welsh *Y Gogledd,* or the North. In many respects the literature emanating from this region is the best authenticated of all the cycles, because the poets of this region describe themselves and their heroes as *Gwŷr y Gogledd,* "the men of the North." This poetry represents the original Celtic tradition in literature, and therefore unites Welsh literature to the indigenous literature of all Aryan nations. The names of two poets are connected with this cycle, *Taliessin* and *Aneurin,* and it is unified into one cycle by the fact that we have here a school of poetry based on a genuine and historical tradition; that is to say, all the poems contained in it are concerned with historical heroes who actually lived in *Y Gogledd* about the 6th century, and not with the myths of the early gods for which we must look to the *Mabinogion* in the Western Cycle. This manner of song persisted in Wales in its greatest vigour under the princes of Gwynedd, whose court was at Aberffraw in Anglesey, and afterwards, after the loss of Welsh independence in 1282, in the houses of the *uchelwyr,* the aristocracy. It underwent a great quickening under the influence of France in the 14th century and, after many vicissitudes, still flourishes in our day in what is known as the *Mesurau Caethion*—"Un-free Metres." Its preservation, as we shall presently see, was mostly due to Gronwy Owen (1723–69) in the 18th century, and to Sir John Morris-Jones in our own day. Thus have the primitive modes of the Aryan heroic poetry descended to us in the 20th century in a manner which is probably unparalleled in any other country.

The eastern and central portion of ancient Wales comprised the country of the ancient Ordovices. This corner of Wales, which came afterwards to be called *Powys,* or the "Settlement," had as its chief town the ancient Pengwern, not far from the modern Shrewsbury. It is probable that Powys had been profoundly affected by Roman influences, which are reflected in its characteristic literature. The product of this district was the early *englyn,* a form of epigrammatic verse unknown in the heroic poetry of the North, and which, if the present writer, following Sir John Rhys, is right[2], was developed directly from the Latin

[1]They are *The Book of Aneirin, c.* 1250, *The Black Book of Carmarthen, c.* 1170–1230, *The Book of Taliessin, c.* 1275, and *The Red Book of Hergest, c.* 1375–1425. All four have been copied and printed by Dr. Gwenogvryn Evans.

[2]Sir John Morris-Jones in his *Cerdd Dafod,* maintains that the hexameter and the *englyn* are independent developments of the same Aryan form.

elegiac couplet, as recorded on British tombstones. These early *englynion,* some of which have been preserved in the oldest ms. of Welsh poetry (the *Juvencus* ms. at Cambridge), were assigned by tradition to Llywarch Hen, and it is probable that the bulk of them, in their original form, is the work of a poet of that name flourishing in the 6th or 7th century. Whether they have any direct connection with the Latin hexameter or not, they have marked characteristics which separate them from the more primitive poetry of *Y Gogledd.* This song of the East is, comparatively speaking, sophisticated and literary; it is elegiac and reflective in tone, and is almost exclusively a lament for dead friends or the glory that is no more. In form, it is marked with great reserve and bleakness.

That tract of Celtic territory which is roughly included in the modern counties of Cornwall and Devon, the home of the ancient Dumnonii, seems to have been left alone by the Romans. By the triumph of the West Saxons at the battle of Deorham in 577, the Britons of this district were, with their kinsmen of Somerset and Gloucester, completely cut off from the rest of Wales. In the extreme west of their land, however, *i.e.,* in Cornwall, they still spoke the British tongue well into the 18th century, though they made no direct contribution to Welsh literature. But they had a share in the material of literature, which, in its effect upon the world, is of greater importance than all the rest; for to them must be given the credit of cradling the legend of Arthur. The earliest Welsh literature knows little or nothing of Arthur.

The Northern Cycle.—In the additions to the work of the historian Nennius, dating from about the 9th century, we are told that in the time of Ida son of Eobba (reigned A.D. 549–559), five poets sang in the British tongue, Talhaearn Father of Song, Neurin, Taliessin, Bluchbard and Cian. Of the first and the last two we know nothing, but a large amount of poetry purporting to be the work of Neurin, or as he is generally known Aneurin, and of Taliessin has been preserved. Much controversy has raged around these names, but we here accept the conclusions of Sir John Morris-Jones, that a large portion of the verse assigned to Aneurin and Taliessin was actually sung in the 6th century. Aneurin is the reputed author of the *Gododin,* but it is clear that what we possess to-day is a much later version of the original poem with additions by later hands. The *Gododin* belongs to the Celtic and Aryan Heroic age, which had probably come to an end by the close of the 6th century. But imitations of the manner and substance of the Heroic Poetry persisted for almost 800 years, that is to say, throughout the whole period of those bards known as the *Gogynfeirdd,* or the post-primitive bards. All the heroic poetry of the Aryan nations was probably sung or recited when the heroes whom it celebrated were still in the flesh, and it is likely that the original poet of the *Gododin* described scenes which he had himself witnessed and heroes with whom he had caroused in the mead-hall. Aneurin's poem describes the warriors, mostly men of the *Gododin,* who went to battle at Catraeth against the Angles of Bernicia and Deira. We know from ancient geographers that the Gododin (Votadini) were a tribe in the southeast of Scotland, and it is generally agreed that Catraeth was situated at Catterick in Yorkshire. The *Gododin* does not describe the battle itself, but rather the heroes who went to it. A note of melancholy underlies the whole of the poem, though it is concerned with two events that are prominent in all heroic poetry—the carousal and the fight. But what marks the *Gododin* as different from most heroic poems is that it tells of heroes who fought and lost; its champions go singing to battle, but after that, silence. Other heroes merrily drink the mead, and slay their enemies in their great joy; here the heroes drink, and their foes exult over the fallen drunkards.

The poetry of Taliessin is more varied, and somewhat more primitive in character. Of the mixed collection attributed to him, we may safely assume that most of the poems dealing with Urien and his son Owein, lords of Rheged in the North,—the Uryence and Yvain of Arthurian Romance—are genuine and contemporary with the heroes whom they celebrate. Here we have no flowers of rhetoric, none of the craftily worded hyperbole of praise, which is the certain mark of later practitioners of the bardic art of the Northern Cycle. The diction is simple.

In addition to the historical poems, there are some songs of Taliessin that deal with the early myths of the Welsh, and it is probable that these are by a later hand.

The Eastern Cycle.—The earliest poetry in this cycle is probably not much later than the genuine work of Aneurin and Taliessin. It is written in stanzas of three or four lines called *englyn* (pl. *englynion*), and is important as the probable channel by which those outside influences travelled which quickened the conventional court poetry of the North. The first examples, traditionally the work of Llywarch Hen, describe the desolation and waste that followed in the train of the Mercians who had sacked the court of Cynddylan at Pengwern. One very special characteristic marks all this *englyn* poetry,—the poet is always in solitude, and whether he meditates on the unhappy things of old or the desolation of the present or on external nature, he treats all his themes from the same point of view. Is the theme war?—then the poet is the sole survivor of his lord's retinue and his own family of gallant sons. Is it religion?—then he is an anchorite in the wilderness, stilling the weary restlessness of his heart with the sight of a bleak and unfriendly nature. He always stands in the *anghenedl,* in the desolate no-man's land, and turns to the only consolation which is left to him, now that he has no longer the merry candle-lit mead-hall and the society of his fellows. He turns to nature, not as Wordsworth did to seek a mystical union, but objectively to find a new interest, and an analogy to his own bleak condition. Thus was developed a new kind of verse which is divided into well-marked stages, first the desolation of a ravaged country side; then the plaints of a lonely old age; then the reflections of a hermit who describes, rather than interprets, the sights and sounds of nature; then the longing of the lover who unifies all beauty in the crucible of his own imagination; and finally, in the poet-princes of the Gogynfeirdd period, we find a new element, the love of country and one's own people, though the verse is no longer in *englyn* form. This attitude towards nature persisted throughout the whole history of Welsh poetry, and is nowhere more deeply marked than in the Snowdon poets of the 19th century, Ieuan Glan Geirionydd and Glasynys. The earliest of these *englynion* contained in the *Juvencus* ms., are simple, and as yet contain no hint of a consciousness of external nature. Later this kind of poetry degenerated into a conventional gnomic verse which utilized well-known forms, as in *The Hall of Cynddylan,* to introduce a proverb at the end of each stanza. Closely connected with this poetical *genre* are the *Verses of the Graves,* in which some unknown poet lets his fancy wander over the whole of Wales, and describes the places where the warriors of old are buried.

The Western Cycle.—In the extreme Western portions of Wales (*i.e.,* Anglesey with the opposite coast of Arvon, and the peninsula of Lleyn which still bears its Irish name of "the land of the Leinster men," and Dyved) the old Irish civilization died hard. Here grew up the legends which were utilized by some one to form the *Mabinogion,* that choicest flower of the Welsh genius. It is likely, however, that the impulse which caused their final reduction to writing came from outside. It was when the Norman, in the early part of the 12th, or even perhaps in the 11th century, began to reproduce in his own tongue the marvellous stories of Britain, that Welshmen began to realize the value of their own traditions. Welsh writers treated those traditions in many different ways. (1) They reduced to writing the *cyvarwyddyd,* the spoken tale which formed the stock-in-trade of the lower orders of the wandering bards; this became what is called the *Four Branches,* the *Mabinogion* proper, namely, *Pwyll, Branwen, Manawydan* and *Math.* (2) They translated into Welsh the stories which had already been put together in France from Welsh material, and thus we have *Peredur,* the *Lady of the Fountain,* and *Geraint.* These tales were not all treated alike; to *Peredur* much was added from independent Welsh sources, to *The Lady of the Fountain* a little less, and to *Geraint* hardly any at all. (3) They took an old Arthurian folk-tale of south-west Wales, added to it material from other sources, much of it Irish in origin, and produced the charming jumble known as *Culhwch and Olwen.* (4)

British tradition, as distinguished from the British-Irish material found in the *Mabinogion* proper, had already supplied Geoffrey of Monmouth with the basis of his great work the *Gesta Regum;* some of this was now re-hashed and mixed with traditions not known to Geoffrey and became the two stories of the *Dream of Macsen* and *Lludd and Llevelys.* (5) Some time after 1160, when the Arthurian stories had been already disseminated all over Europe, a purely "literary" *cyvarwyddyd* was composed, an independent tale imagined for the first time by the author on the model of other Arthurian romances, and this was named the *Dream of Rhonabwry.*

The *Mabinogion,* dated about A.D. 1100 was by no means the beginning of Welsh prose, but it was the first attempt to utilize prose for purely artistic purposes. The *Laws of the Hywel Dda* in the 10th century, shows that Welsh prose had been for centuries used as the vehicle for legal documents. The contrast between the *Mabinogion* with their directness, their restraint, their disciplined selection, and the French Arthurian romances, with their extreme sophistication is to be noted. Though the *Mabinogion* are a mass of irrelevances, though they would be laughed at by a school-boy writing a story as a task, yet they are immortal.

The Gogynfeirdd, 1150–1350.—During the dark ages of Welsh poetry, that is to say, between the 6th and the 12th centuries, little poetry was produced, or at least preserved. It is true that here and there in the "Four Ancient Books" are found poems which belong to this period; they are for the most part religious, composed probably not by the regular bards, but by the inmates of the monastic institutions where the mss. were copied. Others, again, such as the fragment, in the Black Book, of a lost *Trystan and Esyllt* poem, lead us to suppose that we have preserved for us only minute fragments of a large corpus of literature dealing with such legends as underlie the *Mabinogion* and the romances.

With the consolidation of the principality of Gwynedd under Gruffudd ap Cynan (1054–1137) and his descendants, a new song suddenly appears in that province. It is as if a new hope had informed the activities of the bards, and the first notes tell of spring and renewed vigour. It is certain, however, that the poems of the first bards of this period are the culmination of long ages of literary activity of which there is now no record. Critics of the last century tried to account for this sudden change by attributing it to the influence of Ireland, seeing that Gruffudd ap Cynan of Gwynedd was half an Irishman and had spent his youth in Ireland, and that his contemporary Rhys ab Tewdwr, king of south Wales (d. 1093), was thought to have been an exile in Ireland. There are undoubted traces of Irish influence on the works of the bards, and especially on music, but as far as poetry is concerned it can be explained by the fact that Anglesey, where the court of Gwynedd was situated, had always been the stronghold of the Irish in Wales. The court poetry of the *Gogynfeirdd* was the direct and inevitable development of the work of the primitive poets (*Cynfeirdd*) of the Northern Cycle. It was in Gwynedd that this ancient heritage found its home, and it is in Gwynedd that the classical tradition flourishes to this day. Thus we may say that modern poetry in the 'unfree metres' represents the unbroken tradition of the Northern Cycle modified and augmented by the contribution of Powys, the Eastern Cycle.

The Bardic System.—The organization and position of the bards of this period in the social and political life of the country seem to be peculiar to the Celtic peoples. They were divided into grades, the upper grade or *Pencerdd* ("chief of song") being a high officer of the court, whose duty it was to sing the praises of his lord and his family, and of God and the saints. He was forbidden to sing of love and nature, and his field of song was mapped out and prescribed. He was not only the bard of the court, but was a kind of metropolitan of poetry for the whole province; under him came the *Bardd Teulu* (the bard of the king's guards) who did for the king's household what the *Pencerdd* did for the king himself. He also was restricted as to subject, but he might sing of love and nature, and such songs as would please the ladies but be distasteful to the virile warrior kings. Last of all came many kinds of *Cerddorion* (musicians) who might be permitted ribaldry and satire, and who told the *cyvarwyddyd* or tale which was eventually written as *Mabinogion.* They might be conjurors and court entertainers, and even jesters, but they were forbidden to use the metres or the subjects of the higher orders. Across this classification, which is somewhat analogous to a similar division in Ireland, cuts another, based on an entirely different principle,—the grading of the bards according to degrees of proficiency. This classification was educational, and lay at the root of all learning in Wales. There is reason to believe that these two classifications had widely different origins. The former was probably inherent in the tribal system of the Celtic conquerors of Wales; the latter was of religious origin, and grew out of the druidic system. It was this latter classification which remained in Wales after the loss of its independence; its essential feature, the relation of disciple and teacher, has persisted almost to our day. In the time of Henry IV. it led to the holding of an eisteddfod, or session of the bards, to confer certificates of proficiency, and to prevent the lower orders from flooding the country and drifting into mere mendicancy. The modern "National Eisteddfod" is a development of the end of last century, which goes back to small eisteddfodau held by learned societies at the end of the 18th century. It was at the end of the 18th century, too, that the "Gorsedd of the Bards" was devised.

One of the natural results of a bardic system of this type was an unparalleled conservatism in literature. Most of the 13th century bards, presently to be discussed, use a conventional diction which was consciously archaic, not only in its vocabulary, but even in its grammar and idiom. It could not possibly be understood by any but those classes whose education had included the study of poetry; indeed it is doubtful whether the princes to whom this poetry was addressed, and who spoke a language not widely different from our modern Welsh, could understand these Gogynfeirdd any better than we can to-day. This archaicism was one of the means by which they produced that "exquisiteness," the aim of all bardism, and non-Celtic critics often find it extremely hard to appreciate an artistry the methods of which differ so widely from those of their own.

Bardism often went by families, and the first names of the new period are those of Meilir, his son Gwalchmai, and his grandson Meilir ap Gwalchmai, who were attached to the court of Gwynedd at Aberffraw. Gwalchmai (*fl.* 1150–90) has left on record his *Gorhoffedd* or "Boasting," a spring-song typical of much that was contemporary in Ireland. Unfortunately the text is extremely defective, and we can only pick out the meaning of the poem here and there. In his *Praise of Owein,* he displays one characteristic of all the *Gogynfeirdd,* description of water, whether of river or sea. Nearly all the great poets of this period get their finest effects when they picture the waves red with the blood of their enemies. The traditional master of the archaic was Cynddelw (*fl.* 1150–1200), the court bard of the prince of Powys.

The official bards of this period all used the same material and used it in the same way. Song and its modes were prescribed for them, and to go beyond the stated limits was to be un-bardic. In the 19th century, Islwyn in his greatest poem cried that the muse should have "eternity for its path"; it was the cry of the great revolt against the conventions that have often clogged all thought in Welsh poetry. But then, the poetry of the bardic tradition was not measured by the depth and extension of its thought, but by its exquisiteness; its value was ornamental, and to be in a position to judge Cynddelw and his contemporaries, one must think of a culture that sought not to interpret life but to adorn it. Now and then would burst into song a prince of the royal house, who was not of the order of the bards, but who sang because God had set a song in his heart and on his lips. Two such princes, Owein Cyfeiliog of Powys (d. 1197) and Hywel ab Owein of Gwynedd (d. 1170), stand out in clear distinction from the contemporary bards. Owein Cyfeiliog's most famous work is the *Hirlas* (The Long Grey Drinking Horn), in which he describes his warriors making merry over the mead after a victorious fight. Hywel ab Owein, soldier, lover and patriot, was killed with his foster-brothers fighting against his own kin at the battle of Pentraeth in Anglesey in 1170. His departure from convention is even more striking than that of Cyfeiliog; for the first time in Welsh litera-

ture we get the love of country, its scenery, its people, and its language, extolled as objects worthy of song. Hywel loved beauty, in the modern sense; that is to say, he found that land and sea and women and the Welsh speech spoken in cultured accents by his lady, all awoke in him the emotion of awe and wonder, and he unifies in his own experience all these beautiful things; they depend one upon the other; they are not merely beautiful for their own sakes, they are part of a universal beauty. He thus strikes what seems to us, satiated with the bardic praises and battle songs, a very "modern" note. The Gogynfeirdd alternate throughout this period between *marwnad* (praise of the dead) and *moliant* (praise of the living) till the time when the English conquest of Wales removed from Welsh life the occasion of both. The period ends with the most famous of all the Welsh *marwnadau* sung by Gruffudd ap yr Ynad Coch, after the death of Llywelyn the last prince of Wales.

The Later Gogynfeirdd.—With the princes and their pageantry, there passed away the older modes and conventions of Welsh poetry. For the next 100 years, that is to say, from about 1280 to 1380, a new kind of poetry held the field. The audience that could once accept and understand the intricate and involved *awdl* of the old period could no longer find the means to educate themselves for the understanding of it. The old metres still remained, but the language became simpler. The poetical conventions which governed the old poetry having been thus in part relinquished, it was necessary to invent a new presentation of poetry, which contained some element that could be regarded as a substitute for them. The poets who sang in the years between the English Conquest (1282) and Dafydd ap Gwilym seem either to have returned to an earlier poetic fashion or to have been greatly influenced by new ideas from Ireland. The probability is that both suppositions are true, that is to say, that the poets of the *bardd teulu* class, whose work has not been preserved, were greatly influenced in the 11th century by the poetry of Ireland, but that this influence did not penetrate into the work of the *penceirddiaid* until the loss of Welsh independence had made them more directly dependent on what (to use an anachronism) might be called middle-class opinion.

Whereas in the early period "exquisiteness" was sought in archaic precision and in the suggestion of older modes, the new poets employed colour and form to an extent hitherto unknown in Welsh poetry, and unparalleled in later times. Dress, jewels, armour, are described in such a way as to convey to the mind of the modern reader exactly the same suggestion as he gets from the old Irish jewels, such as the Tara brooch. In the same way a lady's hair and cheeks, her form and gestures, even her silences are amply and precisely described in poetic words. The famous names in this period are those of Gruffudd ap Maredudd, Gruffudd ap Davydd, and Casnodyn, who all flourished in the first half of the 14th century.

The Golden Age of the Cywydd, 1350–1450.—The conquest of Wales by Edward I. did not put an end to the poetry associated with the royal courts of Gwynedd and Powys. Its effect was to transfer its patronage from the princes to the smaller land-owners, and to diminish the prestige which it enjoyed in Wales. Henceforth there was to be no legal recognition of the *pencerdd* and his particular department of song at the expense of the *bardd teulu*; all the political changes in Wales served to diminish the prestige of the bards who had been associated with the native princes, and to give an opportunity to the lower orders whose work had not hitherto been regarded as meriting preservation by the coypists. Indeed, in south Wales, where the Normans had been established for a whole century before the conquest of Gwynedd in 1282, the old song had probably died out, and the lower orders in the South had thus had an earlier opportunity of becoming vocal. While Gruffudd ap Maredudd and Casnodyn in Gwynedd were still, though in a simpler form, following the old conventions of the *gwawd*, the *pencerdd's* song, the unknown bards of south Wales were developing an entirely new literature of which we have no trace in the mss. before the work of Davydd ap Gwilym, who like his contemporary Chaucer in England, may be regarded, in his own land, as the father of modern poetry.

Davydd ap Gwilym.—Davydd ap Gwilym was probably born about 1320. His family are associated with Dyved, but he seems to have spent most of his time at the home of his patron Ivor Hael in Morgannwg.

In the first of his periods he wrote according to two entirely distinct traditions. His *awdlau* to his patrons, his uncle Llywelyn and Ivor Hael, follow the strictest conventions of the later Gogynfeirdd; he sang these as a *penderdd*. At the same time, he produced a large body of poetry in what must be regarded as the tradition of the *bardd teulu*. These are *cywyddau* and *traethodlau*. The *cywyddau* are in couplets of seven syllables, one rhyme being accented and the other unaccented; in this first period they are not regularly in *cynghanedd* (alliteration) as the rules of the *pencerdd's* song demanded. His other form, the *traethodl*, is also in couplets of seven syllables, but both rhymes are unaccented and there is no *cynghanedd* at all. From the fact that his *cywyddau* are the earliest known, and that his name was always associated with the *cywydd* by his contemporaries, he has come to be regarded as the inventor of the *cywydd*. There is, however, ample reason to suppose that Davydd's work was only the culmination of a long process of development among the *beirdd teulu* in south Wales who, both politically and socially, had been for a century cut off from the main tradition of Welsh poetry.

His important advance was in diction. Up to this time, poetry was written in a conventional and deliberately archaic language. Davydd ap Gwilym, in his *cywyddau*, discarded altogether the old archaisms, and wrote in the ordinary language of the educated Welshmen of his own time. His successors followed his lead, and the old diction was discarded for ever. He thus established the standards of modern Welsh.

The substance also of his poetry was new. Up to his time, the bards were confined by regulation to a few well-defined subjects, and the poetic art had now degenerated into a kind of jugglery with *clichés*. Davydd however had listened to the songs which were then delighting the ordinary educated man in Europe, and he reproduced them in his *cywyddau*. Much has of late been written about his sources, and the question is not yet settled. But we can trace the chief influences on his work, namely the song of the *clerici vagantes*, the wandering minstrels, and of the trouvères of France. His own county Glamorgan had a bilingual aristocracy speaking both Welsh and French, and was thus especially open to outside influence. The conventional divisions into which the poetry of the troubadours and trouvères is divided, *aubade, serenade, tenson, pastourelle*, and so on, are faithfully and minutely reproduced in his work. Besides this, a large part of his poetry is derived from the popular songs of wandering minstrels in Latin, French, and probably in English; in other words, whatever had become the theme of song in the Europe of the 14th century was introduced by Davydd into his *cywydd*. He has, without much discrimination, been hailed as the greatest of love poets, but this is certainly to misunderstand his work. Of love poetry, as such, he has very little; love is a peg on which he hangs his exquisite nature poems, and it is in these that we must find his greatest contribution to the poet's interpretation of life. In his nature poems he made use of two conventions, the foreign convention of the *llatai* or love-messenger, and the purely native tradition of the *dyvaliad* or descriptive poem. The first part of the poem is generally a conventional statement of his love for a lady, the second a short address to a bird, or a fish, or a natural feature, such as the cloud or the wave, praying it to take a message to the lady; the third and main portion is a minute description of the messenger. Davydd has been called the "Wordsworth of Wales," but there is no comparison between him and Wordsworth as nature-poets. To Davydd, nature is purely external, it has no mystical significance. But his treatment of it, curiously like that of his countryman W. H. Davies, invests it with a new wonder and significance.

Davydd ap Gwilym's Contemporaries.—Davydd's influence was twofold; not only was the *cywydd* established as the leading form, but the new subjects came to be recognized as themes fit for poetry. One of his oldest contemporaries, Gruffudd ab Adda (*fl.* 1350), wrote a *cywydd* "to a birch-tree that had been

made into a maypole at Llanidloes," which goes much further than Davydd in the direction of the modern conception of nature. It has now been proved that Iolo Goch (*c.* 1320–1400) was not Owen Glyndŵr's family bard, and that most of the poems to Glyndŵr popularly attributed to him were written neither to Glyndŵr nor by Iolo Goch. His greatest work is a *cywydd* to the Llafurwr (Husbandman) which shows traces of contemporary English ideas as seen, for instance, in *Piers Plowman.* Llywelyn Goch amheurug Hen (*fl.* 1360–1400) wrote some of his earlier poems in the Gogynfeirdd tradition, but his *Elegy to Llencu Llwyd,* his best-known work, is a *cywydd* and combines with striking success the Welsh tradition of the elegy with the imported form of the serenade. Other poets almost contemporary with Davydd were Gruffudd Llwyd ap Davydd (*fl.* 1380–1410), who sang two superb *cywyddau* to Owen Glyndŵr, and Rhys Goch Eryri (*c.* 1365–1448) who is chiefly famous for his literary quarrel on the nature of true poetry with Siôn Cent and Llywelyn ap y Moel, the author of a *cywydd* which gives a spirited description of one of Glyndŵr's battles. The most elusive figure in this period is Siôn Cent, to whom are attributed a large number of *cywyddau brud* or semi-political songs, and *cywyddau'r byd,* similar in every respect to the poems *du temps jadis,* so popular in every country in Europe at the beginning of the 14th century, and exemplified in the works of Villon, Dunbar, Menot and Manrique. It is probable that these poems are by many hands, but the dominant thought of them all is so characteristic that it is found convenient to refer them to the traditional name of Siôn Cent.

Davydd ap Gwilym's Successors.—With the dawn of the 14th century the *cywydd* enters a new period. The poets purified the *cywydd* from the last traces of the old convention.

Davydd Nanmor (*c.* 1435–95) in treatment of his subject and in imagination is inferior to most of Davydd ap Gwilym's contemporaries, but in his mastery of the *cywydd* form he has no equal. His poem to "Llio's Hair" and his "Maiden's Elegy," among others, mark the zenith of that conception of poetic art which aimed at simplicity. Lewis Glyn Cothi (*fl.* 1450–85) and Guto'r Glyn (*fl.* 1433–69) show a further advance in the handling of the *cywydd* metre. In their work we detect for the first time a real consciousness of nationhood among the Welsh. Other poets of this period were Maredudd ap Rhys (*fl.* 1430–50), Hywel Swrdwal (*fl.* 1460), Tudur Penllyn (*fl.* 1470) and Davydd Llwyd ap Llywelyn (*fl.* 1447–86).

The Silver Age of the Cywydd, 1450–1650.—For a short time there arose a school of literary formalists. The chief of this school was Davydd ab Edmwnd (*c.* 1425–1500), who at the Eisteddfod of the Bards held at Caermarthen in 1451 rearranged the 24 recognized metres. His poetry, apart from its great ingenuity, has little significance. His poetic heir was his nephew Tudur Aled (d. 1526) who made a further rearrangement of the rules of poetry, and whose poems, in execution, mark the very zenith of the bard's craft as conceived in that age. Unfortunately he reintroduced the *trychiad* and the *geiriau llanw* in their worst form, and his work, as a whole, marks a reaction towards the poetry of Iolo Goch and other poets of Davydd ap Gwilym's period. His contemporary Gutun Owain, though too much of his *moliant* consists of intolerable genealogical details, could, in his *dyvaliadau,* rival even Davydd ap Gwilym in his description of nature.

In the latter part of this period, two events of supreme importance occurred—the Protestant Reformation and the accession of the Tudors. The former had little immediate influence on literature, except indirectly through its effect upon the language, since, with the decline of the old Catholic educational system, the general appreciation of literature was diminished. The Tudor policy of encouraging the spread of English at the expense of Welsh, and of inducing the Welsh aristocracy to emigrate to England, almost destroyed the old Welsh culture which was altogether bound up with the language. Yet for more than a century after Henry VII. the bards plied their craft, though patronage was much diminished. Siôn Tudor (*c.* 1520–1602) satirized the new aristocracy of profiteers. Edmwnd Prys (1541–1623), archdeacon of Meirioneth, is best known for his "contention" with William Cynwal, and for his biting satire on contemporary manners; William Llŷn (1535–80) and Siôn Phylip (*c.* 1543–1620) are among the great poets of the Silver Age of the *cywydd.*

The Rise of Modern Prose.—One of the most striking features of Welsh literature is the almost entire absence of prose between 1300 and 1550. The two political movements during this period, the revolt of Glyndŵr and the accession of Henry VII. had sufficient of romance in them to repel the historian and to capture the poet. What prose the nation required it found in the tales of romance, in the legends of Arthur, of the Grail, and of Charlemagne. The little prose that was produced consisted of exercises in extravaganza called *Araith,* similar to the *Rithairec* of Ireland.

The first Welsh book, *Yn y Lhyvyr hwn,* published in 1546, consisted of extracts in Welsh from the Scriptures and the prayer book. Probably in the same year was published William Salesbury's *Oll Synnwyr Pen,* a collection of proverbs. From now on Welsh prose literature begins to take definite form, and may be studied under four headings: (1) The Reformation (2) The Counter-Reformation (3) The Welsh Renaissance (4) Puritanism.

The Reformation.—The most important name among this group of writers is that of William Salesbury (*c.* 1520–*c.* 1600) who devoted a long life to supply what he considered the means of salvation for the Welsh people, namely the Scriptures in Welsh and the ability to read and understand those Scriptures. His work, begun in 1546, culminated in his translation of the New Testament published in 1567. This work was largely experimental, as Welsh prose had not hitherto been used to express abstract ideas. If we consider accuracy of idiom and fidelity to the original, Salesbury's Testament must be called a great pioneer work. Unfortunately it is marred by his philological foibles and the mechanical means which he employed to make the language intelligible in every part of Wales. In the same year, 1567, was published the Welsh prayer book, translated by Richard Davies, bishop of St. David's (1501–81). In 1588 was published the Welsh Bible translated by William Morgan, bishop of St. Asaph (1541–1604), aided by Edmwnd Prys. This translation revised and amended by Richard Parry, bishop of St. Asaph (1560–1623), and John Davies (1570–1644) was republished in 1620, and that is the version which is used to this day. It would be difficult to exaggerate the importance of these three translations, the Testament of 1567 and the Bible of 1588 and 1620, in the development of Welsh literature. The translators were in a sense forming a new prose language, and for their material used the standard language of the bards as stabilized by Davydd ap Gwilym. Their success was at once obvious because from 1588 onwards there has been no break in the production of Welsh prose books. The first of these were naturally translations from English and Latin written with the purpose of grounding the Welsh nation in the principles of the Reformation. The following are some of the most important books under this heading: *Deffyniad y Ffydd* (1595), a translation of Bishop Jewel's *Apologia,* by Morys Kyffin (*c.* 1555–98); *Perl Mewn Adfyd* (1595), a translation of Coverdale's *A Spiritual and most Precious Pearl,* by Huw Lewys (1562–1634); *Homiliau* (1606), a translation of the *Homilies,* by Edward James (1570–1610); *Llwyhr Hyffordd* (1630), a translation of Dent's *Plain Pathway,* by Robert Llwyd (1565–*c.* 1650); *Yr Ymarfer o Dduwioldeb* (1630), a translation of Bayly's *Practice of Piety,* by Rowland Vychan (*c.* 1590–1667); *Llyfr y Resolution* (1632), a translation of Parson's *Christian Directory,* by Dr. John Davies of Mallwyd (*c.* 1570–1644). To these must be added a work which was never published, the *History* of Ellis Gruffydd (b. *c.* 1500). This document is now at the National Library. It sheds much light on the life of the court and the army.

The Counter-Reformation.—During the years in which the reformed religion was being established in Wales, Welsh society and the Welsh language were at their lowest ebb. Rome had left Wales without spiritual guidance, and the principles of the Reformation had not taken hold.

Every book during this period bewails the general ignorance. It is probable that it was during this period that the Welsh language came nearest to extinction. The Catholic writers of the Counter-Reformation regarded the new religion as something imported from England, and they thought that the way to preserve

the old religion was to insist on the old Catholic culture. This was why Gruffydd Robert (*c.* 1535–1611), canon of Milan, published his *Dosbarth Byrr,* the first printed grammar of the Welsh tongue. This book is not a mere grammar; it consists of a series of discussions between teacher and disciple, and in beauty of style it stands among the greatest monuments of Welsh prose. Other works stimulated by the desire to preserve the old religion were Gruffydd Robert's *Drych Cristianogawl* (1585); *Theater du Mond* (1615), a translation from the French, and two other books in 1609 and 1611 by Dr. Rhosier Smyth (*c.* 1546–1625); *Athravaeth Gristnogawl* by Morys Clynnog (*c.* 1525–81); and *Eglurhad Helaethlawn* (1618), a translation from the Italian by John Salisbury. All these and some others were published on the Continent.

The Welsh Renaissance.—Just as Italy and other European countries under the Renaissance turned to the Latin and Greek classics, so Wales turned to its own classical tradition of bardism. The result was the publication during this period of some of the most important Welsh grammars. Gruffydd Robert's *Dosbarth Byrr* has been already mentioned; it was followed in 1592 by the *Cambrobrytannicae . . . Institutiones* of Dr. Siôn Davydd Rhys (1534–*c.* 1617), which was an attempt to set out before the learned world regulations of bardic poetry and principles of the Welsh language. This work is the foundation of all later grammatical studies, though Rhys was far surpassed in scientific knowledge by Dr. John Davies of Mallwyd, who published his *Antiquae Linguae . . . Rudimenta* in 1621 and his great dictionary *Dictionarium Duplex* in 1632. The Latin-Welsh portion of this dictionary was based on the work of Thomas Williams of Trefriw (*c.* 1550–*c.* 1618), which is still in manuscript.

Puritanism.—So far the writers of Welsh prose had contented themselves with translation. It was left to a Puritan, Morgan Llwyd (1619–59), to make an original contribution to Welsh religious thought. He came under three influences from the outside world, namely, the Quakers, the Fifth Monarchy Men, and Jacob Boehme, the German mystic. His chief work *Llyfr y Tri Aderyn* (The Book of the Three Birds) (1653) is a disquisition in two parts, on the theory of government and on religious liberty, under the form of a disputation between the Eagle (Cromwell or the secular power), the Raven (the Anglicans or organized religion) and the Dove (the Nonconformists or the followers of the inner light). In this and in many other works, notably *Llythur ir Cymru* (1653), he expounded a mystical gospel, which (unfortunately as some think) had very little influence, though many editions of his books were published.

From the time of Morgan Llwyd till well in the 19th century, translations, mostly of theological works, continued to pour out of the Welsh press, and it is almost impossible to thread one's way amongst these thousands of books. Many of them were inspired by the activities of the S.P.C.K., and among the clergy who produced books of this description were Edward Samuel (1674–1748), who published among other works *Holl Ddyledswydd Dyn,* a translation of *The Whole Duty of Man* (1718); Moses Williams (1684–1742), a most diligent searcher into Welsh mss. and a translator; Griffith Jones of Llanddowror (1683–1761), the father of Welsh popular education; Iago ab Dewi (?1644–1722) and Theophilus Evans (1694–1769), the famous author of *Drych y Prif Oesoedd* (1716 and 1740). This book, like *Llyfr y Tri Aderyn* and *Y Bardd Cwsc,* has an established position for all time in the annals of Welsh literature.

We come now to the greatest of all Welsh prose writers, Ellis Wynn o Lasynys (1671–1734). His first work was a translation of Jeremy Taylor's *Holy Living,* under the title of *Rheol Buchedd Sanctaidd* (1710). His next work was the immortal *Gweledigaetheu y Bardd Cwsc* (1703). The foundation of this work was L'Estrange's translation of the *Sueños* of the Spaniard Quevedo.

The Rise of Popular Poetry, 1600–1750.—When Henry VII. ascended the throne, the old hostility of the Welsh towards the English disappeared. Naturally enough the descendants of the old Welsh gentry began to look towards England for recognition and preferment, and their interest in their own little country began to wane. The result was that the traditional patrons of the Welsh could no longer understand the language of the poets, and the poets were forced to seek some more profitable employment. Besides, the old conditions were changing; it gradually and imperceptibly came about that the poets of the older school had no audience. The only poets who still followed the old tradition were the rich gentlemen-farmers who "sang on their own food," as the Welsh phrase goes. A new school, however, was rising. The nation at large had a vast store of folk-song, and it was this, despised and unrecorded, that became the groundwork of the new literature.

The first landmark in this new development was the publication in 1621 of Edmwnd Prys's metrical version of the Psalms, and in 1646 of the first poem of the *Welshmen's Candle* (*Cannwyll y Cymry*) of Rhys Pritchard, vicar of Llandovery (1569–1644). These works were not written in the old metres peculiar to Wales, but in the free metres, like those of English poetry. The former is of great importance, as these Psalms were about the first metrical hymns in use. The latter work, the first complete edition of which was published in 1672, consisted of moral verses in the metres of the old folk-songs (*Penillion Telyn*). Many other poets of the early part of this period wrote in these metres, such as Rowland Fychan, Morgan Llwyd and Williamd Phylip (d. 1669). Poetry in the free metres, however, was generally very crude, until it was given a new dignity by the greatest poet of this period, Huw Morys o Bont y Meibion (1622–1709). Most of his earlier compositions, which are among his best, and which were influenced to a great extent by the cavalier poetry of England, are love poems, perfect marvels of felicitous ingenuity and sweetness. Towards the end of the period comes Lewys Morys (1700–65). His poetry alone does not seem to warrant his fame, but he was the creator of a new period, the inspirer and patron of Gronwy Owen. Like his brothers Richard and William, he was an accomplished scholar. His poetry, except a few well known pieces, will never be popular, because it does not conform to the modern canons of taste.

The Revival, 1750.—The middle of the 18th century was, after the 14th, the most fruitful period of Welsh literature. Up to this time, Wales had lain in a terrible stagnation, both social and literary; a people, who had till now never lacked self-expression in literature, had become inarticulate. It was clear that one of two things was essential if Welsh was to survive as a language of culture—either a re-creating literary influence from the outside, or some great spiritual or intellectual revival which would stir the people once more into articulate expression. It was a coincidence that both these events should happen in Wales at the same time.

The first event was the adoption by Gronwy Owen, inspired by Lewys Morys, of the literary standards of the English Augustan classicists; the result was the re-introduction into Welsh poetry of the *cywydd* and the *awdl* in all their traditional correctness of form, but with a new and larger content. Around Gronwy Owen were grouped other poets who thus established a classical school of poetry which is alive to this day; the more important among them were William Wynne of Llangynhaval (1704–60), and Evan Evans (1731–89). Much of the literary activity represented by this school was associated with the Welsh community in London, and with the establishment of the Hon. Society of Cymmrodorion. The direct result of the efforts of the London Welshmen to preserve and spread the knowledge of Welsh literature was the establishment of local eisteddfodau which were periodically held in different parts of Wales under the auspices of the learned societies. These eisteddfodau, by offering a chair for an *awdl* (this practice it must be noted only dates from the end of the 18th century), perpetuated the classical form, i.e., *cynghanedd* and the unfree metres, which would have otherwise certainly disappeared. Thus Gronwy Owen is the fountain-head of modern classicism and it is natural that his works should be the basis of modern literary studies at the schools and in the university. His successors, the eisteddfodic bards, though greatly inferior to him in poetic power, did much to reintroduce the knowledge of the classical forms; chief among these was Dafydd Ddu Eryri (1760–1822) who, both as a writer of *awdlau* and as a grammarian was the teacher of the 19th century. His successor, Dewi Wyn o Eivion (1784–1841), was the first to deviate from the strictness of the old tradition, and much of his work is strikingly deficient in quality. Eben Vardd (1802–63) was the last of the 19th century eisteddfodic

bards who made any real contribution to literature; he is the greatest poet of the descriptive school. After him eisteddfodic poetry, *i.e.*, poetry in the classical tradition, suffered eclipse; the last 40 years of the 19th century, though an enormous mass of so-called poetry was produced, saw what was probably the nadir of popular taste. The end of the 19th century was marked by a reaction back to Gronwy Owen and Davydd ap Gwilym.

The Free Metres, 1750–1890.—The classicists of the 18th century were quite unaware of the Methodist Revival, but it was the intensity of the religious emotion now set free for the first time that broke the inarticulateness which had befallen Wales. The vast store of experience and expression which had been accumulating out of sight in the *Penillion Telyn* (Folk Poetry) was at last displayed in the hymns of William Williams Pantycelyn (1717–91), almost the first poet to use the free metres for a serious purpose. Pantycelyn's hymns in time became by themselves a kind of national literature, and it was on this basis that all modern poetry in the free metres rests, so that in judging Welsh poetry, it must always be remembered that the modern form of it is less than two centuries old. Pantycelyn was followed by many hymn-writers, the last and greatest being Anne Griffiths (1776–1805) who alone shows a trace of that mysticism which was lost in Wales after Morgan Llwyd. The literary importance of the hymns lies in their preparation of the Welsh language for secular poetry. All the poetry of the 19th century betrays its religious origin, the later poetry no less than the earlier. John Blackwell (Alun) (1797–1840) may be regarded as the father of the modern secular lyric. Much of his inspiration came from contemporary English songs and in originality he is inferior to Ieuan Glan Geirionydd (1795–1855) who founded the "Eryri" school of poetry inspired by the natural scenery of Snowdonia; the best known member of this school is Glasynys (1828–70). These earlier lyric writers were followed by a more Bohemian group consisting of Talhaearn (1810–69), Mynyddog (1833–77) and Ceiriog (1832–87). Ceiriog was the greatest lyrical writer of the century. He was the last of the Welsh Victorians. Only one poet, Islwyn (1832–78), made a success of the long poem. His *Ystorm,* which is a series of mystical meditations on life and art, is in the first rank.

Prose, 1750–1880.—For a long time after 1750 Welsh prose though abundant in quantity had a very narrow range. Few writers rose above theological controversy, and the humaner side of literature was almost altogether neglected. The end of the 18th century, however, in Wales as well as in England, saw much activity in political thought, which was the direct result of the French Revolution. The most important of the early political writers was John Jones Glan y Gors (1767–1821), the author of two political pamphlets, much influenced by Tom Paine. Later when modern Liberalism began to emerge, political writing, after the establishment of the periodical press, became an important part of Welsh literature. The greatest political thinker and writer of the century was Samuel Roberts (1800–85), who, with Gwilym Hiraethog (1802–83), may be regarded as having, through his prose writings, formed the habit of thought still prevalent in Wales.

Literary criticism up to the middle of the 19th century had been confined to the work of eisteddfod adjudicators who were still acting on the old classical theory, *ut pictura poesis.* The first appearance of a criticism which might be said to follow European standards was in the articles of Lewis Edwards (1809–87), the founder and editor of the *Traethodydd,* though his ideas were dominated by the Edinburgh school. Literary criticism made no progress at all until the great revival in the 20th century. It was in this period that Wales had her national novelist, Daniel Owen (1836–95), a writer of the Dickens school, who like his master "wrote mythology rather than fiction." His novels, in spite of their rather obvious sentimentality, must always remain the most important document for the study of this extraordinary period of theocracy in Wales.

The Second Revival.—The most important event in Welsh literature was the founding of the university (1878–1905). The immediate result was a great widening of the horizons, accompanied by a strong reaction towards the old Welsh classical ideas. The two men who had most influence on this new movement were Sir Owen Morgan Edwards (1858–1920) and Sir John Morris-Jones. The former in his numerous books, both by the charm of his style and by the lure of his imagination, made the Welsh conscious of their literary identity, and he was certainly the inspiring genius of the new movement on its purely literary side. The latter, by insisting that correctness was the first essential of style and sincerity the first essential of the literary art, revolutionized first the product of the Eisteddfod, and then literature in general. Another critic, whose worth is only slowly being recognized, and whose fearless essays stung the nation into sincerity was Emrys ap Iwan (1851–96).

The extent of the new literary revival is hardly credible to anyone whose study of Welsh ends with 1900. Almost every department of literature is represented by work which may bear comparison with similar work in any country in Europe. Poetry has again become significant. Thomas Gwynn Jones has shown that the *cynghanedd* and the old tradition can answer any demand made upon it by the modern interpretation of life; his work is, however, not confined to the un-free metres. Robert Williams Parry has brought back to poetry the gift of poetic observation, expressed in a faultless technique, which had disappeared from Welsh poetry with Davydd ap Gwilym. The more popular poets, Eivion Wyn (d. 1926), Wil Ifan, and Crwys, though still under the domination of the old sentimental view of life, are as much the product of the new Revival of Learning as the more academic poets.

In prose there has been equal progress. A new literary criticism has been enriched by the influence of European ideas, which can be most clearly seen in the work of Saunders Lewis. No long novel of great merit has been written, though the work of Tegla Davies bears many traits of pure genius. The younger prose writers have developed the art of the short story to a high degree; the early promise of Dewi Williams has not been fulfilled, but Kate Roberts's work stands by itself as a striking example of the impact of contemporary Welsh life on a sensitive nature. Starting with no traditions, drama has made considerable progress, though it has been retarded by material reasons. Two dramatists deserve special mention, D. T. Davies and R. G. Berry. The Report of the Government's Departmental Committee on Welsh suggests that the language will be more fully used in education.

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WELSH LAWS or **LEGES BRITANNIAE.** The earliest and best manuscripts of these, whether in their original Welsh or Latin, do not date from before 1175–1200. Confessedly recensions and reflecting current politics, they bear notwithstanding so striking a general resemblance to one another, that it is hard not to credit their common tradition, namely, that they hail from one original codification of British law and custom by King Howel Dda (*i.e.*, the Good), who died 950. The Welsh manuscripts fall into three classes, each of which begins with its own type of preface. (1) Those which refer exclusively to the king of Aberffraw in north-west Wales and give other indications that they pertain to that kingdom, *i.e.*, Gwynedd or Venedotia, of

which Aberffraw in Anglesey was the chief royal residence. The jurist Iorwerth ap Madog (*c.* 1200) would seem to be responsible for this recension, which Aneurin Owen in 1841 dubbed, not inappropriately, "the Venedotian code." (2) Those which refer exclusively to the king of Dinefwr (anglice Dynevor) in "the South," but would seem from the preface to have prevailed in Powys. The jurists favoured are Morgeneu and his son Cyfnerth. Owen unfortunately called these "the Gwentian code" as pertaining to south-east Wales, of which the manuscripts provide no indication. (3) Those which refer to both the kings of Dinefwr and Aberffraw, stating expressly that of all the kings in Wales gold is payable only to these two. But as they put Dinefwr before Aberffraw and refer to Rhys ap Gruffudd (d. 1197), one of the Dinefwr kings, and contain a special section on Dyfed or Demetia in south-west Wales, they certainly pertain to "the South." Owen, however, called them insufficiently "the Dimetian code." The jurist named in the preface is Blegywryd, who is otherwise known as having intervened in a dispute in 955, where he is described as "that most famous man" (*Bk. of Llan Dav,* 219). He is also known from some ancient Latin verses to have been a teacher of law in Howel's court and to have written a book of laws for the king, which book the king gave "ad partem dexteram," *i.e.,* to "the South," in Welsh Deheubarth, which stands for "Dextera Pars Britanniae," the south part of Britannia or Wales (omitting however Morgannwg, the country from Swansea to Chepstow).

That these three classes really represent law books in vogue in Gwynedd, Powys, and Deheubarth, respectively, seems to be implied or reflected in the preface of the last mentioned class, where we are told that "Howel ordered three law books to be made, one for the daily court to be always with him, another for the court of Dinefwr, the third for the court of Aberffraw, so that the three divisions of Wales, to wit, Gwynedd, Powys and Deheubarth should have the authority of law in their midst, at their need, always and ready." Readers for their guidance should bear in mind: (1) That the earliest mss. extant were written when the Norman French had long interfered in Welsh affairs and had already permanent possession of most of the petty kingdoms of south Wales; when also Geoffrey of Monmouth's *History of the Kings of Britain* was further confirming men's minds in the bizarre notions of the Welsh past, which had originally been set going by the book called *De excidio Britanniae* used by Bede. (2) That Howel Dda was not an original begetter of Welsh law. What Howel did was to "put together the laws of Britannia" (*i.e.,* Wales) with the consent and after the consideration of the wise men of his realm, assembled in one place. (3) That it is not conducive to sound knowledge to accentuate the "tribal" nature of the Welsh laws. No term for "tribe" appears. To read "tribes," therefore, into the Welsh laws is not only to force the text, but to obfuscate the emergence of Wales into the Dark Age from Romano-British Christian civilization.

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(A. W. W-E.)

WELWITSCHIA: *see* GYMNOSPERMS.

WELWYN GARDEN CITY (pronounced "Wellin"), an urban district of Hertfordshire, England, 20 mi. N. of London on the L.N.E.R. main line. Pop. (est. 1938) 12,150. Area, 4 sq.mi. The town was begun by a development company known as Welwyn Garden City, Ltd., in 1920 as a planned industrial and residential centre for an ultimate population of 50,000. It became an urban district in 1927.

WEMBLEY, a municipal borough in the Harrow parliamentary division of Middlesex, England, 7 mi. from London, of which it is a residential suburb, and served by the L.M.S. and L.N.E. rys. and the London Passenger Transport board. Pop. (1938) 118,800. Area, 9.8 sq.mi. Wembley park was the site for the British Empire exhibition in 1924–25. This covered a semi-circular tract of about 2¼ mi., with railways north and south and in the grounds. A main thoroughfare, Kingsway, leading from the north entrance, was flanked by the palaces of industry and of housing and transport, and by the buildings for Australia and Canada, and gave at the southern end upon the stadium, which had an area of 10 ac. and accommodated nearly 100,000 people. Besides those mentioned above, each major division of the empire overseas had its pavilion, the most notable being those of India, South Africa, New Zealand and Malaya. There was a British government pavilion, with exhibits by various government departments and a scientific exhibit organized by the Royal society. There were also a palace of arts, an amusement park, an artificial lake and many other features designed at once to demonstrate the vast resources of the empire and to attract the public. Part of the exhibition site was converted for the use of new factories, film studios, etc., and the stadium is in regular use for sports events. The town was incorporated in 1937.

WEMYSS (wēmz), **EARLS OF,** title of a Scottish family who had possessed the lands of Wemyss in Fifeshire since the 12th century. In 1628 Sir John Wemyss, created a baronet in 1625, was raised to the peerage as Baron Wemyss of Elcho; and in 1633 he became earl of Wemyss, and Baron Elcho and Methel, in the peerage of Scotland. He took part with the Scottish parliament against Charles I., and died in 1649. On the death of David, 2nd earl of Wemyss (1610–1679), the estates and titles passed to his daughter Margaret, countess of Wemyss, whose son David, 3rd earl of Wemyss, succeeded on her death in 1705. His son James, 4th earl (1699–1756), married Janet, daughter of Colonel Francis Charteris, who had made a large fortune by gambling. His son David, Lord Elcho (1721–1787), was attainted for his part in the Jacobite rising of 1745, the estates passing to his younger brother James, while the title remained dormant after his father's death, though it was assumed by Elcho's brother Francis, who took the name of Charteris on inheriting his maternal grandfather's estate. A reversal of the attainder was granted in 1826 to his descendant Francis Charteris Wemyss Douglas (1772–1853), who had been created Baron Wemyss of Wemyss in the peerage of the United Kingdom in 1821, and had assumed the name of Charteris Wemyss Douglas on inheriting some of the Douglas estates through a female ancestor. Thenceforward the title descended in the direct line.

WEMYSS, civil parish of Fifeshire, Scotland, embracing the villages of East and West Wemyss and the small burgh of Buckhaven and Methil, a fishing port and seaside resort on the north of the Firth of Forth. Coal mining is the principal industry and in the vicinity is the Wellesley pit, the largest in Scotland. A new dock was opened at Methil in 1913. Pop. of Buckhaven and Methil (est. 1938) 19,209; of Wemyss parish (1931) 26,619. Nets are made at Buckhaven and there are a brewery and a linen factory at East Wemyss. On the shore are two square towers attributed to Macduff's castle; and near them are the remarkable caves with archaic sculptures from which the district derives its name (weems, from the Gaelic, *uamha*). Wemyss castle is the ancient seat of the family of the name. It was at Wemyss castle that Mary, queen of Scots, first met the earl of Darnley, in 1565, and her room is still known as "the Presence Chamber."

WEN. The popular name for a sebaceous cyst, *i.e.,* an adenoma (*see* TUMOUR), formed from a sebaceous gland and therefore occurring in the neighbourhood of hairy parts, particularly the scalp and neck. The fatty or sebaceous material collects in the centre of the mass and the normal opening of the duct of the gland is often recognizable on the surface as a minute point. A wen may be as large as a hen's egg. The treatment is surgical removal.

WENATCHEE, a city of central Washington, U.S.A. Pop. (1920) 6,324 (91% native white); in 1930 it was 11,627; in 1940, 11,620 by federal census. Wenatchee is the distributing centre for four fertile valleys which constitute a vast apple orchard, with 40,000 ac. under cultivation, producing annually thousands of carloads of the finest fruit. A blossom festival is held every spring. There are lakes, Alpine gardens, and mountain resorts within an hour's drive. Wenatchee was chartered in 1892.

WENCESLAUS (1361–1419), German king, and, as Wenceslaus IV., king of Bohemia, was the son of the emperor Charles IV.

and Anna, daughter of Henry II., duke of Schweidnitz. Born at Nuremberg on Feb. 26, 1361, he was crowned king of Bohemia in June 1363, and invested with the margraviate of Brandenburg in 1373. In September 1370 he married Joanna (d. 1386) daughter of Albert I., duke of Bavaria, and was elected king of the Romans or German king at Frankfort on June 10, 1376, and crowned at Aix-la-Chapelle on July 6 following. He took some part in the government of the empire during his father's lifetime, and when Charles died in November 1378 became sole ruler of Germany and Bohemia, but handed over Brandenburg to his half-brother Sigismund. Germany was torn with feuds, the various orders for the establishment of peace were disregarded, and after 1389 the king paid very little attention to German affairs. In 1383 he inherited the duchy of Luxemburg from his uncle Wenceslaus and in 1387 assisted his half-brother Sigismund to obtain the Hungarian throne.

For some time Wenceslaus ruled Bohemia successfully, but he quarrelled with the nobles; and in 1394 the king was taken prisoner and only released under pressure of threats from the German princes. Having consented to limitations on his power in Bohemia, he made a further but spasmodic effort to restore peace in Germany. He then met Charles VI., king of France at Reims, where the monarchs decided to persuade the rival popes Benedict XIII. and Boniface IX. to resign, and to end the papal schisms by the election of a new pontiff. Many of the princes were angry at this abandonment of Boniface by Wenceslaus, who had also aroused much indignation by his long absence from Germany and by selling the title of duke of Milan to Gian Galeazzo Visconti. The consequence was that in August 1400 the four Rhenish electors met at Oberlahnstein and declared Wenceslaus deposed. Though he remained in Bohemia he took no steps against Rupert III., count palatine of the Rhine, who had been elected as his successor. He soon quarrelled with Sigismund, who took him prisoner in 1402 and sent him to Vienna, where he remained in captivity for nineteen months after abdicating in Bohemia. In 1404, when Sigismund was recalled to Hungary, Wenceslaus regained his freedom and with it his authority in Bohemia.

His concluding years were disturbed by the troubles which arose in Bohemia over the death of John Huss, and which the vacillating king did nothing to check until compelled by Sigismund. In the midst of these disturbances he died at Prague on Aug. 16, 1419. His second wife was Sophia, daughter of John, duke of Bavaria-Munich, but he left no children.

See Th. Lindner, *Geschichte des deutschen Reiches vom Ende des 14ten Jahrhunderts bis zur Reformation,* part i. (Brunswick, 1875–80), and "Die Wahl Wenzels," in the *Forschungen zur deutschen Geschichte,* Band xiv. (Göttingen, 1862–86); F. M. Pelzel, *Lebens-geschichte des römischen und böhmischen Königs Wenceslaus* (Prague, 1788–90); F. Palacky, *Geschichte von Böhmen,* Bände iii. and iv. (Prague, 1864–74); H. Mau, *König Wenzel und die rheinischen Kurfürsten* (Rostock, 1887). The article by Th. Lindner in the *Allgemeine deutsche Biographie,* Band xli., should also be consulted for a bibliography, and also the same writer's work, *Das Urkundenwesen Karls IV. und seiner Nachfolger* (Stuttgart, 1882).

WENCHOW (new name YUNGKIA), a city in the province of Chekiang, China, and one of the five ports opened by the Chefoo convention (1876) to foreign trade, situated on the river Gow, about 20 mi. from the sea. The population (1931) was 631,276.

The site is said to have been chosen by Kwo P'oh (A.D. 276–324) a celebrated antiquary, and the town became known as Tow, or Great Bear, from a supposed topographical similarity of the neighbouring hills to the constellation. Later, through another legend, it became known as the Deer city, or Luh. During the Ming dynasty (1368–1644) it was named Wenchow. A 4-mi. wall, built in the 10th century, surrounded it. After 1937 it became an auxiliary war port and was occasionally attacked.

WENDEN or **VENDEN,** now Cēsis, a town of Latvia on the Gauja river. Pop. (1939) 8,748. Here are the ruins of a castle of the Brethren of the Sword, afterwards (from 1237) of the grandmaster of the Teutonic Knights. In 1577 the garrison blew it up to prevent it from falling into the hands of Ivan the Terrible of Russia. It was rebuilt, but was burned in 1748.

WENDOVER, a market town in Buckinghamshire, England. Pop. (1931) 3,571. It is situated in a shallow defile of the Chiltern hills. Wendover is on the Upper Icknield Way and traces of a British settlement have been found. John Hampden and Edmund Burke represented the borough. From the time of Edward IV. weekly markets were held for over four hundred years, and fairs have been held in October and May from that day to this.

WENDT, HANS HINRICH (1853–1928), German Protestant theologian, was born in Hamburg on June 18, 1853. He became in 1885 professor ordinarius of systematic theology at Heidelberg, and in 1893 was called to Jena. His work on the teaching of Jesus (*Die Lehre Jesu,* 1886–90; Eng. trans. of second part, 1892) made him widely known. He also edited several editions (5th to 8th, 1880–98) of the *Commentary on the Acts of the Apostles* in H. A. W. Meyer's series.

His works include: *Die christliche Lehre von der menschlichen Vollkommenheit* (1882), *Der Erfahrungsbeweis für die Wahrheit des Christentums* (1897), and *Das Johannesevangelium* (1900; Eng. trans., 1902).

WENGEN (4,190 ft.), a health resort and winter sports centre situated on a ledge on the slopes of the Jungfrau in the Bernese Oberland, Switzerland. The place is linked with Interlaken and Lauterbrunnen by a rack railway. From the Little Scheidegg a branch leads to the Jungfraujoch (11,340 ft.) where is the highest station in Europe.

WENLOCK, a municipal borough in the Wrekin parliamentary division of Shropshire, England, on the river Severn. Pop. (est. 1938) 13,660. Area, 35.4 sq.mi. It includes the towns of Broseley, Madeley and Much Wenlock. The parish of Madeley includes Ironbridge and Coalport, with part of Coalbrookdale. The business of the town is mainly agricultural, but there is a large trade in lime and limestone.

Wenlock (*Weneloche*) is said to be of pre-Roman origin, but owed its early importance to the nunnery founded *c.* 680 by St. Milburg. This was destroyed by the Danes but refounded as a priory by Earl Leofric in 1017. It was again deserted after the Conquest until Roger de Montgomery founded a house of the Cluniac order on its site. The town was a borough by prescription, and its privileges began with the grants made to the priory and its tenants. It was incorporated by Edward IV in 1468 and the charter was confirmed in 1547 by Henry VIII and in 1632 by Charles I. By the charter of Edward IV the town obtained the right of sending two members to parliament, but was disfranchised in 1885. The first grant of a market and fair is dated 1227. The right is still valid.

WENNERBERG, GUNNAR (1817–1901), Swedish poet, musician and politician, was born at Lidköping, of which place his father was parish priest, on Oct. 2, 1817. In his twentieth year he became a student at Uppsala. In 1843 he became a member of the musical club who called themselves **"The Juvenals,"** and for their meetings were written the trios and duets, music and words, which Wennerberg began to publish in 1846. In the following year appeared the earliest numbers of *Gluntarne* (or "The Boys"), thirty duets for baritone and bass, which continued to be issued from 1847 to 1850. These remarkable productions, masterpieces in two parts, presented an epitome of all that was most unique and most attractive in the curious university life of Sweden. In 1850 Wennerberg travelled through Sweden, singing and reciting in public, and his tour was a long popular triumph. In 1860 he published his collected trios, as *The Three.* He succeeded Fahlcrantz in 1866 as one of the eighteen of the Swedish Academy. He was minister for education (*Ekklesiastikminister*) in the Adlercreutz government (1870–75), and sat first in the lower, then in the upper house of the legislature until he was nearly eighty. He died, on Aug. 24, 1901, at the royal castle of Leckö.

WENSLEYDALE, JAMES PARKE, BARON (1782–1868), English judge, was born near Liverpool on March 22, 1782. He was educated at Macclesfield Grammar school and Trinity college, Cambridge. He was a junior counsel for the Crown in the Queen's trial. In 1834 he was transferred from the king's bench to the court of exchequer, where for some 20 years he exercised considerable influence. The changes introduced by the Common Law Procedure Acts of 1854, 1855, proved too much for his legal conservatism and he resigned in December of the latter

year. The Government, anxious to have his services, as a law lord in the House of Lords, proposed to confer on him a life peerage, but this was opposed by the House of Lords (*see* PEERAGE), and he was eventually created a peer with the usual remainder (1856). He died at his residence, Ampthill Park, Bedfordshire, on Feb. 25, 1868, and having outlived his three sons, the title became extinct. Parke was perhaps the last of the great "block-letter lawyers," the men to whom technicalities were the breath of life. Of his devotion to the intricacies of pleading the stories are innumerable; best is perhaps that of his taking one of his special demurrers to read to a dying friend. "It was so exquisitely drawn," he said "that it must cheer him to read it." In Serjeant Hayes' *Cugate's Case,* printed in Holdsworth's *History of English Law,* Parke figures as "Baron Sussebutter."

See E. Nanson, *Builders of Our Law* (London, 1904).

WENSLEYDALE, the upper valley of the river Ure in Yorkshire, England. The valley widens into the Vale of York.

As far up as Hawes, broken limestone crags of the valley walls with high lying moors beyond them contrast with the fertile valley bottom. Beyond Hawes, towards the source, the valley becomes a bleak, wide, shallow drift-covered area with much wilder scenery. On both sides, throughout the dale, steep sided tributary valleys with torrent streams are numerous. Magnificent morainic hills may be seen between Masham and Jervaulx. The dale is characterized by terraced hills caused by the fact that the limestone beds are thin and form sequences with shales and sandstones, and by abundant waterfalls. The chief falls are Aysgarth Force where the Ure descends in three cascades extending over 1½ m. in length and with a total fall of over 100 ft.; Hardraw Force near Hawes, the finest of all, which leaps over a projecting ledge of limestone 96 ft. high, leaving a clear passage behind it; and Mill Gill Force on a tributary near Askrigg. In the bed of the Mill Gill above the falls are narrow canyon-like gorges with peculiar solution drainage, which is also found in the Buttertubs pass near Hawes and in Oxnop Gill north of Askrigg.

At Bainbridge are the remains of a square Roman camp. Jervaulx abbey, the ivy-clad ruins of which stand on the right bank of the river, was founded in 1156 by Cistercians from Byland who had previously settled near Askrigg. The remains are mainly transitional Norman and Early English and are not extensive. The chapter house, refectory and cloisters remain in part. Above the small town of Middleham rises the massive Norman keep of a 12th century castle; subsidiary buildings surrounding the tower date down to the 14th century. The castle was a stronghold of Warwick the "King-maker." In Coverdale, near Middleham, are the curious remains of the Premonstratensian abbey of Coverham, founded here in the 13th century and retaining the gatehouse and other portions of Decorated date. Farther up the valley, standing high on the north side, is Bolton castle, founded in the time of Richard I. Its walls, four corner towers, and fine position still give it an appearance of great strength. Wensley must have been an important centre in very early times. Eight pre-Norman sculptured stones, dating from the 8th to the 11th centuries have been discovered in the walls of the church. The present church was built in the 13th century. It possesses some interesting carved woodwork dating from about 1510, a large proportion of which was brought from Easby abbey at the period of the dissolution of the monasteries.

WENTWORTH, the name of an English family, various members of which are separately noticed. (*See* also FITZWILLIAM, ROCKINGHAM, STRAFFORD, CLEVELAND.) The Wentworths trace their descent to William Wentworth (who died in 1308) of Wentworth Woodhouse, Yorks. Thomas Wentworth (1501–1559) was summoned to parliament as Baron Wentworth of Nettlestead in 1529. The last baron Wentworth in the male line was Thomas (1613–1645), son of Thomas Wentworth, 1st earl of Cleveland. His daughter Henrietta Maria became Baroness Wentworth in her own right on her grandfather's death. This lady, who was the duke of Monmouth's mistress, died unmarried in 1686. The barony of Wentworth then reverted to Cleveland's daughter Anne, who married the 2nd Lord Lovelace, from whom it passed to her grand-daughter Martha (d. 1745), wife of Sir Henry Johnson, and afterwards to a descendant of Anne's daughter Margaret, Edward Noel, who was created Viscount Wentworth of Wellesborough in 1762. The viscountcy became extinct at his death, and the barony again passed through the female line in the person of Noel's daughter Judith to the latter's daughter Anne Isabella, who married Lord Byron the poet; and from her to Byron's daughter Augusta Ada, whose husband was in 1838 created earl of Lovelace. The barony of Wentworth was thereafter held by the descendants of this nobleman in conjunction with the earldom of Lovelace.

WENTWORTH, PETER (1530–1596), English politician, was a prominent Puritan leader in parliament, which he first entered as member for Barnstaple in 1571. He was examined by the Star Chamber in connection with a speech delivered in parliament on Feb. 8, 1576, and spent some time in the Tower. He was enduring a third imprisonment in the Tower when he died on Nov. 10, 1596. While in the Tower he wrote *A Pithie Exhortation to her Majesty for establishing her Successor to the Crown,* a famous treatise preserved in the British Museum. Peter Wentworth was twice married; his first wife, by whom he had no children, was a cousin of Catherine Parr, and his second a sister of Sir Frances Walsingham, Elizabeth's secretary of State. His third son, Thomas Wentworth (*c.* 1568–1623), recorder of Oxford, was an ardent opponent of royal prerogative in parliament, where he represented Oxford from 1604 until his death.

A grandson, SIR PETER WENTWORTH (1592–1675), represented Tamworth in the Long Parliament, but refused to act as a commissioner for the trial of Charles I. He was a member of the council of State during the Commonwealth; but was denounced for immorality by Cromwell in April 1653, and his speech in reply was interrupted by Cromwell's forcible expulsion of the Commons. By his will he left a legacy to John Milton, and considerable estates to his grand-nephew Fisher Dilke, who took the name of Wentworth; and this name was borne by his descendants until dropped in the 18th century by Wentworth Dilke Wentworth, great-grandfather of Sir Charles Wentworth Dilke (*q.v.*).

WENTWORTH, WILLIAM CHARLES (1793–1872), the "Australian patriot," was born in 1793 in Norfolk Island, the penal settlement of New South Wales, the son of D'Arcy Wentworth, the government surgeon of the settlement. The son was educated in England, but he spent the interval between his schooling at Greenwich and his matriculation (1816) at Peterhouse, Cambridge, in adventurous exploration in the Blue Mountains, Australia. Having been called to the bar, he began to practise in Sydney. With a fellow barrister, Wardell, he started a newspaper, the *Australian,* in 1824, to advocate the cause of self-government and to champion the "emancipists"—the incoming class of ex-convicts, now freed and prospering—against the "exclusivists"—the officials and the more aristocratic settlers. With Wardell, Dr. William Bland and others, he formed the "Patriotic Association," and carried on a determined agitation both in Australia and in England, where they found able supporters.

They attacked the governor, Sir Ralph Darling, who was recalled in 1831 to give evidence before a select committee of the House of Commons on his administration. The Constitution Act of 1842 was generally recognized as mainly Wentworth's work. In the first legislative council, he led the "squatter party."

He was the founder of the University of Sydney (1852), he led the movement which resulted in the new constitution for the colony (1854), and in 1861 became president of the new legislative council. For some years before 1861 he lived chiefly in England, where in 1857 he founded the "General Association for the Australian Colonies," with the object of obtaining from the government a federal assembly for the whole of Australia; and in 1862 he definitely settled in England, dying on March 20, 1872. His body was taken to Sydney and accorded a public funeral.

WERDEN, a former town in the Prussian Rhine province, Germany, on the river Ruhr, 6 mi. S. of Essen. Pop. was 13,201. Werden was incorporated with Essen in 1929.

WERFEL, FRANZ (1890–1945), German writer, was born in Prague on Sept. 10, 1890, and lived successively in Prague, Hamburg, Leipzig, Vienna and Breitenfeld, near Vienna. His early

poems, *Der Weltfreund* (1912), *Wir Sind* (1913), *Einander* (1915) and *Der Gerichtstag* (1919), were difficult but beautiful in expression, and were animated by the idea of the community of souls in all living things. The World War and subsequent political troubles gave Werfel's work a strongly revolutionary tinge; his brotherhood seemed best attained by the destruction of obstacles erected by tradition. His novels, *Nicht der Mörder, der Ermordete ist schuldig* (1920) and *Der Abituriententag* (1928) deal with problems and revolt of adolescence, but are less fine than his verse, which ranks with the most powerful in modern German literature. His dramatic works include an adaptation of Euripides' *Troades* (1915); a very brilliant symbolic trilogy, *Der Spiegelmensch* (1920); the more conventional *Juarez und Maximilian* (1924); *Paulus unter den Juden* (1926) and *Der Tod des Kleinbürgers* (1926). Werfel died on Aug. 26, 1945, at Hollywood, Calif.

See A. Luther, *Franz Werfel und seine besten Bühnenwerke* (1922).

WERGELAND, HENRIK ARNOLD (1808–1845), Norwegian poet and prose writer, was born at Christiansand on June 17, 1808. He was the eldest son of Professor Nikolai Wergeland (1780–1848), who had been a member of the constitutional assembly which proclaimed the independence of Norway in 1814 at Eidsvold. He established libraries, and tried to alleviate the widespread poverty of the Norwegian peasantry. But his numerous and varied writings were coldly received by the critics, and a monster epic, *Skabelsen, Mennesket og Messias* (Creation, Man and Messiah), 1830, showed no improvement in style. It was remodelled in 1845 as *Mennesket*. From 1831 to 1835 Wergeland was submitted to severe satirical attacks from J. S. le Welhaven and others, and his style improved in every respect. His popularity waned as his poetry improved, and in 1840 he found himself a really great lyric poet, but an exile from political influence. In that year he became keeper of the royal archives. He died on July 12, 1845. In 1908 a statue was erected to his memory by his compatriots at Fargo, North Dakota. His *Jan van Huysums Blomsterstykke* (1840), *Svalen* (1841), *Jöden* (1842), *Jödinden* (1844) and *Den Engelske Lods* (1844), form a series of interesting narrative poems in short lyrical metres.

Wergeland's *Samlede Skrifter* (9 vols., Christiania, 1852–1857) were edited by H. Lassen, the author of *Henrik Wergeland og hans Samtid* (1866), and the editor of his *Breve* (1867). *See* also H. Schwanenflügel, *Henrik Wergeland* (Copenhagen, 1877); and J. G. Kraft, *Norsk Forfatter-Lexikon* (Christiania, 1857), for a detailed bibliography.

WERMUND, an ancestor of the Mercian royal family, a son of Wihtlaeg and father of Offa. He appears to have reigned in Angel, and his story is preserved by certain Danish historians, especially Saxo Grammaticus. According to these traditions, his reign was long and happy, though its prosperity was eventually marred by the raids of a warlike king named Athislus, who slew Frowinus, the governor of Schleswig, in battle. Frowinus's death was avenged by his two sons, Keto and Wigo, but their conduct in fighting together against a single man was thought to form a national disgrace, which was only obliterated by the subsequent single combat of Offa. It has been suggested that Athislus, though called king of the Swedes by Saxo, was really identical with the Eadgils, lord of the Myrgingas, mentioned in Widsith. As Eadgils was a contemporary of Ermanaric (Eormenric), who died about 370, his date would agree with the indication given by the genealogies which place Wermund nine generations above Penda. Frowinus and Wigo are doubtless to be identified with the Freawine and Wig who figure among the ancestors of the kings of Wessex.

For the story of the aggression against Wermund in his later years, told by the Danish historians and also by the *Vitae duorum Offarum*, *see* OFFA; also Saxo Grammaticus, *Gesta Danorum*, edited by A. Holder, pp. 105 ff. (Strassburg, 1886); *Vitae duorum Offarum* (in Wats's edition of Matthew Paris, London, 1640). *See* also H. M. Chadwick, *Origin of the English Nation* (Cambridge, 1907).

WERNER, ABRAHAM GOTTLOB (1750–1817), father of German geology, was born in Upper Lusatia, Saxony, on Sept. 25, 1750. He was educated at Bunzlau, Silesia, and in 1764 joined his father at Count Solm's iron-works at Wehrau and Lorzendorf, with the idea of ultimately succeeding him as inspector. In 1769, however, he entered the mining school at Freiburg, and in 1771 went to Leipzig, where he studied law and mineralogy. In 1775 he was appointed inspector and teacher in the mining school at Freiberg. He devoted himself for 40 years to the development of the school, which rose to be one of the centres of scientific intelligence in Europe. He died at Freiburg on June 30, 1817.

One of the distinguishing features of Werner's teaching was the care with which he taught lithology and the succession of geological formation; a subject to which he applied the name geognosy. His views on a definite geological succession were inspired by the works of J. G. Lehmann and G. C. Fuchsel (1722–73). He showed that the rocks of the earth follow each other in a certain definite order. He had never travelled, and the sequence of rock-masses which he had recognized in Saxony was believed by him to be of universal application. (*See* his *Kurze Klassifikation und Beschreibung der verschiedenen Gebirgsarten*, 1787.) He taught that the rocks were precipitates of a primaeval ocean, and followed each other in successive deposits of world-wide extent. Volcanoes were regarded by him as abnormal phenomena, probably due to the combustion of subterranean beds of coal. Basalt and similar rocks, already recognized by other observers as of igneous origin, he believed to be water-formed accumulations of the same ancient ocean. Hence arose one of the great historical controversies of geology. Werner's followers preached the doctrine of the aqueous origin of rocks, and were known as Neptunists; their opponents, who recognized the important part taken in the construction of the earth's crust by subterranean heat, were styled Vulcanists. Though much of Werner's theoretical work was erroneous, science is indebted to him for so clearly demonstrating the chronological succession of rocks.

See S. G. Frisch, *Lebensbeschreibung A. G. Werners* (Leipzig, 1825); Lyell, *Principles of Geology* (1830); and Sir A. Geikie, *Founders of Geology* (1897; 2nd ed., 1906).

WERNER, ALFRED (1866–1919), French-Swiss chemist, was born at Mulhouse in Alsace, on Dec. 12, 1866. In 1886 he went to Zürich to study, and later worked at Zürich with George Lunge and in Paris with Marcellin Berthelot, but returned in 1893 as extraordinary professor of chemistry at Zürich. In 1895 he was made ordinary professor of chemistry, an appointment he held until his death on Nov. 15, 1919. He was awarded the Nobel prize in 1913 "in recognition of his works on the linking up of atoms within the molecule, whereby new light has been thrown upon older fields of research, and new fields have been opened up, especially within the realm of inorganic chemistry."

Werner's earliest work was with Arthur Hantzsch (*q.v.*) on the stereochemistry of the oximes (*q.v.*), but his greatest contribution to chemistry was the co-ordination theory of valency (*q.v.*), which he put forward in 1893. In this he introduced the important ideas of co-ordination number and subsidiary valence. Werner stated that he awoke one morning at two, as the theory flashed into his consciousness. By five in the afternoon, the essential features had been worked out. By means of this theory not only was a simple method of classifying complex inorganic compounds made available, but new and unsuspected cases of geometrical and optical isomerism were brought to light, including optically active substances whose activity is due to elements other than carbon. (*See* ISOMERISM.) Although Werner's views met with some opposition and had to be modified slightly, they undoubtedly gave a great stimulus to the development of certain branches of chemistry. His ideas may be said to underlie the modern development of inorganic chemistry, since they departed from the inadequate theories of structure based on the study of carbon compounds, and prepared the way for the electronic theory of valency. Werner deserves to be named with Friedrich Kekulé as an originator of structure theory. Attempts are being made to bring Werner's co-ordination theory into line with the modern views of the structure of the atom and valency (*see* F. Ephraim, *Inorganic Chemistry*, 1943). More than 200 dissertations were prepared under his direction, and his papers exceed 150 in number. He and his students prepared numerous new series of compounds, and fitted them into the new system.

Werner wrote *Neuere Anschauungen auf dem Gebiet der anorganischen Chemie* (1905); it has been translated into English by E. P. Hedley. *See* obituary notice by G. T. Morgan in *Jour. Chem. Soc.*, p. 1639 (1920); K. A. Hofmann, *Berichte der deutschen chemischen Gesellschaft* (1920); P. Karrer, *Helvetica Chimica Acta* (1920); P. Pfeiffer, *Journal of Chemical Education* (1928). (R. E. O.)

WERNIGERODE, a town in Prussian Saxony, Germany, on the north slopes of the Harz mountains. Pop. (1939) 25,565.

The counts of Wernigerode, who can be traced back to the early 12th century, were successively vassals of the margraves of Brandenburg (1268) and the archbishops of Magdeburg (1381). On the extinction of the family in 1429 the county fell to the counts of Stolberg. The latter surrendered its military and fiscal independence to Prussia in 1714.

WESEL, JOHANN RUCHRAT VON (d. 1481), German theologian, was born at Oberwesel early in the 15th century. He appears to have been one of the leaders of the humanist movement in Germany, and to have had some intercourse and sympathy with the leaders of the Hussites in Bohemia. Erfurt was in his day the headquarters of a humanism which was both devout and opposed to the realist metaphysic and the Thomist theology which prevailed in the universities of Cologne and Heidelberg. Wesel was one of the professors at Erfurt between 1445 and 1456, and was vice-rector in 1458. In 1460 he was appointed preacher at Mainz, in 1462 at Worms, and in 1479, when an old and worn-out man, he was brought before the Dominican inquisitor Gerhard Elten of Cologne. The charges against him were chiefly based on a treatise, *De indulgentiis*, which he had composed while at Erfurt twenty-five years before. He had also written *De potestate ecclesiastica*. He died under sentence of imprisonment for life in the Augustinian convent in Mainz in 1481.

The best account of Wesel is to be found in K. Ullmann's *Reformers before the Reformation*. His tract on *Indulgences* is published in Walch's *Monumenta Medii Aevi*, vol. i., while a report of his trial is given in Ortuin Gratius's *Fasciculus rerum expetendarum et fugiendarum* (ed. by Browne, London, 1690), and d'Argentré's *Collectio judiciorum de novis erroribus* (Paris, 1728). *See* also Otto Clemen's art. in Herzog-Hauck's *Realencyklopädie für prot. Theologie und Kirche* (3rd ed., Leipzig, 1908), xxi. 127.

WESEL, a town in the Prussian Rhine province, Germany, at the confluence of the Rhine and the Lippe, 46 mi. S.W. of Münster and 35 mi. N.W. of Duisburg. Pop. (1939) 24,047. Wesel, formerly known as Lippemünde, was one of the points from which Charlemagne directed his operations against the heathen Saxons. Incorporated in 1241, it became a flourishing commercial town, and though repeatedly subject to the counts of Cleves, was a member of the Hanseatic League, and as late as 1521 a free imperial city. It was occupied by the Spaniards, the Dutch and the French in turn, and was ceded to Prussia in 1814. There is a junction of seven railway lines and it is also a centre for river traffic. Wesel contains some quaint old houses. Its bridge over the Rhine, railway yards, airfield and factories were frequent objects of bombing attack in World War II.

WESER, one of the chief rivers of Germany, 440 mi. long, formed by the union of the Werra and the Fulda at Münden, flowing generally north and entering the North sea below Bremerhaven, between Jade bay and the estuary of the Elbe. The fairway up to Bremen has a minimum depth of 18 feet and boats of 350 tons can usually go up to Münden, thanks to locks and weirs which avoid rapids. Above Münden, the Weser arises from the junction of the Werra and Fulda, both navigable, the Aller, Wümme, Geeste and Hunte being also navigable. Below the junction of the Hunte the Weser's channel is divided by islands. The Weser is connected by canal with the Elbe.

WESERMÜNDE. An urban district in the province of Hanover, Germany, formed by union of several older administrative units. Pop. (1939) 84,838. It is an important fishing port at the mouth of the Weser with steel industries, fisheries, fish salting and ship-fitting industries and general commerce. Its docks and airfield were frequently bombed in World War II.

WESLEY (FAMILY). The Wesley family sprang from Welswe, near Wells in Somerset. Their pedigree has been traced back to Guy, whom Athelstan made a thane about 938. One branch of the family settled in Ireland. Sir Herbert Westley of Westleigh, Devon, married Elizabeth Wellesley of Dangan in Ireland. Their third son, Bartholomew, studied both medicine and theology at Oxford, and, in 1619, married the daughter of Sir Henry Colley of Kildare. In 1660 he held the rectories of Catherston and Charmouth in Dorset valued at £35, 10s. per annum. He was ejected in 1662 and gained his living as a doctor. He was buried at Lyme Regis on Feb. 15, 1670.

His son, JOHN WESTLEY, grandfather of the founder of Methodism, was born in 1636 and studied at New Inn Hall, Oxford, where he became proficient in Oriental languages and won the special regard of John Owen, then vice-chancellor. Cromwell's Triers approved him as minister of Winterborn-Whitchurch, Dorset, in 1658. The following year he married the daughter of John White, the patriarch of Dorchester. In 1661 he was committed to prison for refusing to use the Book of Common Prayer. His candour and zeal made a deep impression on Gilbert Ironside the elder, Bishop of Bristol, with whom he had an interview. He was ejected in 1662 and became a Nonconformist pastor at Poole. He died in 1678; his widow survived him for 32 years. One of his sons, Matthew, became a surgeon in London, where he died in 1737.

Another son, SAMUEL, was trained in London for the Nonconformist ministry, but changed his views, and, in Aug. 1683, entered Exeter college, Oxford, as a sizar. He dropped the "t" in his name and returned to what he said was the original spelling, Wesley. In 1689 he was ordained and married Susanna, youngest daughter of Dr. Samuel Annesley, vicar of St. Giles, Cripplegate, and nephew of the 1st earl of Anglesea. Annesley gave up his living in 1662, and formed a congregation in Little St. Helen's, Bishopsgate. Samuel Wesley was appointed rector of South Ormsby in 1691, and moved to Epworth in 1697. He had 19 children, of whom eight died in infancy. His lawless parishioners could not endure his faithful preaching, and in 1705 he was confined in Lincoln castle for a small debt. Two-thirds of his parsonage was destroyed by fire in 1702 and in 1709 it was burnt to the ground. He managed to rebuild the rectory, but his resources were so heavily strained that 13 years later it was only half furnished. Samuel Wesley wrote a *Life of Christ* in verse (1693), *The History of the Old and New Testament in Verse* (1701?), a noble *Letter to a Curate*, full of strong sense and ripe experience, and *Dissertations on the Book of Job* (1735). He died at Epworth in 1735. Susanna Wesley died at the Foundry, London, in 1742 and was buried in Bunhill Fields.

Their eldest son, SAMUEL WESLEY (1690–1739), was born in London, entered Westminster school in 1704, became a Queen's scholar in 1707 and in 1711 went up to Christ Church, Oxford. He returned to Westminster as head usher, took orders and enjoyed the intimate friendship of Bishop Atterbury, Harley earl of Oxford, Addison, Swift and Prior. He became headmaster of Blundell's school at Tiverton in 1732 and died there on Nov. 6, 1739. He was a finished classical scholar, a poet and a devout man, but he was never reconciled to the Methodism of his brothers. His poems, published in 1736, reached a second edition in 1743, and were reprinted with new poems and a *Life* by W. Nichols (1862).

CHARLES WESLEY (1707–1788) was the 18th child of the Rector of Epworth, and was saved from the fire of 1709 by his nurse. He entered Westminster school in 1716, became a King's Scholar and was captain of the school in 1725. He was a plucky boy, and won the life-long friendship of the future earl of Mansfield by fighting battles on his behalf. Garret Wesley of Ireland wished to adopt his young kinsman, but this offer was declined and the estates were left to Richard Colley on condition that he assumed the name Wesley. Charles Wesley was elected to Christ Church in 1726. John had become fellow of Lincoln the previous March. Charles lost his first 12 months at Oxford in "diversions," but whilst John was acting as their father's curate, his brother "awoke out of his lethargy." He persuaded two or three other students to go with him to the weekly sacrament. This led a young gentleman of Christ Church to exclaim: "Here is a new set of Methodists sprung up." The name quickly spread through the university, and Oxford Methodism began its course. In 1735 Charles Wesley was ordained and went with his brother to Georgia as secretary to Colonel, afterwards General, Oglethorpe, the Governor. The work proved uncongenial, and after enduring many hardships his health failed and he left Frederica for England on July 26, 1736. He hoped to return, but in Feb. 1738 John Wesley came home, and Charles found that his state of health made it necessary to resign his secretaryship. After his evangelical conversion on Whit Sunday (May 21, 1738), he became the poet of the Revival.

He wrote about 6,500 hymns. They vary greatly in merit, but Canon Overton held him, taking quantity and quality into consideration, to be "the great hymn-writer of all ages." Their early volumes of poetry bear the names of both brothers, but it is generally assumed that the original hymns were by Charles and the translations by John Wesley. For some years Charles Wesley took a full share in the hardships and perils of the Methodist itinerancy, and was often a remarkably powerful preacher. After his marriage in 1749 his work was chiefly confined to Bristol, where he then lived, and London. He moved to London in 1771 and died in Marylebone on March 29, 1788. He was strongly opposed to his brother's ordinations, and refused to be buried at City Road, because the ground there was unconsecrated. He was buried in the graveyard of Marylebone Old Church.

Charles Wesley married Sarah Gwynne, daughter of a Welsh magistrate living at Garth, on April 8, 1749. She died in 1822 at the age of ninety-six. Five of their children died as infants and are buried in St. James's Churchyard, Bristol. Their surviving daughter Sarah, who was engaged in literary work, died unmarried in 1828. Charles Wesley, Jr. (1759–1834), was organist of St. George's, Hanover Square. He published *Six Concertos for the Organ and Harp* in 1778. He also died unmarried. Samuel, the younger brother (1766–1837) (*q.v.*), was even more gifted than Charles as an organist and composer; he was also a lecturer on musical subjects. Two of his sons were Dr. Wesley, sub-dean of the Chapel Royal, and Dr. Samuel Sebastian Wesley (*q.v.*) (1810–1876), the famous organist of Gloucester cathedral.

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(J. TE.)

WESLEY, JOHN (1703–1791), English divine, was born at Epworth Rectory on June 17th (O.S.) 1703. He was the 15th child of Samuel and Susanna Wesley. (*See* WESLEY FAMILY.) His mother's training laid the foundation of his character, and under her instruction the children made remarkable progress. On Feb. 9, 1709, the rectory was burnt down, and the children had a narrow escape. On the duke of Buckingham's nomination, Wesley was for six years a pupil at Charterhouse. In June 1720 he went up to Christ Church, Oxford, with an annual allowance of £40 as a Charterhouse scholar. His health was poor and he found it hard to keep out of debt, but he made good use of his opportunities. A scheme of study which he drew up for 1722 with a time-table for each day of the week is still to be seen in his earliest diary.

The standard edition of *Wesley's Journal* (1909) has furnished much new material for this period of Wesley's life, Curnock having unravelled the difficult cipher and shorthand in which Wesley's early diaries were kept. He reached the conclusion that the religious friend who directed Wesley's attention to the writings of Thomas à Kempis and Jeremy Taylor, in 1725, was Miss Betty Kirkham, whose father was rector of Stanton in Gloucestershire. Wesley frankly disclaimed inward holiness.

He was ordained deacon on Sept. 19, 1725, and admitted to priest's orders on Sept. 22, 1728. In 1726 he had been fellow of Lincoln. His private diaries, seven of which are in the hands of Mr. Russell J. Colman of Norwich, contain monthly reviews of Wesley's reading. It covered a wide range, and he made careful notes and abstracts of it. He generally took breakfast or tea with some congenial friend and delighted to discuss the deepest subjects. At the coffee house he saw the *Spectator* and other periodicals. He loved riding and walking and was an expert swimmer.

He preached frequently in the churches near Oxford in the months succeeding his ordination, and in April 1726 he obtained leave from his college to act as his father's curate. The new material in the *Journal* describes the simple manner of his life. He read plays, attended the village fairs, shot plovers in the fenland, and enjoyed a dance with his sisters. In October he returned to Oxford, where he was appointed Greek lecturer and moderator of the classes. He gained considerable reputation in the disputation for his master's degree in February 1727. He was now free to follow his own course of studies and began to lose his love for company, unless it were with those who were drawn like himself to religion. In August he returned to Lincolnshire, where he assisted his father till Nov. 1729. During those two years he paid three visits to the university. In the summer of 1729 he was up for two months. Almost every evening found him with the little society which had gathered round Charles.

The Holy Club.—When he came into residence in November he was recognized as the father of the Holy Club. It met at first on Sunday evenings, then every evening was passed in Wesley's room or that of some other member. They read the Greek Testament and the classics; fasted on Wednesday and Friday; received the Lord's Supper every week; and brought all their life under review. In 1730 William Morgan, an Irish student, visited the gaol and reported that there was a great opening for work among the prisoners. The friends agreed to visit the Castle twice a week and to look after the sick in any parish where the clergyman was willing to accept their help. Wesley's spirit at this time is seen from his sermon on "The Circumcision of the Heart," preached before the university on January 1, 1733. In 1765 he said it "contains all that I now teach concerning salvation from all sin, and loving God with an undivided heart." Wesley rose at four, lived on £28 a year and gave away the remainder of his income. William Law's books impressed him and on his advice the young tutor began to read mystic authors, but he soon laid them aside.

Wesley had not yet found the key to the heart and conscience of his hearers. He says, "From the year 1725 to 1729, I preached much, but saw no fruit to my labour. Indeed it could not be that I should; for I neither laid the foundation of repentance nor of preaching the Gospel, taking it for granted that all to whom I preached were believers, and that many of them needed no repentance. From the year 1729 to 1734, laying a deeper foundation of repentance, I saw a little fruit. But it was only a little; and no wonder; for I did not preach faith in the blood of the covenant. From 1734 to 1738, speaking more of faith in Christ, I saw more fruit of my preaching." Looking back on these days in 1777, Wesley felt "the Methodists at Oxford were all one body, and, as it were, one soul; zealous for the religion of the Bible, of the Primitive Church, and, in consequence, of the Church of England; as they believed it to come nearer the scriptural and primitive plan than any other national church upon earth." The number of Oxford Methodists was small and probably never exceeding twenty-five. John Clayton, James Hervey, Benjamin Ingham and Thomas Broughton, were members of the Holy Club, and George Whitefield joined it on the eve of the Wesley's departure for Georgia.

Mission to Georgia.—Wesley's father died on April 25, 1735, and in the following October John and Charles took ship for Georgia, with Benjamin Ingham and Charles Delamotte. John was sent out by the Society for the Propagation of the Gospel, and hoped to labour as a missionary among the Indians, but though he had many interesting conversations with them the mission was found to be impracticable. The cabin of the "Simmonds" became a study for the four Methodists. The calm confidence of their Moravian fellow-passengers amid the Atlantic storms convinced Wesley that he did not possess the faith which casts out fear. Closer acquaintance with these German friends in Savannah deepened the impression. Wesley needed help, for he was beset by difficulties. Mrs. Hawkins and Mrs. Welch poisoned the mind of Colonel Oglethorpe against the brothers for a time. Wesley's attachment to Miss Hopkey also led to much pain and disappointment. All this is now seen more clearly in the standard edition of the *Journal*. Wesley was a stiff High Churchman, who scrupulously followed every detail of the rubrics. He insisted on baptizing children by trine immersion, and refused the Communion to a pious German because he had not been baptized by a minister who had been episcopally ordained. At the same time he was accused of "introducing into the church and service at the altar compositions of psalms and hymns not inspected or

authorized by any proper judicature." The list of grievances presented by Wesley's enemies to the Grand Jury at Savannah gives abundant evidence of his unwearying labours for his flock.

The foundation of his future work as the father of Methodist hymnody was laid in Georgia. His first *Collection of Psalms and Hymns* (Charlestown, 1737) contains five of his incomparable translations from the German, and on his return to England he published another *Collection* in 1738, with five more translations from the German and one from the Spanish. In April 1736 Wesley formed a little society of thirty or forty of the serious members of his congregation. He calls this the second rise of Methodism, the first being at Oxford in November 1729. The company in Savannah met every Wednesday evening "in order to a free conversation, begun and ended with singing and prayer." A select company of these met at the parsonage on Sunday afternoons. In 1781 he writes, "I cannot but observe that these were the first rudiments of the Methodist societies."

In the presence of such facts we can understand the significance of the mission to Georgia. Wesley put down many severe things against himself on the return voyage, and he saw afterwards that even then he had the faith of a servant though not that of a son. In London he met Peter Böhler who had been ordained by Zinzendorf for work in Carolina. By Böhler Wesley was convinced that he lacked "that faith whereby alone we are saved." On Wednesday, May 24, 1738, he went to a society meeting in Aldersgate Street where Luther's *Preface to the Epistle to the Romans* was being read. "About a quarter before nine, while he was describing the change which God works in the heart through faith in Christ, I felt my heart strangely warmed. I felt I did trust in Christ, Christ alone, for salvation; and an assurance was given me that he had taken away *my* sins, even *mine,* and saved *me* from the law of sin and death." Mr. Lecky points out the significance of that event. "It is scarcely an exaggeration to say that the scene which took place at that humble meeting in Aldersgate Street forms an epoch in English history. The conviction which then flashed upon one of the most powerful and most active intellects in England is the true source of English Methodism" (*History of England in Eighteenth Century,* ii. 558).

Wesley spent some time during the summer of 1738 in visiting the Moravian settlement at Herrenhut and returned to London on Sept. 16, 1738, with his faith greatly strengthened. He preached in all the churches that were open to him, spoke in many religious societies, visited Newgate and the Oxford prisons. On New Year's Day, 1739, the Wesleys, Whitefield and other friends had a Love Feast at Fetter Lane. In February Whitefield went to Bristol, where his popularity was unbounded. When the churches were closed against him he spoke to the Kingswood colliers in the open air, and after six memorable weeks wrote urging Wesley to come and take up the work. Wesley was in his friend's congregation on April 1, but says, "I could scarcely reconcile myself to this strange way of preaching in the fields . . . having been all my life (till very lately) so tenacious of every point relating to decency and order, that I should have thought the saving of souls almost a sin, if it had not been done in a church." Next day Wesley followed Whitefield's example. His fears and prejudices melted away as he discerned that this was the very method needed for reaching the multitudes.

Foundation of the "Society."—On May 1, 1738, he wrote in his journal: "This evening our little society began, which afterwards met in Fetter Lane." Among its "fundamental rules" we find a provision for dividing the society into bands of five or ten persons who spoke freely and plainly to each other as to the "real state" of their hearts. The bands united in a conference every Wednesday evening. The society first met at James Hutton's shop, "The Bible and Sun," Wild Street, west of Temple Bar. About Sept. 25, it moved to Fetter Lane. Wesley describes this as the third beginning of Methodism. After the field preaching began converts multiplied. They found all the world against them, and Wesley advised them to strengthen one another and talk together as often as they could. When he tried to visit them at their homes he found the task beyond him, and therefore invited them to meet him on Thursday evenings. This meeting was held in the end of 1739 at the Foundry in Moorfields which Wesley had just secured as a preaching place. Grave disorders had arisen in the society at Fetter Lane, and on July 23, 1740, Wesley withdrew from it. About 25 men and 48 women also left and cast in their lot with the society at the Foundry. The centenary of Methodism was kept in 1839.

Wesley's headquarters at Bristol were in the Horse Fair, where a room was built in May 1739 for two religious societies which had been accustomed to meet in Nicholas Street and Baldwin Street. To meet the cost of this Captain Foy suggested that each member should give a penny per week. When it was urged that some were too poor to do this, he replied, "Then put eleven of the poorest with me; and if they can give anything, well: I will call on them weekly, and if they can give nothing I will give for them as well as for myself." Others followed his example and were called leaders, a name given as early as Nov. 5, 1738, to those who had charge of the bands in London. Wesley saw that here was the very means he needed to watch over his flock. The leaders thus became a body of lay pastors. Those under their care formed a class. It proved more convenient to meet together and this gave opportunity for religious conversation and prayer. As the society increased Wesley found it needed "still greater care to separate the precious from the vile." He therefore arranged to meet the classes himself every quarter and gave a ticket "under his own hand" to every one "whose seriousness and good conversation" he found no reason to doubt. The ticket furnished an easy means for guarding the meetings of the society against intrusion. "Bands" were formed for those who wished for closer communion. Love-feasts for fellowship and testimony were also introduced, according to the custom of the primitive church. Watch-nights were due to the suggestion of a Kingswood collier in 1740.

Wesley issued the rules of the united societies in February 1743. Those who wished to enter the society must have "a desire to flee from the wrath to come, to be saved from their sins." When admitted they were to give evidence of their desire for salvation "by doing no harm; by doing good of every possible sort; by attending upon all the means of grace." It was expected that all who could do so would contribute the penny a week suggested in Bristol, and give a shilling at the renewal of their quarterly ticket. Wesley had at first to take charge of the contributions, but as they grew larger he appointed stewards to receive the money, to pay debts, and to relieve the needy. The memorable arrangement in Bristol was made a few weeks before Wesley's field of labour was extended to the north of England in May 1742. He found Newcastle ripe for his message. English Christianity seemed to have no power to uplift the people. Dram-drinking was an epidemic. Freethinkers' clubs flourished.

The doctrine of election had led to a temporary separation between Whitefield and the Wesleys in 1741. Wesley believed that the grace of God could transform every life that received it. He preached the doctrine of conscious acceptance with God and daily growth in holiness. Victory over sin was the goal which he set before all his people. He made his appeal to the conscience in the clearest language, with the most cogent argument and with all the weight of personal conviction. Hearers like John Nelson felt as though every word was aimed at themselves. No preacher of the century had this mastery over his audience. His Evangelical Arminianism is shown in his four volumes of sermons and his *Notes on the New Testament.*

Itinerary Work.—Up till 1742 Wesley's work was chiefly confined to London and Bristol, with the adjacent towns and villages or the places which lay between them. On his way to Newcastle that year Wesley visited Birstal, where John Nelson, the stonemason, had already been working. On his return he held memorable services in the churchyard at Epworth. Methodism this year spread out from Birstal into the West Riding. Societies were also formed in Somerset, Wilts, Gloucestershire, Leicester, Warwickshire, Nottinghamshire and the south of Yorkshire. In the summer Charles Wesley visited Wednesbury, Leeds and Newcastle. Next year he took Cornwall by storm. The work in London was prospering. In 1743 Wesley secured a west-end centre at West

Street, Seven Dials, which for fifty years had a wonderful history. In August 1747 Wesley paid his first visit to Ireland, where he had such success that he gave more than six years of his life to the country and crossed the Irish Channel forty-two times. Ireland has now its own conference presided over by a delegate from the British conference. Wesley's first visit to Scotland was in 1751. In all, he paid 22 visits.

Such extension of his field would have been impossible had not Wesley been helped by a heroic band of preachers. Wesley says: "Joseph Humphreys was the first lay preacher that assisted me in England, in the year 1738." That was probably help in the Fetter Lane Society, for Wesley then had no preaching place of his own. John Cennick, the hymn-writer and schoolmaster at Kingswood, began to preach there in 1739. Thomas Maxwell, who was left to meet and pray with the members at the Foundry during the absence of the Wesleys, began to preach. Wesley hurried to London to check this irregularity, but his mother urged him to hear Maxwell for himself, and he soon saw that such assistance was of the highest value. The autobiographies of these early Methodist preachers are among the classics of the Evangelical Revival. As the work advanced Wesley held a conference at the Foundry in 1744. Besides himself and his brother, four other clergymen were present and four "lay brethren." It was agreed that "lay assistants" were allowable, but only in cases of necessity. This necessity grew more urgent every year as Methodism extended. One of the preachers in each circuit was the "assistant," who had general oversight of the work, the others were "helpers." The conference became an annual gathering of Wesley's preachers.

In the early conversations doctrine took a prominent place, but as Methodism spread the oversight of its growing organization occupied more time and more attention. In February 1784 Wesley's deed of declaration gave the conference a legal constitution. He named one hundred preachers who after his death were to meet once a year, fill up vacancies in their number, appoint a president and secretary, station the preachers, admit proper persons into the ministry, and take general oversight of the societies. In October 1768, a Methodist chapel was opened in New York. At the conference of 1769 two preachers, Richard Boardman and Joseph Pilmoor, volunteered to go out to take charge of the work. In 1771, Francis Asbury, the Wesley of America, crossed the Atlantic. Methodism grew rapidly, and it became essential to provide its people with the sacraments. In September 1784 Wesley ordained his clerical helper, Dr. Coke, superintendent (or bishop), and instructed him to ordain Asbury as his colleague. Richard Whatcoat and Thomas Vasey were ordained by Wesley, Coke and Creighton to administer the sacraments in America. Wesley had reached the conclusion in 1746 that bishops and presbyters were essentially of one order. (*See* METHODISM: *United States.*)

He told his brother in 1785: "I firmly believe that I am a scriptural επισκοπος as much as any man in England or in Europe; for the uninterrupted succession I know to be a fable, which no man ever did or can prove." Other ordinations for the administration of the sacraments in Scotland, the colonies and England followed. The interests of his work stood first with Wesley. He did everything that strong words against separation could do to bind his societies to the Church of England; he also did everything that legal documents and ordinations could do to secure the permanence of that great work for which God had raised him up. In the words of Canon Overton and Rev. F. H. Relton (*Hist. of Eng. Ch.* 1714–1800): "It is purely a modern notion that the Wesleyan movement ever was, or ever was intended to be, except by Wesley, a church movement." Despite his strong sayings, it was Wesley who broke the links to the church, for, as Lord Mansfield put it, "ordination is separation."

Wesley's account of his itinerancy is given in his famous *Journal*, of which the first part appeared about 1739. Mr. Birrell has called it "the most amazing record of human exertion ever penned by man." The development of his work made a tremendous strain upon Wesley's powers. He generally travelled about 5,000 miles a year and preached fifteen sermons a week. His rule was always to look a mob in the face.

Wesley's writings did much to open the eyes of candid men to his motives and his methods. Besides the incomparable *Journal*, his *Appeals to Men of Reason and Religion* also produced an extraordinary effect in allaying prejudice and winning respect. He constantly sought to educate his own people. No man in the 18th century did so much to create a taste for good reading and to supply it with books at the lowest prices. Sir Leslie Stephen pays high praise to Wesley's writings, which went "straight to the mark without one superfluous flourish." As a social reformer Wesley was far in advance of his time. He provided work for the deserving poor, supplied them with clothes and food in seasons of special distress. The profits on his cheap books enabled him to give away as much as £1,400 a year. He established a lending stock to help struggling business men and did much to relieve debtors who had been thrown into prison. He opened dispensaries in London and Bristol and was keenly interested in medicine.

Wesley's supreme gift was his genius for organization. He was by no means ignorant of this. "I know this is the peculiar talent which God has given me." Wesley's special power lay in his quickness to avail himself of circumstances and of the suggestions made by those about him. The class-meeting, the love-feast, the watch-night, the covenant service, leaders, stewards, lay preachers, all were the fruit of this readiness to avail himself of suggestions made by men or events.

In 1751 Wesley married Mary Vazeille, a widow, but the union was unfortunate and she finally left him. John Fletcher, the vicar of Madeley, to whom Wesley had turned as a possible successor, died in 1785. He had gone to Wesley's help at West Street after his ordination at Whitehall in 1757 and had been one of his chief allies ever since. He was beloved by all the preachers, and his *Checks to Antinomianism* show that he was a courteous controversialist. Charles Wesley died three years after Fletcher. During the last three years of his life John Wesley was welcomed everywhere. His visits were public holidays.

Wesley preached his last sermon in Mr. Belson's house at Leatherhead on Wednesday, Feb. 23, 1791; wrote next day his last letter to Wilberforce, urging him to carry on his crusade against the slave trade; and died in his house at City Road on March 2, 1791, in his eighty-eighth year. He was buried on March 9, in the graveyard behind City Road chapel. (J. TE.)

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WESLEY, SAMUEL (1766–1837), English musical composer, son of Charles Wesley, was born at Bristol, Feb. 24, 1766. Though suffering for many years from an accidental injury to the brain, Wesley was one of the most brilliant organists and most accomplished extemporaneous performers of his time. He may indeed be regarded as the father of modern English organ-playing, for he it was who, aided by his friends Benjamin Jacob and C. F. Horn, first introduced the works of Sebastian Bach to English organists, not only by his superb playing, but by editing with Horn, in 1810, the first copy of *Das wohltemperirte Clavier* ever printed in England. Wesley died on Oct. 11, 1837, leaving a vast number of ms. and printed compositions.

WESLEY, SAMUEL SEBASTIAN (1810–1876), English composer and organist, natural son of Samuel Wesley, the eminent composer, was born in London on Aug. 14, 1810. He was one of the Children of the Chapel Royal from 1819, held various unimportant posts as organist from the age of fifteen and later on in 1832 he was appointed to Hereford Cathedral. He was successively organist at Exeter Cathedral, Leeds parish church, Winchester and Gloucester Cathedrals. He again conducted the Three Choirs Festivals of 1865, 1868, 1871 and 1874. A civil list pension

of £100 a year was conferred on him in 1873; he died at Gloucester on the 19th of April 1876, and was buried at Exeter. Wesley was the first English organist of his day. As a composer he is still highly esteemed for the dignity and beauty of his anthems, the finest of which are "Blessed be the God and Father," "The Wilderness," "Ascribe unto the Lord" and "O Lord, Thou art my God." His service in E, published with a rather trenchant preface in 1845, became widely known.

WESLEYAN METHODIST CHURCH, one of the chief branches of Methodism. *See* METHODISM and WESLEY, JOHN.

In 1790 there were 294 preachers and 71,668 members in Great Britain, 19 missionaries and 5,300 members on the mission stations; 198 preachers and 43,265 members in the United States. The crisis was serious. The large proportion of Wesley's members had been taught to observe the sacraments and desired that provision should be made to administer them in their chapels. But on May 4, 1791, eighteen laymen met at Hull and expressed their conviction that the usefulness of Methodism would be promoted by its continued connection with the Church of England. A trenchant reply was prepared by Alexander Kilham (*q.v.*), one of the younger Methodist preachers.

The conference met in Manchester on the 26th of July, 1791. A letter from Wesley (dated Chester, April 7, 1785) was read, beseeching the members of the Legal Conference not to use their powers for selfish ends but to be absolutely impartial in stationing the preachers, selecting boys for education at Kingswood School, and disposing of connectional funds. The conference at once resolved that all privileges conferred by Wesley's Poll Deed should be accorded to every preacher in full connection. To supply the lack of Wesley's supervision the circuits were now grouped together in districts. As to the sacraments and the relations of Methodism to the Church of England the decision was: "We engage to follow strictly the plan which Mr. Wesley left us." This was ambiguous and was interpreted variously. Some held that it forbade the administration of the sacraments except where they were already permitted; others maintained that it left Methodism free to follow the leadings of Providence.

The conference of 1792 was so much perplexed that it resorted to the casting of lots. The decision was thus reached that the sacraments should not be administered that year. This was really shelving the question, but it gave time for opinion to ripen, and in 1793 it was resolved by a large majority that "the societies should have the privilege of the Lord's Supper where they unanimously desired it." In 1794, this privilege was definitely granted to ninety-three societies. The feeling in Bristol was very strong. The trustees of Broadmead, who were opposed to the administration of the sacrament by the preachers, forbade Henry Moore to occupy that pulpit. Nearly the whole society thereupon withdrew to Portland Chapel. The conference of 1795 had to deal with this controversy. It prepared a "Plan of Pacification" which was approved by the conference and by an assembly of trustees, and was welcomed by the societies. The Lord's Supper, baptism, the burial of the dead and service in church hours were not to be conducted by the preachers unless a majority of the trustees, stewards and leaders of any chapel approved, and assured the conference that no separation was likely to ensue. The consent of conference had to be given before any change was made.

In 1796, Alexander Kilham, who refused to abstain from agitation for further reform, and accused his brethren of priestcraft, was expelled from their ranks and the New Connexion was formed with 5,000 members (*see* METHODIST NEW CONNEXION). The conference of 1797 set itself to remove any ground for distrust among the societies and to enlist their hearty support in all branches of the work. Annual accounts were to be published of various funds. The Circuit Quarterly Meeting had to approve the arrangements for the support of the preachers. Local preachers had to be accepted by the local preachers' meeting, and the powers of trustees of chapels were considerably extended. The constitution of Methodism thus practically took the shape which it retained till the admission of lay representatives to conference in 1878. No period in the history of Methodism was more critical than this, and in none was the prudence and good sense of its leaders more conspicuous. Advance was quietly made along the lines now laid down. The preachers had agreed in 1793 that all distinction between those whom Wesley had ordained and their brethren should cease. In the minutes of conference for 1818 "Rev." appears before the names of preachers who were members of the Missionary Committee. Jabez Bunting (*q.v.*), who had become the acknowledged leader of the conference, wished to have its young ministers set apart by the imposition of hands, but this scriptural custom was not introduced till 1836. The introduction of laymen into the Wesleyan Conference in 1878 was commemorated by a Thanksgiving Fund of £297,500.

Meanwhile, Methodism was growing into a great missionary church. Its work in the West Indies was firmly established in Wesley's lifetime. In 1786 eleven hundred negroes were members of the society in Antigua. The burden of superintending these missions and providing funds for their support rested on Dr. Coke, who took his place as the missionary bishop of Methodism. In 1813 he prevailed on the conference to sanction a mission to Ceylon. He sailed with six missionaries on the 30th of December, but died in the following May in the Indian Ocean. To meet these new responsibilities a branch Missionary Society had been formed in Leeds in October 1813, and others soon sprang up in various parts of the country. Methodist Missions really date from 1786 when Dr. Coke landed at Antigua. The area of operations gradually extended. Missions were begun in Madras, at the Cape of Good Hope, in Australia, and on the west coast of Africa. Two missionaries were sent to the Friendly Islands in 1826, and in 1835 a mission was undertaken among the cannibals of Fiji, which spread and deepened till the whole group of islands was transformed. The work in China began in 1851; the Burma mission was established in 1887. The rapid progress of the Transvaal and Swaziland missions has been almost embarrassing. The Missionary Jubilee in 1863–1868 yielded £179,000 for the work abroad. As the growth of the missions permitted conferences have been formed in various countries. Upper Canada had its conference in 1834, France in 1852, Australia in 1855, South Africa in 1882. The missionary revival which marked the Nottingham Conference of 1906 quickened the interest at home and abroad and the *Foreign Field* (monthly) is prominent among missionary periodicals.

In 1834 Hoxton Academy was taken as a training place for ministers. Didsbury College was opened in 1842, Richmond in 1843. Headingley was added in 1868, Handsworth in 1881.

The Centenary of Methodism was celebrated in 1839 and £221,939 was raised as a thank-offering: £71,609 was devoted to the colleges at Didsbury and Richmond; £70,000 was given to the missionary society, which spent £30,000 on the site and building of a mission-house in Bishopsgate Within; £38,000 was set apart for the removal of chapel debts, etc.

In 1837 Methodism had nine infant schools and twenty-two schools for elder children. A grant of £5,000 was made from the Centenary Fund for the provision of Wesleyan day-schools. The conference of 1843 directed that greater attention must be given to this department, and a committee met in the following October which resolved that 700 schools should be established if possible within the next seven years, and an Education Fund raised of £5,000 a year. In 1849 the Normal Training College for the education of day-school teachers was opened in Westminster, and in 1872 a second college was opened in Battersea for schoolmistresses. Besides its day-schools, Methodism possesses the Leys School at Cambridge, Rydal Mount at Colwyn Bay and boarding-schools for boys and girls.

The Forward Movement in Methodism dates from the period of the Thanksgiving Fund. Large mission-halls have been built in the principal towns of England, Scotland and Ireland. The Forward Movement of the 'eighties will always be associated with the name of Hugh Price Hughes (*q.v.*). Village Methodism shared in the quickening which the Forward Movement brought to the large towns. Chapels which had been closed were reopened; an entrance was found into many new villages. Weak circuits were grouped together and gained fresh energy and hope by the union.

A milestone in the history of Methodism in the present century was the Twentieth Century Fund begun by Sir Robert W. Perks

in 1898. From the total sum of £1,073,782 grants were made as follows: General Chapel Committee, £290,617; Missionary Society, £102,656; Education Committee, £193,705; Home Missions, £96,872; Children's Home, £48,436. The Royal Aquarium at Westminster was purchased and a central hall and church house as the headquarters of Methodism erected. For this object £242,206 was set apart.

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WESSEL, JOHAN (*c.* 1420–1489), Dutch theologian, whose real name was Wessel (Basil) Harmens Gansfort, was born at Groningen. He was educated at the famous school at Deventer, which was under the supervision of the Brothers of Common Life, and in close connection with the convent of Mount St. Agnes at Zwolle, where Thomas à Kempis was then living. At Deventer Wessel imbibed that earnest devotional mysticism which was the basis of his theology and which drew him irresistibly, after a busy life, to spend his last days among the Friends of God in the Low Countries. From Deventer he went to Cologne and then to Paris to pursue his studies. After a visit to Rome, where he was in contact with the leading humanists he returned to Paris where he gathered round him a band of enthusiastic young students, among whom was Reuchlin. In 1475 he was at Basel and in 1476 at Heidelberg teaching philosophy in the university. After thirty years of academic life he went back to his native Groningen, and spent the rest of his life partly as director in a nuns' cloister there and partly in the convent of St. Agnes at Zwolle. His remaining years were spent amid a circle of warm admirers, friends and disciples, to whom he imparted the mystical theology, the zeal for higher learning and the deep devotional spirit which characterized his own life. He died on Oct. 4, 1489, with the confession on his lips, "I know only Jesus the crucified."

See *Vita Wesseli Groningensis,* by Albert Hardenberg, published in an incomplete form in the preface to Wessel's collected works (Amsterdam, 1614; this preface also contains extracts from the works of several writers who have given facts about the life of Wessel); K. Ullmann, *Reformers before the Reformation*—the second volume of the German edition is a second and enlarged edition of a previous work entitled *Johann Wessel, ein Vorgänger Luthers* (1834); A. Ritschl, *History of the Christian Doctrine of Justification and Reconciliation* (Edinburgh, 1872); E. W. Miller, *Wessel Gansfort; Life and Writings. Principal Works translated by J. W. Scudder* (2 vols., New York, 1917).

WESSEX, one of the kingdoms of Anglo-Saxon Britain. According to the Saxon Chronicle, it was founded by two princes, Cerdic, and Cynric his son, who landed in 494 or 495 and were followed by other settlers in 501 and 514. After several successful battles against the Welsh they became kings in 519 around the southern part of Hampshire. In 530 Cerdic and Cynric are said to have conquered the Isle of Wight, which they gave to two of their relatives, Stuf and Wihtgar. Cerdic died in 534. Cynric defeated the Britons at (Old) Salisbury in 552 and again in conjunction with his son Ceawlin at Beranburh, probably Barbury hill near Surndon, in 556. At his death in 560 he was succeeded by Ceawlin, who is mentioned by Bede as the second of the English kings to hold an *imperium* in Britain. With him we enter upon a period of more or less reliable tradition. How far the earlier part of the story deserves credence is still much debated. It is worthy of note that the dynasty claimed to be of the same origin as the royal house of Bernicia.

Whatever may be the truth about the origin of the kingdom, we need not doubt that its dimensions were largely increased under Ceawlin. In his reign the Chronicle mentions two great victories over the Welsh, one at a place called Bedcanford in 571, by which Aylesbury and the upper part of the Thames valley fell into the hands of the West Saxons, and another at Dyrham in Gloucestershire in 577, which led to the capture of Cirencester, Bath and Gloucester. Ceawlin is also said to have defeated Aethelberht at a place called Wibbandun in 568. In 592 he was expelled and died in the following year. Of his successors Ceol and Ceolwulf we know little though the latter is said to have been engaged in constant warfare. Ceolwulf was succeeded in 611 by Cynegils, whose son Cwichelm provoked a Northumbrian invasion by the attempted murder of Edwin in 626. These kings are also said to have come into collision with the Mercian king Penda, and it is possible that the province of the Hwicce (*q.v.*) was lost in their time. After the accession of Oswald, who married Cynegils's daughter, to the throne of Northumbria, both Cynegils and Cwichelm were baptized. Cynegils was succeeded in 642 by his son Cenwalh, who married and subsequently divorced Penda's sister and was on that account expelled by that king. After his return he gained a victory over the Welsh near Pen-Selwood, by which a large part of Somerset came into his hands. In 661 he was again attacked by the Mercians under Wulfhere. At his death, probably in 673, the throne is said to have been held for a year by his widow Sexburh, who was succeeded by Aescwine, 674–676, and Centwine, 676–685. According to Bede, however, the kingdom was in a state of disunion from the death of Cenwalh to the accession of Ceadwalla in 685, who greatly increased its prestige and conquered the Isle of Wight, the inhabitants of which he treated with great barbarity. After a brief reign Ceadwalla went to Rome, where he was baptized, and died shortly afterwards, leaving the kingdom to Ine. By the end of the 7th century a considerable part of Devonshire as well as the whole of Somerset and Dorset had come into the hands of the West Saxons. On the resignation of Ine, in 726, the throne was obtained by Aetheheard, apparently his brother-in-law, who had to submit to the Mercian king Aethelbald, by whom he seems to have been attacked in 733. Cuthred, who succeeded in 740, at first acted in concert with Aethelbald, but revolted in 752. At his death in 756 Sigeberht succeeded. The latter, however, on account of his misgovernment was deserted by most of the leading nobles, and with the exception of Hampshire the whole kingdom came into the hands of Cynewulf. Sigeberht, after putting to death the last of the princes who remained faithful to him, was driven into exile and subsequently murdered; but vengeance was afterwards taken on Cynewulf by his brother Cyneheard. Cynewulf was succeeded in 786 by Berhtric, who married Eadburg, daughter of the Mercian king Offa. Her murderous conduct led to the king's death in 802. Berhtric was succeeded by Ecgberht (*q.v.*), who overthrew the Mercian king Beornwulf in 825. This led to the establishment of West Saxon supremacy and to the annexation by Wessex of Sussex, Surrey, Kent and Essex.

Aethelwulf (*q.v.*), son of Ecgberht, succeeded to the throne of Wessex at his father's death in 839, while the eastern provinces went to his son or brother Aethelstan. A similar division took place on Aethelwulf's death between his two sons Aethelbald and Aethelberht, but on the death of the former in 858 Aethelberht united the whole in his own hands, his younger brothers Aethelred and Alfred renouncing their claims. Aethelberht was succeeded in 865 by Aethelred, and the latter by Alfred in 871. This was the period of the great Danish invasion which culminated in the submission of Guthrum in 878. Shortly afterwards the kingdom of the Mercians came to an end and by 886 Alfred's authority was admitted in all the provinces of England which were not under Danish rule. From this time onwards the history of Wessex is the history of England.

See *Anglo-Saxon Chronicle,* edited by Earle and Plummer (Oxford, 1892–99); Bede, *Hist. Eccl.* and *Continuatio,* edited by C. Plummer (Oxford, 1896); "Annales Lindisfarnenses," in the *Monumenta Germ. hist.* xix. (Hanover, 1866); Asser, *Life of King Alfred,* ed. W. H. Stevenson (Oxford, 1904); W. de G. Birch, *Cartularium Saxonicum* (London, 1885–93). (F. G. M. B.)

WEST, BENJAMIN (1738–1820), English historical and

portrait-painter, was born on Oct. 10, 1738 at Springfield, Pennsylvania, of an old Quaker family from Buckinghamshire. He showed artistic talent at an early age, and at the age of eighteen settled in Philadelphia as a portrait-painter. He then removed to New York, and in 1760, through the assistance of friends, he was enabled to visit Italy, where he remained nearly three years. On leaving Italy he settled in London as an historical painter. George III. took him under his special patronage and commissions flowed in upon him from all quarters. In 1768 he was one of the four artists who submitted to the king the plan for a royal academy, of which he was one of the earliest members; and in 1772 he was appointed historical painter to the king. He painted large pictures on historical and religious subjects, conceived, as he believed, in the style of the old masters, and so high did he stand in public favour that on the death of Sir Joshua Reynolds, in 1792, he succeeded him as president of the Academy. He died in London on March 11, 1820, and was buried in St. Paul's. West's large "Death of Wolfe" is interesting as introducing modern costume.

An account of West's life was published by Galt (*The Progress of Genius,* 1816). *See* also H. T. Tuckerman, *Book of the Artists* (N.Y., 1868).

WEST, THE, a term of special significance in the United States because the major direction of settlement has always been westward. To New Englanders at the beginning of the 19th century "west" meant western New York, and to those of the Middle Atlantic shore it meant the Ohio valley. As settlement proceeded the "west" was continually carried forward and followed the retreating frontier across the country. Before the Civil War the Mississippi valley was "west" but for the next generation this region had become the "Middle West" (*q.v.*) and a "Far West" had grown up beyond. For the characteristics of this transitory "west" and its significance in American life *see* the article THE AMERICAN FRONTIER.

Since the disappearance of a definite frontier about 1890 the use of terms has become more stable, but the West still begins in a different place for every person. For easterners it usually begins at the Mississippi river, for some others the natural place of delimitation would seem to be where the prairies blend into the plains, a line slightly beyond the western border of the first row of States west of the Mississippi. From this line to the Pacific stretch three successive geographical divisions, the plains, the mountains and the Pacific slope. The last is the oldest in settlement. Migration leaped across the arid plains and the forbidding mountains to the fertile agricultural valleys of Oregon or to the gold placers of California. It then dribbled back through the mountains separating and collecting again where ever mineral wealth was found. Lastly it spread thinly over the plains in the ranching frontier, which after 1890 was largely replaced by the denser homesteading population. The Pacific slope has come to be known as the "Coast." The real West, then, is made up of the last frontiers, the mountains and the plains. Its population is more varied in character than in any other major portion of the country. Settled during and after the Civil War by southerners, middle-westerners, and easterners, it possesses different characteristics from the older sections. Except in the few cities developed social strata are scarcely noticeable. Out of the west, or the "Coast" have come the more democratic governmental ideas, notably the initiative, referendum and recall. Wyoming as a territory provided for woman suffrage and was the first State of the Union and perhaps the first in the world to do so. Property rights of women were also early made more nearly equal to those of men. In all cultural fields, though people carried with them the ideas of their backgrounds, the lack of established traditional institutions made modification and experiment easier. Dependence on the public schools became greater as the influence of other institutions declined.

WEST AFRICA. As a geographical region West Africa may be taken to include the coast lands from Cape Blanco to the estuary of the Congo, the basins of the Niger, the Senegal and Gambia, and of the Volta and other rivers entering the Gulf of Guinea. Eastward it extends to Lake Chad, and northward it merges into the Sahara. While it includes the Cameroons and the Gabun it does not include Angola, which is properly West-Central Africa. As defined, West Africa has an area of about 3,000,000 sq.m. not reckoning the Sahara region. The population is about 40,000,000.

Physical Features.—In physical features West Africa presents a fairly simple structure. The coast makes a great bend from south to east, and then south again, but it is of a remarkably regular outline, and the only good natural harbours are in the estuaries or mouths of the rivers. A coast plain varying from a narrow strip to 50 or 60 m. deep is succeeded by an area of dense forest. In some places, as in the Niger delta, the forest comes to the water's edge and then consists of mangroves. The coast line is usually low and often ill-defined, and behind it run lagoons and creeks, so that considerable areas are forested swamp. North of the forest area the ground rises to a comparatively low plateau, forming mountain ranges parallel to the coast. In the east rise the mountains of Adamawa, which are the outliers of the plateau which there marks the limit of the Congo basin. From Adamawa a volcanic range runs south-west, culminating at the coast in Mt. Cameroon. From a submerged peninsula extending from Mt. Cameroon rise the islands of Fernando Po, Principe, St. Thomas and Annobon. From the western face of the Adamawa mountain streams descend to form the Benue. More important to hydrography of the country are the Futa Jallon mountains, which are parallel to the coast.

Climate.—The climate of the coast and forest regions is hot and excessively humid. Variations of temperature are normally not great and the average is about 80° F. The yearly rainfall is from 80 to 100 in. in most districts; in the Kasamance region of Senegal and in the Niger delta the fall is frequently 150 in. in a year. The climate of the interior is, as a rule (Senegal is an exception), hot and dry, with temperature often higher than on the coast, but with much greater daily variations. In the inland regions the rainfall is generally not above 30 in. a year, but in some places may be 60 in., while in the north—as at St. Louis, Senegal—it is but 12 inches. In the coast regions the rainy season lasts nine months or more; in the interior that is usually the length of the dry season. The difference is largely due to the fact that the coast is subject to the moisture-laden winds from the Atlantic, and that the rise to the plateau intercepts these winds, while the interior is more subject than the coast to the *harmattan,* the dry, hot wind from the desert. Malaria, dysentery and other diseases prevail, and no part of West Africa is suitable for permanent occupation by Europeans, though in some regions, such as the Bauchi plateau, whites can live.

Forest and Plain.—The great forest belt extends from the Gambia to the Congo and covers probably some 700,000 sq.m. Along the shores, lagoons and creeks there are mangrove forests, behind which are great areas of oil palms. Besides the oil palms are other palms, including the coconut palm. Other characteristic trees of the dense forest are mahogany, cedar, ebony and walnut. The rubber vine and rubber trees are abundant. In the more open forest are giant baobabs and shea butter trees, and in the north gum-yielding acacia. The open country usually begins about 7° N. latitude. Its general character is that of a granite and sandstone plateau forming undulating plains traversed by the alluvial valleys of the great rivers. West of the Niger at Timbuktu, as far as Mopti, the Niger valley is a wide, marshy, fertile plain. Within the Niger bend in the French Sudan, and east of the river to Lake Chad, are considerable areas of grassland giving pasture to large herds of cattle and flocks of sheep and goats, and much arable land. These plains cover over 1,000,000 sq.m., without reckoning the open country on the Cameroons plateau. In the extreme west, in Senegal, the country north of the Gambia is a sandy plain without surface water for eight months of the year, but with excellent pasturage after the rains. Two large regions, the French Niger Colony, which lies immediately north of (British) Nigeria, and Mauretania, the country north of the lower Senegal, which between them have an area of over 500,000 sq.m., are half or more than half Saharan in character. In small part they have cultivated land and a considerable area of pasture.

Natives and Europeans.—The vast majority of the people are of the negro race, but in the region north of the great forest belt other races have been represented from the earliest period of which there is record. Egyptian influences spread westward from the Nile valley in ancient times, and in all likelihood there were migrations of various clans. It is possible that the Fula people came originally from the East. Again the Sahara proved no barrier comparable to that of the forest zone, and Berbers from North Africa crossed the desert and settled in the region north of the lower Senegal, along the middle course of the Niger and in the Lake Chad region. Thus the negro peoples were in contact with the Mediterranean world and to some extent shared its civilization. After the Arab conquest of North Africa in the 7th century, Arab tribes settled in the Lake Chad and other districts, and the influence of Islam spread over a wide area. By the 11th century Mohammedanism had become the religion of many of the negroes, and pilgrims travelling eastwards to Mecca renewed, or strengthened, the connection of West Africa with Nubia and Egypt. Long before the rise of Islam the peoples of this northern part of West Africa, consisting largely, as has been seen, of open plains watered by large and navigable rivers, had developed well organized States, of which the oldest known, Ghana (or Ghanata), is thought to have been founded in the 3rd century A.D. Later arose the empire of Melle and the more famous and more powerful Songhoi (Songhay) empire. These were mainly west of the Niger; east of that river the Hausa—still largely pagan—founded several States and around Lake Chad grew up the powerful empire of Bornu. Marking the importance, commercial and political, of these States, large cities were founded.

The trade of all these countries was, to a small extent, eastward to the Nile valley, but chiefly across the Sahara to the Barbary States, the principal routes leading to Morocco and Tripoli. The barrier presented by the forest belt appeared almost insuperable to trade with the south, though there was some traffic with its warlike inhabitants. The routes across the Sahara were well known; along them passed great camel caravans with slaves, gold dust, ostrich feathers and leathern goods curiously wrought. The modern occupation of North Africa by European Powers, begun with the capture of Algiers by the French in 1830, did not lead to any revival of trade, partly because one of its main supports was the sale of slaves. The bringing of the western Sudan into the orbit of Western influence and the development of a new and richer commerce with the outer world was accomplished from the south, with the breaking of the barrier of the forest belt.

The inhabitants of the dense forest and of the Guinea coast had not been affected by the contact with the outer world which their northern brethren had possessed. Pure negroes, these southern folk were very primitive, nor did they develop any seafaring instinct which might have led them to the discovery of other lands. But among them the Yoruba, the Ashanti, the Dahomi and the Beni created well organized and powerful kingdoms. All the southern tribes had a profound belief in religion, chiefly shown in spirit, that is, ancestor worship and in the power of spirits to control the life of the living. In communal organization there was a thoroughly democratic element; the most powerful king was subject to the control of a council of chiefs. These peoples were made known to Europe by the discoveries of the Portuguese navigators in the 15th century, and for over 300 years their contact with the outer world was mainly through providing slaves, ivory, peppers and spices and gold to the Europeans, and getting from them gin, gunpowder and guns, beads, cotton cloths, and "Kafir truck" generally. For over a century the Portuguese were left undisturbed by European rivals on the Guinea coast, Spain not interfering, in accordance with the bull of Pope Alexander VI. of 1493 and the Treaty of Tordesillas of 1494. But after the Reformation the Protestant Powers paid no attention to the papal bull (which the Spaniards later on also disregarded). The English were among the first to challenge the Portuguese; they were trading on the Gold Coast by the middle of the 16th century, and were quickly followed by other nations, the Dutch and the French proving the most formidable. In 1642 the Portuguese were forced by the Dutch to withdraw from the Gold Coast, and thereafter, partly through inertia, they were ousted by rivals from other places until, in the end, they were able to retain only the small patch of territory known now as Portuguese Guinea.

Among the other Powers the struggle was keenest for the Gold Coast—with its double attraction of gold and slaves. Here a perfect patchwork of forts was built—Dutch, British, Danish, Swedish, even German (the Braddenburgers). It was not until late in the 19th century that the coast became definitely British. (*See* GOLD COAST.) On the Guinea Coast generally the Dutch were for a time the most powerful European State. Their power waned in the 17th century and they gave up Senegal to the French in 1678, and though Senegal was afterwards seized by the British, it became definitely French after the downfall of Napoleon. The Gambia had been contended for by British and French, the former gaining possession of the lower river. Towards the end of the 18th century the British laid the foundations of Sierra Leone, making there a home for ex-slaves; the first settlement of American negroes was made in what is now Liberia in 1821; the British acquired Lagos in 1861 as a step to ending the slave trade in the Bight of Benin, and the French claim to the Gabun had begun with the establishment in 1840 of Libreville as a home for former slaves. The Spaniards acquired the island of Fernando Po towards the end of the 18th century with settlements on the Muni river.

For a long while the European Powers established on the Guinea coast made no attempt to exercise jurisdiction outside the limits of their forts, but gradually the authority of the whites was acknowledged by the coast peoples. France was the first nation seriously to undertake the conquest of the interior. From 1854 they pushed inland from Senegal—tackling the forest belt last and mainly from the north. At that period, however, the British had begun to penetrate inland by way of the Niger and the Benue, while along the coast, apart from the French possessions, their influence was paramount, notably in the Niger delta and the Cameroons. While this influence was exercised no claim to sovereignty was made in those regions and when, in 1884–85, the "scramble" for Africa became acute, Germany was able to drive the Togoland wedge between the Gold Coast (British) and Dahomey (French) and also to secure the Cameroons. For the rest, Great Britain secured Nigeria and a fairly large area for the Gold Coast, the greater part of the hinterland falling, however, to France. (The "scramble" and partition are described in the article AFRICA.) The giving to France and Great Britain, after the World War, the mandate to administer the former German colonies, added responsibilities of those Powers in West Africa.

By the establishment of peace and by the building of railways and roads through the forest belt, and by placing steamers on the Niger and other rivers, the northern countries were at length brought into communication with the outer world by a shorter and much safer route than the Sahara, and the commerce of the Guinea coast was reinforced by the produce of the north. The great development in trade from about 1890 was due, however, to the insistent demands of European and American industry for "jungle produce," notably oil and rubber. The coast-people first, and later the tribes of the interior, were brought into ever growing contact with Western civilization.

Contact with Europeans also led to new wants, intellectual and social, and in various districts to a keen demand for education. This development took place under the guidance of French and British administrators. If Liberia be excepted, nowhere was there an independent African State left. In general the effect of the contact between the white and black was favourable to the African. What result would ultimately flow from the different systems pursued by the French and the British in their dealing with the African remained to be seen. Here only the main difference can be stated. The British, as far as possible, maintained in existence, naturally under ultimate control by the colonial administration, the native States with their own rulers, Governments and treasuries. This was the system known as indirect rule. The French governed their colonies directly, that is, European officials were everywhere in charge of the administration. Former rulers lost all attributes of sovereignty, and native chiefs, employed for purely local purposes, were, in effect, Government

officials. The French sought also to infuse French ideas into the African; the British essayed the difficult task of trying to build up a civilization which, while taking what was suitable from the West, would be essentially African.

As indicated, the greater part of West Africa belongs to France, and all the French colonies are joined one to another to form a continuous block, while each of the British protectorates is neighboured by foreign territory. Of some 3,000,000 sq.m. France administers about 2,600,000 (the Cameroons and the Gabun colony included). The British share is about 430,000 sq.m.; the negro republic of Liberia covers approximately 40,000 sq.m.; the small remainder consists of Portuguese or Spanish enclaves and a fraction of the Belgian Congo. But on the population basis the British possessions lead with roughly 20,500,000 inhabitants, while the French area has no more than 15,000,000 people. The regions most densely populated are on the coast and in the forest belt, notably the Gold Coast, Dahomey, the Niger delta and Yorubaland (where there are many large towns).

Products and Trade.—The outstanding product is oil in various forms. Besides palm oil itself, palm kernels, ground nuts, benniseed, sesame, copra and shea butter are exported for their oils. Senegal and the French Sudan, the Gambia and Northern Nigeria are conspicuous for the cultivation of the ground nut; the Ivory Coast, Sierra Leone, Dahomey, the Niger delta and the Cameroons export great quantities of palm oil and palm kernels. Other products of prime importance are cocoa, principally from the Gold Coast, which, since World War I, has become one of the main sources of the world's supply. Cocoa is also increasingly cultivated in Nigeria and the Cameroons. Cotton growing for export dates from 1905 and is likely to become important. Of sylvan products other than oil, "wild rubber" was of great value in the closing years of the 19th century and for a few years after. After about 1910 it was largely ousted by plantation rubber from the Far East, but in the Cameroons, the Gabun, Nigeria and elsewhere there are now rubber plantations, and plantations on a vast scale have been begun in Liberia. The export of timber is the chief industry in the Gabun and in almost all the other coast districts timber, largely mahogany, is exported. Fishing is of some account in various districts; the French have given much attention to the fishing grounds off the coast of Mauretania. The internal trade is large and active.

Mineral production, up to 1929, was almost wholly from the Gold Coast and Nigeria. In Nigeria tin and coal are extensively mined; the Gold Coast has not only its gold mines, but vast beds of manganese, which were discovered in 1914, and bauxite. The Gold Coast also produces "sand" diamonds, some 26 to the carat, which find a ready market. Gold is found in the rivers of Senegal and in Bambuk; salt comes from north-east of Timbuktu.

External trade has grown very greatly since the beginning of the 20th century, largely, if not chiefly as the result of the opening up of the country by the building of railways. In British West Africa in 1900 the trade was valued at £7,896,000; in 1927 it was valued at £63,797,000. In French West Africa, owing to the post-war fluctuations in the value of the franc and to differences in methods of returns, comparison is not so exact, but £5,000,000 for 1900 and £25,000,000 for 1927 represent approximately the volume of trade. The chief ports are Dakar (French), Freetown (Sierra Leone), Takoradi (Gold Coast), Lagos, Port Harcourt (all British) and Duala, in the Cameroons. All these have good sheltered harbours and have railway connection with the inland markets; most of the other ports are open roadsteads.

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WESTARP, KUNO, COUNT VON (1864–1945), German politician, was born at Ludom, Aug. 12, 1864, and educated at the universities of Tübingen, Breslau, Leipzig and Berlin. He entered the civil service in 1886, becoming director of police in Schöneberg (1904), president of police (1908) and Oberverwaltungsgerichtsrat (1908). In 1920, after the establishment of the German Republic, he retired. In 1908 he entered the reichstag as a Conservative. In 1919 he opposed the government on the question of fulfilling the terms of the Allied ultimatum. From 1925 he was chairman of the reichstag group of the German National People's party. After the revolution the Conservative party was embodied in the Nationalist party, without entirely losing its own identity. Early in 1928 it issued an appeal for votes for the candidates of a "people's National *Bloc,*" in opposition to the Nationalist party candidates, together with a program advocating the restoration of the monarchy by legal means. This action led to the resignation of Count von Westarp from the leadership of the party. He died on Aug. 5, 1945, at Berlin.

WESTBOROUGH, a town of Massachusetts, U.S.A., area (land) 20.9 sq.mi. Pop. (1940) 6,463. It was the birthplace of Eli Whitney, inventor of the cotton gin. It was settled about 1659.

WEST BROMWICH, county borough in Staffordshire, England, 6 mi. northwest of Birmingham. Pop. (1938) 82,680. Area 11 sq.mi. Although of ancient origin, the appearance of the town is modern and industrial. The Church of All Saints, formerly St. Clement, was given by Henry I to the convent of Worcester. The present structure (1872) follows an old Decorated plan. The chief public buildings are the town hall, the institute, the free library and law courts. The picturesque Oak house (16th century) was opened as a museum and art gallery in 1898. Sandwell hall, a former seat of the Earls of Dartmouth, was demolished in 1925; the site, with remains of a Benedictine priory, is preserved as an open space. The borough returns one member to parliament and is celebrated for its metal industries.

WESTBROOK, a city of Maine, U.S.A. Pop. (1920) 9,453 (80% native white); 1940 federal census 11,087. It is served by the Boston and Maine railway. The city manufactures paper, silks and cotton goods. Westbrook was separated from Falmouth in 1814 and incorporated as the town of Stroudwater, adopting its present name in 1815, in honour of Col. Thomas Westbrook, an Indian fighter. A charter was granted in 1889.

WESTBURY, RICHARD BETHELL, 1ST BARON (1800–73), lord chancellor of Great Britain, was the son of Dr. Richard Bethell, and was born at Bradford, Wilts., on June 30, 1800. He was educated at Wadham college, Oxford, and in 1823 was called to the bar at the Middle Temple. He was appointed vice-chancellor of Lancaster in 1851. His most important public service was the reform of the then existing mode of legal education, a reform which ensured that students before call to the bar should have at least some acquaintance with the elements of the subject which they were to profess. In 1851 he obtained a seat in the House of Commons, where he continued to sit, first as member for Aylesbury, then as member for Wolverhampton, until he was raised to the peerage. Attaching himself to the liberals, he became solicitor-general in 1852 and attorney-general in 1856 and again in 1859. On June 26, 1861, on the death of Lord Campbell, he was created lord chancellor, with the title of Baron Westbury of Westbury, county Wilts. The ambition of his life was to set on foot the compilation of a digest of the whole law, but for various reasons this became impracticable. While personal corruption is not imputed to him, he acted with some laxity, and after Parliamentary enquiries, he resigned (1865).

In 1872 he was appointed arbitrator under the European Assurance Society act 1872. Perhaps the best known of his judgments is that delivering the opinion of the judicial committee of the privy council in 1863 against the heretical character of certain extracts from *Essays and Reviews.* His principal legislative achievements were the passing of the Divorce act 1857, and of the Land Registry act 1862 (generally known as Lord Westbury's act), the latter of which in practice proved a failure. What chiefly distinguished Lord Westbury was the possession of a blistering tongue. He waged a remorseless war on the clergy in general and bishops in particular. He died on July 20, 1873, within a day of the death of Bishop Wilberforce, his special an-

tagonist in debate among the clergymen of England.

See T. A. Nash, *Life of Lord Westbury* (2 vols., 1888).

WESTBURY, an urban district of Wiltshire, England. Pop. (1938) 4,166; area 5.7 sq.mi. All Saints' church is Norman and later, with a magnificent nave. A chained black-letter copy of Erasmus' "Paraphrase of the New Testament" is preserved in the south chapel. In Westbury Leigh is the "Palace Garden," a moated site said to have been a royal residence in Saxon times.

Westbury figures in Domesday as a manor held by the king. The earliest mention of the town as a borough occurs in 1442–43. The charter of incorporation is lost (tradition says it was burnt), and the town possesses no other charter. The borough, which ceased to exist in 1886, returned two members to parliament from 1448. In 1832 the number was reduced to one, and in 1885 the representation was merged in that of the county.

WEST CHESTER, a borough of southeastern Pennsylvania, U.S.A. Pop. (1920) 11,717 (78% native white); 13,289 in 1940. It is the seat of a State Teachers college (1871) and several academies of long standing. The Turk's Head inn dates from 1762. On the outskirts of the town are a number of fine estates, where thorough-bred horses and cattle are raised. West Chester was settled in 1713, succeeded Chester as the county seat about 1784, and was incorporated as a town in 1788, as a borough in 1799. The Battle of Brandywine (Sept. 11, 1777) was fought 7 m. to the south, and on Sept. 20 Gen. Wayne, with a small force, was surprised and routed by the British at Paoli, 8 m. N.E.

WESTCOTT, BROOKE FOSS (1825–1901), English divine and bishop of Durham, was born on Jan. 12, 1825, near Birmingham. His father, Frederick Brooke Westcott, was a botanist of some distinction. Westcott was educated at King Edward VI. school, Birmingham, and at Trinity College, Cambridge. He took his degree in January 1848, obtaining double-first honours. In mathematics he was twenty-fourth wrangler, Isaac Todhunter being senior. In classics he was senior, being bracketed with C. B. Scott, afterwards headmaster of Westminster. Westcott then remained for four years in residence at Trinity. In 1849 he obtained his fellowship, and took holy orders. Among his pupils at Cambridge were his school friends J. B. Lightfoot, E. W. Benson and F. J. A. Hort (*qq.v.*). He devoted much attention to philosophical, patristic and historical studies, but it soon became evident that he would throw his strength into New Testament work.

In 1852 he became an assistant master at Harrow, where he taught for nearly twenty years under C. J. Vaughan and Montagu Butler. The writings which he produced at this period created a new epoch in the history of modern English theological scholarship. These are *History of the New Testament Canon* (1855), which, frequently revised and expanded, became the standard English work upon the subject; *Characteristics of the Gospel Miracles* (1859); *Introduction to the Study of the Gospels* (1860), expanded from his Norrisian essay; *The Bible in the Church* (1864); *The Gospel of the Resurrection* (1866); and a *History of the English Bible* (1869).

In 1868 Westcott was appointed examining chaplain by Bishop Connor Magee (of Peterborough); and in the following year he accepted a canonry at Peterborough, which necessitated his leaving Harrow. But the regius professorship of divinity at Cambridge fell vacant, and Westcott was elected to the chair on Nov. 1, 1870. This was the turning-point of his life. He now occupied a great position for which he was supremely fitted, and at a juncture in the reform of university studies when a theologian of liberal views, but universally respected for his massive learning and his devout and single-minded character, would enjoy a unique opportunity for usefulness. Supported by his friends Lightfoot and Hort, he threw himself into the new work with extraordinary energy. His *Commentaries* on St. John's Gospel (1881), on the Epistle to the Hebrews (1889) and the Epistles of St. John (1883) resulted from his public lectures. One of his most valuable works, *The Gospel of Life* (1892), a study of Christian doctrine, incorporated the materials upon which he was engaged in a series of more private and esoteric lectures delivered on week-day evenings. Between the years 1870 and 1881 Westcott was also continually engaged in work for the revision of the New Testament, and, simultaneously, in the preparation of a new text in conjunction with Hort. In the year 1881 there appeared the famous Westcott and Hort text of the New Testament, the outcome of nearly thirty years of incessant labour. The reforms in the regulations for degrees in divinity, the formation and first revision of the new theological tripos, the inauguration of the Cambridge mission to Delhi, the institution of the Church Society (for the discussion of theological and ecclesiastical questions by the younger men), the meetings for the divinity faculty, the organization of the new Divinity School and Library and, later, the institution of the Cambridge Clergy Training School, were all, in a very real degree, the result of Westcott's energy and influence as regius professor. To this list should also be added the Oxford and Cambridge preliminary examination for candidates for holy orders.

In 1883 Westcott was elected to a professorial fellowship at King's. Shortly afterwards he was appointed by the crown to a canonry at Westminster, and became examining chaplain to Archbishop Benson. He held his canonry at Westminster in conjunction with the regius professorship. The strain was heavy but preaching at the Abbey gave him a welcome opportunity of dealing with social questions. His sermons were generally portions of a series; and to this period belong the volumes *Christus Consummator* (1886) and *Social Aspects of Christianity* (1887).

In March 1890 he succeeded his friend Lightfoot as bishop of Durham. The new bishop surprised the general public, which had supposed him to be a recluse and a mystic, by the practical interest he took in the mining population of Durham and in the great shipping and artisan industries of Sunderland and Gateshead. In 1892 he procured a peaceful solution to a long and bitter coal strike. He was a staunch supporter of the co-operative movement. He was practically the founder of the Christian Social Union, and an ardent supporter of foreign missions. His last book, *Lessons from Work* (1901), was dedicated to the memory of his wife, who died in that year. He preached a farewell sermon to the miners in Durham cathedral at their annual festival on July 20, and died on July 27.

The following is a bibliography of Westcott's more important writings, giving the date of the first editions:—*Elements of the Gospel Harmony* (1851); *History of the Canon of First Four Centuries* (1853); *Characteristics of Gospel Miracles* (1859); *Introduction to the Study of the Gospels* (1860); *The Bible in the Church* (1864); *The Gospel of the Resurrection* (1866); *Christian Life Manifold and One* (1869); *Some Points in the Religious Life of the Universities* (1873); *Paragraph Psalter for the Use of Choirs* (1879); *Commentary on the Gospel of St. John* (1881); *Commentary on the Epistles of St. John* (1883); *Revelation of the Risen Lord* (1882); *Revelation of the Father* (1884); *Some Thoughts from the Ordinal* (1884); *Christus Consummator* (1886); *Social Aspects of Christianity* (1887); *The Victory of the Cross: Sermons in Holy Week* (1888); *Commentary on the Epistle to the Hebrews* (1889); *From Strength to Strength* (1890); *Gospel of Life* (1892); *The Incarnation and Common Life* (1893); *Some Lessons of the Revised Version of the New Testament* (1897); *Christian Aspects of Life* (1897); *Lessons from Work* (1901).

See the *Life* by his son B. F. Westcott (1903), and also that by J. Clayton (1906).

WESTERLY, a town of Rhode Island, U.S.A., separated from Connecticut by the Pawcatuck river. Pop. (1940) 11,199 (19·9% foreign-born white); 1930 federal census 10,997. It embraces the villages of Westerly and Bradford, and Watch Hill, a seaside resort with a summer population of 5,000. Westerly was settled in 1661 and the town was organized in 1669.

WESTERMANN, FRANÇOIS JOSEPH (d. 1794), French general, was born at Molsheim in Alsace. He accompanied Dumouriez on his campaigns and was arrested as an accomplice in his negotiations with the Austrians. He succeeded in proving his innocence, and was sent with the rank of general of brigade into La Vendée, where he distinguished himself by his extraordinary courage. He was then summoned to Paris, where, proscribed with the Dantonists, he was executed on April 5, 1794.

See P. Holl, *Nos généreux alsaciens . . . Westermann* (Strasbourg, 1900).

WESTERMARCK, EDWARD ALEXANDER, (1862–1939), Finnish anthropologist, was born at Helsingfors on Nov. 20, 1862. He was educated at a lyceum in his native town, and at the University of Finland where he later became professor of

moral philosophy. In 1890 he went to England, and from 1907 to 1930 was professor of sociology at the University of London. He made a special study of primitive marriage and ethical origins, and published *The Origin of Human Marriage* (1889); *The History of Human Marriage* (1889, 5th ed. rewritten in 3 vol. 1921); *The Origin and Development of the Moral Ideas* (1906); *Marriage Ceremonies in Morocco*, 2 vol. (1914).

WESTERN ASIATIC ARCHITECTURE from Egypt to Archaic Greece. Racially, as well as geographically, the whole Mesopotamian region is one. The Chaldaeans of the earlier settlements—a mixture of Sumerian and Semitic elements—the Babylonians and the Assyrians, all had the same broad characteristics in their architecture as in their beliefs. The vast plain, watered by the Euphrates and Tigris, was liable to flooding. Hence, the terraced platform was an indispensable preparation for all Mesopotamian building. The ziggurat, or terraced pyramid, was its principal feature but would have been impossible, by itself, without a base on which to stand. Herein lies the great contrast between the architecture of Babylonia and Assyria and that of the dry, firm sand of Egypt.

Chaldaea.—Under this head may be included the architecture of the lower Mesopotamian region from the earliest times till the effective rise of Assyria, *c.* 1275 B.C. The principal factors are (1) the early Sumerian centres of Ur, Erech, Larsa and Lagash, dating from *c.* 3500 B.C. or earlier, to *c.* 2200 B.C.; (2) the overlapping power of Akkad which became the dominating power *c.* 2700–2600 B.C. under Sargon I. and Naram Sin; and (3) the rise of Babylon, *c.* 2200 B.C., culminating in the reign of the great lawgiver, Hammurabi. Each important Chaldaean settlement was primarily the home of the reigning god and of the local ruler as his priest. Ur was devoted to the cult of the moon-god, Nannar, and of his wife, Nin-Gal. The ziggurat—200 ft. by 150 ft. and still 70 ft. high—is a solid mass of brick in high stages and built with bitumen instead of mortar, standing on a brick-paved terrace having a clear front space 300 ft. long and 174 ft. wide. It is the work of Ur Engur, 3rd dynasty king of Ur (*c.* 2300 B.C.) and of his son, Dungi. There is no doubt that the final or temple stage was finished with great richness. At Abu Shahrein there were evidences that the topmost chamber was lined with a mosaic of agate, alabaster, marble and gold, fixed with gold-headed copper nails. This technique has been borne out by recent finds at Ur (*q.v.*).

The retaining walls of the terrace at Ur are massively constructed of sun-dried brick with sloped faces having a series of shallow buttresses. Burnt clay cones are built in at intervals and the circular inscribed ends of these show on the face. On the terrace were cultural buildings and the houses of the god and his wife. Remarkable results have been disclosed by recent excavation. The earliest tomb structures, far below terrace level, go back to *c.* 3500 B.C. and show astonishing facility in the construction of barrel vaults and semi-domes of crude brick. Bricks, both crude (or sun-dried) and burnt, were the great building material of Mesopotamia, a natural result of the rich stiff clay which was the subsoil everywhere. "The walls, constructed and repaired with bricks stamped with names of lords of the locality, contain in themselves alone an almost complete history" (Maspero). Plaster was the usual finish on this brickwork. An important decorative work is the "stela" (inscribed tablet or pillar) of Ur Engur, 15 ft. high and 5 ft. wide, with carvings in panels of unequal heights—arranged horizontally—and an inscription (*cf.*, the later Assyrian stela of Shalmaneser II. in the British Museum). At Tell-el-Obeid, near Ur, was a temple of *c.* 3500 B.C. "At the door stood statues of lions made of copper and on each side of the door were columns encrusted with mosaic in mother-of-pearl and red and black stones" (Woolley, *Times* report, 1925). There is a Greek perfection in the green stone door socket at Ur, "shaped as a serpent with a hollow in the top of its head, wherein the pivot of the door hinge turned" (*ibid.*).

At Lagash (Tello) there is a palace platform 174 ft. by 69 ft., rising 40 ft. above the plain. It belongs to the time of Gudea, *c.* 2600 B.C. There is a distinct arrangement in the setting-out of the buildings and the treatment of portions of the external wall is characteristic—deep rectangular grooves arranged vertically at regular intervals, or rows of semicircular projecting pilasters, like "gigantic organ pipes." At Erech (Warka) the treatment is rendered more decorative by diaper, chevron and spiral patterns, coloured, which are formed of terra-cotta cones sunk deep into solid plaster. Tello is justly celebrated for the quality of its sculpture (now in the Louvre) in excessively hard stone, which is comparable with the early dynastic work of Egypt.

Assyria.—The plan of an Assyrian palace can be seen in Sargon's great centre at Khorsabad, on the east bank of the Tigris. The whole palace area is some $7\frac{3}{4}$ ac., of which about $\frac{2}{5}$ rd. is given over to the palace, the remainder being platform area containing the ziggurat and other ritual buildings; but the palace was placed on the centre of the river front of a square enclosure containing the town, occupying, roughly, a square mile, and surrounded by a fortified wall strengthened with towers at intervals. The court-yard system is at once evident in the palace and there is more symmetry (or at least deliberate grandiose arrangement) than is apparent at first sight. It is also impossible to judge of the effect of such a work as this from a plan only and without taking into account the accessories of Assyrian architecture—the coloured tile decorations, the gigantic human-headed bulls or lions of the entries and, above all, the magnificent reliefs which are so evident from the show cases of the British Museum. For precision and delicacy of treatment, fine sense of design and mastery in the rendering of animal form, these reliefs can compare with the architectonic sculpture of any age. The entire absence of the column in all Mesopotamian buildings is noticeable.

Babylon.—The latest rebuilding of Babylon by Nebuchadrezzar II. in 604 B.C., after the destruction of Nineveh by the Medes, Babylonians and Scythians, exhibits one of the greatest building achievements that has ever been attempted. It was to some extent a continuation of earlier work by the later Assyrian kings and Nabopolassar, father of Nebuchadrezzar. The palace (or rather palaces) proper, as at Khorsabad, can only be considered as incidents in an immense area which lay on the east bank of the Euphrates for the most part, but also crossed it. The outer wall on the east side consists of two thicknesses of brickwork, respectively 23 ft. and $25\frac{1}{2}$ ft., with an intervening space of 40 ft. This was filled in and a roadway 86 ft. wide constructed on the top. The labour involved recalls the building of the pyramids of Egypt. Various coloured stones were used as paving slabs.

The decorations of the palace were in the prevailing Babylonian style of coloured and glazed tiles—lions, bulls, dragons, flower forms and formal patterns, executed with extraordinary *verve* and richness of colour. Inscriptions record that "the chamber of Marduk, lord of the gods" was "furnished with shining gold" and that eight bronze serpents at the doorways were covered with silver. The Ishtar gate is in a remarkable state of preservation and gives a clear indication of the character of the chains of towers that encircled the palace. The building activities of Nebuchadrezzar were continued by his successor Nabonidus, who became a restorer of sacred sites in Chaldaea. He effected a great levelling up and rebuilding scheme at Ur.

The greatest ziggurat of Mesopotamia—the Birs Nimrûd—11 m. S. of Babylon, was completely restored by Nebuchadrezzar. It was the more usual type which had its origin in early Chaldaea. Its irregular form facilitated ascending stepways between the stages. The whole intention was radically different from the tomb idea of the Egyptian step pyramid (*see* EGYPTIAN ARCHITECTURE). The Mesopotamian ziggurat was a "mountain" built in solid stages having a shrine for the divinity at its summit.

Saturated with the idea of man's conflict with invisible powers, the art expression of Mesopotamia is remote from the humanistic thought of Greece and the modern world. Nevertheless, it contained some forms of great importance in the history of architectural development. (1) The fortified walls with their square towers, especially at gateways, entered into the mediaeval use of Europe; (2) the round pilaster strips of external walls reappear in the Sassanid palaces of the 3rd and 4th centuries A.D., as well as in the Romanesque churches of Italy; (3) lions or other carved pedestals as bases for columns also reappear in Italian

Romanesque work; (4) the bronze bands of the gates of Shalmaneser II. (860 B.C.—now in the British Museum) were so perfect that a very complete restoration of the gates is possible and they remain one of the finest examples extant of metal-craft on such a large scale before mediaeval times; (5) the magnificent output of glazed tile relief which, originating in Babylonia, was characteristic of Assyrian and Neo-Babylonian work, was translated into new forms by later Persian artists and became the greatest contribution of the Middle East to architectural decoration; (6) lastly and most important of all there is the first use of the arch, vault and semi-dome—with all that is meant by that—anticipating the construction of Rome, not a few centuries but some 3,000 years later.

Persia.—The Neo-Babylonian empire was founded in an insecure age and perished, with all its splendour, in 538 B.C., only 66 years after the final collapse of Assyria. The real masters of western Asia during this period were the Medes in the first instance, followed by the Persians, to whom they were allied but by whom they were subsequently conquered (550 B.C.). The Medes overran Asia Minor and subdued the great Ionian State of Lydia—an important event, as it brought western Asia into direct contact with Greek culture. The 6th century temple of Artemis at Ephesus was built by Croesus, king of Lydia; and Cyaxares, the Mede, may have seen this as well as the temple of Sardis, the capital. There are comparatively few architectural remains from this warlike period and from the succeeding one of Cyrus, the great Persian, conqueror of Media and Babylonia. The most important is the "tomb of Cyrus" at Passargadae—a very interesting stone-built monument recalling the tombs of Lycia and certainly foreign to its district; though it has been suggested that it may be a Persian adaptation of the stepped towers of Mesopotamia. Cambyses, son of Cyrus, effected the complete conquest of Egypt, and his successor Darius (521 B.C.) consolidated the empire and founded Persepolis. Xerxes, following him, continued building at Persepolis, invaded Greece and after a ten years' conflict was finally routed at Plataea (479 B.C.).

We note the geographical position of Media and Persia on the Iranian plateau, at a high elevation above and to the east of the Tigris valley. Stone of superb quality was abundant in this region and may partly account for the entirely new plan principle that is discovered in Persian architecture. The Persian palaces at Persepolis and Susa were built on raised platforms enclosed by terrace walls and approached by step-ways, recalling in this way those of Mesopotamia; but the structures above were columnar halls, like those of Egypt. The largest of these—the hall of the 100 columns at Persepolis—is 225 ft. square, though its columns were only 37 ft. high as against 67 ft. in the smaller hall of Xerxes on the same site. In many respects also the details were partly Egyptian and partly Greek. The gateways of the hall of Xerxes have the colossal winged genii associated with Assyrian palaces and the staircase leading to the terrace has wild-beast reliefs on its balustrade (though these are not purely Mesopotamian in feeling), but the cornices over the doors are Egyptian in form and the side posts of the doors in the hall of 100 columns have a surface decoration in low-relief set in panels, the idea of which is strongly reminiscent of Egypt.

The much discussed columns of the hall of Xerxes are frankly bizarre. They had no permanent influence on future work. But the halls of the Persians were probably the finest that have ever been built and their decorative craft work of the early 5th century B.C. was equal to any Greek work of similar technique.

The Hittites.—Hittite architecture must be considered an anti-climax after the developments previously described, but it constituted an element of stability influencing the whole of the east Mediterranean region at a most important period, from *c.* 1500–1000 B.C., a period in which Mesopotamia was comparatively quiescent and which survived the zenith and decline of Aegean art. The earlier Hittite palace of importance was at Boghaz-Keui in north Anatolia; the later was at Carchemish, on the Upper Euphrates, and on the same latitude as the Assyrian sites but some 300 miles to the west. The architectural evidences were of a rude and primitive kind and the sculpture similarly so; but there are abundant examples of the latter in vigorous reliefs. At Carchemish, also, there were some carved lions of a rather fine though archaic type, which appear to have carried columns, though this is not certain; but of their decorative function as guardians of an entrance there can be no doubt.

Crete.—Not even the discoveries of 1925 to 1928 in southern Babylonia have been so arresting as the disclosure of the civilization in Minoan Crete which forms the connecting link between Egypt (*see* EGYPTIAN ARCHITECTURE) and Greece (*see* GREEK ARCHITECTURE). The island formation of Crete was favourable to settled development, as the sea formed an insuperable obstacle to nomadic tendencies. This may of itself have accounted for the steady progression of Crete in systems of rectangular construction, which rapidly absorbed all circular or oval constructions (except for certain tomb structures) and culminated in palaces of great size. The immensely important site of Knossos—situated some four miles inland from Candia, the mediaeval capital of Crete—contains on its palace site the clearest evidence of unbroken continuity in development from early Neolithic times till about 1400 B.C. We have here therefore a Mediterranean tradition which, though it had contacts with Egypt and Mesopotamia, is neither African nor Asiatic and which became one of the life-giving sources of all later European art.

The vital force of Minoan building development lies in its amazing output of palace construction which reached its culminating point during the third Middle Minoan period (*c.* 1700–1580 B.C.). Many centuries before history and in a remote island of the Mediterranean there were building developments which were not matched in a domestic sense till the era of the greatest palaces of the Renaissance. There was a certain amount of faced masonry but a thorough system of wooden construction prevailed as a framework to a general infilling of—for the most part—such very rough rubble that it survives practically as mere earth. The inner walls, where not faced with large, thin gypsum slabs, were covered with lime plaster of superb quality, varying in thickness from 2 or more in. to the thinnest possible coating of stucco. The ultimate finish was colour, on a slip of the finest stucco, forming a true fresco. It is remarkable that so much of this apparently flimsy construction and finish should have survived for more than 2,500 years in a semi-northern climate by no means altogether dry.

Knossos.—The frescoes at Knossos enable us to re-construct the entire life of the period. The variety and scale of the subjects represented were extraordinary—life-size figure processions and bull-grappling scenes; landscapes with figures, animals, birds and marine creatures, set as definite picture-subjects within borders; ceremonial scenes, often with crowds of figures and architectural backgrounds—the last mentioned extremely valuable in their structural suggestion and in their proof that the buildings of the palace were themselves coloured. The floors of the principal rooms were paved with gypsum slabs covered with thin hard coloured stucco. Some of the ceilings must also have been of coloured plaster, in semi-geometrical or running patterns. The principle of coloured decoration was carried through the whole of the palace: even the storage rooms of the basement were finished with deep-red plaster, having skirtings and dado lines in grey and white. The fresco finds show that the elaborately dressed Minoan ladies were able to watch spectacular displays from windows with great facility; also that windows were large and had "mullions."

Columns must have been of wood and have formed part of the colour scheme. Column bases of circular or oval form projected slightly above the floor and were of gypsum or limestone. A few were of coloured marble or beautifully variegated stone, indicating a technique of which no further details are available. Of architectural details and accessories the most important are some wonderfully carved stone bands with rosettes and other patterns; the gypsum benches that lined the walls of some of the rooms (those in the "Throne Room," dating from the last phase of the late Minoan period, being associated with a gypsum throne of unique character, showing clear indications of a wooden origin); the stepped balustrades of the staircases and of the low-level tanks that were probably associated with religious rites;

and, even more important, the niched seat or throne raised three steps as a centrepiece behind a low parapet at one end of the principal suite of apartments in the "Royal Villa," with its strong suggestion of the raised altar and apse of later Christian usage.

The layout and economy of the great centre which contained these features has been preserved almost entire in its ground plan. Broadly, it is a square of about 400 ft. with a central open court 175 ft. long and nearly 100 ft. wide. At the northern end of this, towards the sea, is the main entrance passageway, but this entrance was masked and probably strongly guarded. The main state entrance was on the west side, an indirect entry looking on to a great paved court and leading to the south terrace. Here the king may have "sat in the gate." The impressive size of the entry—which has a large central column dividing a total span of 37 ft.—and the frescoed richness of the processional way leading from it formed a fitting approach by a double turn to a great suite of state apartments going northwards and raised some 8 ft. above the central court. The greater part of this western area was carried on the massive basement walls which are now existing, the floor being below the level of the central court. The outstanding feature of this basement is its great series of storage magazines, over 200 ft. in length.

On the east side of the central court the ground descended smartly to a pleasant river valley. A deep cut in this slope held the most perfectly preserved portion of the palace—the domestic quarter—accessible from the central court by a fine staircase in tiers of two flights round a newel wall. This staircase affords conclusive evidence of three stories; in all probability there was a fourth story. The domestic quarter at Knossos is the most complete epitome of Minoan planning on a grand scale that exists. The open balustraded area on the farther (east) side of the grand staircase was one of a system of five internal areas which gave light and air to the whole group of apartments. These areas were faced with limestone and paved with pebble cement, in contrast to the gypsum finish of covered quarters. Descending shafts and a perfect system of underground drains, all stone-built, carried away the roof water and other drainage. Two smaller staircase systems served the treasury and the queen's apartments respectively. On the upper floors must have been bedrooms and nurseries and other rooms for general use. The whole system ends gracefully on a columned piazza with a spacious verandah above, overlooking the river.

Phaestos, Hagia Triada, Gournia, etc.—The palace of Phaestos, near the south coast of the island, is distinctly inferior to Knossos in size and importance, but it was probably the seat of a king, though perhaps a tributary one. It supplements in an admirable way many things that Knossos has lost, owing to the fortunate fact that the great stepway leading to its state apartments still exists complete and is here a truly monumental feature, about 42 ft. across. The peristyle character of at least a considerable part of the central court at Phaestos is clearly evident and also the existence of smaller courts of peristyle type. The little summer palace of Hagia Triada, near Phaestos, is more complete in a domestic sense. Its fragment of "cat and bird" fresco is one of the greatest treasures of Minoan art. There were other centres in the eastern part of Crete, of which Gournia, close to the north coast, is the most perfect Minoan town that has so far been discovered. Its whole extent is less than that of the palace at Knossos, but it contains streets, houses and a tiny palace. It also illustrates, equally with Knossos and Phaestos, the skilful choice of a Minoan site.

The last two centuries of the late Minoan period were a time of decadence and re-occupation, following conquest (*c.* 1400 B.C.) by some outside power, probably Mycenae on the mainland of Greece. Architectural remains which are pre-Greek and yet subsequent to 1000 B.C. are practically non-existent. The most important is a unique temple building, of which considerable fragments were found, at Prinias in Crete (*c.* 700 B.C.). The doorway of this—cut out of soft stone and now in the Candia museum—is strongly reminiscent of Egypt. There is the same tendency to put shallow relief sculpture on architectural members. The horse appears for the first time in these reliefs. The lintel has an opening above it, flanked by seated figures of semi-Egyptian character, while the lintel itself has a full-length female figure carved on its underside, probably the mother-goddess of the earlier age.

Mycenae and Tiryns.—Mycenae is the outstanding example of a mainland architectural development intimately associated with the zenith and decline of Crete. There are the same motives in palace planning, and the same decorative outlook; but Mycenae —and even more pronouncedly the neighbouring fortress of Tiryns —show a cyclopean method of construction hardly found in Crete. The most impressive single feature is the Lion gate of the citadel of Mycenae; the greatest structural works are the "beehive" tombs of the same centre, particularly the largest and best preserved—the so-called "Treasury of Atreus," which was undoubtedly a tomb. The galleries (or side entrance passages) of Tiryns can justly be placed beside them. We see quite clearly that this massive building development in stone reflects an age of insecurity, when powerful kings built fastnesses which were key positions, in periods succeeding one another approximately from 1700–1200 B.C. The Lion gate is an appropriate incident in such a fastness. Its rude but semi-scientific cyclopean construction absorbs a feature which has made it famous—the great slab above the lintel, carved with two majestic maneless lions fronting a central pillar. The beasts' heads are gone and may have faced the spectator, but whether in stone or in bronze we do not know. The existing remains are in a very hard breccia stone.

The beehive tomb shows by contrast, a fine method of construction. The doorway to this tomb, even in its nearly stripped condition, is the most important purely architectural work of prehistoric times in Europe. Its scale is impressive; the inner lintel is 29½ ft. long, 16½ ft. deep, 3 ft. high and 120 tons in weight. The finish was given by attached half columns, applied rosettes and bands of various forms, all richly carved in gray-green and purple porphyry-like stones. Some considerable fragments of these are in the British museum. The tomb itself—which is nearly 50 ft. wide—is a pointed dome, but (as in more ruined Cretan examples) is built with overhanging stones laid flat. There is no sign of a true radiating arch or vault anywhere, the keystones of the vaulted galleries at Tiryns being the nearest approach to such construction.

Troy.—The city of Hissarlik, or Troy, on the eastern shore of the Dardanelles, is the remaining work of Mycenaean times on the mainland which need be noticed. It can show nothing of positive architectural value which cannot be seen at Tiryns or Mycenae. The great value of Troy is its burg or fortified site showing successive strata dating from *c.* 3000 to 1000 B.C. As at Mycenae and Tiryns, the central round hearth is found, which was practically unknown in Crete. That this was a northern feature is certain. Another fact of interest is the use of crude brick for walling—an important link with Mesopotamia.

So far as we are aware, there was no continuity of tradition between the architectural forms of the Aegean civilization and those of historic Greece (*see* GREEK ARCHITECTURE), but there were several root forms, particularly in the plans of buildings, which are common to both and bring Greek structures much nearer to Aegean ones than to any others. (1) The idea of the Greek temple plan can be seen clearly in the *megaron* (hall) with its extended side walls at Mycenae and the contemporary Troy; (2) the plan of the Athenian propylaea or great entrance gateway to the Acropolis is based directly on forms in Crete and on the mainland; (3) the high course of upright marble slabs at the base of the cella wall in the typical Greek temple of the 5th century B.C. can be seen in the west wall of the palace of Knossos and other Minoan sites; (4) the use of the column for various purposes is very much the same in both epochs. The decorative use of fresco in Cretan houses and palaces deserves special mention, as its influence on Greek and subsequent painted decoration may have been profound, but only the threshold of this enquiry has, so far, been reached. The sense of decorative values and the acute observation of natural forms conventionally rendered, all produced in pure colour, bring the best Cretan fresco into line with Chinese and Japanese painting; and the oriental touch is surer than in the somewhat parallel art of Tel-el-Amarna (*see*

EGYPTIAN ARCHITECTURE; ARCHITECTURE; PERIODS OF ART).

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WESTERN AUSTRALIA, the largest of the states of Australia, occupying 975,920 sq.mi. The length is about 1,480 mi. and the breadth about 1,000 mi. while over one-third of the total area (37.3%=364,000 sq.mi.) lies north of the tropic of Capricorn. Its distance from the populous eastern parts of the continent is offset by its position with regard to the ocean routes leading to the homeland, to which it is the nearest, and from which it is,—in spite of the Panama canal—often the first Australian land of call.

Physiography.—The broken coast line of the northwest, formed by the marginal submergence of a deeply dissected plateau, contains several fine areas of enclosed waters which flank a main gateway between the Pacific and Indian oceans. Large tidal ranges—up to 38 ft. in Hanover bay—and in some cases tidal currents (*e.g.,* King Sound) are a disadvantage.

Moreover, southward from this the sandy Ninety Mile beach, and further on, the low, straggling, and often shallow inlets, promontories and islands, fringed in places by coral reefs, form part of a relatively undistinguished and inhospitable coast where exposure and silting (due partly to recent coastal elevations) present difficulties to harbour construction. The estuary of the Swan river forms a notable exception, Fremantle being one of the best and most commodious of natural harbours, while Geographe bay is also relatively protected.

From Cape Naturaliste onwards much of the south and southwest is flanked by high, rocky and exposed coasts in which such inlets as King George sound form excellent harbours (Albany), while further east this passes over into the unbroken cliffs of the Nullarbor Plain area. As a whole Western Australia is a closed land mass and has no relatively large maritime indentations.

To water supply, owing to the climate, peculiar importance attaches. Four main, besides parts of smaller, artesian basins lie wholly or in part within the state; the Eucla or Southeastern (*i.e.,* approximately the Western Australian portion of the Nullarbor Plain); the Coastal Plains basin in the southwest (Cape Leeuwin—Dongarra); the Northwestern or Carnarvon basin (Gantheaume bay—Onslow); and the Desert or Broome basin.

The extent and capacity of the Eucla and Broome basins has not yet been fully tested though they are both, and particularly the latter, large, and, in general, apart from the Coastal Plains basin, the resources have as yet not been fully exploited (1939: 284 bores, yielding *c.* 66,760,000 gal.; depths from 4,006 feet).

In the Perth area some 50 bores supply water to the city, Fremantle and adjoining districts, while the northern basins largely underlie coastal lowlands and enhance their natural pastoral value.

The wells in the Perth area are notably fresh, but around Eucla and in some other parts they are saline. Fresh discoveries of artesian or sub-artesian supplies are from time to time reported *e.g.,* in the Northern Goldfields pastoral area, and there are, in addition, considerable reserves of shallow-seated sub-surface waters (*e.g.,* in the Perth and other coastal lowlands). In the interior large areas can be made available for the carrying and movement of stock (*e.g.,* Murchison area and *cf.* the Wiluna-Hall's Creek route) by means of wells many of which are natural-solution pits in limestones, "native wells," "gnamma holes," etc. Unfortunately these shallow supplies are saline over considerable tracts (*e.g.,* in the Wheat Belt and Kalgoorlie areas), while the vast number of "lakes" in the interior are little more than saline flats akin to the widespread clay pans. The lack of adequate fresh water in the interior southwest has been met by a vigorous policy of surface (rainfall) storage and reticulation. Chief among such schemes is the Gold-Fields Water-supply scheme by which water derived from a catchment in the Darling ranges behind Perth is stored in the Mundaring reservoir (760 ac.; 4,650,000,000 gal.) and conducted thence by means of a pipe line with 8 pumping stations to a service reservoir (12,000,000 gal.) at Bullabulling 307 miles distant. Thence the water is reticulated by gravity to Kalgoorlie (44 mi.); it is also supplied to 30 towns "en route," to mines, and to agricultural areas (500 extensions). (Total area covered: 16,000 sq.mi.; total length of mains [1939]: 1,721 mi.; total consumption: 1,469,000 gal. per ann.—railways, *c.* 8%; mines, 22%; "other," 70%. Capital cost, £5,738,959; revenue, £322,377; expenditure, £312,281.) There is an extensive system of water supply to towns (1939: 23 towns, pop. *c.* 14,000; 291,000,000 gal., including railways) and to agricultural areas.

Climate.—Western Australia covers such a wide area that several distinct climatic regions are included in it, though observations for considerable areas are scanty or lacking. (*a*) The north has a "monsoon" climate, with prevailing high temperatures (85°–70°), a markedly summer rainfall (November–April with maximum December, January, February) brought by depressions ("lows") from the tropical seas to the northwest. The rains are heavier in the north and tail off southwards and they are irregular and often torrential, causing severe floods in the valleys; (*b*) the northwest, lying southwest from the above, is characterized by its high summer temperatures—there is a large area with averages over 90°; by its long and severe heat spells—at Marble Bar temperatures over 100° have been recorded on 103 consecutive days—and by an extremely erratic rainfall (10–20 in.). Thus in the north rain falls mainly January–March but further south winter rains predominate and these reach occasionally as far north as Broome. This region is visited in summer, but at irregular intervals (45 during 50 years) by intensely developed cyclonic depressions coming from the northwest ("Willy-Willies"). The Cossack and Onslow areas in particular suffer from their destructive violence. (*c*) The southwestern "winter-rain" region comprises most of the southwest of the state. Temperatures there range from 50°–80° with occasional short heat spells, though conditions are progressively less equable towards the interior. The weather is dominated by the passage (west-east) of large anticyclonic (high-pressure) and cyclonic (low-pressure) systems which involve variations (chiefly short period) of temperature, wind direction, etc. Occasional rains penetrate southwards from the north and fall in summer, but the chief rainfall is brought by the "lows" from the Indian ocean and this falls in winter (May–October) and is relatively reliable. (*d*) Of the vast interior little definite is known, but of the more settled portions it may be said in general that they partake of the character of the areas described and form inland extensions of them. (*See* KALGOORLIE.) Rainfall, however, decreases to 10 in. or (av. ann.) less and it also becomes less reliable. The range of temperature (ann.

and diurnal) becomes greater (up to 30° or more), and in parts the climatic conditions become those of a desert. This desert approaches the coast in the northwest and runs thence broadening in an east and southeast direction into the winter rainfall area, the rather higher (average) rainfall in the north being counteracted by higher temperatures.

Of the Western Australian climate it may be said that, in spite of the heat, dryness, humidity and dust which afflict parts in various degrees and seasons, in general it is not unhealthful. (*See* AUSTRALIA.)

Vegetation, Timber, etc.—Most of the state is clothed, though unevenly, with vegetation, even arid portions having some scrub, heath, or wiry grasses. In the north (Kimberley Divisions) the coastal lowlands, river valleys and ranges carry in parts patches of forest which may contain some useful timber. But the predominant type is grassland with trees, savanna adapted to the annual dry season. Inland and southwards, as rainfall diminishes, this type degenerates into scrub and passes into the scrub ("desert gums") and spinifex of the sandier interior.

Along part of the northwest coast lies a belt of grasslands backed by scrub which affords useful grazing, and mangroves, common farther north, line parts of the coast there also. But farther south the poor country approaches close to the coast (*see* above, Climate), and from hereabouts stretches southeastwards into the little-known east-central interior the scrub and spinifex type which at best has poor pastoral value. On the southern side of this poor belt in the northwest "shoulder" of the state (Ashburton, etc.), a better type of scrublands begins to appear and south and east from the Gascoyne river (*i.e.,* from the beginning of the regular winter rainfall area) begins the mulga pastoral country possessing also good sub-surface waters. This extends southeastwards inland to *c.* lat. 29° S. where it passes over into the beginnings of the southern forest country—the Salmon gum open-forest lands of the Kalgoorlie, etc. gold fields. This forest has proved invaluable to the mining industry by supplying mining timber and fuel.

In what is known as Swanland, the southwestern corner of the continent—*i.e.,* the portion lying southwest of a line running approximately from Sharks bay (*c.* lat. 25° S.) to near Israelite bay (*c.* lat. 33° S.; long. 124° E.)—the belts of vegetation, as indicated above, appear to follow rather closely the belts of (winter) rainfall. Thus the gold-fields forest (Morrell—Salmon gum) passes southwards, in the belt of 10–20 in. av. ann. rainfall, into the mallee, jam and wandoo forests farther southwest, though mallee and saltbush country prevail towards the southern (Bight) coast. The prevailing types are now eucalyptus—the "jam" is an acacia—and the belts referred to (jam, wandoo, York gum, marri or red gum) form a transition zone in which trees of increasingly better growth pass over into the real forest area of the state. This lies S.W. of (approximately) the 15 in. rainfall line and is *c.* 350 miles long and 50–100 mi. wide, about $\frac{1}{5}$ of the total forested area of the state (i.e., *c.* 20,000,000 out of *c.* 100,000,000 ac.) being contained herein, though probably only some 3,000,000 acres carry merchantable timber.

A line drawn from about Gingin to rather east of Albany marks off what is perhaps the most valuable timber area in Australia. Here the distribution of types is markedly dependent upon rainfall and soils. Behind the immediate coastal fringe in the south lie, in the areas of 40–30 in. rainfall, *c.* 250,000 ac. of karri forest composed of handsome giants 200–250 ft. in height yielding tough wood valuable, when "powellised," for constructional purposes, etc. From near Busselton to about Marginiup (N. of Fremantle) the 5-mi.-wide strip of coastal limestones supports tuart (average height *c.* 150 ft.) growing in more open formation. But the greater part of the area (40–25 in. rainfall) north of the karri forests is occupied mainly by jarrah interspersed with marri (*c.* 8,000,000 ac., of which some 2,750,000 ac. are commercially useful). The jarrah prefers lateritic soils and the trees, which in good areas average 100 ft. in height, yield first-class hardwood resistant to weathering and insects which is in demand for paving-blocks, piers and other out-door constructional purposes. The area "dedicated" to forests has been recently largely extended (1,832,000 ac.) and a total of 3,000,000 ac. is aimed at. Vigorous measures were taken to control and regenerate the timber reserves, and the planting of pines (softwoods) on a large scale was begun (*e.g.,* Mundaring and South Perth).

Sawmilling is an important industry. In 1939–40 some 118,000,000 super ft. were cut, much of the product being used locally, but considerable quantities were exported abroad largely through Bunbury (*q.v.*).

Other forest products are sandalwood, a shrub (*c.* 18 ft. high) which grows sporadically upon sandy soils over much of the southwest interior. It yields a wood especially valued in China, to which it is exported, and also an essential oil. Mallet bark has valuable tanning properties.

Wasteful exploitation caused production to decline, but reforestation is in progress.

(*See* also AUSTRALIA: *Forestry,* and below. Statistical Survey *s.v.* Manufacturing Industries, in which "Woodworking" refers largely to sawmilling; also *s.v.* Trade: exports.)

Mining.—This industry has improved somewhat in recent years. Western Australia (1939) was the most important producer of minerals (surpassing New South Wales) and the value of her total output reached a sum of £12,288,532 (*cf.* New South Wales, £12,123,751), the number of men employed had risen to 16,000, and mineral exports represented about 47% of the total value of exports (*cf.* 1903: 84.5%).

Gold is the most important mineral produced (73.5% of the commonwealth total). Most of the well known fields are still being worked, but the Coolgardie, Mount Margaret and Murchison areas were by far the most important (*e.g.,* E. Coolgardie gold field: 50% of miners, and 73% of output, of gold in state). More recently there have been indications of a large revival in Western Australian mining and great prospects undoubtedly lie before the Wiluna (*q.v.*) gold field.

Coal: The only field being worked (1939) was at Collie (7 collieries producing 560,000 tons). The coal is consumed within the state (largely by railways), the coal reserves being a particular boon in view of Western Australia's position and her relative shortness of power resources.

Recent borings for oil in the north (Kimberley Division), though inconclusive, give some promise.

(*See* also: AUSTRALIA: *Minerals; Mining and Minerals.* Also KALGOORLIE; and below, Statistical Survey: Production; Mining [giving figures for 1937]; Exports; above, Water supply.)

Land Settlement, Agriculture, Dairying, etc.—Western Australia, though founded as a colony as early as 1829, grew slowly and in 1890 when it became a self-governing state the population was only 46,290. The gold boom of the '90s nearly quadrupled this total (1900: 179,708). Thereafter came a lull, followed by a decline owing to World War I. The population is again increasing steadily (1933: 438,852). These statistics are significant in that they reveal the vital factors controlling Western Australian development. In 1914 Western Australia had barely begun to emerge from the more purely pastoral and mining regime which formed the earlier stage in the development of most Australian states. She is now fully launched upon a course of intensive land settlement. She is attracting men and capital not only from overseas but from her eastern neighbours; the area of occupied lands is rapidly expanding.

The "3,000 farm scheme" inaugurated about 1928 was "probably the largest single (land-settlement) scheme which has ever been undertaken by a government in Australia." It aimed at establishing 3,000–3,500 new 1,500 ac. wheat-and-wool farms in the block of country (*c.* 12,500 sq.mi. or 8,000,000 ac.) which lies southwards from Southern Cross and the main (gold fields) railway line. Unfortunately the soils were found to be infertile, and little came of this elaborate plan.

Wheat.—In the first 70 years of her existence Western Australia produced altogether only *c.* 15,000,000 bu. of wheat; in the year 1927–28 she produced 35,187,195 bushels. This had dropped to 21,549,000 bushels by the end of Feb. 1937. All the southern states have increased their wheat areas, but Western

Australia has probably shown the greatest relative increase.

In 1927–28, 422,000 ac. were added and in the period 1920–21 and 1928–29 nearly 2,000,000 ac. (excluding wheat areas cut for hay: 1928–29, 250,000 ac. estimated), an increase of 156% (South Australia, 56%; Victoria, 22% in the same period).

Moreover while the yield per ac. is very fair (11–12 bu. per ac.; *cf.* Australian average ten years 1916–26: 12.41 bu.), the seasonal fluctuations have been less marked than in some of the eastern states:

	N.S.W.	Victoria	S. Aust.	W. Aust.
1926–27	47.37	46.88	35.56	30.02
1927–28	27.01	26.16	24.06	35.18 (mill. bus.)
Increase (+) or decrease (—)	—20.36	—20.72	—11.50	+5.16

However, in the seven years 1931–37 the wheat area dropped from 4,000,000 to 2,500,000 ac.

Further, Western Australia's exports of wheat mounted in value from virtually nil to nearly £7,000,000 within the 22 years 1905–06—1927–28. The reasons for this lie to some extent in physical circumstances. Some 93,500 sq.mi. of territory in the southwest of the state receive an average rainfall of 10 in. or more during the winter growing season (April-Oct. inclusive), and the belt of country climatically suited to wheat growing is bounded by a line running from the coast north of Geraldton (*c.* lat. 27° 30′ S.) southeastwards via Southern Cross and Norseman to the sea coast at about Israelite bay (lat. 33° S.; long. 124° E.). On the southwest the limits are partly geological (soils) but mainly set by heavier rainfall, and coincide in the main with the eastern limits of the heavy (jarrah) forest area. Within this 10–20 in. rainfall area, though there is much rocky, saline and otherwise unsuitable terrain, the surface is generally flat, often monotonously so. The rainfall, though fluctuating, is relatively reliable, so that a smaller fall is economically as valuable as the heavier but more erratic falls in some of the wheatlands of the eastern states. Experience, seed selection, "dry-farming," and an appreciation of the value of light lands and increasing skill in dealing with them, the growing use of artificial manures—almost entirely superphosphates—the extension of mixed wheat-and-sheep farming, and water conservation have all played a part in the expansion referred to, the work of the state agricultural services, the State Agricultural bank, etc. being also largely responsible. A hot sunny summer for ripening the harvest is shared by the eastern states, as is also the general benefit of an expanding world market, and perhaps the reliable winter rainfall, cheap land, and an enterprising railway construction and settlement policy are the chief factors in attracting settlers and capital from the eastern states. Clearing is lightest in the eastern (Salmon gum, etc.), heaviest in the western (Wandoo, etc.) part of the wheat belt, and the agricultural seasons—plowing, sowing, harvesting, etc.—become progressively later as the wetter southwest and southern coastal areas are approached, where, however, heavier yields are apt to be obtained (*e.g.*, 30–42 bu. in the Gnowangerup district north of the Stirling range).

Dependent on wheatgrowing is the manufacture of agricultural machinery and the making of superphosphates (*e.g.*, fertilizer factories near Perth and in construction at Geraldton. Output, 1923: 93,000 tons; 1926–27: 187,000 tons. In 1927–28 217,000 tons were carried over the state railways). Western Australian wheat is of good quality. The value of wheat exports in 1927–28 was £6,994,528, Fremantle alone shipping 5,683,000 bags. In 1939 the wheat export was worth £3,000,000.

The export trade was greatly strengthened by the government policy of (voluntary) inspection and guarantee and it is significant of Western Australia's commercial position that among her customers she includes South Africa, India and Egypt. *Oats* are the cereal second in importance to wheat. The yield of grain was (1936–37) more than 3,000,000 bu. (7.4 bu. per ac.) and for 1937 some 463,000 ac. were sown. The grain is not of such good quality as that which comes from wetter climates (*e.g.*, Tasmania) and a considerable area is cut for hay. *Hay,* as elsewhere in Australia, is an important crop since roots and similar fodders are not so plentiful as in the moister lands of northwest Europe. Wheat, barley and oats all provide hay, the drier lands of the eastern wheat belt, where the crops will grow but will not seed, being largely used. With the increase in grain production and the growth of more intensive farming (*see* below) the area under hay has in some years declined (1923: 431,600 ac.; 1928: 354,000 ac.). The product is mainly consumed locally. *Dairying, Fruitgrowing, etc.:* The belt of coastal country which extends from about Gingin (*c.* 50 mi. north of Perth) and runs southwards past Bunbury round to about Albany, and which is served by the South-Western railway and also, farther east, by the Great Southern railway systems, contains the bulk of the natural dairying, mixed farming and fruit areas of the state. Its natural condition is largely forest land (*see* above), with plentiful surface water, mild climate (30–40 in. av. ann. rainfall) and varied but predominantly good soils, being distinguished from the jarrah belt proper which has lateritic soils more suitable to forests. Clearing is difficult and expensive and progress has been slow but there is developing here one of the great dairying districts of Australia. Dairying is only in its infancy in Western Australia but the number of dairy cattle is rapidly increasing (1916: 31,000; 1939: 130,000), scientific methods are becoming general—largely owing to the teaching and example of the state dairy farm at Denmark—and the yield per animal is increasing. In 1936 Western Australia produced: butter, 12,500,000 lb.; cheese, 1,032,000 lb.; bacon and hams, *c.* 4,000,000 lb. (*cf.* 1914: 415,000 lb.; 1,675 lb.; 112,400 lb. respectively) and should, at the present rate, soon dispense with the dairy products it has so far imported from the eastern states (see *Statistical Survey: Imports*). The revolution, for such it is, which is taking place, is due partly to the adoption of "subterranean" clover cultivation with superphosphates. Sheep also almost everywhere form a part of the mixed farming regime in the "southwest" and very heavy carcasses and fleeces are grown. *Fruitgrowing* is also practised, the forests cleared from the well drained hill slopes being replaced by orchards. The fruit mainly grown so far is apples, but a beginning has been made of growing oranges and other sub-tropical fruits. Vines are also cultivated, mainly along the inner margins of the coastal belt north and south from Perth (*cf.* the Swan River valley), the grapes, raisins, currants and wine (1926–27: 292,000 gal.; 1937, *c.* 350,000 gal.) having found an increasing market. The sandy and swampy coastal margins which are near Perth are also found very suitable for market gardening and large quantities of vegetables are grown, while in addition to the above, poultry farming is also a rising industry.

Pastoral Industries—Various.—As elsewhere in Australia the pastoral industry was a pioneer, though in places it followed upon, and partly subserved, mining (*e.g.*, Goldfields area). Similarly it yields, broadly speaking, to closer settlement as cattle yield, upon lands suitable to both, to the more profitable sheep. Important exceptions, however, are the mixed sheep-and-arable and also the dairy farming systems already noted, where the agricultural and pastoral economy interpenetrate, or rather co-operate, to intensify and stabilize production. Thus the southwest portion of the state contains perhaps 50% of the total sheep population, and a fair amount of stock fattening (meat) is carried on here also.

Sheep as an independent product are favoured by the light and relatively dry climate of the southeast, centre and northwest portions of the state; in the north, with its heavier (summer) rainfall and rank-growing grasses, they yield in importance to cattle. The Western Australian Nullarbor Plains have not yet been developed; the wide area between these and the wheat belt (*i.e.*, approximately around the Kalgoorlie gold fields) suffers from lack of good water supply, though the after-growth of the cleared forests affords a fair pasturage. Along the west and northwest coasts, as far as about Port Hedland and also for some 150–250 mi. inland the natural vegetation (mulga, saltbush, grasses, etc.) affords pasture varying locally in quality but mostly good, and here also supplies of good sub-surface water are widespread.

Recent progress has also been reported in the flocks of the northern area (Fitzroy basin around Derby). The far eastern interior has probably little pastoral value, but an enormous tract comprising the west-centre of the state (Northern Coolgardie, Murchison, Mount Margaret gold fields areas up to *c.* lat. 25° S.) has very fair underground waters, fair fodder, and is one of the "sparse" sheep areas. As settlement has advanced, so fencing, well-sinking, water conservation (including the provision of stock routes, *e.g.*, along the west coast; Hall's Creek-Wiluna, etc.), stock management and breeding improved and became more widespread, though rabbits, and in some areas (*e.g.*, the Wandoo forest) poison plants, cause losses.

Western Australia now carries more than 9,000,000 sheep (nearly all merino) which yielded (1936) 63,537,000 lb. of wool, the average weight of fleece having advanced to *c.* 7.1 lb. or approximately the commonwealth average, and the all-round progress in the industry has been marked.

An indication of the distribution and relative importance of the sheep areas is afforded by the wool exports of their respective ports: (1928) Fremantle, 55,340,000 lb.; Geraldton, 2,230,000; Carnarvon, 1,710,000; Port Hedland, 1,430,000; Onslow, 270,000; Albany, 150,000; Roebourne, 96,000 lb. (See *Statistical Survey: Exports.*)

Cattle for slaughter purposes are kept to some extent in the southwest and also in the rougher lands (*e.g.*, upper river basins) throughout the west interior wherever sufficient water and fodder are available. But by far the greater number of the state's 792,000 head are in the north (Fitzroy basin, with centre Derby) and in the extreme northeast (Antrim plateau and Ord basin, with centre Wyndham). Here plains (1,000–20,000 ac.) are interspersed with rougher ridge and hill country and the 30–50 in. summer rainfall produces rank, though not wholly satisfactory, fodder. Land and black labour are cheap and here is the region of vast cattle runs (500,000 ac. and upwards) held by such firms as Messrs. Bovril (Australia) Estates, Vestey Bros., etc.

The government freezing works at Wyndham are efficiently managed, they work for the five winter months (April–September) and deal with *c.* 25,000 head of cattle per season. The white workers (200–300) are brought up each season from Fremantle.

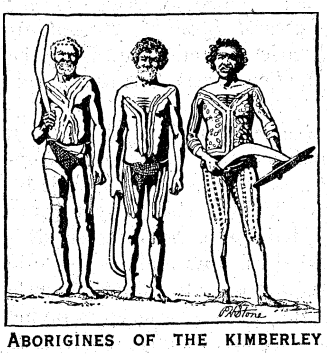
Note on the Northern Areas (Kimberley Division).—Mining has proved profitable, but the area has not been thoroughly tested. Pearl-shell fishing centring on Broome is of tried value (1939: 73 boats, employing 565 men [largely Asiatics], obtained *c.* 807 tons of pearl shell [£70,000] and pearls [£2,200]). The proposal of the commonwealth government that the area should be handed over to federal control was rejected. The air service (*see* below) marks an advance.

Towns, Manufacturing Industries, Communications, Trade.—The greater part of the interior of the state is, and will probably remain, apart from relatively impermanent mining centres, sparsely populated by human beings whatever its sheep and cattle population may ultimately be. Most of the increase is taking place around or near the coasts, the southwest corner being chiefly notable. In this zone of coastal, or sub-coastal, settlement, ports naturally play a prominent part. Perth (*q.v.*), with its port Fremantle, holds a key position upon what is perhaps the most important part of the coast. Commercially if not physically it lies midway between north and south. Convenient to important gold fields and also to the still more important and developing southwest, it lies besides, upon or near a world sea route and is terminal to the shortest land route to the eastern states. With its population of 207,440 the metropolitan area contains nearly half of the total population of the state. Apart from Perth and some ports—of which Albany, Bunbury, Geraldton (*qq.v.*) may serve as examples—the towns of Western Australia generally known hitherto have been associated with mining (*e.g.*, Coolgardie—Kalgoorlie, *q.v.*).

The settlements of the southwest, destined one day perhaps to become important are as yet mainly small agricultural and, usually also, railway centres of which in their youth it is perhaps sufficient to remark that they are numerous.

Manufactures, in the stage of development indicated, are naturally confined mainly to the metropolitan—and particularly to the Fremantle (*q.v.*)—area, to the gold fields, and to the primary producing centres (sawmilling; butter and cheese making; bacon curing; ore crushing and concentrating). Nevertheless, in the relative isolation of the community, industrial activity has made considerable progress, noteworthy being the manufacture of superphosphates and railway engineering (Midland Junction, etc.), while the supply of electrical power has also assumed large proportions (see *Statistical Survey: Manufacturing Industries*).

Communications.—Over large parts of the interior camels (1936: 1,935), mules and donkeys (1936: 8,700) still form indispensable means of transport, and in the northern interior the bullock-wagon is beginning to yield to the motor tractor. Elsewhere, as settlement and roads advance, or even before that stage, the flat terrain encourages motors while the aeroplane here, as in northeast Australia, must be looked upon as a pioneering vehicle. The Perth–Derby (1,467 mi.) service, calling at Geraldton, Carnarvon, Onslow, Roebourne, Whim Creek, Port Hedland, Broome "en route," is carried out by West Australian Airways Ltd. subsidized by the commonwealth government. This company completed in June 1928 its first 1,000,000 mi. of commercial flying and had then carried 1,250,000 letters and 70 tons freight with very little serious mishap but with almost untold benefits—including urgent medical assistance—to the settlers in the far north.



ABORIGINES OF THE KIMBERLEY DISTRICT, WESTERN AUSTRALIA

In 1939 air services linked Perth with Adelaide to the east, with Wiluna to the northeast and with Broome and Daly Waters (and Darwin) to the north. Branch lines linked Kalgoorlie and Wiluna, and Hall's Creek with Wyndham in the far north.

Railways were first developed in the coastal lands behind Geraldton (Geraldton–Northampton, 1879), Albany–Fremantle to connect various mining, timber and agricultural areas with their ports and one another. Later the great mineral lines were run out far into the almost unknown interior—Perth to Kalgoorlie: 375 mi., with extension to Laverton, 586 mi.; Geraldton to Meekatharra: 334 mi.; to Sandstone: 309 mi.; Perth to Meekatharra: 600 mi., etc.; and in the northwest an isolated line, Port Hedland–Marble Bar: 114 mi.

These lines have also proved invaluable in opening up the pastoral interior. In the railway system of the southwest, with its curious herring-bone pattern, can still be distinguished the timber, the mineral, and the agricultural lines, but the outstanding feature of recent construction is the development of wheat belt lines reaching out long arms eastwards to draw grain and wool in to the main trunk systems (*cf.* the similar development in the South Australian Mallee [*see* SOUTH AUSTRALIA] and the Victorian Wimmera [*see* VICTORIA]). In the north these debouch upon Geraldton, but by far the greater number upon Fremantle. Of this development the Norseman-Esperance (Kalgoorlie–Esperance: 258 mi.) line is a logical continuation in the east.

The Western Australian railways are, somewhat unfortunately, of narrow (3′.6″) gauge, and though like most Australian railways they are often built for developmental purposes (*see* AUSTRALIA: *Railways*), recent returns have been encouraging. The railways are mainly state-owned, but there are considerable lengths of private (mineral and timber) lines of semi-permanent nature but mostly open to general traffic. Of the transcontinental (commonwealth government, 4′.8½″) line, 454 mi. lies in Western Australia, and, apart from its increasing passenger and goods

Shipping Statistics for Fremantle

	1903–04	1927–28
Shipping tonnage (net)	626,692	3,462,776
Cargo tonnage	560,000	1,679,545
Revenue collected	£79,361	£581,849
Wheat shipped	3,132 bags	5,683,104 bags
Flour shipped	nil	52,132 tons
Shed floor space	72,000 sq. ft.	340,000 sq. ft.
Oil fuel bunkered	nil	103,583 tons

services (*see* below), it will doubtless help to develop considerable areas of pastoral lands provided adequate (nonsaline) water supplies can be uncovered. (See *Statistical Survey: Railways.*)

Trade, the general nature and extent of which can be gauged from the foregoing, and also from the appended statistics (*Trade; Shipping; Ports; see* also above *Pastoral Industries: wool exports*) has increased in volume and variety, Fremantle taking the lion's share. As an index of growth, therefore, the trade of this port is valuable.

A considerable portion of Western Australian trade is with other Australian states and it is significant that in the year 1927–28 imports to the value of £621,000 entered Western Australia by the overland railway line from eastern states, while only £15,500 worth of exports proceeded east by that route. *Shipping* services include (*a*) the main overseas lines which now make Fremantle (not Albany) their first Australian port of call, and Fremantle is the largest oil-bunkering port in Australia; (*b*) services plying to other states; (*c*) coasting services plying, mainly, northwards up the coast and back.

From Western Australia *submarine cables* connect (1) Broome through Java (Banjoewangie), etc., to London, Broome being connected by an overland line with Perth and thence, via Albany, Eucla and Port Augusta, with South Australia and the eastern states, (2) Fremantle with Durban, (3) Fremantle–Adelaide (alternative to the overland line), (4) Broome via Java—as in (1)—and Cocos Island with South Africa.

Statistical Survey.—*Area and Land Occupation:* 975,920 sq.mi. (624,588,800 ac.) = 32.81% of commonwealth—364,000 sq.mi. (=37.3% of total area) within tropical zone. Coast line: 4,350 miles.

Alienated or in process of alienation (1937): 33,002,000 ac.; leases and licences: 205,000,000 ac.; unoccupied: 386,526,935 ac. (pastoral leases: *c.* 201,722,000 ac.; mining: *c.* 106,000 ac.; timber: *c.* 1,664,000 ac.).

Population (June 1933 census): 438,852 (males: 233,937; females: 204,915); not including the aboriginals (1940 estimate: about 27,000, including half-castes) = 6.6% of the population of the commonwealth, and 0.5 persons per sq.mi. The population had increased to 468,311 by the end of 1940. The 1926 birth rate was about 22 and the death rate 9 per 1,000.

The average annual increase from 1923–27 was 9,700. Metropolitan Perth, covering 87,563 acres with its suburbs, had 207,440 inhabitants in 1933 or 48% of the state's total.

Mining: (1939) Total: £12,288,000. Gold: £11,796,000 (95% of total Western Australian mining output and 74% of total Australian gold output) (rising); silver and lead, £29,477 (fluctuating); tin, £7,421 (fairly constant); copper, low (1923: £65,100); coal (1939) all Collie: 557,000 tons, £362,000 (falling).

Agriculture: Area devoted to cultivation and being cleared (1937): 15,216,000 ac. (under crop, 3,849,000 ac.; fallow, 2,539,000 ac.). Wheat: 2,575,000 ac.; 21,550,000 bu. (8.4 bu. per acre) (1928: *c.* 3,000,000 ac., 35,134,000 bu.). Hay: 478,000 ac., 412,000 tons. Oats: 463,000 ac., 3,445,000 bu. Orchards: 22,320 ac. Vineyards: 6,105 ac., 348,000 gal. wine.

Pastoral and Dairying (1936): Horses, 155,000; cattle, 792,000; sheep, 9,007,000; pigs, 76,451.

Production (1935–36): butter, 12,600,000 lb.; bacon and ham, 4,500,000 lb.

Manufacturing Industries: Factories (1939–40): 2,129, employing 22,825 hands. Value added by process: £9,000,000. Food and drink factories 458 (employing 3,893 hands); clothing, 234 (3,173 hands); woodworking, 213 (2,532 hands); machinery, etc., 643 (6,796).

Trade, Commerce, Communications: (*a*) *Trade:* Total (1939) £42,400,000. *Exports:* £23,000,000. Value per caput (1939–40): £49. (Interstate: *c.* 7%, overseas, *c.* 93%). *Wheat:* £3,000,000; flour, £584,000. *Wool:* £3,270,000 (72,000,000 lb.). *Timber:* £722,000; sandalwood £47,000. *Cattle products:* hides, etc., £367,000. *Gold:* £10,710,000. *Fruit:* £648,985; *Pearl shell:* £105,000. *Imports:* £19,394,166. Value per caput (1939): £42.

(*b*) *Shipping* (1938–39): Entered: 493 vessels (net tonnage 2,097,000); cleared: 556 (2,278,000 tons).

(*c*) *Ports:* Total trade (1927–28); Fremantle, £30,639,000; Bunbury, £2,256,700; Geraldton, £1,124,100; Albany, £708,000, Wyndham, £263,500; Carnarvon, £253,000; Busselton, £213,500; Broome, £195,200; Port Hedland, £109,200. In 1938–39 Fremantle shipped overseas 555,000 tons out of a total for the state of 943,000 tons. The interstate trade was 119,000 tons for Western Australia.

(*d*) *Railways.* State government lines (1941): 4,331 mi. (3′ 6″ gauge). Commonwealth government (transcontinental line, Western Australian section Kalgoorlie—South Australian border): *c.* 454 mi. (4′ 8½″ gauge).

In addition, *c.* 815 mi. private railways (mainly 3′ 6″), of which *c.* 277 mi. open for general traffic. The state railways in 1928 showed a net profit of £26,671.

Finance: (1941): Revenue: £11,432,000 (24.4 per caput); expenditure: £11,420,000 (£24.0). Public debt (net): £97,791,000; average interest payable: 3.65%; £207.4 per caput. Cheque-paying banks (10): liabilities (1941): £25,403,000; assets, £30,102,000. State Savings bank: deposits, *c.* 239,000; £12,521,000 (*c.* £52.4 per caput). (O. H. T. R.; X.)

See: E. de C. Clarke: "Natural Regions in Western Australia" in *Journal Royal Soc. Western Australia,* vol. xii, no. 14 (1926); W. C. S. McLintock: *The Swan Geography* (1923); *Western Australia: An Official Handbook* (1925); S. M. Wadham and G. L. Wood, *Land Utilisation in Australia* (1939); G. Taylor, *Australia* (1943).

HISTORY

Both the western and northern coasts of the colony are very roughly laid down on maps said to date from 1540 to 1550, where the western side of the continent terminates at Cape Leeuwin. The position of the coast may have been known to Portuguese and Spanish navigators, who were in the seas northward of Australia as early as 1520.

The Dutch explored the coast about 1616 and the French in the 18th century.

The earliest settlement was made from Port Jackson, at the end of 1825, when, owing to a fear that the French might occupy King George sound, Major Lockyer took formal British possession of it with a party of convicts and soldiers, 75 in all, though Vancouver had previously done so in 1791. Yet the Dutch had long before declared New Holland, which then meant only the western portion of Australia, to be Dutch property. This convict establishment returned to Sydney in 1829. In 1827 Captain Stirling surveyed the coast from King George sound to the Swan river, and Captain Fremantle, R.N., in 1829 took official possession of the whole country.

Stirling's account stimulated the emigration ardour of Sir F. Vincent and Peel, Macqueen, etc., who formed an association, securing from the British government permission to occupy land in Western Australia proportionate to the capital invested, and the number of emigrants they despatched thither.

In this way Peel had a grant of 250,000 ac., and Colonel Latour of 103,000. Captain (afterwards Sir James) Stirling founded the Swan River Settlement, the towns of Perth and Fremantle, and was appointed lieutenant-governor in 1829. The people were scattered on large grants. The land was poor, and the forests heavy, provisions were at famine prices; and many left for Sydney or Hobart Town. The overland journey of Eyre from Adelaide to King George sound in 1839–40, through a waterless waste, discouraged settlers; but Grey's overland walk in 1838 from Shark's bay to Perth revealed some rivers and good land in Victoria district, subsequently occupied by farmers, graziers and miners. The difficulties of the settlers had compelled

them to seek help from the British treasury, in the offer to accept convicts. These came in 1850, but transportation ceased in 1868, in consequence of loud protests from the other colonies.

The progressive history of Western Australia may be said to commence in 1870, with the beginning of partial representative government under the presidency of Governor Sir Frederick Weld. The colony was fortunate in possessing two explorers of the best practical type—the brothers, John and Alexander Forrest. The object of their expeditions was to find more land available for pastoral or agricultural settlement. Perhaps the most famous of these journeys was that accomplished by Mr. (afterwards Sir) John Forrest between Eucla and Adelaide in 1870. Other explorers—notably Mr. Ernest Giles, the Gregorys and Mr. Austin—also contributed to the growing knowledge of the resources of the vast territory. In 1882 the government geologist reported indications of auriferous country in the Kimberley district, and the first payable goldfield was shortly afterwards "proclaimed" there. Within five years goldfields were proclaimed at Yilgarn, about 200m. to the east of Perth, and the discovery of patches of rich alluvial gold in the Pilbarra district quickly followed, but the rush for the Coolgardie and Kalgoorlie goldfields did not begin until 1893.

A bill enabling the queen to grant a constitution to Western Australia received the royal assent on Aug. 15, 1890. This provided for a governor, a legislative council and a legislative assembly, the two bodies to be appointed by the governor until the population reached 60,000. In 1893 the Colonial Parliament passed an act so amending the constitution.

For a long time the advantages of federation were not so apparent to the people of Western Australia as to those of the eastern colonies. They were slow to grasp the principles of the bill framed at the Federal Convention which had held its sittings since 1886 in Adelaide, Sydney and Melbourne; and they hesitated to join the Commonwealth without receiving a pledge for the retention of their own customs dues for five years. Early in 1900 Sir John Forrest as premier made an unsuccessful attempt to obtain this concession. On a referendum of the electors, a majority of over 25,000 votes decided in favour of federation, as the Constitution Act provided that this state should have the right to enact her own tariff as against the sister states for the desired five years, decreasing annually at the rate of one-fifth of the amount of the original duty until the whole disappeared. In 1933 a referendum favoured secession from the Commonwealth, but a joint committee of the British Houses of Parliament declared itself in 1935 incompetent to consider the state's petition to that effect. By the Constitution Acts Amendment Act, 1911, the legislative council is limited to 30 members representing 10 provinces and elected for six years. The legislative assembly consists of 50 members, elected for three years.

WESTERN INDIA STATES AGENCY, an agency for Indian States in Kathiawar, Cutch and Palanpur, formed in 1924. The States included are Bhavnagar, Cutch, Dhrangadhra, Dhrol, Gondal, Jafarabad, Junagadh, Demdi, Morvi, Nawanagar, Palanpur, Palitana, Porbandar, Radhampur, Rajkot, Wadhwan, Wankaner. Formerly under Bombay, they now have direct relations with the Imperial Government through an agent in Rajkot.

WESTERN PACIFIC RAILROAD CORPORATION, THE, incorporated under the laws of Delaware June 29, 1916, is a holding company owning the entire capital stock, except directors' qualifying shares, of the Western Pacific Railroad Company (operating company). The corporation, along with other assets, owns one-half interest, or 150,000 shares of the no-par common stock of the Denver and Rio Grande Western Railroad Company, and equity in 50,000 shares (one-half) of the capital stock of Utah Fuel Company. The capital structure of the corporation is as follows: Capital stock, 6% preferred (par $100), $40,000,000 outstanding; common (par $100), $60,000,000 outstanding; no funded debt.

Late in 1935, the Western Pacific Railroad Company (wholly owned) and the Denver and Rio Grande Western Railroad Company (one-half owned) filed petitions in the Federal District Court in their respective districts for purpose of effecting reorganization under Section 77 of the amended Federal Bankruptcy Act. Plans were filed by various interests and hearings were held before the Interstate Commerce Commission. The commission thereafter approved and certified to the respective court plans of reorganization for both companies. The plan for Western Pacific was upheld by the U.S. supreme court in March 1943, after it had previously been rejected by the 9th circuit court of appeals. The commission's plan for the Denver and Rio Grande was approved by the federal district court at Denver in Sept. 1943. (M. J. C.; X.)

WESTERN UNION TELEGRAPH COMPANY, THE, was incorporated in New York, April, 1851, as The New York and Mississippi Valley Printing Telegraph company to construct, own and operate a telegraph line from Buffalo, N.Y., to St. Louis, Mo., via Cleveland, Columbus and Cincinnati. The capital was fixed at $360,000. In 1856 the name was changed to The Western Union Telegraph company. In Oct. 1943, having absorbed, in the preceding years, more than 535 telegraph companies, Western Union purchased Postal Telegraph, Inc., the second largest U.S. telegraph company, after the passage of a special act of congress amending the Federal Communications act to permit the merger to take place. In the year 1942 Western Union's plant comprised 208,321 mi. of pole lines; 1,904,963 mi. of wire; 4,211 mi. of landline cables; 30,341 nautical mi. of ocean cables and 18,677 telegraph offices. Postal Telegraph's assets, which were acquired by Western Union at the time of the merger, included 37,100 mi. of pole lines; 407,000 mi. of wire and 3,214 main telegraph offices, as well as a number of branches. Western Union's telegraph service is universal in the United States and through its cable system extends to Great Britain and Europe, South America, the West Indies, Mexico and Canada. By connections it goes to all parts of the world. (R. B. Wh.; X.)

WESTER WEMYSS, ROSSLYN ERSKINE WEMYSS, 1st Baron cr. 1919, G.C.B., 1918 (1864–1933), British sailor, was born in London on April 12, 1864. He entered the navy in 1877. Rear-admiral of 2nd Battle Squadron 1912–13 and of the 12th Cruiser Squadron 1914, he was made vice-admiral 1916 and admiral of the fleet 1919. He commanded a squadron during the landing of the British troops in Gallipoli (1915), was commander-in-chief in the East Indies and Egypt (1916–17), deputy first sea lord, and afterwards first sea lord of the Admiralty (1917–19) and a member of the War Cabinet (1918). In 1924 he published *The Navy in the Dardanelles Campaign.*

WESTFIELD, a city of Massachusetts, U.S.A. Pop. (1940) 18,793. It is the seat of the Westfield State Teachers college, established by Horace Mann. Its manufactures include bicycles, boilers, textile machinery, grinding wheels and abrasives, paper, envelopes, brushes, thread, fish lines, boxes, brick, gas pumps, small hardware, name plates, celluloid and foundry products, dresses. The manufacture of whips and lashes began early in the 18th century and, engaging more than 40 concerns at its height, was the city's leading industry until the multiplication of automobiles cut down the market. Westfield academy (1800–66) was a famous secondary school. A trading post known by the Indian name of Woronoco was established there about 1640, and in 1669 Westfield was set off from Springfield and incorporated as a town. It was incorporated as a city in 1921. There is a municipal airport.

WESTGATE-ON-SEA, watering-place, Isle of Thanet. Pop. (1931) 4,642. There are gardens and promenades over 1 mi. long, a marine drive along the cliffs, and golf links. Birchington, to the west, is a growing resort. Both were transferred to the borough of Margate in 1935. All Saints' church is Perpendicular, with Early English tower, and has interesting monuments.

WEST HAM, a county and parliamentary borough of Essex, England, forming an eastward suburb of London. Pop. (1938) 254,900. Area 7.4 sq.mi. The old church of All Saints has a good Perpendicular tower and some early mural painting. A Transitional Norman clerestory remains above the later nave. The town owns 8 recreation grounds besides West Ham park (80 ac.), which occupies the site of Ham house, the residence of Samuel Gurney, the banker and philanthropist. Within the borough is Stratford, where there are extensive railway works of the L.N.E.Ry. This

industrial centre is continued eastward to East Ham, where the old village church of St. Mary Magdalene retains Norman portions. West Ham manufactures artificial stone for street-paving and carries on distilling, silk printing, the making of chemicals and shipbuilding.

At the time of Domesday West Ham belonged to Ralph Gernon and Ralph Peverel. It received the grant of a market and annual fair in 1253. The lordship was given to the abbey of Stratford, and, passing to the crown at the dissolution, formed part of the dowry of Catherine of Portugal and was therefore called the Queen's Manor. West Ham was incorporated in 1886 and made a county borough in 1889. It returns 4 members to parliament.

WEST HAVEN, a town of Connecticut, U.S.A. Population was 30,021 in 1940. It is mainly a residential and industrial suburb of New Haven. Savin Rock, rising out of Long Island sound, is a popular pleasure resort. West Haven was taken from New Haven in 1822 and united with North Milford to form the town of Orange. It was incorporated as a borough in 1873; reverted to Orange town after 1910; and in 1921 was incorporated as an independent town.

WEST INDIES, THE, sometimes called the Antilles (*q.v.*), an archipelago stretching in the shape of a rude arc or parabola from Florida in North America and Yucatan in Central America to Venezuela in South America, and enclosing the Caribbean sea (615,000 sq.mi.) and the Gulf of Mexico (750,000 sq.mi. in area). The land area of all the islands is, roughly, 93,000 sq.mi., with an estimated population of nearly 14,000,000, that of the British islands about 13,500 sq.mi. The islands differ widely one from another in area, population, geographical position and physical characteristics. They are divided into the Bahamas, the Greater Antilles (Cuba, Jamaica, Hispaniola and Puerto Rico), and the Lesser Antilles, which comprise the remainder. The Lesser Antilles are again divided into the Windward Islands and Leeward Islands. Geographically, the Leeward Islands are those to the north of St. Lucia, and the Windward, St. Lucia and those to the south of it; but for administrative purposes the British islands in the Lesser Antilles are grouped as is shown in the table given later.

Geology.—The West Indies are the summits of a submerged mountain chain, the continuation of which toward the west must be sought in the mountains of Honduras. In Hispaniola the chain divides, one branch passing through Jamaica and the other through Cuba, the Cayman Islands and the Misteriosa bank. In Cuba and Hispaniola there are schists which are probably of pre-Cretaceous age, and have, indeed, been referred to the Archaean; but the oldest rocks which have yet been certainly identified in the West Indies belong to the Cretaceous period. Throughout the Greater Antilles the geological succession begins, as a rule, with volcanic tuffs and conglomerates of hornblende-andesite, etc., in the midst of which are intercalated occasional beds of limestone with *Rudistes* and other Cretaceous fossils. These are overlaid by sediments of terrigenous origin, and the whole series was folded before the deposition of the next succeeding strata. The nature of these Cretaceous deposits clearly indicates the neighbourhood of an extensive area of land; but during the succeeding Eocene period and the early part of the Oligocene, a profound subsidence led to the deposition of the Globigerina chalks and white Radiolarian earths of Jamaica, Cuba and Hispaniola. The Greater Antilles must, at this time, have been almost completely submerged, and the similar deposits of Barbados and Trinidad point to a similar submergence beyond the Windward Islands. In the middle of the Oligocene period a mighty upheaval, accompanied by mountain folding and the intrusion of plutonic rocks, raised the Greater Antilles far above their present level, and united the islands with one another, and perhaps with Florida. A subsequent depression and a series of minor oscillations finally resulted in the production of the present topography.

The geology of the Lesser Antilles is somewhat different. In some of the islands there are old volcanic tuffs which may possibly be the equivalents of the Cretaceous beds of Jamaica, but volcanic activity there continued throughout the Tertiary period and even down to the present day. Another important difference is that, except in Trinidad and Barbados, which do not properly belong to the Caribbean chain, no deep-sea deposits have yet been found in the Lesser Antilles and there is no evidence that the area ever sank to abysmal depths.

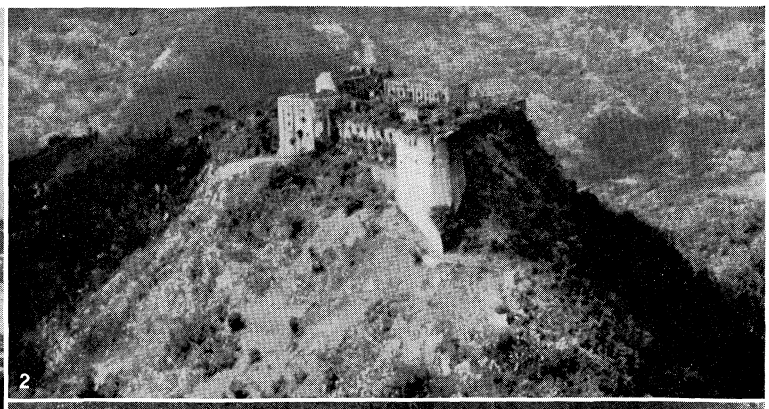
The mineral wealth of the islands, except for petroleum in Trinidad, is neither remarkable nor of great consequence. Gold, silver, copper, tin, platinum, lead, a poor quality coal, cobalt, mercury, antimony, manganese and rock salt are worked or have been worked in the past. Phosphate is of some importance in Curaçao, and asphalt is worked to considerable advantage in the pitch lakes of Trinidad. Opal and chalcedony are the principal precious stones.

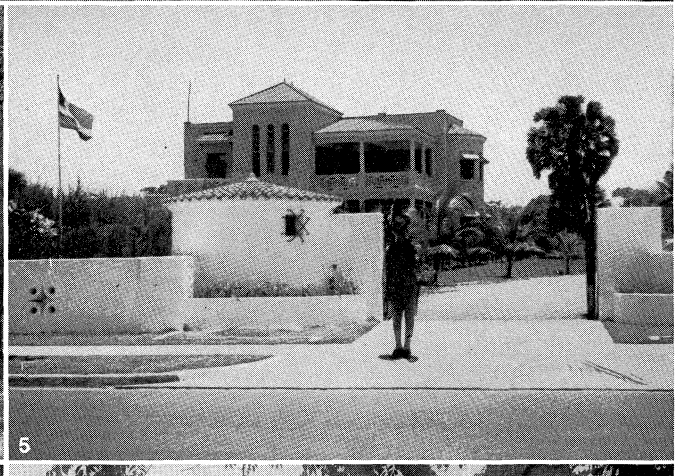
Some petroleum exists in Barbados, but only in small quantities. Trinidad, however, has important deposits which have been successfully exploited since 1911, when the first shipment overseas was made. Production subsequently increased until Trinidad became the greatest source of crude oil within the British empire.

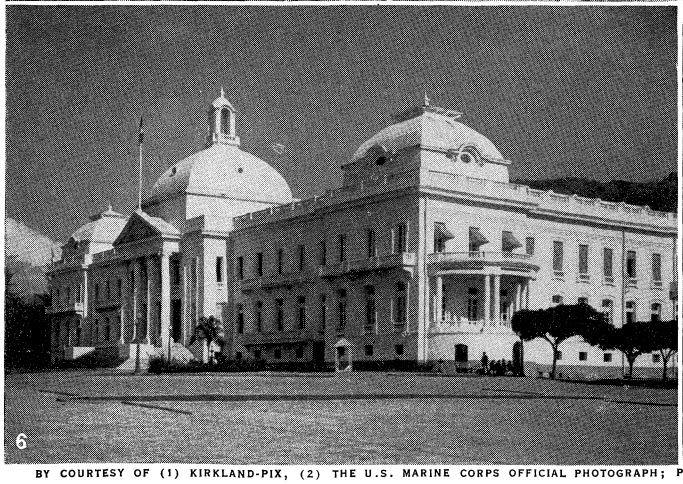
Climate.—As in most tropical countries where considerable heights are met with—and more than 15,500 sq.mi. lie at an elevation of more than 1,500 ft. above sea level—the climate of the West Indies (in so far at least as heat and cold are concerned) varies at different altitudes, and on the higher parts of many of the islands rather low temperatures are found. These islands all lie in the path of the northeasterly trade winds and their climatic conditions are typical of islands in this belt. With the exception of part of the Bahamas, all the islands lie between the annual isotherms of 77° and 82° F. The climate, however, is everywhere marine, and the extreme heat is greatly tempered by the steady trades, by the daily sea breezes and by cool, refreshing nights. Frost occasionally occurs in the cold season, but snow is unknown. The seasons may be divided as follows: The short, wet season, or spring, begins in April and lasts from two to six weeks, and is succeeded by the short dry season, when the thermometer remains almost stationary at about 80° F. In July the heat increases and continues until September or October, when the great rainfall of the year begins, accompanied frequently by tremendous and destructive hurricanes. This season is locally known as the "hurricane months." The annual rainfall averages about 60 inches. December marks the beginning of the dry season, which, accompanied by fresh winds and occasional showers, lasts till April. The average temperature of the air at Barbados, which may be taken as typical, is, throughout the year, 80° F in the forenoon, and about 82° in the afternoon. The maximum is 87°, and the minimum 75°.

Flora.—The flora of the islands is of great variety and richness, as plants have been introduced from most parts of the globe, and flourish either in a wild state or under cultivation; grain, vegetables and fruits, generally common in cool climates, may be seen growing in luxuriance within a short distance of like plants which only attain perfection under the influence of extreme heat, nothing being there required for the successful propagation of both but a difference in the height of the lands upon which they grow. The forests, which are numerous, produce the most valuable woods and delicious fruits. Palms are in great variety, and there are several species of gum-producing trees. Some locust trees have been estimated to have attained an age of 4,000 years, and are of immense height and bulk. Pimento is peculiar to Jamaica. For centuries almost the whole care of the planters was bestowed upon the cultivation of the sugar cane and tobacco plant, but in modern times attention has been turned to the production of other and more varying crops. Crops of tobacco, beans, peas, maize and Guinea corn are popular, and a species of rice which requires no flooding for its successful propagation, is largely produced. *Hymenachne striatum* covers many of the plains, and affords food for cattle.

Fauna.—The fauna of the region is Neotropical, belonging to that region which includes South and part of Central America, although great numbers of birds from the North American portion of the Holarctic realm migrate to the islands. The resident birds, however, 18 genera of which are certainly Neotropical, show beyond doubt to which faunal region the islands properly belong. The nonmigrating birds include trogons, sugarbirds, chatterers,





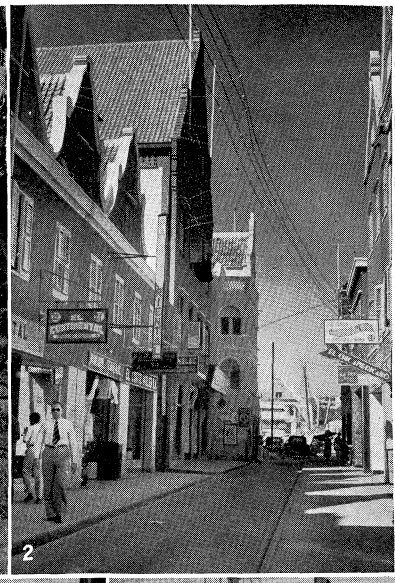


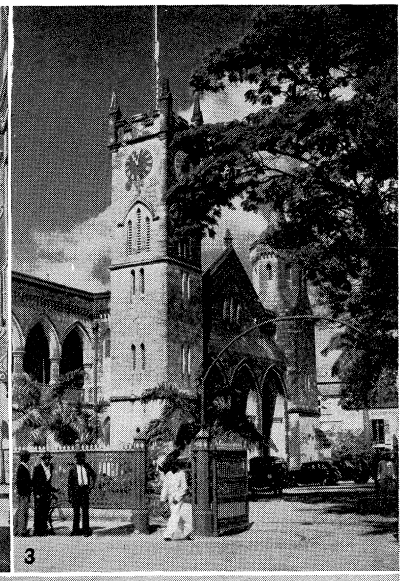
BY COURTESY OF (1) KIRKLAND-PIX, (2) THE U.S. MARINE CORPS OFFICIAL PHOTOGRAPH; PHOTOGRAPHS, (3) ERIC SCHAAL-PIX, (4) LOTTE JAY-PIX, (5, 6) BURTON HOLMES FROM EWING GALLOWAY, (7) PUBLISHERS PHOTO SERVICE

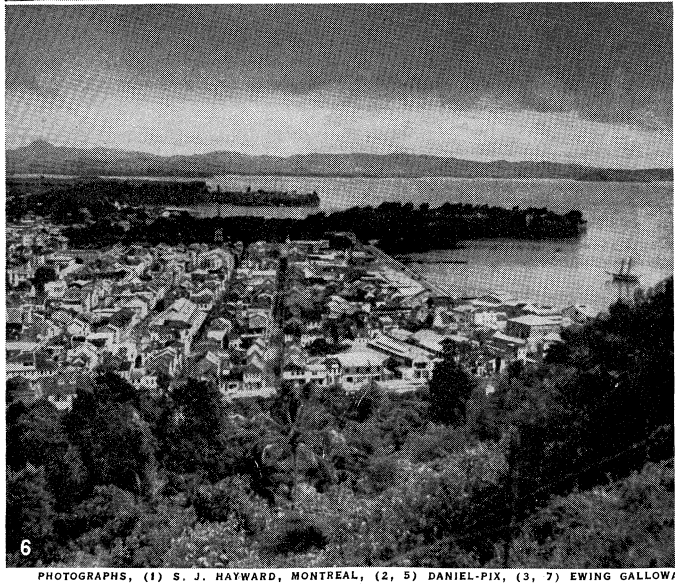
THE GREATER ANTILLES

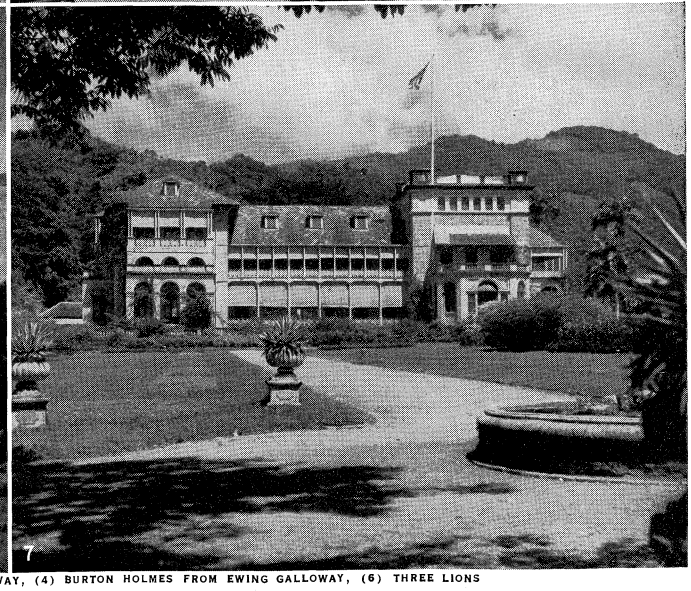
1. Native Negroes along the waterfront at Kingston, capital of Jamaica
2. "La Ferrière," the citadel of Henri Christophe (ruled 1811–20), second Negro king of Haiti. Erected on a peak near Cap Haitien, this citadel is a remarkable monument to the early years of the first state in the world governed constitutionally by Negroes
3. Street vendors in Havana, Cuba
4. The square of Villalba, a Puerto Rican village near Ponce
5. Presidential residence at Ciudad Trujillo, capital of the Dominican Republic, on the island of Hispaniola
6. Capitol at Port-au-Prince, capital of Haiti
7. Country scene in Puerto Rico, most easterly of the Greater Antilles

WEST INDIES









PHOTOGRAPHS, (1) S. J. HAYWARD, MONTREAL, (2, 5) DANIEL-PIX, (3, 7) EWING GALLOWAY, (4) BURTON HOLMES FROM EWING GALLOWAY, (6) THREE LIONS

THE LESSER ANTILLES

1. Gros Islet bay, St. Lucia, and Pigeon island. This is the site of the U.S. air base leased from Great Britain in 1940
2. Business street in Willemstad, capital of Curaçao in the Netherlands West Indies
3. The parliament building at Bridgetown, capital of the British colony of Barbados
4. The main business street in Port of Spain, capital of Trinidad
5. The waterfront at Willemstad
6. Harbour of Fort de France, on the French island of Martinique
7. The governor's mansion in Port of Spain, Trinidad

and many parrots and hummingbirds. Waterfowl and various kinds of pigeons are in abundance. Mammals are, as in most island groups, rare. The agouti abounds, and wild pigs and dogs are sufficiently numerous to afford good sport to the hunter, as well as smaller game, in the shape of armadillos, opossums, muskrats and raccoons. Reptiles are numerous: snakes—both the boa and adder—are innumerable, while lizards, scorpions, tarantulas and centipedes are everywhere. Insects, too, are very numerous and are often annoying. Among domestic animals mules are largely reared, and where the country affords suitable pasture and forage, cattle breeding is practised. Goats abound, and large flocks of sheep are kept for the sake of their flesh alone, as the climate is not adapted for wool growing.

Archaeology.—At the time of Columbus the West Indian groups of islands were inhabited by tribes of two distinct South American ethnic stocks; the Greater Antilles by a branch of the Arawak people (known as Tainan); the Bahamas by another Arawak branch (the Lucayan); and the Lesser Antilles by the Carib.

The West Indies, in the first instance, seem to have been populated by a wave of Arawak immigration, followed by a second wave of Carib immigrants, who, by the end of the 15th century had exterminated the male population of the Lesser Antilles, and had even obtained a foothold on the eastern end of Puerto Rico. The culture of the two races appears to have been very similar, though the Tainan were superior in craftsmanship. The Carib practised cannibalism, a custom which was rare (even if it existed at all) among the Tainan. It is possible that certain Maya influences from Yucatan had affected the ethnography of, at any rate, western Cuba; and there are indications that the Lucayan inhabitants of the Bahamas were in touch with the tribes of Florida, though, in this case, they appear to have given more than they received. The Tainan lived under the rule of a number of hereditary chieftains, known as *cacique,* whose rule was mildly despotic, who were leaders in war, and also exercised certain priestly functions. Inheritance of rank seems to have passed to the eldest son, or failing male issue to the eldest son of the late cacique's sister. As to property, among the general populace, the sister's son was the normal heir. The Carib organization appears to have been rather more democratic. The chiefs were essentially war leaders, and the adult members of the *Carbet* (or "Men's House") constituted a sort of council. Chieftainship was not necessarily hereditary, but depended to a great extent on personal prowess. The difference was the natural outcome of circumstances. The surviving Tainan had been in long occupation of the larger islands, and were comparatively sedentary. The Carib, with only small islands at their disposal, were still a semi-migratory people, engaged in the conquest of fresh territory. Though all the islanders practised agriculture (maize being the most important crop), cultivation played a more important part in Tainan culture, while the fishing industry was more important among the Carib. Carib organization, which was devised to provide for long fishing excursions or military raids, gave rise to rumours of "Amazon" tribes in the Caribbean, since the early explorers occasionally encountered islands peopled, apparently, only by women. Again, the practice of the Carib of taking the Arawak women as wives, after killing the men, led to a dual linguistic system on certain islands; the women (and their daughters) speaking Arawak, while the men and elder boys (who from an early age accompanied their fathers in their various voyages) spoke Carib.

The religion of both peoples was a form of nature worship. A number of aetiological myths have been preserved, mostly of a very inconsequential nature (for details *see* bibliography). Certain high powers, connected with the sky and rain, were propitiated, and the spirits of ancestors and tree spirits were objects of common worship. Most of the idols fall under the class of "fetishes," to which the word *Zemi* was applied. This term is almost exactly parallel to the Peruvian word *Huaca,* and has as wide a connotation, including both the great powers, and images of wood and cotton (the latter often enclosing the bones of ancestors), and amulets and even ceremonial paintings on the body. Both Tainan and Carib were expert in the handling of stone, though the former were superior. The practice of flaking was practically nonexistent, and implements and ceremonial objects were prepared by polishing. The comparative superiority of the Tainan rested to a great extent on the fact that they had access to a larger, and more varied, supply of raw material. In fact on certain of the Carib islands (notably Barbados) workable stone was nonexistent, and implements were carved from fossil shell. Certain stone products of the Tainan artisan show remarkable proficiency, especially the large "horse-collar" fetishes (principally from Puerto Rico, and probably connected with tree worship); the so-called "three-pointed stones" (also chiefly related to Puerto Rico, and probably connected with the cult of the cassava); and the pestles and axe blades of Jamaica, of which the latter, in qualities of form and polish, challenge comparison with the celts of any other region of the world. In the Greater Antilles gold was collected from the rivers, or by excavation, and worked into ornaments by means of hammering, the process of casting being unknown. Pottery, of rather a rude nature, was made, more particularly by the Tainan, but in no case approximated to the wares of Central America or Peru.

One product, which possessed both an economic and religious significance, was the tobacco plant, known as *Cohiba* or *Cogioba,* the smoke of which was inhaled through tubes termed *Tabaco.* The name of the tube became transferred to the plant, and has survived in modern civilization. The inhalation of tobacco smoke was practised at important ceremonies, and eventually reduced the officiating priest to a state of coma, during which he ex-

Name	Area sq.mi.	Population	Capital Cities
British			
Bahamas (main islands 4,375 sq. mi.)	5,450	68,846 (1943)*	Nassau (29,391 on New Providence Is.)
Jamaica (not incl. dependencies)	4,470	1,237,063 (1943)*	Kingston (109,056)
Cayman Islands	93	6,670 (1943)*	Georgetown (1,400)
Turks and Caicos Is.	202	6,138 (1943)*	Grand Turk (1,668)
Leeward Islands			
Antigua (incl. Barbuda and Redonda 62.5 sq.mi.)	171	40,972 (1942)**	St. John's (10,000)
Montserrat	32	13,332 (1942)**	Plymouth (2,000)
St. Kitts-Nevis (St. Christopher, 68 sq.mi.; Nevis, 50 sq.mi.; Anguilla, 34 sq.mi.)	152	38,848 (1942)**	Basseterre (8,500)
Virgin Islands	67	6,720 (1941)**	Road Town (400)
Barbados	166	203,411 (1943)**	Bridgetown (84,568 in St. Michael parish)
Windward Islands			
Dominica	304	53,202 (1941)**	Roseau (9,000)
Grenada (incl. Carriacou, 13 sq.mi.; pop. 9,358)	133	90,586 (1940)**	St. George's (6,500)
St. Lucia	233	71,232 (1940)**	Castries (9,000)
St. Vincent (incl. the Lesser Grenadines)	150	61,447 (1940)**	Kingstown (4,500)
Trinidad and Tobago (Tobago, 116 sq.mi.; pop. 32,074)	1,978	522,168 (1942)**	Port of Spain (100,585)
Netherlands			
Curaçao	210	73,343 (1943)**	Willemstad (31,264)
Aruba	69	35,933 (1943)**	
Bonaire	95	5,725 (1943)**	
Saba	5	1,229 (1943)**	
St. Eustatius	7	1,018 (1943)**	
St. Martin (southern part)	17	2,337 (1943)**	
French			
Guadeloupe (incl. Marie-Galante), 58 sq.mi.; Désirade, 14½ sq. mi.; Les Saintes Is., 5½ sq.mi.; St. Bartholomew, 8 sq.mi.; St. Martin (northern part), 20 sq.mi.	688	304,239 (1936)*	Basse-Terre (13,638)
Martinique	427	246,712 (1936)*	Fort-de-France (46,446)
United States			
Puerto Rico	3,435	1,869,255 (1940)*	San Juan (169,247)
Virgin Is. of the U. S.			
St. Croix	82	12,992 (1940)*	Christiansted (4,495)
St. Thomas	32	11,265 (1940)*	Charlotte Amalie (9,801)
St. John	19	722 (1940)*	
Independent Republics			
Cuba	44,217	4,778,583 (1943)*	Havana (659,883)
Dominican Republic	19,332	1,678,220 (1942)**	Ciudad Trujillo (71,091)
Haiti	10,695	3,000,000 (1942)**	Port-au-Prince (125,000)

*Census **Estimate

perienced visions which were regarded as divine revelations.

(T. A. J.)

Area and Population.—The table on p. 535 gives the area, latest census or official estimate of population and the capital cities or towns of each of the West Indian islands.

Racially, the character of the West Indies has undergone a marked transformation since their occupation by European nations. The aboriginal race has almost entirely disappeared. Only on a few of the islands, particularly St. Vincent and Dominica, are there natives left. Even there they are but few in number and of mixed race rather than pure-blooded. Elsewhere the West Indian Carib is virtually extinct. His place has been taken only in part by the invader. Although the white race (either from Spain or northwestern Europe) was the conqueror and first settler on all the islands, and although for a century or so it seemed that the West Indies, like the mainland of the new world, would become filled with a European population, most of the islands have not proved suitable for permanent settlement by this race. In Cuba and Puerto Rico the whites have become firmly established and now constitute about 75% of the total population. But upon all the other islands the white race has failed to hold its own. In nearly every other part of the archipelago Africans now vastly outnumber all other races. These people, brought in to meet the needs of tropical agriculture, have survived the conditions presented by the tropics far better than their masters, and the West Indies have become virtually a racial extension of Africa. In the republic of Haiti some nine-tenths of the population are Negroes and the remaining tenth is mulatto. In Martinique only about 1% is not Negro or mulatto. Three-quarters of the populations of Barbados and Jamaica are of African Negro descent and less than 10% are white, the remainder being of mixed blood. Most of the other islands present a similar racial composition, although a considerable percentage of East Indians are also to be found in Trinidad and elsewhere. In the Netherlands islands and in some of the Bahamas the proportion of Negroes is somewhat smaller than elsewhere.

History.—The archipelago received the name of the West Indies from Columbus, who hoped that, through the islands, he had found a new route to India. The name of Antilles was derived from the fact that Columbus, on his arrival there, was supposed to have reached the fabled land of Antilia. Columbus first landed on San Salvador, generally identified with Watling Island of the Bahamas, and several voyages to this new land were made in rapid succession by the great discoverer, resulting in the finding of most of the larger islands and a more intimate knowledge of those already known. The importance of its latest possession was at once recognized by the court of Spain, and, by 1540, Spanish settlements had been made on all of the larger islands and upon many of the smaller ones. The natives were promptly reduced to a state of serfdom or virtual slavery, being distributed, with the lands upon which they lived, among the *conquistadores,* in the form of *encomiendas* or *repartimientos,* institutions which were designed to bring the Indians into subjection to Spanish authority, to provide them with the instruction necessary for becoming Christians and to furnish the Spanish settlers in these tropical islands a labour supply for the fields and mines. The system resulted in great oppression and contributed materially to the decimation of the native population. The small remnant that survived mingled with the Spanish population to such an extent that few individuals of pure Indian blood could be found on the principal islands.

Spain was not long allowed to retain an undisputed hold upon the West Indies. British, Dutch, French and Danish seamen, coming down the path of the trade winds in their sailing vessels and thus touching at the islands as the first outposts of the new world, soon asserted their claims to parts of this region whose fabled wealth had stirred all Europe, and a persistent warfare began to be waged for its possession, in consequence of which the Spaniards found themselves gradually but surely forced from many of their vantage grounds.

In 1625 the English began their colonization of the West Indies by establishing a settlement upon the diminutive island of St. Christopher (St. Kitts), 23 mi. long by 5 broad. This was quickly followed by other settlements on St. Eustatius, Barbados, Tobago and St. Croix (all in the same year, 1625), and upon Nevis (1628), Antigua and Montserrat (1632). Other English settlements were made within the next few decades, and by 1713 Britain had such a firm hold in the West Indies that the treaty of Utrecht recognized her claims to the Bahamas, Jamaica, the Caymans, the Caicos and Turks, as well as to most of the islands upon which the settlements above listed had been made and to some others of lesser importance. The first care of the English was to find out the agricultural possibilities of the islands, and they diligently set about planting tobacco, cotton and indigo. About 1650 sugar cane came to be systematically planted, and it is from this crop that the greatest prosperity of the West Indies has come. Plantation agriculture has long been the basis of economic, social and political development.

Meanwhile the French also had been attracted to the islands. A French West India company was incorporated in 1625 and a settlement established on the island of St. Christopher, where a small English colony was already engaged in clearing and cultivating the ground. These were driven out by the Spaniards in 1630 but only to return and again assume possession. Another colony was planted by the French beside the English settlement on St. Eustatius, and Grenada was occupied at the same time, both in 1625. Dominica followed in 1632 and Martinique in 1635, while Guadeloupe, St. Bartholomew and St. Martin were occupied in 1648. The treaty of Utrecht confirmed France in possession of most of the above islands and in addition, the western third of Hispaniola (the portion broadly corresponding to the present republic of Haiti), Désirade, St. Lucia and St. Croix. France was to share St. Martin with the Dutch. Several lesser islands were also included in the French domain. In 1784 France ceded St. Bartholomew to Sweden, who retained it for nearly a century, at which time it was sold back to France in 1877.

Although the Dutch were slightly later in getting a secure foothold in the West Indies, the treaty of 1713 allowed them to retain St. Eustatius, Saba, most of St. Martin, and the group of islands (Aruba, Curaçao and Bonaire) along the coast of Tierra Firme (Venezuela). This latter group had long been the stronghold of Dutch contraband trade with the Spanish main, carried on principally from the well-protected lagoon harbour of the Schattegat (St. Ann's bay). The Danes, too, had planted colonies on at least one of the West Indian islands, and the treaty of Utrecht left them in possession of St. Thomas and St. John, to which St. Croix was later added. The Spanish thus had lost nearly all of the smaller islands and their holdings were limited principally to Cuba, Puerto Rico and eastern Hispaniola. The West Indies had become a region of great political complexity, with nearly all the maritime nations of western Europe represented on the map.

During the 17th century and into the beginning of the 18th, the celebrated buccaneers, French, British and Dutch, infested the Caribbean and neighbouring seas, doing much damage to legitimate trade and causing commerce to be carried on only under armed protection and with much difficulty and danger. In fact, piracy lingered off the coasts down to the early 19th century.

Few important political changes were made in the West Indies after the treaty of 1713 until the period of the wars for independence in America, when both the Spanish and the French parts of Hispaniola were able to break away from the mother countries and establish the new nations of Haiti and the Dominican Republic, 1804 and 1844 respectively. The next great change in the political map was made in 1898 when the Spanish-American War brought independence to Cuba and the acquisition of Puerto Rico by the United States. In 1917 the Danish West Indies also passed into possession of the United States by purchase, Denmark receiving $25,000,000 for her three islands of St. Thomas, St. John and St. Croix, which are now known as the Virgin Islands of the United States.

One of the most important developments in the history of the West Indies was the abolition of slavery. In the French, British, Dutch and Danish islands the Negro and mulatto element had become so numerous that it was no longer possible to hold them in

bondage. Long continued agitation and repeated revolts, particularly in the French colony of Haiti, where the white population was nearly exterminated, made it necessary to remedy the evil. In 1838 the British freed all the slaves in their West Indies possessions, the French and Danes following ten years later. The reform came more slowly in the Dutch and Spanish colonies, and it was not until 1873 that the former freed all their slaves, while in the Spanish islands of Cuba and Puerto Rico slavery continued until 1886. Emancipation, while marking an important advance in human liberty, brought serious consequences in its train. The freed men have been unable to maintain the economic prosperity of former times, while, wherever they are not under the direct control of foreign government, political and social conditions leave much to be desired.

Since the opening of the Panama canal the West Indies have acquired increased importance, due to their strategic location athwart the ocean highway leading to that interoceanic communication. This has not added greatly to the economic value of the islands but has made their numerous excellent harbours rank high as naval bases. Cuba has granted to the United States the use of two of her strategically situated bays, Guantánamo and Bahía Honda, the latter covering the Straits of Florida and the former guarding the Windward passage into the Caribbean between Cuba and the island of Hispaniola. On Puerto Rico the harbour of San Juan serves the same purpose, guarding the gateways to the east and the west of that island, while the spacious, nearly landlocked harbour of St. Thomas in the Virgin Islands of the United States guards the Virgin passage,—the chief feature that led the United States to desire this group of small islands, and to secure them from Denmark at a then fabulous price. Jamaica, Barbados and St. Lucia have played somewhat the same part among the British holdings in the West Indies and Martinique among the French. In 1939, the United States began extensive fortification of Puerto Rico as the keystone of a Caribbean-wide defense system, which was extended in 1940 through the acquisition from Great Britain of the right to establish on 99-year lease naval and air bases in certain British West Indian colonies (see *Defense,* below). The Anglo-American Caribbean commission (*see* below) was formed in 1942 to facilitate joint action in dealing with problems connected with World War II; representatives of the possessions of the Netherlands and France shared in some phases of the work of the commission, and thus a pattern was set for postwar international co-operation in colonial areas.

Government.—The British West Indian colonies present a variety of forms of government. In the cases of the Bahamas and Barbados, all members of the legislatures are elected on a moderate franchise, and a new constitution for Jamaica pending in 1943 provided for election of the entire legislature on a basis of universal adult suffrage. In all other colonies there is a minority of official members in each legislature; the unofficial members are in part nominated and in part elected, the latter being more numerous in every instance. The Leeward Islands colony has a federal form of government, with a general legislative council, and in addition there is a separate legislature for local affairs in each of three of the presidencies (the governor making the laws for the Virgin Islands); while the Windward Islands have a single governor, there is no federal legislature but a legislative council in each of the four constituent colonies. Unification of the judiciary and police services of the Leeward and Windward Islands in 1940 indicated a trend toward both groups being merged into one colony. Governors and high officials are appointed by the crown; other officials are appointed by the governors.

Under the Third French republic, Guadeloupe and Martinique each had an appointed governor and an elective council, with representation in the French parliament, but these rights were materially curtailed under the Vichy regime (1940–43). The Netherlands colonies are governed much as are the British, except that there is less local participation in administration. A territorial dependency of the United States, Puerto Rico has an appointed governor but maintains its own popularly elected insular legislature and is represented in the United States congress by a nonvoting resident commissioner. The Virgin Islands of the United States have a civil government, with a governor and other officials appointed by the president of the United States, but the two main islands have municipal councils, each with considerable powers.

Defense.—Until 1940 the only fortified places in the British West Indies were Jamaica, Barbados and St. Lucia—whose chief importance was as coaling stations. The Anglo-United States "destroyer-base exchange agreement" of Sept. 1940, however, gave the United States sites on 99-year lease for naval and air bases in the Bahamas, Jamaica, St. Lucia, Antigua and Trinidad, and sites were selected and construction begun on them during late 1940 and 1941. The United States has other bases, in Cuba at Bahía Honda and Guantánamo, in Puerto Rico and in the Virgin Islands. Martinique is strongly fortified by the French and Curaçao somewhat less so by the Dutch.

Economic Conditions.—In the 17th and 18th centuries, the West Indian islands were economic pawns of the European states, who developed tropical agriculture on a one- or two-crop basis, using Negro slaves for labour. Abolition of slavery in the 19th century was a generally serious setback, especially in the Lesser Antilles and Jamaica. Too, cane sugar, which the West Indies had long supplied the world in large quantities, was soon faced with keen competition from a rapidly expanding and subsidized European beet sugar industry, and an increasing population found itself unable to enlarge or even to maintain its accustomed markets. Construction of the Panama canal proved an economic boon to all the Caribbean area, and in the first quarter of the 20th century, Cuba above all expanded sugar production immensely—only to face a world overproduction of the commodity and consequently a chronic glut in the world market.

Sugar cane is grown extensively almost everywhere. In Tobago and the Windward Islands, however, cacao is of greater importance, while arrowroot in St. Vincent, spices in Grenada, sea-island cotton in Nevis and Montserrat, limes in Dominica and St. Lucia, bananas and other fruits in Jamaica and coffee in Haiti are leading commodities, as are tomatoes in the Bahamas. The tourist trade is the basis of Bahaman economy and an important factor in the economy of Cuba, Puerto Rico and the Virgin Islands. Trinidad, with its petroleum and asphalt, and Curaçao, the funnel through which most of Venezuelan petroleum passes to be refined and put on the world market, are the only islands with important nonagricultural industries. The archipelago is in no sense self-sufficient, even in foodstuffs, and flour, rice and many other comestibles, and nearly all the necessary manufactured goods are imported. During World War II the shortage of shipping brought the export of bananas, coconuts and citrus fruits almost to a standstill and made it necessary for the islands to grow many foodstuffs hitherto imported. Citrus fruits were pulped to save shipping space, wild rubber was tapped in Trinidad after the plantations in the orient had fallen into Japanese hands, and in all territories many thousands of additional acres were placed under food crops.

Agricultural Education and Research.—All of the British West Indian colonies are served by the Imperial College of Tropical Agriculture, opened at St. Augustine, 8 mi. east of Port of Spain, Trinidad, in 1922. The site was provided by the government of Trinidad and Tobago, and the institution is financed by imperial grants and by contributions from colonies and industries participating. Instruction is provided for undergraduate and postgraduate students of West Indian agriculture and tropical veterinary science, research and investigation is undertaken in the college's laboratories and fields, and its scientists perform much advisory work throughout the Caribbean area.

Social and Economic Betterment.—The effects of the worldwide economic depression of the 1930s were felt particularly in the British West Indies, where low price levels for exports accentuated an already severe unemployment problem. Following labour riots in Trinidad, Jamaica, Barbados and elsewhere, a royal commission, with Lord Moyne as its chairman, was appointed in 1938 to investigate conditions in the West Indian colonies, British Guiana and British Honduras. Acting on the recommendations of the commission, in 1940 the British government planned to establish a West Indian Welfare fund, with a special organization headed by a comptroller to administer it, and to finance it with an annual grant. A comptroller, Sir Frank Stockdale, proceeded to the West Indies, but instead of the fund being established it was decided that the West Indies were to share in the general financial provision made by the Colonial Development and Welfare act, 1940, fixed at £5,000,000 annually for ten years. Stockdale and his advisers visited practically every island in the West Indian sphere, and in a report published as a White Paper in 1943 (Colonial No. 184) he outlined approved schemes for improving public health, agriculture and communications; the Stockdale report was prefaced by a brief description of the natural advantages and disadvantages of each colony and an account of the problems to be solved. The total cost of West Indian schemes approved by March 31, 1943, was £2,228,178, this representing two-thirds of all expenditure sanctioned under the act for the whole empire down to that date.

Anglo-American Caribbean Commission.—Stockdale was also co-chairman of the Anglo-American Caribbean commission (Charles W. Taussig similarly representing the United States). This body consisting of six members (three from each country), was created by joint action in 1942 to deal primarily "with matters pertaining to labour, agriculture, housing, health, education, social welfare, finance and related subjects in territories under British and United States flags," and to advise the respective governments. While Stockdale's headquarters were in Barbados, a permanent secretariat of the commission was established in Washington, with secretaries of the British and United States sections respectively, and a Caribbean office of the state department was set up to serve as the executive agency of the United States section. Confronted with urgent problems arising from the submarine menace in the Caribbean, the

commission concerned itself with the regulation of food imports and increasing local production, with the importation of goods from Canada and the United States and the ships to carry them, and with formation of a schooner pool for better utilization of local vessels in inter-island trade. A fishing survey was also organized, the position of the sugar industry was examined, and the venereal problem dealt with on a co-operative basis.

Labour Supervision.—Conditions under which labour is employed in the British West Indies are supervised by the respective colonial governments. Legislation fixed minimum wages, regulated hours of labour and housing conditions, ensured safeguards for health and against accidents, and provided for workmen's compensation. Labour departments exist in all West Indian colonial administrations, as well as labour exchanges or labour bureaus in the cases of Barbados, Jamaica, St. Kitts-Nevis, St. Vincent and Trinidad. In most colonies, too, there are labour advisory boards, consisting of representatives of employers and workers, with an independent chairman; in the Bahamas, United States officials were co-opted to assist in the discussion of questions affecting the employment of local labour on the American bases. The British government was under treaty obligation to apply to the colonies conventions of the International Labour Office which it should ratify. Both Jamaica and Trinidad have numerous trade unions, and trade union legislation, modelled on that of Great Britain, has been enacted in all the West Indian colonies.

(L. W. Be.; X.)

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(G. M. McB.; L. W. Be.; X.)

WESTINGHOUSE, GEORGE (1846–1914), U.S. inventor and manufacturer, was born at Central Bridge (N.Y.), on Oct. 6, 1846. He entered the Union army in the Civil War in 1863, but in 1864 was appointed third assistant engineer in the navy. In 1865 he invented a device for replacing derailed cars and also a reversible steel railway frog. In 1869 he patented his air brake and organized the Westinghouse Air Brake company. In 1872 he invented the automatic air brake. This brake was quickly adopted by railways in America and gradually in Europe. He also developed a system of railway signals, operated by compressed air with the assistance of electrical contrivances. In June 1912 he received the Edison gold medal for "meritorious achievement in connection with the development of the alternating current system for light and power." In 1893 this system was installed at the Chicago exposition. He built dynamos for the power plants at Niagara Falls, for the rapid transit systems of New York city, and for the London Metropolitan railway. Westinghouse also devised a method for conveying gas through long-distance pipes, thus making it a practicable fuel. He died in New York on March 12, 1914.

WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, situated at East Pittsburgh, Pa., U.S.A., was founded by George Westinghouse (*q.v.*). In 1882, Westinghouse began the manufacture of direct-current electric lighting generators. After a study of alternating current development and the purchase of many patent rights, George Westinghouse set up, with the assistance of William Stanley, a system which is the basis of present-day alternating-current generation and distribution. The first commercial alternating-current lighting plant was installed in Buffalo, N.Y., in 1886.

Later developments have been the alternating-current system; the induction (Tesla) motor; the rotary converter; the single-reduction-gear street-railway motor; the electro-pneumatic system of multiple-unit train control; the alternating-current system of main railway electrification; the single-double-flow turbine; the turbo-generator; the de-ion principle of arc interruption; the ignitron for current rectification; the electrostatic precipitator for air purification; and contributions to the art of radio broadcasting. In 1937, sales were $206,348,307 and the number of employees was 52,249. The outstanding capital stock was $133,606,450. The foreign business is handled by the Westinghouse Electric International company. (F. A. M.)

WEST LOTHIAN or **LINLITHGOWSHIRE,** south-eastern county, Scotland; land area, 76,860 ac., or 120.1 sq.mi. The surface rises gradually from the Firth to a hilly district in the south, with summits up to 1,000 ft.

History.—Traces of the prehistoric inhabitants still exist. Stone cists have been discovered at Carlowrie, Dalmeny, Newliston and elsewhere; on Cairnnaple is a circular structure of remote but unknown date; and at Kipps is a cromlech that was once surrounded by stones. The wall of Antoninus lies for several miles in the shire, and Roman camps can be distinguished. The historical associations mainly cluster round Linlithgow (*q.v.*).

Agriculture and Industry.—About two-thirds of the county, the agriculture of which is highly developed, was under cultivation in 1938. The best land is found along the coast, as at Carriden and Dalmeny. The farming is mostly arable, permanent pasture being practically stationary (at about 23,000 ac.). Dairy farming provides fresh butter and milk for Edinburgh. Of the 621 holdings in 1938 about 38% were of 15 ac. and under, though the average size was 83½ ac.

There are large shale oil works at numerous places, and important ironworks; coal is also largely mined, and steel is made at Armadale. Fire clay is extensively worked. Old silver mines near Bathgate have been reopened. Limestone, freestone and whinstone are all quarried. Paper is made at Linlithgow and Bathgate, and distilling carried on at Linlithgow and Bo'ness (Borrowstounness). Bo'ness is the principal port.

Communications.—The L.N.E. Railway company's line from Edinburgh to Glasgow controls the approaches to the Forth bridge. The Union canal (31 mi. long), connecting Edinburgh with the Forth and Clyde canal, crosses the county.

Population and Administration.—The population was estimated in 1938 at 83,524. In 1931 Gaelic and English were spoken by 180 persons. The small burghs are Linlithgow (est. 1938 pop., 3,550), Queensferry (2,013), both royal burghs, Bathgate (10,401, Borrowstounness (10,394), Armadale (5,391) and Whitburn (4,081). There are six county districts. The shire returns one member to parliament, and is part of the sheriffdom of the Lothians, Selkirk and Peebles, with a resident sheriff-substitute at Linlithgow. The county is under school-board jurisdiction, and there are academies at Linlithgow, Bathgate and Bo'ness.

WESTMACOTT, SIR RICHARD (1775–1856), British sculptor, was born in London in 1775. As a boy he worked in the studio of his father, a sculptor of some reputation. In 1793 he went to Rome and became a pupil of Canova, then at the height of his fame. Hence, his real sympathies were with pagan rather than with Christian art. In 1805 he was elected an associate, and in 1811 a full member of the Royal academy, London. In 1827 he succeeded Flaxman as Royal academy professor of sculpture. Westmacott is best represented by his pedimental figures over the portico of the British museum, completed in 1847, and his colossal nude statue of Achilles in bronze, copied from the original on Monte Cavallo in Rome and set up in 1822 by the ladies of England in Hyde Park as a compliment to the duke of Wellington. He died on Sept. 1, 1856.

WESTMEATH, a county of Eire in the province of Leinster. The area is 435,605 ac. or about 680 sq.mi. Pop. (1936) 54,706. Westmeath is a county of carboniferous limestone.

The only heights are Knocklayde (795 ft.), Hill of Ben (710 ft.) and Knockayon (707 feet). A considerable system of eskers, notably north of Tullamore, diversifies the surface of the limestone plain. A large surface is occupied by bog. The loughs of the county have a combined area of nearly 17,000 ac. In the north, on the borders of Cavan, is Lough Sheelin, with a length of 5 mi., and an average breadth of between 2 and 3 mi., and adjoining it is the smaller Lough Kinale. In the centre of the county is Lough Derravaragh, 6 mi. long by 3 mi. broad at its widest part. To the north of it are Loughs Lene, Glore, Bawn and others; and to the south, Loughs Iron and Owel. Farther south is Lough Ennell or Belvidere, and in the southwest Lough Ree, a great expansion of the river Shannon, forming part of the boundary with Roscommon. The loughs are noted for their trout.

Westmeath was severed from Meath (*q.v.*) in 1543. The insurrection of 1641 was concerted at Multifarnham abbey, and both in the wars of this period and those of 1688 the majority of the estates in the county were confiscated. There are a considerable number of raths or encampments: one at Rathconrath is of great extent; another at Ballymore was fortified during the wars of the Cromwellian period and those of 1688 and was afterwards the headquarters of Gen. Ginkell, when preparing to besiege Athlone; and there is a third near Lough Lene.

The soil is generally a deep rich loam well adapted both for tillage and pasturage. The occupations are almost wholly agricultural, dairy farming predominating. Flour and meal are largely produced.

The only textile manufactures are those of friezes, flannels and coarse linens for home use.

Water communication with Dublin is furnished by the Royal canal. The county constituencies of Meath and Westmeath return five members to Dáil Eireann.

WESTMINSTER, MARQUESSES AND DUKES OF. The title of marquess of Westminster was bestowed in 1831 upon Robert Grosvenor, 2nd Earl Grosvenor (1767–1845), whose grandson, Hugh Lupus Grosvenor (1825–1899), was created duke of Westminster in 1874. The family of Grosvenor is of great antiquity in Cheshire. The ancestors of the dukes of Westminster, the Grosvenors of Eaton, near Chester, were cadets of the knightly house of Le Grosvenur. Their baronetcy dates from 1622.

Sir Thomas Grosvenor, the 3rd baronet (1656–1700), in 1676 married Mary (d. 1730), heiress of Alexander Davies (d. 1665), a scrivener, who brought to the Grosvenor family certain lands now covered by some of the most fashionable quarters of the West End. His grandson, Sir Richard Grosvenor (1731–1802), was created Baron Grosvenor in 1761 and Viscount Belgrave and Earl Grosvenor in 1784. The 1st earl, a great breeder of racehorses, was succeeded by his only surviving son Robert, 2nd earl (1767–1845), who rebuilt Eaton hall and developed his London property, which was rapidly increasing in value. In the house of commons, where he sat from 1788 to 1802, he was a follower of Pitt, who made him a lord of the admiralty and later a commissioner of the board of control, but after 1806 he left the Tories and joined the Whigs. He was created a marquess at the coronation of William IV in 1831. Hugh Lupus (1825–1899), grandson of the preceding, was created a duke in 1874, and was a member of parliament for Chester (1847–69), and master of the horse under Gladstone (1880–85), but he left the Liberal party over home rule for Ireland. He was succeeded by his grandson Hugh Richard Arthur, 2nd duke (b. 1879).

WESTMINSTER, a part of London, England; strictly a city in the administrative county of London, bounded east by "the City," south by the river Thames, west by the boroughs of Chelsea and Kensington, and north by Paddington, St. Marylebone and Holborn. Westminster was formed into a borough by the London Government Act of 1899, and by a royal charter of the 29th of October 1900 it was created a city. The city comprises two parliamentary divisions known as the Abbey and St. George's, each returning one member. Area, 3.9 sq.mi. Pop. (1938) 124,400. The City of Westminster, as thus depicted, extends from the western end of Fleet street to Kensington gardens, and from Oxford street to the Thames, which it borders over a distance of 3 mi., between Victoria (Chelsea) bridge and a point below Waterloo bridge. It thus contains a large number of national and imperial public buildings from the Law Courts in the east to the Imperial institute in the west, including Buckingham and St. James's palaces and the National gallery. But the name of Westminster is more generally associated with a more confined area, namely, the quarter which includes the abbey, the houses of parliament, the government and other buildings in Whitehall, the Roman Catholic cathedral, and the parts immediately adjacent to these.

Westminster Abbey.—The Abbey of St. Peter is the most widely celebrated church in the British empire. The Thames was bordered in early times by a great expanse of fen land from Chelsea and Battersea, while near the point where the abbey stands was a low island perhaps three-quarters of a mile in circumference, known as Thorney or Bramble islet. Tributary streams from the north formed channels through the marsh, flanking the island north and south, and were once connected by a dyke on the west. These channels belonged to the Tyburn, which flowed from the high ground of Hampstead. There have been stories of a temple of Apollo and of a church founded under "King Lucius"; there is more probability in the statement of Stow that King Sebert founded a church of St. Peter on Thorney Isle, and legend relates the coming of St. Peter himself to hallow his new church. A charter of Offa, king of Mercia (785), deals with the conveyance of certain land to the monastery of St. Peter; and King Edgar restored the church, defining by a charter dated 951 (not certainly genuine) the boundary of Westminster, extending (in modern terms) from the Marble Arch south to the Thames and east to the City boundary, the former river Fleet. Westminster was a Benedictine foundation. In 1050 Edward the Confessor took up the erection of a new church, cruciform, with a central and two western towers. It was consecrated in 1065 before the Confessor died, but building was continued afterwards. In 1245 Henry III set about the rebuilding of the church east of the nave.

The Church.—The present abbey is a cruciform structure consisting of nave with aisles, transepts with aisles (but in the south transept the place of the western aisle is occupied by the eastern cloister walk), and choir of polygonal apsidal form, with six chapels (four polygonal) opening north and south of it, and an eastern Lady chapel, known as Henry VII's chapel. There are two western towers, but in the centre a low square tower hardly rises above the pitch of the roof. The main entrance in common use is that in the north transept. The chapter-house, cloisters and other conventual buildings and remains lie to the south. The total length of the church (exterior) is 531 ft. and of the transepts 203 ft. in all. The breadth of the nave without the aisles is 38 ft. 7 in. and its height close upon 102 ft. These dimensions are very slightly lessened in the choir. The exterior is finely proportioned, but the building has been much altered. Wren designed the western towers, completed in 1740 after his death, and Sir Gilbert Scott and Pearson rebuilt the north front.

Within, the abbey is a superb example of the pointed style. The body of the church is remarkably uniform, because, although the building of the new nave was continued with intermissions from the 14th century until Tudor times, the Early English design in the eastern part was carried on. The choir, with its radiating chapels, plainly follows French models. Exquisite ornament is seen in the triforium arcade, and between some of the arches in the transept are figures, specially finely carved though much mutilated, known as the censing angels. Henry VII's chapel replaces an earlier Lady chapel, and is the most remarkable building of its period. It comprises a nave with aisles, and an apsidal eastward end formed of five small radiating chapels. A splendid series of carved oak stalls lines each side of the nave, and above them hang the banners of the Knights of the Bath. The fan-traceried roof, with its carved stone pendants, is exquisite. The choir stalls in the body of the church are modern. The reredos is by Scott, with mosaic by Salviati.

Ceremonies and Monuments.—From William the Conqueror onward every sovereign has been crowned at Westminster excepting Edward V. The coronation chairs stand in the Confessor's chapel. That in use dates from the time of Edward I, and contains beneath its seat the stone of Scone, on which the Scottish kings were crowned. It is of Scottish origin, but tradition identifies it with Jacob's pillow at Bethel. Here also are kept the sword and shield of Edward III, still used in the coronation ceremony. The second chair was made for Mary, consort of William III. Subsequent to the Conquest many kings and queens were buried here, from Henry III to George II. A part of the south transept is famed under the name of the Poets' Corner. The north transept contains many monuments to statesmen, and the abbey is crowded with tombs and memorials of famous British subjects, the custom of burial here being traditionally linked with the presence of the shrine of Edward the Confessor. The burial of "The Unknown Warrior" in the centre of the nave after World War I is a notable commemoration of the sacrifice made by the people in that war. A number of undistinguished persons also have their tombs in the abbey.

Conventual and Other Buildings.—The monastery was dissolved in 1539, and Westminster was then erected into a bishopric, but only one prelate, Thomas Thurleby, held the office of bishop. In 1553 Mary again appointed an abbot, but Elizabeth reinstated the dean, with twelve prebendaries. Of the conventual buildings, the cloisters are of the 13th and 14th centuries. On the south side of the southern walk remains of a wall of the refectory are seen from without. From the eastern walk a porch gives entry to the chapter house and the chapel of the Pyx. The first is of the time of Henry III, a fine octagonal building, its vaulted roof supported by a slender clustered column of marble. It was largely restored by Scott. There are mural paintings of the 14th and 15th centuries. The chapel or chamber of the Pyx is part of the undercroft of the original dormitory, and is early Norman work of the Confessor's time. It was used as a treasury for the regalia in early times, and here were kept the standard coins of the realm used in the trial of the pyx now carried out at the mint. The undercroft is divided into compartments by walls; above it is now the chapter library. To the southeast lies the picturesque Little Cloister, with its court and fountain. Near it are slight ruins of the monastic infirmary chapel of St. Catherine. West of the main cloisters are the Deanery, Jerusalem chamber and College hall, the building surrounding a small court and dating mainly from the 14th century. This was the abbot's house. Its most famous portion is the Jerusalem chamber, believed to be named from the former tapestries on its walls, representing the holy city. The College hall, adjoining it, was the dining-hall of Westminster school.

During World War II the abbey was seriously damaged at the crossing, but the surrounding buildings suffered more. The Deanery, the Little Cloister, with its residences, the College hall, with its hammerbeam roof, and Dr. Busby's library were completely gutted. The dormitory of Westminster school was also burned out, but its interior was of slight architectural value.

Westminster School.—St. Peter's college, commonly called Westminster school, is one of the ancient public schools of England. A school was maintained by the monks from very early times. Henry VIII took interest in it, but the school owes its present standing to Queen Elizabeth. The school buildings lie east of the conventual buildings. They are modern or largely modernized. The great schoolroom is a fine panelled hall. Ashburnham house, containing one of the school houses, the library and many classrooms, is named from the family for whom it was built, traditionally but not certainly, by Inigo Jones. The finest part remaining is the grand staircase. In the college dormitory a Latin play is annually presented, in accordance with ancient custom. The boys have the privilege of acclaiming the sovereign at the coronation in the abbey. There is a long-standing custom of struggling for the possession of a tossed pancake on Shrove Tuesday. The winner of this Pancake Greaze is rewarded by the Dean.

St. Margaret's.—On the north side of the abbey, close beside it, is the parish church of St. Margaret. It was founded in or soon after the time of the Confessor, but the present building is Perpendicular, of greater beauty within than without. St. Margaret's is officially the church of the house of commons.

Westminster Palace: Houses of Parliament.—A royal palace existed at Westminster under Canute, but the building spoken of by Fitzstephen as an "incomparable structure furnished with a breastwork and a bastion" is supposed to have been founded by Edward the Confessor and enlarged by William I. The hall, called Westminster hall, was built by William Rufus and altered by Richard II. In 1512 the palace suffered greatly from fire, and thereafter ceased to be used as a royal residence. St. Stephen's chapel, originally built by King Stephen, was used from 1547 for the meetings of the house of commons, which had been held previously in the chapter house of the abbey; the lords used another apartment of the palace.

A fire in 1834 destroyed the whole palace save the historic hall and St. Stephen's chapel. The present buildings were erected on the site 1840–67, but of these the commons chamber was burned out as a result of World War II air raids. The southwestern Victoria tower is 336 ft. high. The Clock tower, 329 ft. high, contains the clock famous for its 13½ ton bell, Big Ben, upon which the hours are struck. The bell is named after Sir Benjamin Hall, First Commissioner of Works at the time it was hung. Of the modern rooms, the house of lords is an ornate chamber, 97 ft. in length; that of the commons is 70 ft. long.

Westminster Hall.—The original hall was finished in 1099, during which year it is recorded that King William Rufus held his first court in the hall. Little remains of Rufus's hall beyond its walls which have been encased with modern linings. The open timber roof, described as a "miracle of Gothic carpentry, easily the most remarkable timber structure of its age in any country," was erected by King Richard II in 1394, when Richard appointed John Gedeney to supervise the work of repair to the hall, with power to engage any necessary masons, carpenters and labourers. Hugh Herland, a master carpenter in the service of the king, was appointed controller to Gedeney and it is probably to Hugh Herland that we owe the creation of the magnificent roof. The span is 67 ft. 6 in. without any intermediate supports, and its construction presented a problem the solving of which had not previously been attempted. The roof was designed with an upper triangulated framed structure consisting of the main collar beam, principal rafters, and queen posts, with a crown post centrally supporting the heavy ridge piece. This upper triangular framed structure was supported on two cantilever structures embodying the lower principal rafter, the hammer post, the hammer beam, the wall post and the curved strut between wall post and hammer beam, the whole roof being tied together by a great curved brace or arch springing from the corbel at the foot of the wall post passing the hammer beam, the hammer post with its crown at the centre of the main collar beam.

Evidence is available of repairs being carried out to the structure and the roof on many occasions, but the most drastic restoration work was undertaken in recent years and was not completed until 1922. This restoration became an urgent necessity owing to the ravages of the "Death-watch beetle" (the *Xestobium tossellatum*) whose operations during many years had caused the roof to become entirely unsafe. Investigation undertaken by His Majesty's office of works revealed an actual danger of a collapse of a portion of the roof. The ends of many of the principal rafters, the purlins and some of the main collar beams were found to be hollowed out to a thin shell by the attacks of the beetle. In the restoration various expedients were tried to destroy the beetle and its eggs, the most satisfactory result being obtained by spraying the affected timbers after they had been thoroughly cleaned with a solution of ortho-para-dichlor-benzene. A system of steel reinforcement was adopted for supporting the roof structure, and this was so placed as to be invisible. The roof was damaged, fortunately slightly, during an air raid in World War II.

Westminster hall was the seat of the chief law court of England for centuries and it witnessed the trials of, among others, Wallace, Richard II, Sir Thomas More, Thomas Campion, Charles I, Titus Oates, Warren Hastings and Queen Caroline. It

is thus one of the chief centres of English history.

Whitehall.—Northward from Parliament square a broad, slightly curving thoroughfare leads to Trafalgar square. This is Whitehall, which replaced the narrow King street. Here, between the Thames and St. James's park, formerly stood York house, a residence of the archbishops of York from 1248. Wolsey beautified the mansion and kept high state there, but on his fall Henry VIII acquired and reconstructed it, employed Holbein in its decoration, and made it his principal residence. Inigo Jones designed a new palace for James I, but only the banqueting hall was completed (1622), and this survived several fires, by one of which (1697) nearly the whole of the rest of the palace was destroyed. The hall, converted into a royal chapel by George I, and now housing the museum of the Royal United Service institution, is a fine specimen of Palladian architecture, and its ceiling is adorned with allegorical paintings by Rubens.

The principal government offices are situated in Whitehall. On the left, following the northerly direction, are the boards of education and trade and the ministry of education. The home, foreign, colonial and India offices occupy the next block. Downing street, separating these from the treasury, contains the official residences of the First Lord of the Treasury (No. 10) and the Chancellor of the Exchequer (No. 11). The official connection of these houses with their occupiers dates from the time of Sir Robert Walpole, the first prime minister, who occupied No. 10 from 1735–42. George II, who owned it, had offered it to Walpole as a gift in 1731. He refused it; but it was soon after arranged that the two houses should accompany the offices with which they are now associated. The Horse Guards was built in 1753 on the site of a guard-house dating from 1631. The portion of the admiralty facing Whitehall dates from 1726 and is plain and sombre; but there are new buildings on the park side. On the right of Whitehall, besides the banquet hall, are the war office, and Montagu house, now occupied by the ministry of labour. The Cenotaph, erected in memory of those who fell in World War I, stands in Whitehall.

Trafalgar square is an open space sloping sharply to the north. On the south side, facing the entry of Whitehall, is the Nelson column (1843), 145 ft. in height, a copy in granite from the temple of Mars Ultor in Rome, crowned with a statue of Nelson. Behind the terrace on the north rises the National gallery (1838), with its splendid collection of paintings. The National Portrait gallery is on the northeast side of the National gallery.

Westminster Cathedral.—A short distance from Victoria st., towards its western end, stands Westminster cathedral (Roman Catholic), a remarkable modern building (1896–1905) in early Christian Byzantine style with a stately domed campanile.

WESTMINSTER, STATUTES OF. During the reign of Edward I two statutes were passed bearing this title. The first, in 1275, was, in the words of Stubbs (*Const. Hist.* cap. xiv.), "almost a code by itself; it contains 51 clauses, and covers the whole ground of legislation. Its language now recalls that of Canute or Alfred, now anticipates that of our own day; on the one hand common right is to be done to all, as well poor as rich, without respect of persons; on the other, elections are to be free, and no man is by force, malice or menace, to disturb them. The spirit of the Great Charter is not less discernible: excessive amercements, abuses of wardship, irregular demands for feudal aids are forbidden in the same words or by amending enactments.

The second statute of Westminster was passed in the parliament of 1285. Like the first statute it is a code in itself, and contains the famous clause *De donis conditionalibus* (*q.v.*), "one of the fundamental institutes of the mediaeval land law of England." Stubbs says of it: "The law of dower, of advowson, of appeal for felonies, is largely amended; the institution of justices of assize is remodelled, and the abuses of manorial jurisdiction repressed; the statute *De religiosis,* the statutes of Merton and Gloucester, are amended and re-enacted".

The Statute of Westminster, 1931, laid down that "Dominions are autonomous Communities within the British Empire, equal in status, in no way subordinate to one another in their domestic or external affairs though united by a common allegiance to the Crown, and freely associated as members of the British Commonwealth of Nations."

The statute *Quia Emptores* of 1290 is sometimes called the statute of Westminster III.

WESTMINSTER, SYNODS OF. Under this heading are included certain of the more important councils of the English Church held within the present bounds of London. Though the precise locality is occasionally uncertain, the majority of the mediaeval synods assembled in the chapter-house of old St. Paul's, or the former chapel of St. Catherine within the precincts of Westminster Abbey or at Lambeth. The councils were of various types, each with a constitutional history of its own. Before the reign of Edward I., when convocation assumed substantially its present form (*see* CONVOCATION), there were convened in London various diocesan, provincial, national and legatine synods; during the past six centuries, however, the chief ecclesiastical assemblies held there have been convocations of the province of Canterbury. From the time of Edward VI. on, many of the most vital changes in ecclesiastical discipline were adopted in convocations at St. Paul's and in the Abbey.

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WESTMINSTER BANK LIMITED. British joint stock banking company, one of the "Big Five" of British banking. The London and Westminster Bank, in which it had its beginning, was the pioneer of joint-stock banking in London, and was founded, in the face of strenuous opposition, in 1834. Its inception was due to the persistent efforts of W. R. Douglas and a group of friends, who, dissenting from the popular belief that the Bank of England had a legal monopoly of joint-stock banking within a radius of 65m. of London, and interpreting the restriction to apply only to banks of issue, resolved to test their case, and applied to parliament to define the Bank of England's powers. The law officers of the Crown upheld the view that the bank's charter did not prevent the formation of joint-stock banks in the London area, provided they did not issue notes, and the legality of such institutions was affirmed by the Bank Charter Renewal Act of 1833.

Douglas's committee thereupon formed a bank of deposit termed the London and Westminster Bank. In March 1834 it opened with a paid-up capital of only £50,000, with £30,000 in its tills. In 1854, after much obstruction, admission to the London Bankers' Clearing House was secured, and the bank became a limited liability company in 1880.

Little of the growth of the bank had depended on the absorption of smaller banks. That had been more potent in the histories of the two great banks with which the Westminster was destined to merge—The London & County in 1909 (established 1836, and important in London and the home counties), and Parr's Bank in 1918 (established 1865, with special spheres of influence in the North-West, the Midlands, and in Somerset through Stuckey's Bank). Affiliation with the Ulster Bank, Limited took place in 1917, and other amalgamations followed: with the Nottingham and Notts Banking Co. (1919); the Yorkshire banking houses of Beckett & Co. (1921) etc. The bank has built up a strong position as an issuing house, especially in relation to the stocks of British Dominions and Corporations; and it is represented in France and Belgium by an auxiliary Bank.

The title of the institution was shortened in 1923 to Westminster Bank, Ltd., and the foreign auxiliary became Westminster Foreign Bank, Ltd. Early in 1939 the bank had 1,097 offices, of which 216 were in the metropolitan area. Its authorized capital was £33,000,000, of which £30,533,127 had been subscribed, and £9,320,157 paid up. The reserve equalled the paid-up capital. Current, deposit and other accounts totalled £346,220,783. The head office of the bank is in Lothbury, London. (J. H. ARN.)

See T. E. Gregory, *The Westminster Bank through a Century.*

WESTMORLAND, EARLS OF. Ralph Neville, 4th Baron Neville of Raby, and 1st earl of Westmorland (1364–1425), eldest son of John, 3rd Baron Neville, and his wife Maud Percy (*see* NEVILLE, family), was knighted by Thomas of Woodstock, afterwards duke of Gloucester, during the French expedition of 1380, and succeeded to his father's barony in 1388.

He was repeatedly engaged in negotiations with the Scots, and his assistance to the court party against the lords appellant was rewarded in 1397 by the earldom of Westmorland. He married as his second wife Joan Beaufort, half-sister of Henry of Lancaster, afterwards Henry IV., whom he joined on his landing in Yorkshire in 1399. He already held the castles of Brancepeth, Raby, Middleham and Sheriff Hutton when he received from Henry IV. the honour and lordship of Richmond for life. The only rivals of the Nevilles in the north were the Percies, whose power was broken at Shrewsbury in 1403; and the wardenship of the west marches was now assigned to Westmorland, whose influence was also paramount in the east, which was under the nominal wardenship of the young Prince John, afterwards duke of Bedford. In May the Percies were in revolt, with Thomas Mowbray, earl marshal, and Archbishop Scrope. Westmorland met them on Shipton Moor, near York, on May 29, 1405, and suggested a parley between the leaders. By pretending accord with the archbishop, the earl induced him to allow his followers to disperse. Scrope and Mowbray were then seized and handed over to Henry at Pontefract on Jan. 3. The improbabilities of this narrative have led some writers to think, in face of contemporary authorities, that Scrope and Mowbray must have surrendered voluntarily. If Westmorland betrayed them he at least had no share in their execution. Thenceforward he was busily engaged in negotiating with the Scots and keeping the peace on the borders. He did not play the part assigned to him by Shakespeare in *Henry V.*, for during Henry's absence he remained in charge of the north, and was a member of Bedford's council. Of his daughters, Catherine married in 1412 John Mowbray, second duke of Norfolk, brother and heir of the earl marshal, who had been executed after Shipton Moor; Anne married Humphrey, first duke of Buckingham; Eleanor married, after the death of her first husband, Richard le Despenser, Henry Percy, 2nd earl of Northumberland; Cicely married Richard, duke of York, and was the mother of Edward IV. and Richard III. The earl died on Oct. 21, 1425, and a fine alabaster tomb was erected to his memory in Staindrop church close by Raby castle.

See J. H. Wylie, *History of England under Henry IV.* (4 vols., 1884–98).

CHARLES, 6th earl (1543–1601), eldest son of Henry, 5th earl, by his first wife Jane, daughter of Thomas Manners, 1st earl of Rutland, was brought up a Roman Catholic, and was further attached to the Catholic party by his marriage with Jane, daughter of Henry Howard, earl of Surrey. He was a member of the council of the north in 1569, when he joined Thomas Percy, 7th earl of Northumberland, and his uncle Christopher Neville, in the Catholic rising of the north, which aimed at the liberation of Mary, queen of Scots. On the collapse of the ill-organized insurrection Westmorland fled with his brother earl over the borders, and eventually to the Spanish Netherlands, where he died on Nov. 16, 1601. He left no sons, and his honours were forfeited by his formal attainder in 1571. Raby castle remained in the hands of the Crown until 1645.

The title was revived in 1624 in favour of Sir Francis Fane (*c.* 1574–1629), whose mother, Mary Neville, was a descendant of a younger son of the first earl. He was created baron of Burghersh and earl of Westmorland in 1624, and became Lord le Despenser on his mother's death in 1626. His son Mildmay Fane, 2nd or 8th earl of Westmorland (*c.* 1602–1666), at first sided with the king's party, but was afterwards reconciled with the parliament. John Fane, 7th or 13th earl of Westmorland (1682?–1762), served with distinction in various campaigns under Marlborough, and was made in 1739 lieutenant-general of the British armies.

JOHN FANE, 11th or 17th earl (1784–1859), only son of John, 10th earl, was known as Lord Burghersh until he succeeded to the earldom in 1841. He entered the army in 1803, and in 1805 took part in the Hanoverian campaign as aide-de-camp to General Sir George Don. He was assistant adjutant-general in Sicily and Egypt (1806–07), served in the Peninsular War (1808–13), was British military commissioner to the allied armies under Schwarzenberg, and marched with the allies to Paris in 1814. He was subsequently promoted major-general (1825), lieutenant-general (1838) and general (1854), although the latter half of his life was given to the diplomatic service. He was British resident at Florence (1814–30), and ambassador at Berlin from 1841 to 1851, when he was transferred to Vienna. He retired in 1855, and died at Apthorpe House, Northamptonshire, on Oct. 16, 1859. He composed several operas, took a keen interest in the cause of music in England, and in 1822 made proposals which led to the foundation in 1823 of the Royal Academy of Music. His wife Priscilla Anne (1793–1879), daughter of William Wellesley-Pole, 3rd earl of Mornington, was a distinguished artist.

His published works include *Memoirs of the Early Campaigns of the Duke of Wellington in Portugal and Spain* (1820), and *Memoir of the Operations of the Allied Armies under Prince Schwarzenberg and Marshal Blücher* (1822). *See* also *Correspondence of Priscilla, Countess of Westmorland, 1812–1870* (1909).

FRANCIS WILLIAM HENRY, 12th or 18th earl (1825–1891), fourth son of the preceding, served through the Punjab campaign of 1846, and at Gujrat on Feb. 21, 1849. He went to the Crimea as aide-de-camp to Lord Raglan.

WESTMORLAND, a northwestern county of England. It reaches the sea in the Kent estuary in Morecambe bay. The area (including water) is 789 sq.mi. Prof. Marr recognizes three major and three minor physical divisions. The largest, the slate tract, is west of a line from the foot of Ullswater to Ravenstonedale. In this we find Ordovician (Borrowdale volcanic series) and Silurian rocks (*see* LAKE DISTRICT) which form a region of mountains and fells with deep-cut valleys. The chief peaks are Helvellyn (3,118 ft.), Bow Fell (2,960), Fairfield (2,863), Cringle Crags (2,816), Red Screes (2,541), High Street (2,663), High Raise (2,634) and Langdale Pikes (2,401) with the lakes of Ullswater, Haweswater, Grasmere, Rydalwater, Elterwater and Windermere (in part in the county). The second division embraces the New Red Sandstone tract of the upper Eden valley with its base through Penrith reaching to near Kirkby Stephen. Most of the area lies between the 500 and 1,000 ft. contour. To the east is the third major division, that part of the Pennine hills within the county boundary. It is a moorland tract with Milburn Forest (2,780 ft.) Dufton Fell (2,403), Hilton Fell (2,446) and other heights. The high ground (average 1,000 ft.) in the triangle between Kendal and the southern boundary of the county includes Kendal Fell, Farleton Knott and Whitbarrow. The chief rivers are the upper waters of the Eden (with the Lowther and the Eamont), the Tees, the Lune and the Kent.

History and Early Settlement.—Implements of ground or polished stone have been found in Westmorland, some of rather special types such as certain supposed "sinkers," objects shaped like two acorns base to base with a transverse groove between them; they seem not to have been hammers. A group of monuments extends from Little Salkeld near Penrith in Cumberland to near Shap in Westmorland; it includes a circle, near Penrith, called Long Meg and her daughters, 68 stones with "Long Meg" extra, standing apart, another called Mayborough, another (an earthwork) called King Arthur's Round Table, all in Cumberland. At Gunnerheld (near Shap) is a double circle. A barrow at Crosby Garrett is of special importance. Canon Grenwell considered that the Romans probably found a considerable indigenous population, necessitating defense on their part, and their roads and camps are a feature especially east of the Eden.

The earliest English settlements were by Anglian tribes, in the 6th century in the neighbourhood of Kendal. The northern district remained unconquered, until the close of the 7th century when Ecgfrith drove out the Britons and established the Northumbrian supremacy over the district. The Danes arrived in the 9th century and the Norsemen in the 10th. Westmorland is mentioned in the Saxon Chronicle in 966. At the time of the Domesday Survey the barony of Kendal belonged to the crown. The

annexation of the northern portion of Westmorland to the crown was accomplished by William Rufus, in 1092. Westmorland was established as an administrative county by Henry I in 1131, by the separation of the northern part from the land of Carlisle.

The division of Westmorland into wards originated with the system of defense against the Scots, each barony being divided into two wards, and each ward placed under a high constable. From early times the political history of Westmorland is a record of continuous inroads and devastations from the Scots. Appleby was frequently raided and in 1388 it was sacked and almost completely ruined. In the Wars of the Roses, Westmorland favoured the Lancastrians and in the Civil War of the 17th century the chief families were Royalists. The Jacobite rising of 1745 found many adherents in Westmorland.

There are very few notable ecclesiastical buildings. Among the castles are Appleby, Brough, Brougham and Kendal. In the Kendal district are the houses, Levens hall dating from the 16th century, and Sizergh castle, embodying part of the ancient stronghold. The formal gardens at Levens hall are remarkable for the topiary work. Lowther castle, near Penrith, is a fine modern mansion.

The economic development of Westmorland has been slow and unimportant, the rugged nature of the ground being unfavourable to agricultural prosperity, while the lack of fuel hindered the growth of manufactures. Sheep farming was carried on in the moorland districts, however, and the Premonstratensian house at Shap exported wool to Florentine and Flemish markets in the 13th and 14th centuries. Kendal was a centre of the clothing industry in the 14th century. In 1589 the county suffered severely from the plague. The village of Mardale, near Bampton, was demolished in 1938, as part of the Haweswater reservoir scheme for supplying Manchester with water.

Climate and Agriculture.—The county may be considered to lie within an area having 40 to 60 in. mean annual fall. The summer temperature is mild. The helm-wind (*q.v.*) is characteristic of this district. Less than one-half of the total area is under cultivation, and of this 60⅓% was in permanent pasture in 1939, both cattle and sheep being largely kept. The fell land furnishes nourishment for the hardier breeds of sheep. The sale of these, stock cattle, horses and pigs, and dairy produce is the staple of the farmers' income. A large part of Westmorland was formerly in the hands of "statesmen" (*see* CUMBERLAND) whose holdings were usually small. The proportion of landowners of this class has greatly decreased. The National Trust owned 1,360 ac. in 1942.

Manufactures and Communications.—Woollen manufacture, chiefly confined to Kendal, is the chief industry. Bobbin making, paper making, the manufacture of explosives and several small industries are carried on, and use the water power and hydroelectric power available at points. Granite, roofing slate, marble, graphite and a little coal, iron, lead and barytes are obtained.

The main lines of the L.M.S.R. traverse the county, ascending heavy gradients, of which the most severe crosses Shap Fells. The railways connect, east and west, by means of branches.

Population and Administration.—The population in 1901 was 64,303; in 1938, 63,450. It is the only county in England which has a density of population of less than 100 per sq.mi. Being a remote county with little industry, it was particularly suitable during World War II for the reception of evacuees and refugees, whose immigration caused an increase of 15% in the population between Sept. 1939 and Feb. 1941. The general character of the dialects of Westmorland is that of a basis of Anglian speech, influenced to a certain extent by the speech current among the pre-Anglian peoples of Strathclyde. The people show a well-marked Scandinavian influence. Three distinct dialects can be made out.

Municipal boroughs are Appleby, which is also the county town, and Kendal. The urban districts are Lakes and Windermere. The county is in the northern circuit, and the assizes are held at Appleby. It has one court of quarter sessions and is divided into six petty sessional divisions. Kendal has a separate commission of the peace. Westmorland is in the diocese of Carlisle, except the parish of Firbank, which is in that of Bradford. The county returns one member to parliament.

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WEST NEW YORK, a town of New Jersey, U.S.A., on the Hudson river. Pop. (1920) 29,926 (30% foreign-born white); 1940 federal census 39,439. The town had about 200 industries in 1937, producing goods valued at $15,899,831. Net valuation of property (1940): $41,314,498. It was incorporated in 1898.

WESTON, a city of West Virginia, U.S.A., the county seat of Lewis county. Pop. 5,701 in 1920 (92% native white); 8,268 in 1940 by the federal census. The city lies 1,025 ft. above sea level, in a rich blue-grass region, containing immense coal deposits, oil and gas wells and great stands of poplar and oak. It is the headquarters of many lumber companies, and large glass manufacturing plants. The town was incorporated in 1818, and was chartered as a city in 1847.

WESTON-SUPER-MARE, a seaside resort and municipal borough (1937) of Somersetshire, England, on the Bristol channel, 137½ mi. S.W. of London by the G.W.R. Pop. (est. 1938) 32,690. Area, 10.9 sq.mi. It is sheltered from the north and east by Worlebury hill. Much attention has lately been given to improving the sea front and amusement facilities.

WEST ORANGE, a town of Essex county, New Jersey. Pop. (1930) 24,327; in 1940 it was 25,662. In Llewellyn Park is the home of Thomas A. Edison, who established his laboratories in West Orange in 1887.

WESTPHALIA (Ger. *Westfalen*), a province of Prussia, Germany. The area of the province is 7,806 sq.mi., its length both from north to south and from east to west is about 130 miles.

Nearly half of Westphalia is an extension of the great north German plain, which is broken by outcrops of the underlying Cretaceous beds, and is not very fertile, except in the Hellweg, a zone between the Haarstrang and the Lippe. There are extensive fens in the north and west, and north of Paderborn is a sandy waste called the Senne. The plain is drained in the north by the Ems and in the south by the Lippe, which rise close together in the Teutoburger Wald. Between their basins are the Vechte and other small rivers flowing into the Zuyder Zee. The triangular southern portion of Westphalia, most of which is included in Sauerland ("south land"), is a rugged region of slate hills and wooded valleys drained chiefly by the Ruhr with its affluents the Lenne, Möhne, etc., and in the south by the Sieg and Eder. The hills rise in the southeast to the Rotlager or Rothaargebirge, culminating in the Winterberg plateau with the Kahler Asten (2,713 ft.), the highest summit in the province. The Rotlagergebirge, Eggegebirge and Teutoburger Wald form the watershed between the Weser and the Rhine and Ems. The Weser divides the Wiehengebirge from the Wesergebirge by the narrow pass called *Porta Westfalica.*

The climate is temperate except in the south, which is cold in winter and has a heavy rainfall. The crops include grain of all kinds, peas and beans, buckwheat, potatoes, fruit and hemp. The cultivation of flax is very extensive, especially in the northeast. Swine, which are reared in great numbers in the plains, yield the famous Westphalian hams; horse breeding and the rearing of cattle and goats are also important.

The mineral wealth is very great, especially in coal and iron. The production of coal is greater than that of any other province of Prussia. The great Ruhr coal field extends from the Rhineland into the province as far as Unna, the centre being Dortmund, and there is a smaller coal field in the north at Ibbenbüren. The production of iron ore, chiefly south of the Ruhr, is exceeded in Prussia only by that of the Rhine province. After coal and iron the most valuable minerals are zinc, lead, pyrites and copper. Antimony, quicksilver, stone, marble, slate and potter's clay are also worked, and there are brine springs in the Hellweg and mineral springs at Lippspringe, Öynhausen, etc.

The manufacturing industry of the province, which chiefly depends upon its mineral wealth, is very extensive. Iron and steel

goods are produced in the so-called "Enneper Strasse," the valley of the Ennepe, a small tributary of the Ruhr with the town of Hagen, and in the neighbouring towns of Bochum, Dortmund, Iserlohn and Altena, and also in the Siegen district. The brass and bronze industries are carried on at Iserlohn and Altena, those of tin and Britannia metal at Lüdenscheid; needles are made at Iserlohn and wire at Altena. The very important linen industry of Bielefeld, Herford, Minden and Warendorf has flourished in this region since the 14th century. Jute is manufactured at Bielefeld and cotton goods in the west. Paper is extensively made on the lower Lenne, and leather around Siegen. Other manufactures are glass, chemicals, sugar, sausages and cigars. An active trade is promoted by several trunk lines of railway which cross the province and by the navigation of the Weser (on which Minden has a port), Ems, Ruhr and Lippe. Beverungen is the chief market for corn and Paderborn for wool.

The population in 1939 was 5,205,705, or about 666 per sq.mi. It is very unevenly distributed, and in the industrial districts has been increasing very rapidly; it includes a considerable element of Polish workpeople. As at the peace of Westphalia, the bishoprics of Münster and Paderborn and the former duchy of Westphalia are Roman Catholic, while the secularized bishopric of Minden and the former counties of Ravensberg and Mark (former possessions of Brandenburg) and Siegen (Nassau) are predominantly Protestant.

The province is divided into the three governmental departments (*Regierungsbezirke*) of Minden, Münster and Arnsberg. Münster is the seat of government and of the provincial university.

The inhabitants are mainly of the Saxon stock and speak Low German dialects, except in the Upper Frankish district around Siegen where the Hessian dialect is spoken.

History.—Westphalia, "the western plain" (in early records *Westfalani*), was originally the name of the western province of the early duchy of Saxony, including the western portion of the modern province and extending north to the borders of Friesland. When Duke Henry the Lion of Saxony fell under the ban of the empire in 1180, and his duchy was divided, the archbishop of Cologne, Philip of Heinsberg, received from the emperor Frederick I the Sauerland and some other districts which became the duchy of Westphalia. The duchy received a constitution of its own, and was governed for the archbishop, afterwards elector, by a marshal (*Landmarschall*, after 1480 *Landdrost*), who was also stadtholder, and presided over the Westphalian chancellery. This system lasted till 1803. By the settlement of 1803 the Church lands were secularized, and Prussia received the bishopric of Paderborn and the eastern part of Münster, while the electoral duchy of Westphalia was given to Hesse-Darmstadt.

After the peace of Tilsit, the kingdom of Westphalia was created by Napoleon I on Aug. 18, 1807, and given to his brother Jerome (*see* BONAPARTE). It included the present governmental department of Minden, but by far the larger part of the kingdom lay outside and chiefly to the east of the modern province, and comprised the Hanoverian department of Hildesheim and in part that of Arensberg, Brunswick, the northern part of the province of Saxony as far as the Elbe, Halle, and most of Hesse-Cassel. The area was 14,627 sq.mi., and the population nearly 2,000,000. Cassel was the capital. A constitution on the French imperial pattern granted by the king remained practically inoperative, an arbitrary bureaucratic régime was instituted, the finances were from the beginning in a hopeless condition, and the country was drained of men and money for Napoleon's wars. In Jan. 1810 most of Hanover was added, but at the end of the same year half the latter, together with the city of Minden, was annexed to the French empire. At the congress of Vienna (1815) Hesse-Darmstadt surrendered her share of Westphalia to Prussia. The province suffered heavy bombing attacks in World War II.

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WESTPHALIA, PEACE OF, the name given to the settlement embodied in two treaties concluded on Oct. 24, 1648, by the Holy Roman Empire with France at Münster and with Sweden and the Protestant estates of the empire at Osnabrück, by which the Thirty Years' War (*q.v.*) was brought to an end.

As early as 1636 negotiations had been opened at Cologne at the instance of Pope Urban VIII, supported by the seigniory of Venice, but failed owing to the disinclination of Richelieu to stop the progress of the French arms, and to the refusal of Sweden to treat with the papal legate. In 1637 the agents of the emperor began to negotiate at Hamburg with Sweden, though the mediation of Christian IV, king of Denmark, was rejected by Sweden, and the discussions dragged on for years without result. In the meantime the new emperor Ferdinand III proposed at the diet of Regensburg in 1640 to extend the peace of Prague to the whole empire, on the basis of an amnesty, from which, however, those Protestant estates[1] who were still leagued with foreign powers were to be excluded. His aim was by settling the internal affairs of the empire to exclude the German princes from participation in negotiations with foreign powers; these efforts failed.

The Comte d'Avaux, French envoy at Hamburg, proposed in 1641 that negotiations should be transferred to Münster and Osnabrück. A preliminary treaty embodying this proposal was concluded between the representatives of the emperor, France, and Sweden at Hamburg on Dec. 25, 1641. The two assemblies were to be regarded as a single congress, and neither should conclude peace without the other. The date fixed for the meeting was March 25, 1642, but many months elapsed before all the representatives arrived, and the settlement of many questions of precedence and etiquette caused further delays. England, Poland, Muscovy, and Turkey were the only European powers unrepresented.

The chief representative of the emperor was Count Maximilian von Trautmansdorff, to whose sagacity the conclusion of peace was largely due. The French envoys were nominally under Henry of Orleans, duke of Longueville, but the marquis de Sablé and the comte d'Avaux were the real agents of France. Sweden was represented by John Oxenstierna, son of the chancellor, and by John Adler Salvius, who had previously acted for Sweden at Hamburg. The papal nuncio was Fabio Chigi, afterwards Pope Alexander VII. Brandenburg, represented by Count Johann von Sayn-Wittgenstein, played the foremost part among the Protestant states of the empire. On June 1, 1645, France and Sweden brought forward propositions of peace, which were discussed by the estates of the empire from Oct. 1645 to April 1646. The settlement of religious matters was effected between Feb. 1646 and March 1648. The war continued during the deliberations. The treaty was signed at Münster by the members of both conventions on Oct. 24, 1648, and ratifications were exchanged on Feb. 8, 1649. The papal protest of Jan. 3, 1651, was disregarded.

Sweden received western Pomerania with the isles of Rügen, Usedom and Wollin, the mouths of the Oder, Wismar, and the lands of the archbishopric of Bremen and the bishopric of Verden, together with an indemnity of 5,000,000 thalers. The privileges of the Free Towns were preserved. Sweden thus obtained control of the Baltic and a footing on the North Sea, and became an estate of the empire with three deliberative voices in the diet.

The elector of Brandenburg received the greater part of eastern Pomerania and Cammin, and, as he had a claim on the whole duchy since the death of the last duke in 1635, he was indemnified by the bishoprics of Halberstadt, Minden and the reversion of the archbishopric of Magdeburg, which came to him on the death of the administrator, Prince Augustus of Saxony, in 1680. The elector of Saxony was allowed to retain Lusatia. As compensation for Wismar, Mecklenburg-Schwerin obtained the bishoprics of Schwerin and Ratzeburg and some lands of the Knights of St.

[1] *i.e. Reichsstände*, princes, nobles, and cities holding immediately of the emperor.

John. Brunswick-Lüneburg restored Hildesheim to the elector of Cologne, and gave Minden to Brandenburg, but obtained the alternate succession to the bishopric of Osnabrück and the church lands of Walkenried and Gröningen. Hesse-Cassel received the prince-abbacy of Hersfeld and the county of Schaumburg. The elector of Bavaria was confirmed in his possession of the Upper Palatinate, and in his position as an elector which he had obtained in 1623. Charles Louis, the son and heir of Frederick V., the count palatine of the Rhine, who had been placed under the ban of the Empire, received back the Lower Palatinate, and a new electorate, the eighth, was created for him.

France obtained the recognition of the sovereignty (which she had enjoyed *de facto* since 1552) over the bishoprics and cities of Metz, Toul, and Verdun, Pinerolo in Piedmont, the town of Breisach, the landgraviate of Upper and Lower Alsace, the Sundgau, the advocacy (*Landvogtei*) of the ten imperial cities in Alsace, and the right to garrison Philippsburg. During the Thirty Years' War France had professed to be fighting against the house of Austria, and not against the empire. It was stipulated that the immediate fiefs of the Empire in Alsace should remain in enjoyment of their liberties, but it was added as a condition that the sovereignty of France in the territories ceded to her should not be impaired. The intention of France was to acquire the full rights of Austria in Alsace, but as Austria had never owned the landgraviate of Lower Alsace, and the *Landvogtei* of the ten free cities did not in itself imply possession, the door was left open for disputes. Louis XIV afterwards availed himself of this ambiguous clause in support of his aggressive policy on the Rhine. The independence of Switzerland was at last formally recognized, as was that of the United Netherlands in a separate treaty.

Apart from these territorial changes, a universal and unconditional amnesty to all those who had been deprived of their possessions was declared, and it was decreed that all secular lands should be restored to those who had held them in 1618. Some exceptions were made in the case of the hereditary dominions of the emperor.

Even more important than the territorial redistribution was the ecclesiastical settlement. By the confirmation of the treaty of Passau of 1552 and the religious peace of Augsburg of 1555, and the extension of their provisions to the Reformed (Calvinist) Church, toleration was secured for the three great religious communities of the empire. Within these limits the governments were bound to allow at least private worship, liberty of conscience, and the right of emigration, but these measures of toleration were not extended to the hereditary lands of the house of Habsburg. The Protestant minority in the imperial diet was not to be coerced by the majority, but religious questions were to be decided by amicable agreement. Protestant administrators of church lands obtained seats in the diet. Religious parity was established in the imperial chamber (*Reichskammergericht*), and in the imperial deputations and commissions.

The difficult question of the ownership of spiritual lands was decided by a compromise. The edict of restitution of 1629 was annulled. By the important provision that a prince should forfeit his lands if he changed his religion an obstacle was placed in the way of a further spread of the Reformation. The declaration that all protests or vetoes by whomsoever pronounced should be null and void dealt a blow at the intervention of the Roman curia in German affairs.

The constitutional changes made by the treaty had far-reaching effects. The territorial sovereignty of the states of the empire was recognized. They were empowered to contract treaties with one another and with foreign powers, provided that the emperor and the empire suffered no prejudice. By this and other changes the princes of the empire became absolute sovereigns in their own dominions. The emperor and the diet were left with a mere shadow of their former power. The emperor could not pronounce the ban of the empire without the consent of the diet. The diet, in which the 61 imperial cities gained the right of voting on all imperial business, and thus were put on an equality with the princes, retained its legislative and fiscal powers in name, but practically lost them by the requirement of unanimity among the three colleges.

Not only was the central authority replaced almost entirely by the sovereignty of about 300 princes, but the power of the empire was materially weakened in other ways. It lost about 40,000 sq.mi. of territory, and obtained a frontier against France which was incapable of defence. Sweden and France as guarantors of the peace acquired the right of interference in the affairs of the empire, and the former gained a voice in its councils. For many years Germany thus became the principal theatre of European diplomacy and war and the natural development of national unity was delayed. But if the treaty of Westphalia pronounced the dissolution of the old order in the empire, it facilitated the growth of new powers in its component parts, especially Austria, Bavaria, and Brandenburg. The treaty was recognized as a fundamental law of the German constitution, and formed the basis of all subsequent treaties until the dissolution of the empire.

See the text in Dumont, *Corps universel diplomatique*, vi. 429 ff. (The Hague, 1726–31); J. G. von Meiern, *Acta pacis Westphalicae publica* (Hanover and Göttingen, 1734–36), *Instrumenta pacis Caesareo-Suecicae et Caesareo-Gallicae* (Göttingen, 1738); "A.A." (Bishop Adam Adami), *Arcana pacis Westphalicae* (Frankfort, 1698), ed. J. G. von Meiern (Leipzig, 1737); K. T. Heigel, "Das Westfälische Friedenswerk von 1643–48" in *Zeitschrift für Geschichte und Politik* (1888); F. Philippi and others, *Der Westfälische Frieden, ein Gedenkbuch* (Münster, 1898); *Journal du Congrès de Munster par F. Ogier, aumônier du comte d'Avaux*, ed. A. Boppe (1893); *Cambridge Modern History*, iv. p. 395 ff. and bibliography, p. 866 ff.; J. Bryce, *The Holy Roman Empire*, (1926) ch. xix.; Andrea Rapisardi-Mirabelli, *Le Congrès de Westphalie, ses negociations et ses résultats au point de vue de l'histoire du droit des gens* (1929). (A. B. G.)

WEST POINT, a national military post on a 14,000 ac. reservation on the west bank of the Hudson river in Orange county, N.Y., U.S.A., 50 mi. north of New York city. It is reached by U.S. highway 9W.

The United States Military Academy, located at West Point, is an institution established by the government for the practical and theoretical training of young men for the military service. Its direction and supervision are vested by law in the war department. Its cadets are given a comprehensive and general education of collegiate grade and a sufficient military education and training to enable them to pursue their careers as officers of the army, in which they are commissioned as second lieutenants upon graduation. While at the academy they receive annual pay and allowances amounting to $1,090, which is sufficient to defray all necessary expenses. A candidate for cadetship must be a citizen of the United States. He must never have been married, must be between 17 and 22 years of age and must conform to prescribed mental, physical and educational standards. His physical and mental fitness is determined by examination; his educational qualifications may be shown by regular mental examination or by the submission of certain prescribed certificates with validating examination, or, in certain special cases, by certificate without mental examination.

Under the act of congress approved June 3, 1942, the authorized strength of the corps of cadets was 2,496 cadets, appointed as follows: 8 from each state at large (senatorial), 4 from each congressional district, 4 from each territory (Hawaii and Alaska), 6 from the District of Columbia, 4 from natives of Puerto Rico, 2 from the Panama Canal Zone, 172 from the United States at large and 180 from among the enlisted men of the regular army and of the National Guard, in number as nearly equal as possible. The same act provided that when on the date of admission of a new class the total number of cadets was below the number authorized, the secretary of war might bring the corps of cadets to full strength by appointing qualified alternates and candidates recommended by the academic board. In addition to the 2,496 mentioned above, the secretary of war was authorized by the act to permit no more than four Filipinos, to be designated by the president of the Commonwealth of the Philippine Islands, to receive instruction at the United States Military academy.

Upon admission to the Military academy each cadet takes an oath of allegiance and agrees to serve in the United States army for a period of eight years unless sooner discharged by competent authority.

The normal course at the Military academy is four years; for

the duration of World War II (Act of Congress, Oct. 1, 1942), however, it was temporarily shortened to three. All cadets receive the same basic military training and pursue the same academic course until the latter part of the second year; then those who have elected to receive flying training and have passed the necessary physical examination are designated as "air cadets" and begin the elementary flying course, which is followed by the basic and advanced courses, leading up to qualification as pilot and commission as second lieutenant in the air corps upon graduation. Some minor modifications in the academic course are necessitated for "air cadets" by their flying schedule and their specialized training; but their education is essentially the same as that of the "ground cadets." In order to achieve a well-rounded knowledge of the military profession, all cadets receive instruction in all arms of the service, including the air arm, and there is no specialization, except for the "air cadets," prior to graduation.

The months of June, July and August are devoted to military training and, with the exception of flying, drills after classes and the study of minor tactics, no other military instruction is given during the academic year. The academy has extensive manoeuvre grounds where practical training in all arms under combat conditions is given, and also a large flying field (Stewart field) located 14 mi. to the northwest. In addition to their training at West Point, cadets obtain supplementary instruction at other army training centres and take part in large-scale manoeuvres with other units of the army, in which they exercise command as non-commissioned and junior officers, performing duties expected of them later in combat.

The academic year lasts from September to May, inclusive. The course is primarily mathematical and scientific in nature but includes sufficient cultural material to provide a well-rounded education. It is further supplemented by access to a library which contained more than 120,000 volumes in 1943 and was particularly rich in military works. German, Portuguese, French and Spanish are taught by the department of modern languages. A cadet must choose one foreign language, being limited in his choice only by the number of vacancies available. The academic course is rigorously thorough rather than extremely difficult. The degree of bachelor of science is awarded upon graduation.

A comprehensive program of physical training and development is provided. In addition to compulsory work in the gymnasium, there is a varied intramural athletic schedule in which all cadets must take part. Athletic teams represent the Military academy in competition with other colleges in 18 different sports.

The objectives of West Point training are epitomized in the academy motto, "Duty, Honor, Country." Character based on honour and discipline is stressed as the best foundation for a career devoted to the service of the nation.

West Point is situated in the highlands of the Hudson in a setting of great beauty. The view up the Hudson gorge from Battle monument is renowned. The main buildings of the academy and the Cadet chapel above them are all constructed of native granite in the Gothic style and seem to be a part of their natural surroundings. Some of the buildings of special interest are: The Cadet chapel, remarkable for the purity and beauty of its Gothic architecture; the riding hall, one of the largest in the world; the administration building, unusual for the fact that its 160-ft. tower is of solid masonry construction without a steel frame; Cullum Memorial hall, patterned after the second Erechtheum; central barracks and the old Cadet chapel, rich in associations with famous graduates; the Ordnance museum, containing an interesting collection of weapons, models and trophies, and the library, which contains many rare manuscripts and engravings as well as original sketches by Whistler and portraits by Stuart and Sully.

In addition to the buildings of the Military academy there are several monuments, the most prominent of which is Battle monument, erected to the memory of the officers and men of the regular army who fell during the Civil War in the defense of the union. There are also seven old revolutionary redoubts in the hills behind the academy and three forts—Forts Clinton, Putnam and Constitution—which were also built during the Revolution. On Trophy point are many cannon, relics of U.S. wars and several links of the great chain that was stretched across the Hudson at West Point during the Revolution.

Historical Sketch.—The land occupied by the old part of the reservation originally belonged to the British crown. The first settlement probably dates from 1723, when a royal grant was made to Charles Congreve. Another portion of the reservation was patented to John Moore in 1747. Although West Point had been occupied continuously by troops since 1779, it did not become government property until 1790, when at the request of its owner, Stephen Moore, congress appropriated the money for its purchase. Subsequent acquisitions were made from time to time until by 1943 the reservation comprised approximately 14,000 ac.

At the outbreak of the Revolutionary War, both the colonists and the British realized the importance of gaining possession of the Hudson River valley, and West Point became the strategic key to its defense. General Washington established his headquarters there in 1779. In 1780 Maj. Gen. Benedict Arnold, who was then in command at West Point, attempted to betray it to the British; but his treason was discovered and he fled to the enemy.

Although the founding of a military school had been proposed by General Knox in 1776, and Washington and Hamilton had repeatedly urged adoption of the plan, it was not until March 16, 1802, that congress passed the act establishing the United States Military academy at West Point. During its early years the institution suffered from lack of proper organization and discipline. Finally, in 1817, Maj. Sylvanus Thayer, who had been sent to Europe to study military schools there, assumed the superintendency at West Point and reorganized the academy so effectively that the fundamental features of its instruction and discipline remained essentially the same at the time of World War II. For this reason, Thayer has been justly called the "father of the Military Academy."

Graduates of West Point have borne an honourable part in every war waged by the United States from 1812. From the time of the academy's establishment through 1943, 13,960 had been graduated from it.

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WEST VIRGINIA, a state in the Appalachian Mountain region of the eastern United States, lying between lat. 37° 10′ and 40° 40′ N. and long. 77° 40′ and 82° 40′ W. The boundaries give the state an oval shape except for two extensions, the one to the north between Ohio and Pennsylvania, and the other to the east between Maryland and Virginia, which are usually called "panhandles" and give the state its nickname, "the Panhandle State." The area is 24,181 sq.mi., of which 91 sq.mi. is water.

Physical Features.—The state is divided into two distinct physiographic areas: (1) the Allegheny plateau on the west, comprising perhaps two-thirds of the area of the state, and forming a part of the great Appalachian plateau province which extends from New York to Alabama; and (2) the Newer Appalachian or Great Valley region on the east, being a part of the large province of the same name which extends from Canada to central Alabama. The Allegheny plateau consists of nearly horizontal beds of limestone, sandstone and shales, including important seams of coal; inclines slightly toward the northwest and is intricately dissected by streams into a maze of narrow canyons and steep-sided hills. Along the Ohio river, these hills rise to an elevation of 800 to 1,000 ft. above sea level, while toward the southeast the elevation increases until 3,500 and 4,000 ft. are reached along the southeast

margin of the plateau, which is known as the Allegheny Front. The entire plateau area is drained by the Ohio river and its tributaries. Starting at the north the first of these tributaries is the Monongahela, which crosses into Pennsylvania before it joins the Ohio. Its headwater valleys in the north-central part of the state are among the most beautiful and fertile in West Virginia. A system of dams renders the Monongahela navigable as high as Fairmont. Farther south, entering the Ohio river at Parkersburg, is the Little Kanawha river which drains seven or eight central northwestern counties. More than 44 mi. below, at Point Pleasant, the Kanawha river, the principal tributary in West Virginia, enters the Ohio. This river drains over one-third of the state and its headwaters reach far back into the long mountain valleys. On its banks the capital of the state, Charleston, is situated, and along its main valley and branch valleys several of the principal railway lines are built. The river itself is navigable to Kanawha falls, about 39 mi. above Charleston, and is used regularly by barge lines. In the southwest the Gayandotte, Twelve Pole, Big Sandy and Tug rivers complete the plateau drainage system. All of West Virginia enjoys complete drainage; and not a square mile of marshland is to be found.

In the Newer Appalachian region, the same beds which lie horizontal in the plateau provinces were long ago thrown into folds and subsequently planed off by erosion, leaving alternate belts of hard and soft rock exposed. Uplift permitted renewed erosion to wear away the soft belts, leaving mountain ridges of hard rock separated by parallel valleys. The mountain ridges vary in height to over 4,000 ft., the highest point in the state being Spruce Knob (4,860 ft.). The parallel valleys are drained by streams flowing northeast and southwest, those in the northeast being tributary to the Potomac, which flows to the Atlantic ocean, and those farther south tributary to the Kanawha river, which enters the Ohio and then flows to the Gulf of Mexico. The valleys between the ridges, although not always easy of access, provide broad areas of nearly level agricultural land. The rivers flowing northeast and southwest, after running between parallel ridges for long distances, often turn suddenly through transverse passes formed by erosive cutting of "gaps" through ridges. One of the best known is Harper's Ferry where the Potomac has cut through the Blue Ridge.

Flora.—The plateau portion of the state is still largely covered by hardwood forests, but along the Ohio river and its principal tributaries the valuable timber has been long removed and considerable areas have been wholly cleared for farming and pasture lands. Among the most important trees of this area are the white and chestnut oaks, the black walnut, the yellow poplar and the cherry, the southern portion of the state containing the largest reserve supply. The eastern Panhandle region has a forest region similar to that of the plateau district; but between these two areas of hardwood there is a long belt where spruce and white pine cover the mountain ridges. Other trees common in the state are the persimmon, sassafras, and, in the Ohio valley region, the sycamore. Hickory, chestnut, locust, maple, beech, dogwood and pawpaw are widely distributed. Among the shrubs and vines are the blackberry, black and red raspberry, gooseberry, huckleberry, hazel and grape. Ginseng is an important medicinal plant. Wild ginger, elder and sumach are common, and in the mountain areas, rhododendrons, mountain laurel and azaleas.

Climate.—Like most mountain states West Virginia has a healthful climate. It does not suffer from great extremes of heat or cold. Winter temperatures range from a mean of 26° in the northeastern mountains to 34° in the southwest along the Ohio river; the summer temperatures are 67° and 74°, respectively. Between the last killing frost in the spring and the first killing frost in the fall there is an ample growing season which in the Ohio valley is about a month longer than in the more exposed plateau and mountain districts. Precipitation is greatest in the mountains (over 50 in. annually); and it is smallest over the Ohio valley, the eastern Panhandle, and the extreme southeast (35 to 40 in. annually). Snows are frequent during the winter and are sometimes deep in the higher plateau and mountain regions.

Population.—The population of West Virginia in 1870 was 442,014; in 1890 it was 762,794; in 1910, 1,221,119; and in 1940, 1,901,974. This last figure represents an increase of 10% over the population in 1930. The population per square mile was 79, as compared with 44.2 for the United States as a whole. Of the 1940 population, 534,292, or 28.1%, lived in urban places; that is, in cities and towns of 2,500 or more. The number of occupied dwelling units returned in the housing census of 1940 was 444,889, which is approximately the same as the number of families. The average population per family (occupied dwelling unit) declined from 4.6 in 1930 to 4.3 in 1940. The white population of West Virginia formed 93.8% of the total in 1940, as compared with 93.3% in 1930, practically all the nonwhite population being Negro. The number of males per 100 females in the entire population of the state was 102.8, the sex ratio being 102.7 for the white and 104.4 for the nonwhite population.

The population of the state and of its principal cities is summarized below:

Area	Population			Per cent of increase	
	1940	1930	1920	1930–40	1920–30
The State	1,901,974	1,729,205	1,463,701	10.0	18.1
Urban	534,292	491,504	369,007	8.7	33.2
Rural	1,367,682	1,237,701	1,094,694	10.5	13.1
Per cent urban	28.1	28.4	25.2	..	..
Principal cities:					
Huntington	78,836	75,572	50,177	4.3	50.6
Charleston	67,914	60,408	39,608	12.4	52.5
Wheeling	61,099	61,659	56,208	—0.9	9.7
Clarksburg	30,579	28,866	27,869	5.9	3.6
Parkersburg	30,103	29,623	20,050	1.6	47.7

Government.—The present constitution, which superseded the constitution of 1863, was adopted Aug. 1872. It may be amended (1) by a constitutional convention whose acts shall be ratified by the people, or (2) by amendments passed by a two-thirds majority of each house of the legislature and approved by a majority of the voters at the next general election. All citizens above 21 years of age have the right of suffrage provided they have resided in the state one year and in the county in which they expect to vote 60 days.

The executive department consists of the governor, secretary of state, superintendent of free schools, auditor, treasurer, attorney-general and commissioner of agriculture, all elected by the people at the time of the presidential election and for a period of four years. The governor is ineligible for re-election for a second consecutive term. He appoints, subject to the consent of the senate, all state officers whose selection is not otherwise provided for. By an amendment of 1934 the date of the inauguration of state elective officers was changed from March 4 to the first Monday after the second Wednesday of January following the election.

The legislature, consisting of the senate and the house of delegates, meets at the capital on the first Wednesday in January of odd-numbered years. The senate is composed (1940) of 32 members, chosen from 16 districts for a term of four years, one-half the membership retiring biennially. The house of delegates is composed (1940) of 94 members elected biennially, each county choosing at least one.

The governor may veto a bill or the separate items of an appropriation bill, but this veto may be overridden by a simple majority of the total membership of each house.

Recent legislation includes an act of 1937 creating an "interim committee" to study problems and formulate programs and an act of 1939 providing for a permanent office of budget director. Other important new laws of 1939 included provisions relating to health certificates for marriage, child labour, teacher tenure and retirement, workmen's compensation, unemployment compensation and unlawful or unfair trade practices. An act of 1935 authorized the creation of a water power commission.

The judicial power is vested in the supreme court of appeals, the circuit courts, inferior courts, county courts and justices of the peace. The supreme court of appeals, consisting of five judges, elected for terms of 12 years, holds regular terms twice a year at Charleston and special terms at such times and places as may be designated by the court. The circuit court is com-

posed of 24 circuits with 25 judges. Inferior courts are established by special act of the legislature to relieve the circuit judges, and are found in eight counties of the state. Generally they have criminal jurisdiction only.

As in Virginia, the county is the unit of local government, though an unsuccessful attempt to introduce the township system was made in the first constitution.

Finance.—The assessed valuation of property for 1940 was $1,838,783,059. Of the valuation, real estate amounted to $850,357,039, personal property to $397,668,520 and public utilities to $590,757,500. Counties with the highest assessed valuation in order were: Kanawha, Cabell, Ohio, Harrison, McDowell, Wood, Marion, Monongalia, Fayette, and Mercer.

On the assessed valuation in 1932 ($1,671,276,370) a direct tax totalling $50,657,489 was levied by the state, counties, school districts and municipalities. Out of each $1000 taxed, $0.76 was levied by the state, $5.48 by counties, $6.51 by school districts and $2.45 by municipalities in 1935. Including the property tax, the state collected during the fiscal year ending June 30, 1936, a total of $123,924,249 from all revenues. Of this $12,329,920 was derived from a gross sales tax. A sales tax of four cents a gallon on gasoline (raised from two cents in 1927) netted $6,411,191. An inheritance tax contributed $509,946. The remainder was obtained from miscellaneous sources. For the year ending June 30, 1939, the receipts were $106,637,894 and the disbursements $101,807,327, leaving a balance of $16,470,897. In 1915 the amount of the debt to Virginia, which had been in controversy since the Civil War, was fixed by the U.S. supreme court at $12,393,929, plus 5% interest until paid. Besides this debt, which was paid by 1940, the state incurred a bonded debt of $78,950,000 for highway construction.

The total bonded indebtedness on July 2, 1936 was $85,330,800. In 1940 it was $77,232,000.

The federal income tax in West Virginia for 1939–40 was $13,143,541 (of which $6,882,889 was from corporations and $4,082,943 from individuals).

On June 30, 1936, there were in the state 185 banks (79 of them national banks) with resources and liabilities totalling $322,979,000. The capital, surplus and undivided profits amounted to $46,705,000. The deposits were $272,986,000, of which over $110,000,000 were on time accounts.

The total deposits of 182 banks (78 national) in 1940 were $313,226,065.

Education.—Rapid progress in education between 1930 and 1934 is shown by the increase in the public school enrolment from 395,505 to 434,864, the increase in the days of attendance per pupil from an average of 146·6 to 151·1 per year. Public school expenditures decreased from $28,219,000 to $19,761,000 or from $71.35 to $45.44 per child of school age. The expenditures per pupil are still below the average throughout the United States, but they place West Virginia in the lead of all other southern states except Maryland and Delaware. Of the 1934 enrolment 355,958 were in the elementary schools. High school enrolment increased from 48,814 in 1930 to 78,906 in 1934, of whom 4,391 were enrolled in the Negro high schools. There were in 1934, 11,554 elementary and 4,474 high school teachers to whom a total of $13,503,000 was paid in salaries. In 1939–40 the number of teachers was 11,061 in the elementary and 5,117 in the high schools.

The New River State school (now the West Virginia Institute of Technology) at Montgomery and the Potomac State school at Keyser originated as state-supported preparatory schools at a time when there were few public high schools. They offer college work, the former for degrees and the latter as a two-year junior college.

There were in 1940 six state normal schools for whites, located at Huntington, Fairmont, Athens, Glenville, West Liberty and Shepherdstown. Each of these, which long confined its work chiefly to preparatory subjects and methods of teaching, now offers courses for collegiate degrees.

Bluefield Coloured Institute at Bluefield, serving the Negro population in the southern part of the state, gives a regular high school course, plus normal and junior college courses. West Virginia Collegiate Institute at Institute, also serves the Negro population, offering preparatory, normal and college courses. There are state schools for the white deaf and blind at Romney and for Negroes at Institute. West Virginia university is located at Morgantown, and is divided into colleges of arts and science, engineering, agriculture, law, schools of medicine, pharmacy and journalism. Private denominational colleges of importance are Bethany college at Bethany, West Virginia Wesleyan college at Buckhannon, Davis and Elkins at Elkins, Greenbriar college (for women) at Lewisburg, Salem college at Salem and Morris Harvey college at Charleston.

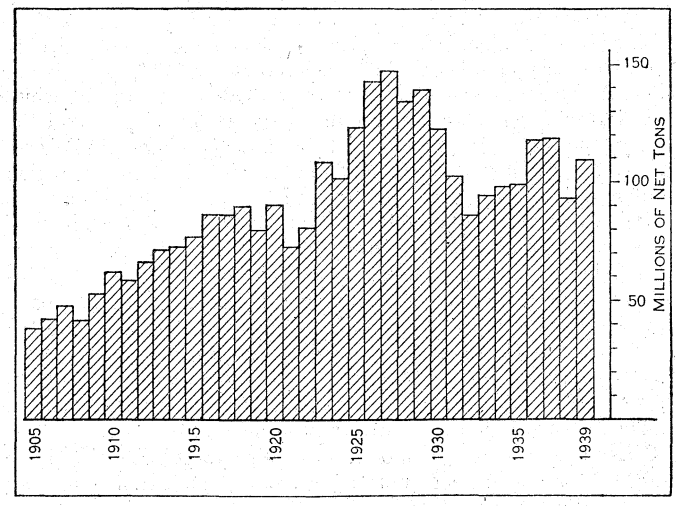
Charities and Corrections.—In 1940 there were 21 state hospital, correctional or penal institutions in operation, all of them managed and governed by the state board of control. The governor appoints the chief executive officer or head of each institution.

There is a state board of children's guardians which has control and custody over dependent and neglected children.

Mines and Quarries.—The extraction of minerals is the most important industry in the state. Mineral products were valued at $346,565,000 in 1929, and $254,995,309 in 1939. In 1923 West Virginia ranked second among the states in total value of its mineral output, but by 1938 it dropped to fifth place. The decrease in the value of the coal output and the increased value of petroleum produced in other states were chiefly responsible for the decrease in rank.

Next to coal the chief minerals, according to the value of their 1938 output, were: natural gas, petroleum, coke, stone, clay and natural gasoline.

The production of coal has increased with remarkable rapidity. In 1924, for the first time the state's production exceeded 100,000,000 tons. In 1929 it amounted to 139,297,946 tons, but by 1932 it fell to 86,114,506 tons, a decrease of approximately 60,000,000 tons in three years, but in 1939 it had risen to 108,515,665 tons. In 1935 the output was far above that of Pennsylvania, formerly the leading state in the production of bituminous coal. It amounted also to more than one-fourth the supply of bituminous coal mined in the United States in that year. During 1934 there were 600 companies reporting 764 operating coal mines. The total of all men employed in connection with the coal



COAL MINED, 1905–1939

mines was 105,906. During the year 1934 the average number of tons mined per man per day was 4·17 and the average production per mine was 129,000. Mines operated an average of 155 days in 1924 and 196 days in 1934. The state department of mines regularly inspects all mines and maintains mine rescue stations at Charleston, Kilsythe, Elkins, Meadowbrook and Williamson. Between 1930 and 1935 labour troubles were frequent in the mining districts, due mainly to the determined attempts of the unions to organize the West Virginia miners. During the unrest attending the formation of the C.I.O., however, West Virginia remained

generally quiet. At the present rate of consumption West Virginia alone could supply the whole United States with coal for nearly 250 years.

From 1909 to 1924 West Virginia held first place among the states in the production of natural gas, but in 1924 dropped to third place, being passed by Oklahoma and California. The gradual decrease in production is revealed by contrasting the 244,004,000,000 cu.ft. produced in 1915 with 150,000,000,000 cu.ft. produced in 1939. In 1934, 20,747,000,000 cu.ft. were consumed in West Virginia and the remainder in Ohio, Pennsylvania, Kentucky and Maryland to which it was transported by underground pipe lines. A large share was used in the production of gasoline. In 1934 there were 90 plants which produced 41,854,000 gal. valued at $1,598,000. There were also 3 plants producing carbon black from natural gas, the output of which was 578,000 lb. in 1929.

Between 1880 and 1910 West Virginia was one of the leading petroleum producing states of the union. The peak of production was reached in the year 1900 when the state ranked second in output. Production then began to decline. From 1926 to 1930 the annual average was 5,655,000 bbl.; in 1935 it amounted to 3,903,000 bbl. and in 1939 to 3,587,000 bbl. The rank in 1935 was 23rd; activity continued, nevertheless.

In 1934 there were 111 stone quarrying plants producing 2,106,130 short tons of stone valued at $1,912,766. Of this 1,731,330 tons were limestone and 374,800 tons were sandstone. Production by 1938 had risen to $4,391,563. Much limestone is also used for burning lime. West Virginia is also the centre of the sand supply for its own 42 glass plants (in 1935), as well as those in eastern Ohio and western Pennsylvania. Sand used for this purpose in 1934 amounted to 424,651 short tons, valued at $784,308.

Other sand and gravel valued at $362,956 was used for building and road-paving purposes. Production of sand and gravel in 1938 was valued at $1,803,474. Salt fields are on the Gauley river, on the Kanawha from Kanawha falls to Pt. Pleasant and up the Ohio river to Pomeroy Bend.

Agriculture and Livestock.—Agriculture plays an important role in the state. In 1935 there were 104,747 farms upon which 561,919 people, or 30·9% of the total population, made their homes. Farm lands occupied 9,424,000 ac. of the 15,417,600 ac., estimated land area of the state. Of this farm acreage, 1,740,000 ac. was reported as crop land. The value of farm land and buildings was $341,976,000 in 1930, in 1935 it had fallen to $237,644,000. The value of livestock on the farms was estimated at $54,544,000, and $37,738,000 for the years 1930 and 1940. The gross farm income in 1935 was $60,500,000; in 1940 it was estimated at $41,723,000, excluding government payments.

For a long period after settlement agriculture was backward in West Virginia. Pioneer conditions lasted longer in the mountains, transportation was poor, and the hills and streams discouraged all but a limited and patchy cultivation of crops. Farmers passed the state by for the more level fields of the prairie west. After 1880 development was constant until about 1910. The World War and the prosperous years of the late 1920s were responsible for temporary increases in activity and production, but subsequent periods of low prices caused hardship. Between 1930 and 1935 there was an increase of 112,805 in farm population; an increase in area of farm land amounting to 622,000 ac., a decrease of $104,332,000 in farm property value; a decrease of $24,960,000 in value of farm livestock. Counties with the greatest farm property value in 1935 were: Harrison, Greenbrier, Kanawha, Berkeley, Mason, Jefferson, Preston, Mercer, Wood, Jackson, Roane, Randolph.

The acreage of important crops in 1939 was as follows: tame hay, 720,000; Indian corn, 491,000; oats, 73,000; wheat, 145,000; potatoes, 32,000; wild hay, 12,000; rye, 7,000; tobacco, 3,600. The total value of important crops was in 1939 as follows: tame hay, $6,988,800; Indian corn, $10,215,620; potatoes, $2,584,000; oats, $627,000; wheat, $1,891,800; tobacco, $498,000; wild hay, $90,000; and rye, $50,000. Besides field crops there are orchard crops valued annually from $4,000,000 to $7,000,000. Fruit is raised chiefly in the eastern and northern Panhandles. The leading apple counties in 1935 were Berkeley, Hampshire, Jefferson and Morgan. Tobacco is cultivated mainly in the southwest near the Kentucky border. The other crops are well distributed.

A large share of the crop of the state is fed to the livestock. An incentive to livestock raising is the large amount of excellent pasture land on the hillsides or in the stream bottoms. In 1941 the estimated value of livestock was $37,313,000. There were 600,000 cattle (335,000 of them milch cows), 95,000 horses, 489,000 sheep, 203,000 swine and 12,000 mules. Chickens in 1940 were valued at $2,805,000. About 5,000,000 are raised annually. Progress has been made in conservation. In 1938 the national Monongahela forest contained 795,000 ac., with plans for enlargement by purchase of about 900,000 additional acres. In 1939 the state owned six forests ranging in size from 5,400 to 12,973 ac.

Manufactures.—There was a sharp drop in manufacturing following 1929. In 1930 there were 1,483 establishments employing 85,289 wage earners at a total of $115,259,081 in wages and producing an output valued at $512,010,502. In 1933 the number had decreased to 887, the wage earners to 67,950. Wages had fallen almost 50%, amounting to $60,399,840, and the value of products was close to one-half its value in 1929, or $262,466,988. By 1937 the number of establishments had risen to 1,057, the number of wage earners to 83,464, total wages to $102,511,473, and value of products to $480,526,000. Leading, with a value of $75,434,989 in 1935, were the products of the 12 steel works and rolling mills. Products of the 42 glass factories were second with a value of $40,500,213. Other leading industries were: chemicals, $37,292,613; pottery, including porcelain ware, $11,374,666; petroleum refining, $10,305,313; bread and other bakery products, $9,244,833; stamped and pressed metal products, $8,740,214; lumber and timber products, $8,154,297; coke oven products, $7,918,550; wholesale meat packing, $7,656,574; steam railroad repair shops, $6,481,213; leather, tanned, curried and finished, $6,437,779. Wheeling, Huntington and Parkersburg were the chief industrial centres of the state.

The state is rich in power resources which are increasingly potential factors in the growth of industry. The vast coal resources are close at hand. Natural gas in many instances furnishes a cheaper power. With one exception, the state has greater potential water power than any state east of the Mississippi river.

Transportation and Commerce.—Railway development in West Virginia has been due largely to the exploitation of the coal and lumber. The mileage increased from 2,228 in 1900 to 4,046 in 1930, and was about 4,000 in 1940. After the issue of state-road bonds to the amount of $43,955,000 in 1930, public road improvement proceeded rapidly. Of the 4,514 mi. in the state system in 1935 there were 3,907 mi. paved and 607 mi. graded or partly graded. Motor vehicles increased in number from 217,589 to 249,287 in 1935 and 274,866 in 1940. The rivers are used for the shipment of coal.

History.—The western part of Virginia was not explored until long after considerable settlements had been made in the east. In 1671 Abraham Wood, able trader and frontiersman, sent out a party under Capt. Thomas Batts, which ascended the Roanoke river in southwestern Virginia and crossed near its headwaters to the New river, a westward flowing stream. This river they descended to the point where it breaks through Peter's mountain at Peter's falls on the Virginia-West Virginia boundary. The pass was later to be one of the chief highways of early western trade and settlement. Other explorations in the 17th century are unknown. After 1700, pioneer traders with the Indians penetrated the Potomac region above Harper's Ferry, but with the exception of Louis Michel (1707) and Van Metre in the valley of the South Branch (in 1725), they left no record. In 1726 or 1730 the first known cabins in the state were built at Shepherdstown by some Germans from Pennsylvania who crossed the Potomac at the "Old Pack Horse Ford" and by Morgan Morgan on Mill creek in Berkeley county. Within a few years other settlers from Pennsylvania and Maryland settled on various creeks flowing into the Potomac as far west as the South Branch. In 1736 an exploring party traced the Potomac to its source. Advance

up the South Branch was rapid. The diary kept by George Washington, who between 1748 and 1751 surveyed much of this land for Lord Fairfax, recorded many squatters, largely of German origin, in the region. The insecurity of title on the Fairfax grant prompted many to go still higher up the branch and its forks into Pendleton county. By 1750 a few of the frontiersmen were crossing the Allegheny divide into the Greenbriar and other rivers whose waters eventually reached the Ohio. Christopher Gist, a surveyor in the employ of the first Ohio company, in 1750–52 explored the country along the Ohio river north of the mouth of the Great Kanawha. Later the Ohio company, merged with the Walpole company, sought to secure from the king the formation of a 14th colony with the name "Vandalia." The westward advance was abruptly terminated by the outbreak of the French and Indian War (1754–63) and many of the settlements were forced back by Indian depredations. At the close of this war the English king, hoping thereby to prevent future conflicts with the Indians, issued (1763) a proclamation forbidding further settlement beyond the divide until arrangements could be made with the Indians, but this proclamation was ignored Between 1764 and 1774, when settlement was again temporarily stopped by Indian attacks, it is estimated that the line of settlement advanced across the Alleghenies and through the wilderness to the Ohio at an average rate of 17 m. per year. The valleys first settled were those of the Monongahela, Greenbriar and the New Rivers and thence down the Great Kanawha to the Ohio. By 1775 the number of people in the West Virginia region was estimated at 30,000. In the face of this relentless advance the savages grew more hostile. The result was Dunmore's War of 1774. The governor of Virginia, Lord Dunmore, led a force over the mountains, and cooperating with a body of militia under Gen. Lewis, dealt the Shawnee Indians under Cornstalk a crushing blow at Point Pleasant (*q.v.*) at the junction of the Kanawha and Ohio rivers. During the Revolutionary War which followed closely, the settlers in West Virginia were generally active Whigs and many served in the Continental army.

Social conditions in western Virginia were entirely unlike those existing in the eastern portion of the State. The population was not homogeneous, as a considerable part of the immigration came by way of Pennsylvania and included German, the Protestant Scotch-Irish and settlers from the States farther north. During the Revolutionary War the movement to create another State beyond the Alleghenies was revived, and a petition (1776) for the establishment of "Westsylvania" was presented to Congress, on the ground that the mountains made an almost impassable barrier between the west and the east. The rugged nature of the western country made slavery unprofitable, and time only increased the social, political and economic differences between the two sections of the State. The convention which met in 1829 to form a new Constitution for Virginia, against the protest of the trans-Allegheny counties continued to require property qualification for suffrage, and gave the slave-holding counties the benefit of three-fifths of their slave population in apportioning the State's representation in the lower Federal House. As a result every county beyond the Alleghenies except one voted to reject the Constitution, which was nevertheless carried by eastern votes. Though the Virginia Constitution of 1850 provided for white manhood suffrage, the distribution of representation among the counties was such as to give control to the section east of the Blue Ridge mountains. Another grievance of the West was the disproportionate expenditure for internal improvements at State expense in the east.

The Civil War merely furnished the occasion for separation from the mother State. In 1861 when the Virginia convention adopted the Ordinance of Secession only 11 of the 47 delegates from the area of the later State of West Virginia voted to secede. After the ordinance had been ratified, a convention of newly elected trans-Allegheny members of the legislature, and other delegates, met at Wheeling (June 11, 1861) and declared the acts of the Secession Convention void, and declared vacant the offices of those in the Virginia government which adhered to it. This convention formed the "reorganized" government of Virginia, chose Francis H. Pierpont as governor and provided for the election of other officials and a legislature. In August the convention reassembled at Wheeling and adopted an ordinance providing for a popular vote on the formation of a new State. At the subsequent election there were 18,489 votes cast for a new State and only 781 against. A constitutional convention (delegates to which were elected on Oct. 24) met at Wheeling in Nov. 1861, and in Feb. 1862 submitted a Constitution which was ratified by the people in April. In May 1862 the legislature of the "restored Government" voted its consent to the erection of the proposed new State. Application for admission to the Union was then presented to Congress, which granted its permission subject to the insertion of a Constitutional provision for the gradual abolition of slavery. On June 20, 1863, following the addition of this provision the State was admitted.

During the Civil War trans-Allegheny West Virginia suffered comparatively little. McClellan's forces gained possession of the greater part of the territory in the summer of 1861, and Union control was never seriously threatened. In 1863, however, Gen. Imboden, with 5,000 Confederates, overran a considerable portion of the State. Bands of guerrillas burned and plundered in some sections and were not entirely suppressed until after the war ended. The State furnished about 30,000 soldiers to the Federal armies and somewhat less than 8,000 to the Confederate. After the war partisan feeling ran high. In 1866 the State adopted a constitutional amendment disfranchising all who had given aid to the Confederacy. In 1871, however, even before the Democratic Party secured political control, the amendment was abrogated by the adoption of the Flick amendment. In 1872 an entirely new constitution was adopted under Democratic control which continued until 1896 when the Republicans triumphed and retained control for two decades. The Democrats again captured the governorship in 1916. Renewed Republican dominance after 1920 was ended by the Democratic victory in 1932, 1936 and 1940.

The largest chapter in the history of the state is doubtless that of the great industrial awakening resulting from increasing demand for timber, coal and oil. The former handicap of lack of transportation was overcome after the Civil War by the rapid extension of railway lines up the principal valleys. Petroleum, first obtained in large quantities on the Little Kanawha river in 1860, increased in production slowly until 1889 and thereafter, with the discovery of new sands and new drilling methods, more rapidly until by 1900 the state ranked second in the union in output. Coal mining, which had scarcely begun before the Civil War, increased slowly until the nineties when it responded to the increasing demands of Pittsburgh and other cities. The chief new factor in development after 1925 was improved roads. Under the road improvement program begun in 1920 by a bond issue of $50,000,000 and continued by later bond issue of 1928 for $35,000,000, the state by June 1938 completed 7,350 mi. of improved roads supplemented by modern bridges. Internal improvements on rivers were accomplished by federal appropriations. Another important factor of growth was the large increase of electric power. Meantime, in 1932, the state completed a new capitol building at a cost of more than $9,310,000, most of which was obtained by a special direct tax on property.

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WEST WARWICK, in Rhode Island, U.S.A. Pop. (1920) 15,461 (31% foreign-born white) and 18,188 in 1940 federal census. It embraces several manufacturing villages with large cotton and textile mills, and the aggregate factory output in 1940 was valued at $20,000,000. West Warwick was organized in 1913.

WETHERSFIELD, a town of Hartford county, Connecticut, U.S.A. Population (1930) 7,512; 1940 federal census 9,644. It is a beautiful old town, a residential suburb of Hartford and the seat of the Connecticut state prison. Among the interesting old buildings are the Webb house, in which Washington and Count de Rochambeau met in 1781 to plan the Yorktown campaign; the First Church of Christ (Congregational), built in 1761; and the old academy building (1804), now used for town offices and the public library. There is a giant elm on Broad Street Green, with a girth of 26·5 feet. Wethersfield was settled in 1634 by colonists from Watertown, Mass., and is the oldest permanently inhabited town in the state. With Hartford and Windsor in 1639 it framed the fundamental orders of the colony of Connecticut.

WETTIN, the name of a family from which several of the royal houses of Europe have sprung. The earliest known ancestor is one Dietrich, count of Hassegau or Hosgau, on the left bank of the Saale, who was killed in 982. His sons Dedo I. (d. 1009) and Frederick (d. 1017) received lands taken from the Wends, including the county or *Gau* of Wettin on the right bank of the Saale. Dedo's son Dietrich II. married Matilda, daughter of Ekkard I., margrave of Meissen. Their son Dedo II. obtained the Saxon east mark and lower Lusatia in 1046, but in 1069 quarrelled with the emperor Henry IV. and was compelled to surrender his possessions. He died in 1075, and his lands were granted to his son Henry I., who in 1089 was invested with the mark of Meissen. In 1103 Henry was succeeded by his cousin Thimo (d. 1104), who built a castle at Wettin, and was called by this name. Henry II., son of Henry I., followed, but died childless in 1123; his cousin, Conrad I., son of Thimo, claimed Meissen, of which he secured possession in 1130, and in 1135 the emperor Lothair II. added lower Lusatia to his possessions. Conrad, abdicating in 1156, his lands were divided between his five sons, when the county of Wettin fell to his fourth son Henry, whose family died out in 1217. Wettin then passed to the descendants of Conrad's youngest son Frederick, and in 1288 the county, town and castle of Wettin were sold to the archbishop of Magdeburg, eventually becoming incorporated in the kingdom of Prussia.

Conrad I. and his successors had added largely to their possessions, until under Henry I., the Illustrious, margrave of Meissen, the lands of the Wettins stretched from the Oder to the Werra, and from the Erzgebirge to the Harz mountains. The subsequent history of the family is merged in that of Meissen, Saxony and the four Saxon dukedoms. In June 1889 the 800th anniversary of the rule of the Wettins in Meissen and Saxony was celebrated with great splendour at Dresden.

See G. E. Hofmeister, *Das Haus Wettin* (Leipzig, 1889); K. Wenck, *Die Wettiner im 14ten Jahrhundert* (Leipzig, 1877); Kämmel, *Festschrift zur 800 jährigen Jubelfeier des Hauses Wettin* (Leipzig, 1889); and H. B. Meyer, *Hof- und Zentralverwaltung der Wettiner* (Leipzig, 1902).

WEXFORD, a county of Eire in the province of Leinster, bounded north by Wicklow, east and south by St. George's Channel, and west by Waterford, Kilkenny and Carlow. The area is 581,061 acres or about 907 sq. mi. Pop. (1936) 94,245. Owing to the number of sandbanks navigation is dangerous near the shore. The only safe harbour on the east coast is Wexford harbour, which, owing to a bar, is not accessible to large vessels at ebb tide. The artificial harbour of Rosslare, outside Wexford harbour to the south, was therefore opened in 1906. On the south coast the great inlet of Waterford harbour separates the county from Waterford and Kilkenny, and among several inlets Bannow bay is the largest. South from Crossfarnogue point are the Saltee islands, and Coningmore and Coningbeg, beyond the latter of which is the Saltee lightship. Southeast from Greenore point is the Tuskar rock.

An elevated ridge on the northwestern boundary forms the termination of the granitic range in Wicklow, and in Croghan Kinshela, on the borders of Wicklow, rises to a height of 1,985 feet. On the western border, another range, situated chiefly in Carlow, extends from the valley of the Slaney at Newtownbarry to the confluence of the Barrow with the Nore at New Ross, and reaches 2,409 ft. in Blackstairs Mountain, and 2,610 ft. in Mount Leinster on the border of Co. Carlow. In the southern district, a hilly region, reaching in Forth Mountain a height of 725 ft., forms with Wexford Harbour the northern boundaries of the baronies of Forth and Bargy, a peninsula of flat and fertile land. The river Slaney enters the county in the north-west and flows south-east to Wexford Harbour. Its chief tributary, the Bann, flows south-westwards from the borders of Wicklow. The Barrow forms the western boundary of the county from the Blackstairs mountains till its confluence with the Suir at Waterford Harbour.

The northern portion of Wexford was included in *Hy Kinselagh*, the peculiar territory of the Mac Murroughs, overlords of Leinster, who had their chief residence at Ferns. Dermot Mac Murrough, having been deposed from the kingdom of Leinster, asked help of Henry II., king of England, secured the aid of Strongbow, and obtained assistance from Robert Fitzstephen and Maurice Fitzgerald of Wales. In 1169 Fitzstephen landed at Bagenbon on the south side of Fethard, and captured the town of Wexford. After this Dermot granted the territory of Wexford to Fitzstephen and Fitzgerald. Mac Murrough having died in 1172, Strongbow became lord of Leinster. At first Henry II. retained Wexford, but in 1174 he committed it to Strongbow.

Wexford was one of the twelve counties into which the conquered territory in Ireland is generally stated to have been divided by King John, and formed part of the possessions of William Marshal, earl of Pembroke. It ultimately passed to John Talbot, earl of Shrewsbury, who in 1446 was made earl of Waterford and baron of Dungarvan. In 1474 George Talbot was seneschal of the liberty of Wexford. The district was actively concerned in the rebellion of 1641; and during the Cromwellian campaign the town of Wexford was carried by storm in 1649. Wexford was the chief seat of the rebellion of 1798, the leaders there being the priests.

Evidences of the Danish occupation are seen in the numerous raths, or encampments, especially at Dunbrody, Enniscorthy and New Ross. Among the monastic ruins special mention may be made of Dunbrody abbey, of great extent, founded about 1178 for Cistercian monks by Hervey de Montmorency, marshal of Henry II.; Tintern abbey, founded in 1200 by William Marshal, earl of Pembroke, and peopled by monks from Tintern abbey in Monmouthshire; the abbey of St. Sepulchre, Wexford, founded shortly after the invasion by the Roches, lords of Fermoy; Ferns abbey, founded by Dermot Mac Murrough (with other remains including the modernized cathedral of a former see, and ruins of a church); and the abbey of New Ross, founded by St. Alban in the 6th century. Old castles include Ferns, dismantled by Parliamentary forces in 1641, and occupying the site of the old palace of the Mac Murroughs; Enniscorthy, founded by Raymond le Gros; Carrick Castle, near Wexford, the first built by the English; and the fort of Duncannon.

The soil of the county of Wexford consists mostly of a cold stiff clay resting on clay-slate. Pre-glacial sands and gravels are used for liming fields, under the name of "manure gravels," on account of the fossil shells which they contain. The interior and western districts are much inferior to those round the coasts. In the south-eastern peninsula of Forth and Bargy the soil is a rich alluvial mould mixed with coralline sandstone and limestone. The peninsula of Hookhead, owing to the limestone formation, is specially fruitful. In the western districts of the county there are large tracts of turf and peat-moss. The principal crops are barley, oats, potatoes and turnips. The numbers of cattle, sheep, pigs and poultry are well maintained. Except in the town of Wexford the manufactures and trade are of small importance. The town of Wexford is the headquarters of sea and salmon fishing districts, and there are a few fishing villages on the inlets of the south coast.

A branch of the Great Southern railway enters the county from the north-east and serves Wexford by way of Enniscorthy, with a branch westward to New Ross from Macmine Junction. Palace East, on this branch line, is also served by the Kildare line of the same system. Wexford has railway connections with Rosslare, and a line across the south of the county connects it also with

Waterford (Co. Waterford). There is water communication for barges by the Slaney to Enniscorthy; by the Barrow for larger vessels to New Ross, and by this river and the Grand Canal for barges to Dublin. The administrative county of Wexford returns five members to Dáil Eireann.

WEXFORD, a seaport and the county town of County Wexford, Eire. Pop. (1936) 12,247. Wexford was an early colony of the English, having been taken by Fitzstephen. It was the second town that Cromwell besieged in 1649. It was garrisoned for William III in 1690. In 1798 it was made the headquarters of the rebels, who, however, surrendered it on the 21st of June. In 1318 the town received a charter from Aymer de Valence, which was extended by Henry IV in 1411, and confirmed by Elizabeth in 1558. By James I it was in 1608 made a free borough corporate. Wexford Harbour, formed by the estuary of the Slaney, is about 5 mi. from north to south and about 4 mi. from east to west. There are quays extending nearly 900 yd. A bar at its mouth prevents the entrance of vessels drawing more than 12 ft. An artificial harbour was therefore opened at Rosslare in 1906, and this is connected with Wexford by a railway (8¾ mi.) owned by the Great Southern company, and is served by the passenger steamers of the Great Western railway of England from Fishguard. Some remains exist of the old walls and flanking towers. The Protestant church, near the ruins of the ancient abbey of St. Sepulchre or Selsker, is said to occupy the spot where the treaty was signed between the Irish and the English invaders in 1169. At Carrick, 2 mi. W., the Anglo-Normans erected their first castle. The principal exports are agricultural produce, livestock and whisky. Shipbuilding is carried on, and also tanning, malting, brewing, iron-founding, distilling and the manufacture of artificial manure, flour, agricultural implements and rope and twine. Wexford is the headquarters of salmon and sea fishery districts.

WEYBRIDGE, a town and, with Walton, an urban district in Surrey, England. Pop. (1938) 30,040. Area 14.2 sq.mi. It lies in the flat valley of the river Wey, 1 mi. above its junction with the Thames. The river is locked up to Godalming, and navigation is assisted by cuts. The Roman Catholic church of St. Charles Borromeo was the temporary burial place of Louis Philippe, who lived at Claremont in Esher, and other members of the Bourbon family. In 1907 the Brooklands racing track for motor cars was opened near Weybridge. It has a circuit of 2 11/16 mi. round the inner edge and, including the straight finishing track, is 3¼ mi. in total length; its maximum width is 103 ft., and it will take ten cars abreast.

WEYDEN, ROGIER VAN DER [originally ROGER DE LA PASTURE] (*c.* 1400–1464), Flemish painter, was born in Tournai, and there apprenticed in 1427 to Robert Campin. He became a gild master in 1432 and in 1435 removed to Brussels, where he was shortly after appointed town painter. His four historical works in the Hôtel de Ville have perished, but three tapestries in the Bern museum are traditionally based on their designs. In 1449 Rogier went to Italy, visiting Rome, Ferrara (where he painted two pictures for Lionel d'Este) and Milan. The well-known little Madonna with four saints at Frankfort, was probably painted at Florence. The "Entombment" in the Uffizi was probably also painted in Italy. On returning (1450) he executed the triptych with half-length figures of Christ, the Virgin and saints in the Louvre; and for Pierre Bladelin the "Magi" triptych, now in the Berlin gallery. Van der Weyden's style is dry and severe as compared with the painting of the Van Eycks, his colour is less rich than theirs, and he lacks their sense of atmosphere. On the other hand, he cared more for dramatic expression, particularly of a tragic kind, and his pictures have a deeply religious intention. Comparatively few works are attributed with certainty to this painter; early works are: "The Descent from the Cross" in the Chapter House of the Escorial; the John the Baptist three-panel altar-piece in the Berlin Museum; the three-panel altar-piece of the Virgin, two panels of which are in Granada Cathedral and the third in the Metropolitan Museum of Art, New York; the "Crucifixion" at the Vienna gallery; that in the Johnson collection, Philadelphia. The "Seven Sacraments" altar-piece at Antwerp is almost certainly his, likewise the triptych of the Beaune hospital. Notable portraits are: Lionello d'Este in the Friedman collection, New York and Charles the Bold in the Berlin Museum. Among his later works are "The Annunciation" in the Metropolitan Museum of Art, New York, and the triptych with the "Adoration of the Kings," the "Annunciation" and the "Presentation" in the Munich Pinakothek. Van der Weyden attracted many followers and his influence was widespread. It is evident in the work of Dierich Bouts, Memline and Martin Schongauer. He died at Brussels on June 16, 1464 and was buried in the church of St. Gudule.

See Sir Martin Conway, *The Van Eycks and their Followers* (1921); M. Friedländer, *Roger van der Weyden, Die alt niederländische Malerei* (1925).

WEYGAND, MAXIME (1867–), French soldier, was born at Brussels Jan. 21, 1867. Having entered the military college at St. Cyr in 1885 he proceeded to the cavalry school at Saumur. He was appointed sub-lieutenant in 1888 and after successive promotions commanded the 5th Hussars in 1912. On Sept. 21, 1914, as a temporary colonel, he was appointed chief of the general staff of an army, and in Aug. 1916 he was made a general of brigade. From the outset of the World War he was the immediate assistant of Marshal Foch, whom he succeeded as the French representative on the Inter-Allied General Staff in 1917. In April 1918 he resumed his work as Chief of the General Staff under Marshal Foch, which post he held during the remainder of the War; and in this capacity he was considered by many to be what Berthier was to Napoleon.

But, and here the balance was in his favour, he proved himself capable of personally directing operations on a very large scale in Poland. In Aug. 1920, when Warsaw was surrounded and threatened by a Soviet army, at a distance of only 20 km., Gen. Weygand arrived, and speedily reconstituting the disorganized Polish army, launched an offensive against the Bolsheviks' vulnerable points. In December the enemy was in retreat. When the people of Warsaw acclaimed him, he said: "My rôle was merely to fill up the gaps; it was the heroic Polish nation itself which won the victory."

Weygand became a member of the *Conseil Supérieur de la Guerre,* and was made a grand officer of the Legion of Honour on Sept. 1, 1920. In Nov. and Dec. 1922 he served as military expert on the French delegation to the Lausanne Conference, and in Jan. 1923, he was sent to the Rhine to inspect the Allied troops. The same year he succeeded Gen. Gouraud as high commissioner in Syria. He returned to Paris in Nov. 1924 to take charge of the *Centre des Hautes Études Militaires.* He was general inspector of the army from 1931 to 1935.

WEYLER Y NICOLAU, VALERIANO, marquess of Tenerife (1839–1930), Spanish soldier of Prussian descent, born at Palma de Majorca. He entered at sixteen the military college of infantry at Toledo, and when he attained the rank of lieutenant, passed into the staff college, from which he came out at the head of his class. Two years afterwards he became captain, and was sent to Cuba at his own request. He distinguished himself in the expedition to Santo Domingo, especially in a daring reconnaissance with few men into the heart of the enemy's lines, for which he got the cross with laurels of San Fernando. From 1868 to 1872 he served also brilliantly against the Cuban rebels, and commanded a corps of volunteers specially raised for him in Havana. He returned to Spain in 1873 as brigadier-general and took an active part against the Carlists in the eastern provinces of the Peninsula in 1875 and 1876, for which he was raised to the rank of general of division. Then he was elected senator and created marquess of Tenerife. He was captain-general in the Canary Isles (1878–83) and afterwards in the Balearic islands and in the Philippines (1888)—where he dealt very sternly with the native rebels of the Carolines, of Mindanao and other provinces. On his return to Spain in 1892 he was put in command of the 6th Army Corps in the Basque Provinces and Navarre where he soon quelled agitations, and then became captain-general at Barcelona until Jan. 1896. In Catalonia, with a state of siege, he made himself the terror of the anarchists and socialists. On the failure of Martinez Campos to pacify Cuba, Weyler was sent out by the Conservative government of Cánovas del Castillo, and this selection met the approval of most Spaniards,

who thought him the proper man to crush the rebellion. Weyler attempted to do this by a policy of inexorable repression which raised a storm of indignation and led to a demand from America for his recall. This recall was granted by the Liberal Government of Sagasta, but Weyler afterwards asserted that, had he been left alone, he would have stamped out the rebellion in six months. After his return to Spain his reputation as a strong and ambitious soldier made him one of those who in case of any constitutional disturbance might be expected to play an important rôle, and his political position was naturally affected by this consideration; his appointment in 1900 as captain-general of Madrid resulted indeed in more than one ministerial crisis. Twice minister of war (1901, 1905), he was captain-general at Barcelona (Oct. 1909) and, without bloodshed, quelled the disturbance connected with the execution of Francisco Ferrer. Weyler died Oct. 20, 1930.

WEYMAN, STANLEY JOHN (1855–1928), English novelist, was born at Ludlow, Shropshire, on Aug. 7, 1855, the son of a solicitor. He was educated at Shrewsbury School, and at Christ Church, Oxford. He was called to the bar at the Inner Temple in 1881, joining the Oxford circuit. He had been practising as a barrister for eight years when he made his reputation as a novelist by a series of romances dealing with French history: *The House of the Wolf* (1889), *A Gentleman of France* (1893), *Under the Red Robe* (1894), *Memoirs of a Minister of France* (1895), and others. He died on April 10, 1928.

Among his later novels were: *Shrewsbury* (1897), *The Castle Inn* (1898), *Sophia* (1900), *Count Hannibal* (1901), *In King's Byways* (1902), *The Long Night* (1903), *The Abbess of Vlaye* (1904), *Starve-crow Farm* (1905), *Chipping* (1906), *The Wild Geese* (1908), *The Great House* (1919), *Ovington's Bank* (1922), *The Traveller in the Fur Cloak* (1925), *Queen's Folly* (1925).

WEYMOUTH, a town of Massachusetts, U.S.A., Pop. (1920) 15,057 (82% native white); 1940 federal census 23,868. The town's area of 17.7 sq.mi. includes four islands besides the peninsula between the Weymouth Fore river and the Weymouth Back river. On the latter, about 2 mi. from its mouth, is a U.S. naval magazine.

The surface of the country is rough: Great Hill (at one of the narrowest parts of the peninsula) is about 140 ft. above the rivers.

In the township are the Fogg library (1898, in South Weymouth) founded by a bequest of John S. Fogg; and the Tufts library (1879, in Weymouth village) endowed by Quincy Tufts and his sister Susan Tufts. In 1635 the plantation of Wessaguscus (settled by Thomas Weston in 1622) was incorporated as a town. In 1637, Round and Grape islands were annexed.

WEYMOUTH and **MELCOMBE REGIS,** a seaport and municipal borough in the southern parliamentary division of Dorsetshire, England, 145½ mi. from London on the G.W. and S. joint railways. Pop. (est. 1938) 32,810. Area 11 sq.mi. It is formed of Weymouth, on the Wey, and Melcombe Regis on the northeast of the river, the two towns being contiguous. The situation is enclosed to the south by the Isle of Portland. A mile S.W. of Weymouth is Sandsfoot Castle, a fort erected by Henry VIII for the protection of the shipping. The chief export is corn. There is some ship and boat building and sail and rope making, but the town depends mainly on visitors. The G.W.R. provides passenger steamers to Guernsey and Jersey.

Bronze weapons and Roman interments have been found, but first mention of "that place called Weymouth" occurs in charters of King Aethelred, dated 866–871 and 895–940. The first charter was granted in 1252 by the prior and convent of St. Swithin, to whom the manor had been granted by Edward the Confessor. By this Weymouth was made a free borough and port for all merchants, the burgesses holding their burgages by the same customs as those of Portsmouth and Southampton. The demand of six ships from the town by the king in 1324 shows its importance in the 14th century, but there is no mention of a mayor until 1467. Probably the town suffered at the hands of the French early in the 15th century, though in 1404 the men of Weymouth were victorious over a party which landed in the Isle of Portland. Commercial disputes with Melcombe led to amalgamation in 1571, and the town received its charter from James I in 1616.

Melcombe Regis first returned two members to parliament in 1307, and Weymouth in 1319, four members being returned by the united boroughs until 1832, when the representation was reduced to two and ceased in 1885. The mediaeval fairs are no longer held. As early as 1293 trade was carried on with Bayonne, and six years later a receiver of customs on wool and wool-fells is mentioned at Weymouth, while wine was imported from Aquitaine. In 1586 sugar is mentioned as an import, and in 1646 deal boards were brought from Hamburg. The town suffered severely during the Civil War, being garrisoned by the parliamentary troops in 1642, taken by the earl of Carnarvon in 1643, and surrendered in the following year. The town is described as "but little" in 1733, but a few years afterwards it gained a reputation as a watering-place, and George III in 1789 paid Weymouth the first of a series of visits which further ensured a popularity it has retained to the present day.

WEYPRECHT, KARL (1838–81), German polar explorer, was born on Sept. 8, 1838, at König in Odenwald, Germany. In 1856 he became a cadet in the Austrian navy and in 1861 an officer. He made several voyages to the Orient and to America and spent two years on a coast-survey of Dalmatia. At his instance two expeditions were sent out to explore Novaya Zemlya and to attempt a northeast passage. That of 1871 reached 78° 48′ north. In 1872 the second got caught in the ice off Novaya Zemlya and drifted north and west for over a year. On Aug. 30, 1873, Weyprecht and his men caught sight of Franz Joseph Land, previously unknown. They wintered on one of the islands and spent the first half of the summer in 1874 making extensive explorations. In the autumn they returned to Novaya Zemlya, having spent almost three years in the Arctic. Weyprecht urged that scientific methods and investigation should dominate polar exploration and advocated a series of simultaneous, co-operative observations from polar observing stations. His plan was reported favorably by the International Meteorological Congress and studied by two successive international polar conferences held at Hamburg and Berne. As a result 15 expeditions were sent out by 11 countries, the historic Greeley expedition being one of the two financed by the United States. Weyprecht published *Die Metamorphosen des Polareises* (1879), and *Praktische Anleitung zur Beobachtung der Polarlichter und der magnetischen Erscheinungen in hohen Breiten* (1881). The best account of the Franz Joseph Land expedition is the translated account of his lieutenant, J. Payer; *New Lands Within the Arctic Circle* (2 vol., 1876). Weyprecht died in Michelstadt on Mar. 29, 1881.

See also *Karl Weyprecht, Erinnerungen und Briefe* (1881).

WEYR, RUDOLF VON (1847–1914), Austrian sculptor, was born on Mar. 22, 1847, at Vienna, and received his art education at the academy in his native city. He concerned himself most with decorative sculpture, chiefly in the revived rococo style. This he executed with great facility and rapidity, excelling especially in relief. His work perhaps shows no great depth of thought but does reveal an amazing faculty of decorative invention. Special mention should be made of the frieze of the Triumph of Bacchus in the Hofburg theatre, his Furies and Graces in the Raimund theatre, the frieze in the rotunda of the Art Museum of Vienna glorifying the Habsburgs as patrons of art, decorations in the Natural History Museum, the reliefs from Grillparzer's dramas on his monument at the entrance of the Volksgarten, the fountain representing Naval Power on the façade of the Hofburg and his statue of the painter Hans Canon in the Stadt-Park.

WHALE: *see* CETACEA.

WHALEBONE, the inaccurate name under which the baleen plates of the right whale are popularly known; the trade-name of whale-fin, which the substance receives in commerce, is equally misleading. Whalebone is formed in the palate on the roof of the mouth and is an exaggeration of the ridges, often horny in character, which are found on the roof of the mouth of all mammals. Three kinds are recognized by traders—the Greenland, yielded by the Greenland whale, *Balaena mysticetus;* the South Sea, the produce of the Antarctic black whale, *B. australis;* and the Pacific or American, which is obtained from *B. japonica.* Of these the Greenland whalebone is the most valuable. It formed the only

staple known in earlier times, when the northern whale fishery was a great and productive industry. This whalebone usually comes into the market trimmed and clean, with the hairy fringe which edges the plates removed. To prepare whalebone for its economic applications, the blades or plates are boiled for about 12 hours, till the substance is quite soft, in which state it is cut either into narrow strips or into small bristle-like filaments, according to the use to which it is to be devoted.

Whalebone is light, flexible, tough and fibrous, and its fibres run parallel to each other without intertwisting. One of its earliest uses, referred to by William le Breton in the 13th century, was to form the plumes on helmets. Steel is now used for several purposes to which whalebone was formerly applied, especially in the umbrella and corset industries. Whalebone is, however, still in demand among dressmakers and milliners and for brushes for mechanical purposes, a use patented by Samuel Crackles in 1808.

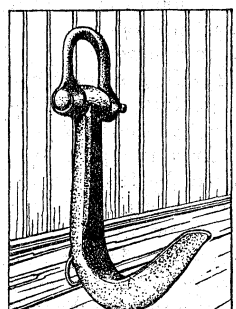
When whalebone came into the English market in the 17th century it cost at first about £700 per ton. In the 18th century its price ranged from £350 to £500 per ton, but early in the 19th century it fell as low as £25. Later it varied from £200 to £250; but with the decrease in whaling the article has become very scarce, and upwards of £2,000 per ton has been paid for Greenland whalebone.

WHALE FISHERIES. The dangerous craft of whaling undoubtedly occurred in times too early for systematic record. The Eskimos traded the "bone" to the Greenland whalers, having apparently attacked the whales when they rose to breathe in the narrow water-lanes among the ice—a position the great whaling fleets of the Antarctic to-day find favourable for their operations. In the 9th century whaling was carried out by the Northmen, as is clear from Ochthere's account of his voyage, given to King Alfred; and according to a later statement it took place off the Flanders coast in the same century. Alfric, archbishop of Canterbury, mentions whaling in the 11th century, though it is not clear that he claims it as an English fishery. The Basques also made a very early start, and by the 13th century had made whaling an important industry. At first only whales approaching close to the shore were attacked—very possibly, in the first instance, only those which accidentally had stranded. Later, watch was kept from specially built towers, and on a whale being sighted near shore the men put out in boats to the attack, armed with harpoons and lances, killed the whale and towed it to shore. The whales becoming more inaccessible, either from lessening numbers or from increased wariness, or from both these causes, and the possibility of boiling down (or "trying out") the blubber on a ship having been demonstrated, ships of as much as 100 tons burden were built for whaling, ships of a specially seaworthy type, and the whalers went further afield. They reached Newfoundland waters, apparently, before the end of the 14th century, and later those of Greenland, where they took a different whale, evidently the right Greenland whale, *Balaena mysticetus,* and not the Biscay whale, *B. biscayensis* of their own coasts.

Early Whaling.—The next important whaling was that of Spitsbergen. The English were the first participants in the fishery, which arose from observations made in 1557 by voyagers of the Muscovy company. They were shortly followed by the Dutch, with whom they shared (and contested) the industry throughout the first part of the 17th century, though Biscayan, Danish and other ships took part. A whaler about the opening of this period was of 200 tons burden, with a crew of 55 men, and was provided with five pinnaces (for which 48 oars were carried). The whales, of which eight kinds are mentioned, were taken at first in the bays, and one of the reasons for the Dutch predominance, which was well developed by about 1650, was that when the whales disappeared from the coast they followed them along the ice more constantly than did the British ships. The boats carried 300 fathoms of rope for their "harping irons" or harpoons. On shore the boiling vats were built in, with a stokehold below. Extensive stations grew up in the islands; Smeerenburg or "Blubbertown," a Dutch station had bakeries, traders in spirits and tobacco, and a church, and was visited by a thousand whalers annually. Early in the 18th century the whaling had spread as far as Davis straits, and over 350 ships took part in it.

The Dutch predominance continued until the middle of the century, whose latter half witnessed a recrudescence of British whaling, assisted by bounties, which at first did much for American (then colonial) whaling also. Hull, Liverpool, Whitby, became whaling ports, and Leith, Dunbar and Dundee participated. The whaling vessels were of some 350 tons burden, carried 50 men and six whaleboats. They used to barrel the blubber for trying out on return; but later the Scottish brought it back in bulk in large tanks; the whalebone was brought whole, as was, for its oil, the jawbone. The rest of the carcase was abandoned. The high price of whalebone, reaching at times £500 per ton, was a material factor in the success of whaling during this period, particularly in America. The fishing was prosecuted vigorously; at times as many as 50 ships being in sight of one another on the grounds. Before the middle of the 19th century, however, it had begun to wane, owing apparently both to the growing scarcity of right whales and the use of substitutes for whale products, particularly of coal gas as an illuminant. Hull, the last English port for the Greenland grounds, ceased whaling in 1868; Dundee and Peterhead, owing in part to a strong local demand in the jute factories for whale oil, continued to a later date, but, in spite of the introduction of whalers with auxiliary steam power, and the capture of seals and other animals as well as whales, their fleets decreased and ultimately disappeared.

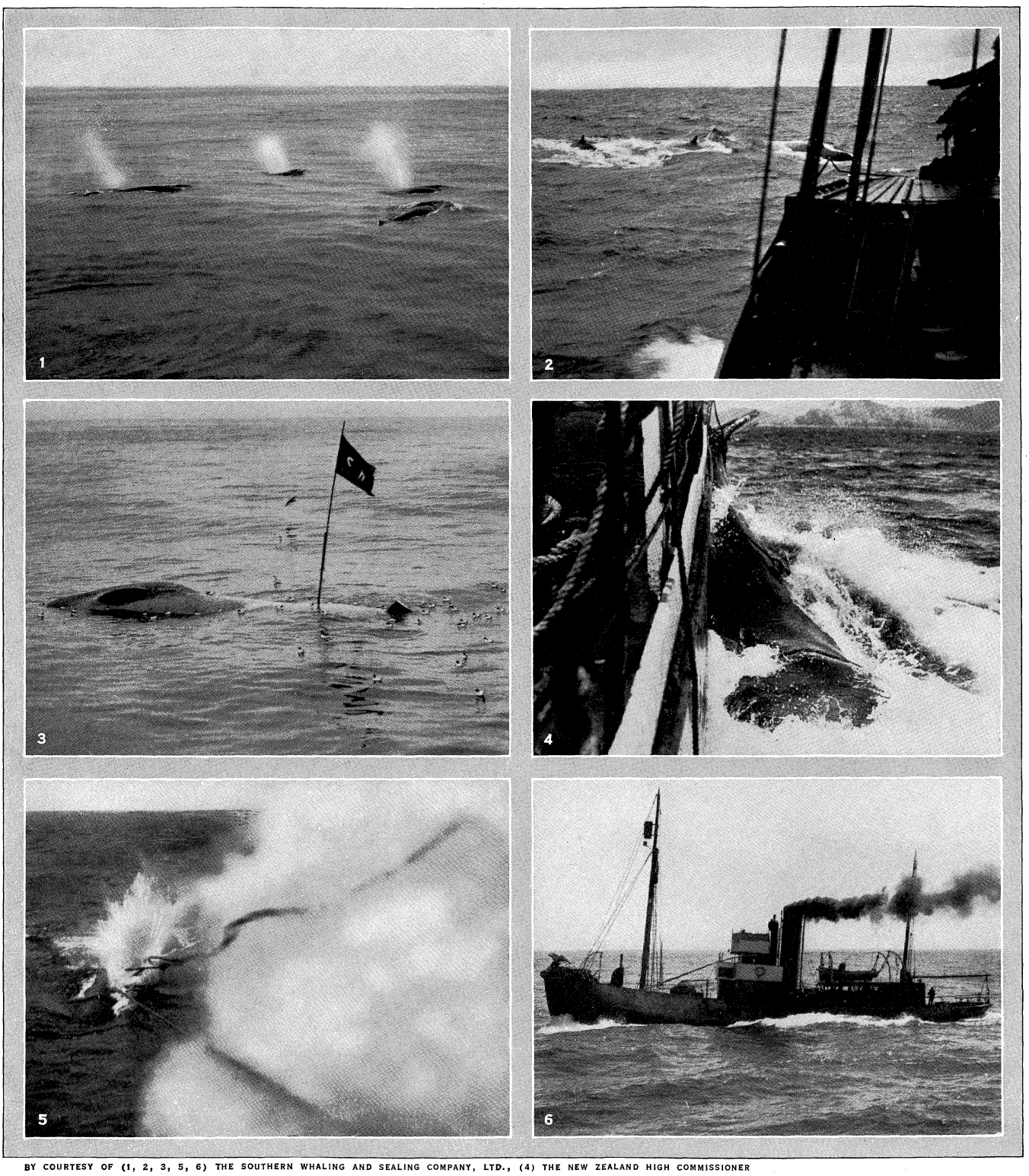
Whaling in the main Atlantic, the Pacific and the Antarctic was developed chiefly from the Newfoundland ports, and from Nantucket and New Bedford. Before 1700 the industry had passed through most of the coastal stages. Part was taken in the Greenland fishery, and from the capture of a sperm whale (*Physeter catodon*) offshore in 1712, American whaling spread down the whole length of the Atlantic, and before 1800 had reached the Pacific. The industry grew rapidly and was well established by the Revolution. Notwithstanding the vicissitudes of wars, from which American whaling suffered, perhaps, even more than did the European industry, a marked power of recovery was always shown. Shortly before 1850 the fleet numbered 680 sail in all; and all but 40 odd ships were employed in the Pacific in the pursuit of sperm and right whales. About the same date the right whales found in the neighbourhood of Bering strait, the bowheads, were hunted for the first time. The value attached to sperm oil, which was used for both ointments and candle making, had much to do with this development. A similar recovery followed the American Civil War; but the use of petroleum for lighting, and the more constant prospects offered to capital in other industries, caused American whaling to dwindle away. By 1900 the sperm whaling was nearly entirely dead, and the main whaling that of the small fleet following the bowhead. The grey whale, *Rhacinactes glaucus,* was also hunted in the lagoons of the western coast, but did not long endure the destruction. In the fisheries of the open sea mentioned above (all south of the Arctic) Great Britain took an active part. They were first in the Pacific and predominated for a time in the Indian ocean; their participation, however, began in 1775 and lasted less than a century. The hardships of these fisheries, known collectively as the Southern Whaling, must have been extreme. The ships were away three or more years and provisioned accordingly. Their crews must endure and work in tropical conditions, and in the rigorous climate of South Georgia and even of more southern latitudes. The attack by open boats (though usually four worked together) in mid ocean, with the added possibility of being towed out of sight of the mother ship, and the risk of fire in such whalers as tried out the blubber on board, must have made the calling hazardous in the extreme.



BY COURTESY OF WHALING MUSEUM, OLD DARTMOUTH HISTORICAL SOCIETY

BLUBBER HOOK USED IN THE OLD DAYS OF WHALE FISHERY IN REMOVING THE BLUBBER FROM THE WHALE

Modern Whaling.—The Sven Foyn gun was first used near the Norwegian coast; it was carried on small steamers, and the

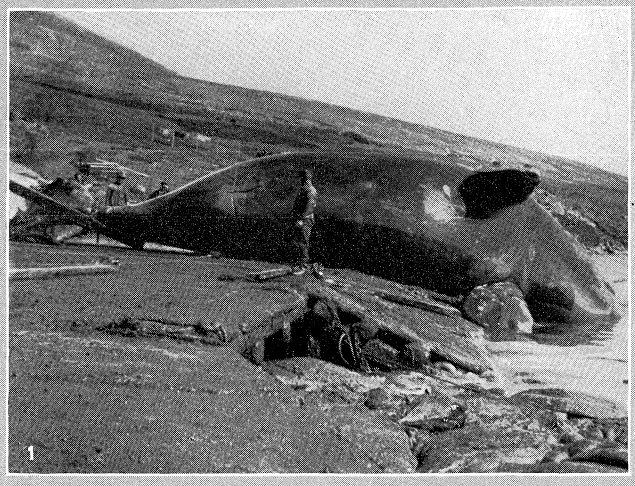


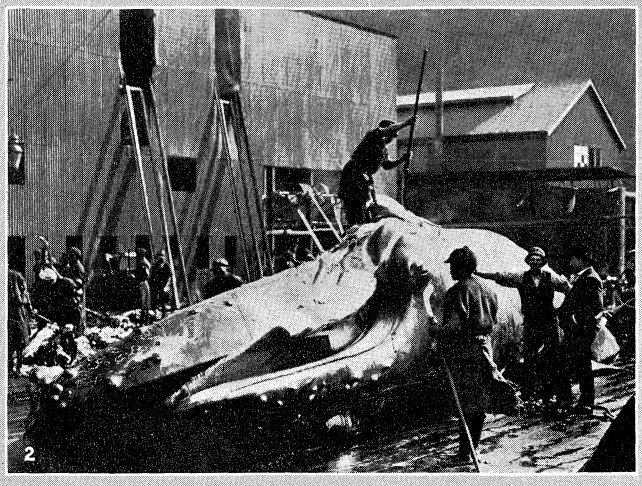
BY COURTESY OF (1, 2, 3, 5, 6) THE SOUTHERN WHALING AND SEALING COMPANY, LTD., (4) THE NEW ZEALAND HIGH COMMISSIONER

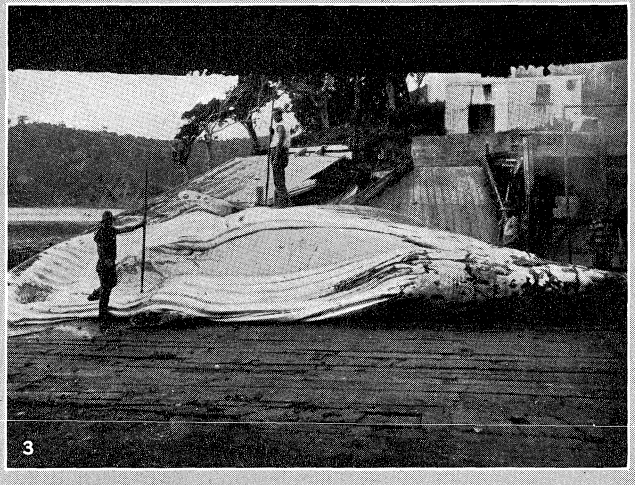
WHALES AND WHALING

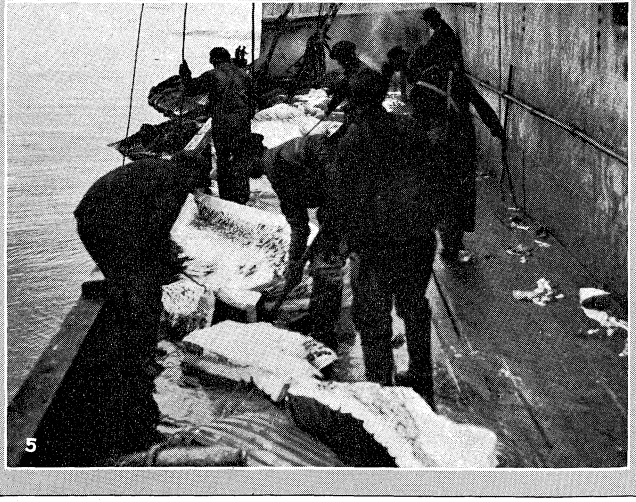
1. School of whales feeding and spouting. The spouting is caused by forcing heated air from the lungs after long periods of holding breath
2. Whaling ship nearing a school of whales. Gunner preparing to fire harpoon gun. The harpoon has a pointed bombhead which explodes on impact. Wide barbs open with the explosion and hold harpoon firmly in flesh of whale
3. Whale "buoyed" for towing in. The carcass with seal birds swimming about it, has been inflated by forcing a sharp perforated steel tube into the stomach and pumping it full of steam and air. The company flag is planted in the body. This method is used only when the whale is to be taken to a shore factory
4. Towing home the catch. The dead whale, with flukes removed to prevent their wearing the vessel, has been made fast alongside
5. A second shot showing the explosive effect of the bomb attached to the harpoon head. In rough weather, three or more shots are often necessary before the whale is struck in a vital spot
6. A whale catcher. These ships, 90–140 tons burden, are seaworthy, easily handled and capable of making 15 knots per hour. The harpoon gun is mounted high on the fore-castle. The crow's nest for the look-out is unusually high. The ships are fitted with steam winches fixed to the bedplates in the forward hold where the whaling gear is stowed

WHALE FISHERIES







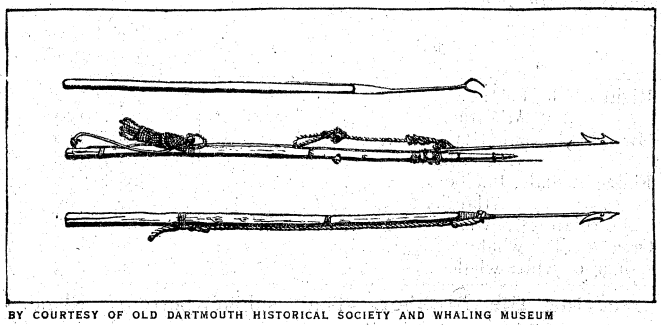


BY COURTESY OF (1, 5) THE SOUTHERN WHALING AND SEALING COMPANY, LTD., (2, 4) THE SOUTH AFRICAN RAILWAYS, (3) THE NEW ZEALAND HIGH COMMISSIONER, (6) TH. SORLLE

WHALES AND WHALING

1. Right whale or whalebone whale being drawn on shore to flensing plane. This species yields true baleen (whalebone) and attains a length of 65 feet
2. Flensing a humpback whale, Durban, Natal. The humpback has black-and-white markings with white splotches on its under surface. The latter are probably scars left by barnacles and parasites. Large catches of this species are made in the Mozambique Channel and off the Cape of Good Hope
3. Flensers beginning to strip blubber from fin whale. The longitudinal slits are made with flensing knives and the blubber is then stripped off by means of steam winches
4. Cutting up whale carcasses after blubber has been stripped. The carcasses are used in the manufacture of oil and fertilizer, and in some countries, as Japan, for food. Blood of the whale is dried and used for fertilizer
5. View on board a floating blubber factory. Captured whales are stripped and dissected in the water and the pieces heaved on the deck of the ship where they are cut into smaller pieces for trying out
6. Westfold Whaling Station on South Georgia Island, which is the centre of the South Atlantic and Antarctic whale fisheries

whales, being taken near shore, were towed back to harbour for flensing and extraction of oil. The harpoon, which weighs over 100 lb., is some 4 ft. long. The cap contains an explosive and a time fuse, which sets it off three seconds after striking. The head behind the cap has four hinged 12 in. barbs, which open out in the body of the whale. The warp is attached to a ring, which is free to slide along a groove running nearly the whole length of the shank;



BY COURTESY OF OLD DARTMOUTH HISTORICAL SOCIETY AND WHALING MUSEUM

IMPLEMENTS USED IN WHALE FISHING. ABOVE, A BLUBBER FORK; CENTRE, DARTING GUN; BELOW, A HARPOON OF LATE TYPE WITH SWIVEL HEAD

when ready for use, the head, forepart of the shank and ring are in front of the gun-barrel, and the first part of the warp is coiled on a plate projecting over the ship's bows and immediately below the gun. A charge of 220 grammes of explosive such as ballisite or of black powder is used, in a cotton bag which is fastened to an hourglass-shaped wooden buffer, ended with rubber discs, and fitting the barrel. This buffer acts as tamping, and disappears on discharge. With the explosive named the barrel remains clean. The guns used are mostly muzzle loaders, though breech loaders are available. The range is usually 30 to 40 yards. The first discharge is sometimes immediately fatal, and slaughter is, in many cases, quicker than with the older methods.

The "catchers" have grown in size, power and speed. They can now, though not without difficulty, travel from the Cape to South Georgia under their own power. Essentially they are small steamers with fore-foot much cut away for facility in turning, with a high bow on which the gun is mounted, built with a pronounced flare to minimize the shipping of water at the gun. A first class boat will exceed 200 tons gross, and is about 130 ft. long. She has a powerful winch, and to reach it the warp passes from the bows over a sheave or pulley on the mast, which in turn is suspended by a warp which communicates with two powerful accumulator springs lying along the keel of the ship; excessive and sudden strain on the warp is in this way minimized. The main length of warp is not on the winch drums, but in bins on each side of the hold, from which it is paid out to them. A good catcher will have a speed of 14 knots and a complement of 11 men, under the gunner, who is also the master. Several catchers, usually from three to six, work in co-operation with one factory.

Factory Processes.—Parts of the tail flukes of the dead whale are removed to reduce resistance, and a chain is passed round the shank, by which the carcase is towed to the factory. Steam power is much used at the factory. By it the whale is drawn up the slope or ramp to the flensing stage. Here skilled flensers cut a V-shaped flap at the head, and secure in it a hook; a warp to which this is attached is then taken to a winch, by which a strip of blubber the whole length of the whale is peeled off. It is cut into "hook" pieces of some 20 kg., and dragged to the intakes of the boilers. After the blubber, the best of the meat is selected and removed (at such stations as the meat is utilized for food). The remainder of the carcase is then cut into pieces for the meat and bone boilers, steam saws being employed very largely. The material is more finely divided by revolving knives and, in some cases mincers, before boiling down. All modern boilers are pressure boilers, the heat being supplied by steam, usually at 65 lb. pressure, acting in closed vessels. The boiler is fitted internally with removable platforms, fitted gradually as it is filled. This prevents blocking, and provides channels for the steam and oil. Usually one boiler can give about 20 barrels of oil ($3\frac{2}{3}$ tons) a day. A factory, however, possesses batteries of such boilers. There are various improved types, designed to speed up production or to economize fresh water, of which a great supply otherwise is necessary; the Hartmann plant, for instance, in which the material is inside a rotating horizontal cylinder pierced by sharply bevelled holes, can yield 150 barrels a day from mixed material, or 225 barrels from blubber. It should be added that extensive use is made of mechanical transport, the meat, etc., being raised in large hoppers working up inclined runners outside the factory to the level of the boiler top. All oil is now brought to post in bulk in large tanks. The material taken from the boilers after oil has been extracted is specially dried as whole meal or as guano. The most recent development is the use of large ships furnished with a ramp in the hull, usually at the stern, up which the whale can be drawn bodily for treatment. Such ships, if need be, work in the open sea, whereas the factory alongside which the whale is flensed must be in the shelter of shore or ice. Old Atlantic liners have been adapted for the work, and 17,000 tons burden is a not uncommon size. A vessel of 12,500 tons, to take an instance, is furnished with seven Hartmann boilers, one especially for bone and 12 ordinary boilers. With her three catchers, she has a complement of 180 men, and can deal with 12 whales a day. Shore stations are temporary settlements, with hospital, cinema, etc.

Products.—Whale meat is used in Japan. On Norwegian stations it is utilized fresh. Cut into 20 kg. blocks, it is refrigerated for shipment by special railway cars. It is sold at about half the price of beef. Only the best meat is used, but in a 50 ft. whale this will reach $2\frac{1}{2}$ tons. Whalebone, though less valuable and in the whales now hunted less abundant, is still useful, that from the fin whale being used mainly for brushes. Oil, however, is the chief product of modern whaling. (*See* WHALE OIL.)

Ambergris, which is used as a fixative for perfumes, is found in a small percentage of sperm whales, and is a pathological product; it is never abundant, and is usually searched for owing to its great value. Whale meal is a valuable constituent of both cattle and chicken food, and whale guano has general utility as manure.

Spread and Extent of Modern Whaling.—The Svend Foyn gun was used first for whales off the Norwegian coast; and finnus (*Balaenoptera physalus*), bottlenose (*Hyperoodon rostratus*), and sei (*Balaenoptera borealis*) are still taken there. Its use spread to Scottish and other waters, and in 1904 Capt. Larsen founded the first company for Antarctic whaling. This whaling rapidly grew to be the chief part of the industry. Norwegian, British and Argentine companies are at work, though the main part of the operations are in all cases carried out by Norwegian. The chief bases are in the dependencies of the Falkland Islands—South Georgia, South Orkneys, South Shetlands and South Sandwich, and these in recent years have (excluding Japan) accounted for nearly two-thirds of the world's productions. In the 1927–28 season, possibly owing to unusually favourable conditions due to ice distribution, whaling showed a tendency to spread from the more southerly stations along the ice edge; in that season the total production of these dependencies was 804,000 barrels, or 136,000 tons. Since 1925 the Ross sea has been laid under contribution.

The tendency to employ pelagic whalers, *i.e.*, those capable of embarking and treating the whale in the open ocean, is undoubtedly increasing, and great sums of money have already been invested in these craft. Apart from the Antarctic, they have been employed on the African coast, where the humpback (*Megaptera nodoza*) is the chief species taken. Evidently the extension of whaling far from land bases will greatly increase the destruction entailed, already immense. A large (89 ft.) blue whale (*Sibbaldus musculus*) may yield nearly 28 tons of oil, but this, though now the chief species hunted, is far above the average of even that large species; the catch probably represents over 12,000 whales.

Regulation.—It is natural that a destruction so rapid should awaken fears that the rate of destruction is greater than the stock of whales can replace. Whales breed slowly, the females giving birth to young (as a rule one only) probably once in two years at most. It has been said that the discovery of the Greenland whale alone saved the Biscay whale from extinction. The Norwegians, the greatest whaling nation, took in all seas 51,400 barrels of oil

in 1904; in 1927 they took 704,000 barrels. The need of some regulations is felt almost universally, and some are in force. The Falkland Islands Government prohibits the capture of right whales and, except by permit, of humpbacks. This and other Governments prohibit the shooting of calves and cow whales with calves. Many authorities insist on the total utilization of the carcase as far as practicable, and the Falklands permit whaling only under licences which prescribe the number of catchers to be employed. None of these regulations deal with operations in the open ocean.

About the year 1926, a well-equipped marine laboratory at South Georgia, the R.R.S. "Discovery," and a vessel ("William Scoresby"), specially built for marking whales for the purpose of tracing their movements began investigating these problems. A cruise to study conditions along the ice edge was projected by Christiansen of Sandefjord. Attempts are made at co-ordinating all results by a committee of the International Council for the Exploration of the Sea, which works in touch with the Economic committee of the League of Nations.

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WHALE OIL. The oils derived from whales fall into two sharply defined classes: *Sperm oil,* obtained from the head cavity of the sperm whale or cachalot, *Physeter catodon,* and the oils obtained from the right whales (genus *Balaena*) and the rorquals (genera *Balaenoptera* and *Megaptera*). Sperm oil is not a true fatty oil, inasmuch as it usually contains only traces of glycerides; it consists mainly of fatty acids in combination with higher monohydric aliphatic alcohols, and is therefore included in the category of liquid waxes.

Sperm whales, when fully grown, may yield up to 145 barrels of oil each; on the average the cows yield about 25 barrels, and the bulls from 75 to 90 barrels (each barrel containing about 230lb. of oil). Large amounts of spermaceti are present in the crude oil, especially in that from the head, which is clear and liquid immediately after removal from the animal, but soon solidifies. In the refineries the oil is allowed to stand in refrigerators for several days at a temperature of 32° F. and pressed in hydraulic presses. The oil so obtained (about 75% of the crude) will not deposit stearine at 38° F. ("cold test"), and is known as *winter sperm oil.* Oils having a cold test of 32° F. have also been prepared, the yield being 67%. The press residues are twice re-pressed, first at a temperature of 50° to 60° F. yielding about 9% of *spring sperm oil* and secondly at 80° F., yielding a further 5% of oil. The press cake (about 11% of the crude oil) consists of crude spermaceti. Spermaceti, which consists principally of cetyl palmitate, also occurs in smaller proportions in the oils from other Cetacea. (For uses *see* SPERMACETI.)

Sperm Oil.—Sperm oil is a pale yellow oil with a slightly fishy smell: it may be recognized by the low specific gravity, 0·875 to 0·880, the low saponification value, 125 to 130, and the high proportion of unsaponifiable matter (about 40%).

Sperm oil is largely used for the lubrication of spindles and other light machinery. It is valued on account of its freedom from gumming tendencies, and also because the viscosity decreases less with increase of temperature than is the case with mineral oils.

Arctic sperm oil, a kindred oil closely resembling sperm oil in its constitution, is obtained from the bottlenose whale, *Hyperoödon rostratus.* Each animal yields about eight barrels of the oil, which has a distinctly lower value than true sperm oil, owing to its more pronounced tendency to gum.

The oil obtained from the blubber, that is, the layer of fat immediately beneath the skin, from all species of whales other than the two mentioned above, is a true fatty oil, consisting almost entirely of glycerides. It was formerly known as "train oil" (German "Tran"). The amount of oil obtainable from the fully-grown animal varies with the species, as is shown in the following table:—

Whale	Yield in barrels of 31·5 gallons
Right whale, Pacific	25 to 250
,, ,, Atlantic	25 ,, 150
Humpback whale, Pacific	10 ,, 110
,, ,, Atlantic	10 ,, 100
Finback whale, Pacific	10 ,, 70
,, ,, Atlantic	20 ,, 60
Californian grey whale	15 ,, 60
Orca or killer whale	1 ,, 6
Beluga or white whale	1 ,, 3

Treating the Blubber.—The "sulphur-bottom" whale is stated to yield 6 tons of oil, 3½ tons of guano and 3 cwt. of whalebone. The first quality oil is that yielded by the right whale, the "southern oil" being of lower quality. The "finner whale oil" is a still lower grade. Some whalers still "try" the blubber on board ship, although this practice has been almost superseded by the modern procedure of rendering the blubber in central stations on shore. In these stations the blubber is stripped clean from every particle of flesh as soon as possible after the capture of the whale, and cut into strips, which are then further divided in chopping machines. The mass is then placed in large pans and boiled with open steam. The oil which first runs off varies in colour from pale yellow to almost water-white. This oil has a very slight fishy smell and is known as "whale oil No. 0." "Whale oil No. 1," the oil obtained on further boiling the comminuted mass, is slightly darker in colour and possesses a more pronounced odour. These two oils are stored in large vessels in the cold, and the deposited stearine or "whale tallow" (consisting largely of palmitin) is removed by pressing in a hydraulic press. After removal of oil No. 1, the mass is subjected to steam in digesters at a pressure of from 40 to 50lb. per sq.in., whereby "whale oil No. 2" is obtained, which is brown in colour with a strong odour. A still darker oil, "whale oil No. 3," is obtained by adding the flesh, cut into rough lumps, together with the bones, and again digesting under steam pressure. Finally, "whale oil No 4" ("carcase oil") is obtained after the mass has putrefied; in some cases the bones are worked up separately, yielding "Whale Bone Oil." The better qualities of oil contain only small amounts of free fatty acids, and can be bleached by treatment with fuller's earth. The lower qualities of oil, however, may contain upwards of 50% of free fatty acids, and cannot always be bleached successfully. In common with other marine oils, whale oil contains considerable amounts of highly unsaturated fatty acids, including members of the clupanodonic acid group, in which the molecule contains four pairs of doubly-linked carbon atoms.

It has yet to be seen whether blubber oils contain, as do cod-liver and some fish body oils, any notable proportion of the fat-soluble vitamins.

The best quality whale oils are used as burning oils and for soap-making. When the margin of price between liquid and solid fats permits, large quantities of pale whale oil are hydrogenated (hardened), producing a white tallow-like fat suitable for edible purposes. Whale oil is also used for batching jute and other vegetable fibres, for quenching steel plates and for leather-dressing. It figures as an ingredient of lubricants for screw-cutting machines. The magnitude of the whaling industry may be gauged from the following figures: for the years 1925 and 1926 the production of whale oil was 1,072,000 and 1,120,000 barrels respectively. The United Kingdom imported nearly 51,000 tons in 1926. (*See* also OILS, FATS, AND WAXES.) (E. L.; G. H. W.)

WHALLEY, EDWARD (*c.* 1615–*c.* 1675), English regicide, was the second son of Richard Whalley, who had been sheriff of Nottinghamshire in 1595, by his second wife Frances

Cromwell, aunt of Oliver Cromwell. On the outbreak of the Civil War he took up arms for the parliament, became major of Cromwell's regiment of horse, and fought with distinction in the campaigns of 1643 to 1647. When the king was seized by the army, he was entrusted to the keeping of Whalley and his regiment at Hampton Court. Whalley refused to remove Charles's chaplains at the bidding of the parliamentary commissioners, and treated his captive with due courtesy, receiving from Charles after his flight a friendly letter of thanks. In the second Civil War, Whalley again distinguished himself as a soldier, and when the king was brought to trial he was chosen to be one of the tribunal and signed his death-warrant. He took part in Cromwell's Scottish expedition, was wounded at Dunbar, and in the autumn of 1650 was active in dealing with the situation in north Britain. Next year he took part in Cromwell's pursuit of Charles II. and was in the fight at Worcester. He followed and supported his great kinsman in his political career, presented the army petition to parliament (August 1652), approved of the protectorate, and represented Nottinghamshire in the parliaments of 1654 and 1656, taking an active part in the prosecution of the Quaker James Naylor. He was one of the administrative major-generals, and was responsible for Lincoln, Nottingham, Derby, Warwick and Leicester. He supported the "Petition and Advice," except as regards the proposed assumption of the royal title by Cromwell, and became a member of the newly constituted House of Lords in December 1657. On the Protector's death, at which he was present, he in vain gave his support to Richard; his regiment refused to obey his orders, and the Long Parliament dismissed him from his command as a representative of the army. In November 1659 he undertook an unsuccessful mission to Scotland to arrange terms with Monk. At the Restoration, Whalley, with his son-in-law, General William Goffe, escaped to America, and landed at Boston on July 27, 1660, living successively at New Haven and at Hadley, Massachusetts, the government at home failing to procure his arrest.

AUTHORITIES.—An account of Whalley's life is in Mark Noble's *Lives of the English Regicides,* and also of his family in Noble's *Memoirs of the Protectoral House of Cromwell,* vol. ii. (1787, 2nd ed.); *see* besides Gardiner's and Clarendon's histories of the period; Peck's *Desiderata curiosa* (1779; Whalley's account of the king's flight); Ezra Stiles's *History of three of the Judges of Charles I.* (1794, etc.). The article by C. H. Firth in the *Dict. Nat. Biog.* is an admirable summary. Whalley's sojourn in America is dealt with in numerous papers published by the Massachusetts Historical Society, and in the Hutchinson Papers published (1865) by the Prince Society; *see* also *Atlantic Monthly,* vi. 89–93; *Pennsylvania Mag.,* i. 55–66, 230, 359; F. B. Dexter's Memoranda concerning Whalley and Goffe, *New Haven Col. Hist. Soc. Papers,* ii. (1877); *Poem commemorative of Goffe, Whalley and Dixwell,* with abstract of their history, by Philagathos (Boston, 1793); Palfrey's *Hist. of New England,* ii. (1866); *Notes and Queries,* 5th series, viii. 359 (bibliography of American works on the regicides).

WHARTON (FAMILY). The Whartons of Wharton were an old north of England family, and in 1543 THOMAS WHARTON (1495–1568) was created a baron. The fifth baron, THOMAS WHARTON (1648–1715), was created in 1706 earl and in 1714 marquess of Wharton. The 1st marquess is famous as the author of the political ballad, *Lilliburlero,* which "sang James II. out of three kingdoms." Wharton was lord-lieutenant of Ireland in Anne's reign, and incurred the wrath of Swift, who attacked him as Verres in the *Examiner* (No. 14), and drew a separate "character" of him, which is one of Swift's masterpieces. Addison dedicated to him the fifth volume of the *Spectator,* giving him a very different "character" from Swift's. His first wife, ANNA WHARTON (1632–1685), was an authoress, whose poems, including an *Elegy on Lord Rochester,* were celebrated by Walter and Dryden. His son, PHILIP WHARTON (1698–1731), duke of Wharton, succeeded to his father's marquessate and fortune, and in 1718 was created a duke. But he earned for himself, by his profligacy and reckless playing at politics, Pope's satire of him as "the scorn and wonder of our days" (*Moral Essays,* i. 179). After spending his large estates he went abroad and gave eccentric support to the Old Pretender. He was outlawed in 1729, and at his death the titles became extinct.

For the history of the family *see* E. R. Wharton's *Whartons of Wharton Hall* (1898).

WHARTON, EDITH NEWBOLD (1862–1937), American writer, the daughter of George and Lucretia Jones, was born in New York city, and was educated at home, but spent most of her later life in Italy and France. In 1885 she married Edward Wharton, a Boston banker, and a few years later she began her literary career by contributing poems and short stories to *Scribner's Magazine.* The *House of Mirth* (1905) definitely established her reputation. The very brief novel *Ethan Frome* (1911) is comparable only to the work of Hawthorne in the grimness of its tragedy of New England love and frustration. Her splendid sense of character, her cutting irony, her technique—in which she shows a decided kinship to Henry James—have secured for her a high place in American literature. Mrs. Wharton's long residence in Europe caused her to write a number of books of travel, such as *Italian Villas and Their Gardens* (1904), but her reputation rested chiefly on her novels and short stories. Among these are: *Crucial Instances* (1901); *The Fruit of the Tree* (1907); *Xingu and Other Stories* (1916); *The Age of Innocence* (1920); *A Son at the Front* (1923); the four volumes portraying the life of old New York: *False Dawn,* a story of the '40s, *The Old Maid,* the '50s, *The Spark,* the '60s, and *New Year's Day,* the '70s, published together in 1924; the novels *Twilight Sleep* (1927), *The Children* (1928), and *Hudson River Bracketed* (1929). She discussed her own method in *The Writing of Fiction* (1925).

See L. M. Melish, *Bibliography of the Collected Writings of Edith Wharton* (1927) and R. M. Lovett, *Edith Wharton* (1925).

WHARTON, FRANCIS (1820–1889), American legal writer and educationist, was born in Philadelphia, Penn., March 7, 1820. After holding various professional and ecclesiastical posts, he settled in Washington, D.C., where in 1885–88 he was lecturer and professor of criminal law at Columbian (now George Washington) university and solicitor of the Department of State. Wharton wrote many legal treatises and was a leading American authority on international law. He died in Washington, D.C., Feb. 21, 1889.

See the *Memoir* (Philadelphia, 1891) by his daughter, Mrs. Viele, and several friends; and J. B. Moore's "Brief Sketch of the Life of Francis Wharton," prefaced to the first volume of the *Revolutionary Diplomatic Correspondence;* Asa W. Russell, "Francis Wharton, L.L.D., D.D., Lawyer, Publicist, Editor, Professor, Author and Clergyman," *Case and Comment,* vol. 18 (1911).

WHARTON, HENRY (1664–1695), English writer, was descended from Thomas, 2nd Baron Wharton (1520–1572), born at Worstead on Nov. 9, 1664, studied at Gonville and Caius college, Cambridge. In 1687 he was ordained deacon, and Sancroft, archbishop of Canterbury, made him one of his chaplains and appointed him in succession to two Kentish livings. He died on March 5, 1695, and was buried in Westminster abbey.

Wharton's most valuable work is his *Anglia sacra,* a collection of the lives of English archbishops and bishops, which was published in two volumes in 1691. In the Lambeth library there are 16 volumes of Wharton's manuscripts. A life of Wharton is included in George D'Oyly's *Life of W. Sancroft* (1821).

WHATELY, RICHARD (1787–1863), English logician and theological writer, archbishop of Dublin, was born in London on Feb. 1, 1787. He was educated at a private school near Bristol, and at Oriel College, Oxford. In 1811 he was elected fellow of Oriel, and in 1814 took orders. During his residence at Oxford he wrote his *Historic Doubts relative to Napoleon Bonaparte,* a very clever *jeu d'esprit* directed against excessive scepticism as applied to the Gospel history. After his marriage in 1821 he settled in Oxford, and in 1822 was appointed Bampton lecturer. The lectures, *On the Use and Abuse of Party Spirit in Matters of Religion,* were published in the same year. In August 1823 he removed to Halesworth in Suffolk, but in 1825, having been appointed principal of St. Alban Hall, he returned to Oxford. His treatise on *Logic* (1826), originally contributed to the *Encyclopaedia Metropolitana,* gave a great impetus to the study of logic throughout Great Britain. A similar treatise on *Rhetoric,* also contributed to the *Encyclopaedia,* appeared in 1828. In 1829 Whately became professor of political economy at Oxford, but lectured only for two years, as he was appointed archbishop of Dublin in 1831. One of his first acts was to endow a chair of

political economy in Trinity college out of his private purse.

In 1837 he wrote his well-known handbook of *Christian Evidences,* which was translated during his lifetime into more than a dozen languages. At a later period he also wrote, in a similar form, *Easy Lessons on Reasoning,* on *Morals,* on *Mind* and on the *British Constitution.* Among his other works may be mentioned *Charges and Tracts* (1836), *Essays on Some of the Dangers to Christian Faith* (1839), *The Kingdom of Christ* (1841). He also edited Bacon's *Essays,* Paley's *Evidences* and Paley's *Moral Philosophy.* His cherished scheme of unsectarian religious instruction was defeated by the opposition of the new Catholic archbishop of Dublin, and Whately felt himself constrained to withdraw from the education board. From the beginning Whately was a keen-sighted observer of the condition of Ireland question, and gave much offense by openly supporting the state endowment of the Catholic clergy as a measure of justice. He died on Oct. 8, 1863.

In 1864 his daughter published *Miscellaneous Remains* from his commonplace book and in 1866 his *Life and Correspondence* in two volumes. The *Anecdotal Memoirs of Archbishop Whately,* by W. J. Fitzpatrick (1864), enliven the picture.

WHAUP: *see* CURLEW.

WHEAT. Among the three or four most important cereals utilized as food by man, wheat (*Triticum*) occupies the first place. It is the cereal above all others from which good bread can be made and in this form is consumed by the most highly civilized nations of the world.

FROM GROOM, "ELEMENTARY BOTANY" (G. BELL & SONS, LTD.)

FIG. 1.—INFLORESCENCE OF WHEAT

The grain from which the plant is grown is a caryopsis or nut-like fruit containing a single seed. The thin shell or pericarp of the fruit and the coat of the seed are so closely united when ripe that they cannot be separated. The colour of the grain is usually a pale creamy tint or some shade of red but in certain Abyssinian wheats it is purple. The surface is smooth except at the tip which is covered with hairs; the dorsal side is convex, the ventral side having a longitudinal furrow. At the base of the grain on the dorsal side is an oval wrinkled patch which covers the embryo of the seed. The embryo possesses several rudimentary rootlets and a terminal bud, or plumule, from which the stem and leaves of the future plant develop.

Beneath the epidermis are a few layers of cells belonging to the pericarp; within these is the coloured testa or seed coat which surrounds the embryo and the endosperm or floury part of the seed. The outer layer of the endosperm consists of cubical cells containing minute aleurone grains composed largely of protein. The rest, which makes up the bulk of the endosperm, is a mass of thin-walled cells within which are vast numbers of starch grains imbedded in a matrix of proteins, chiefly the gluten so essential to the manufacture of good porous bread.

Life-history.—Germination of the grain occurs in a few days when sown in warm soil; the rootlets, breaking out first, are soon followed by the coleoptile leaves. The main axis or stem extends a little and the lateral buds upon it grow into short stems upon which buds also arise, and these in turn produce short stems and buds; such branching of the young plant, termed "tillering," which occurs close to the ground, continues for a variable length of time dependent on the variety of the wheat, and on the time of sowing, condition of the soil and other environmental factors. The many short stems produced are at first hidden by the leaves; later they rapidly elongate or "shoot" upwards forming the straws of the crop. The much branched axis of a strongly "tillered" plant may thus give rise to 5 or 10, or even 20 to 100 straws and ears in widely spaced plants, all of which have come from the embryo of a single grain.

The inflorescence or ear of wheat consists of a notched axis or rachis which bears on alternate sides from 18–25 flattened spikelets, one at each notch. Each spikelet has a thin central axis

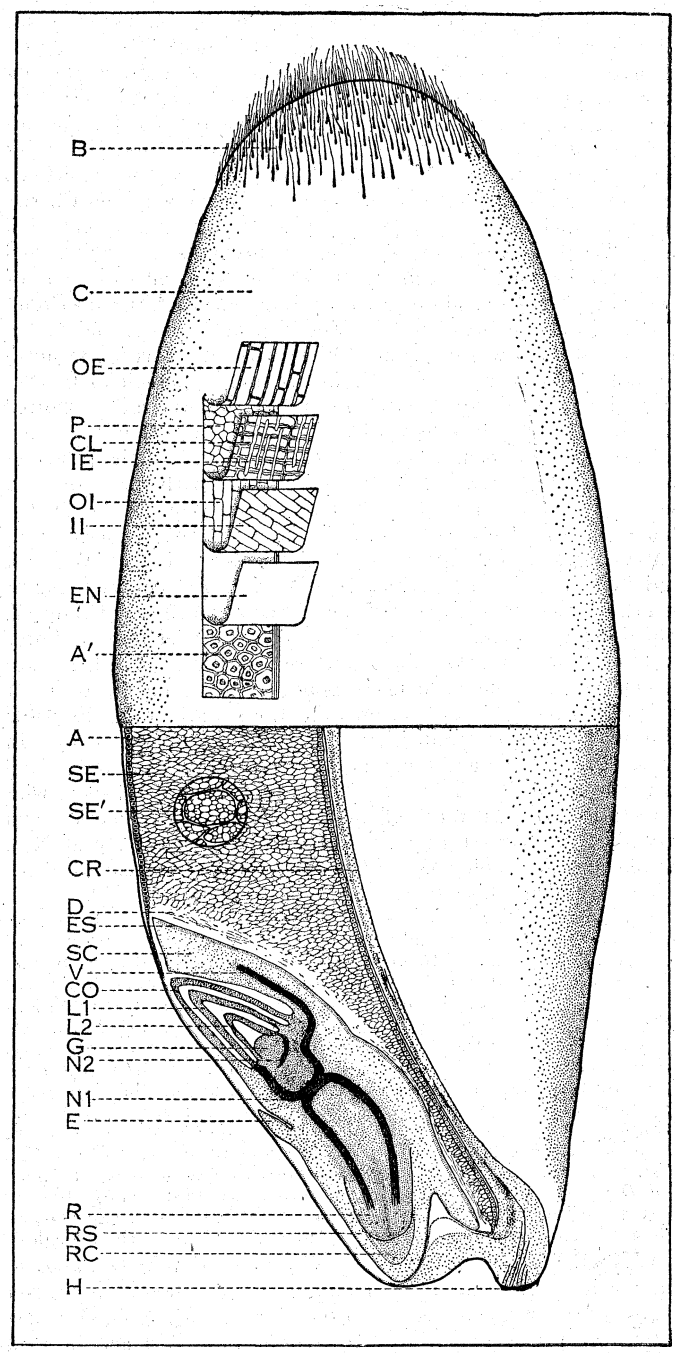

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FIG. 2.—SECTIONAL DRAWING OF A WHEAT GRAIN

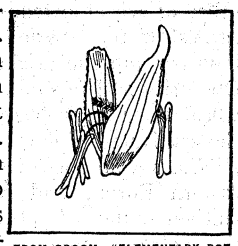
B, brush. C, cuticle. Pericarp: OE, outer epidermis of pericarp; P, parenchyma; CL, crosslayer; IE, inner epidermis of pericarp. Testa: OI, outer integument of seed; II, inner integument of seed (coloured). EN, epidermis of nucellus=nucellar layer. Endosperm at bottom of crease: A, aleurone; A′, aleurone (enlarged); SE, starch and gluten parenchyma; SE′, starch and gluten parenchyma (enlarged); CR, crushed empty cells of endosperm. D, depleted layer of cells from which starch has been removed by the scutellum. SC, scutellum. ES, epithelium of scutellum. V, vascular bundle of scutellum. Plumule: CO, coleoptile; L1, first foliage leaf; L2, second foliage leaf; G, growing point. N2, second node. N1, first node. E, epiblast. R, primary root. RS, root sheath (coleorhiza). H, hilum. RC, root cap.

—the rachilla. At the base are two boat-shaped chaffy scales, the empty glumes; then follow a number of flowers arranged alternately along the rachilla, each enclosed between a flowering glume and palea, the former of which may or may not terminate in a long beard or awn. The flower is very simple, consisting of three stamens and a feathery-styled ovary, at the base of which are two minute membranous scales termed lodicules. The number of flowers in a spikelet varies in different races of wheat, but in ordinary bread wheat is 4–6 or more, of which usually not more than two or three develop into grain, the rest being abortive.

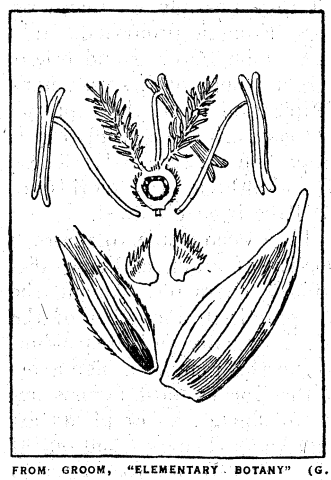
Flowering begins about two days after the ear escapes from the upper leaf sheath, when the glumes surrounding the flowers are pushed apart by the lodicules which swell and become turgid at this period. The filaments of the flower lengthen rapidly and the anthers dehisce at their tips. Some of the abundant pollen falls on the feathery stigmas, often before the flower opens, the rest being shed into the air. Normally the glumes remain separated about 15–20 minutes and then close; self-pollination and self-fertilization is the rule, but crossing from pollen brought to the flower by air currents before the glumes close occurs in a small percentage of the flowers in some seasons. Flowering usually is not abundant in early morning, but it goes on throughout the day. The lowest flower of each spikelet opens first, the rest following in succession upwards. The first spikelet to flower lies in the middle third of the ear, and flowering progresses upwards and downwards from this point, the last to open being those of the terminal and basal spikelets respectively. The whole ear completes its flowering in five or six days in warm weather, but is prolonged to six or eight days when the sky is overcast.

FROM GROOM, "ELEMENTARY BOTANY" (G. BELL & SONS, LTD.)
FIG. 3.—A SPIKELET OF WHEAT

After fertilization the grain begins to develop, its volume increasing day by day. The pericarp expands as the seed within enlarges, and reaches its maximum size in four or five weeks, when the water content is about 70% of the weight of the grain. Later the dry weight increases, but growth stops when the water content drops to about 40%. Thereafter, drying continues until the water content is only about 12–14% when the grain is ripe. At the time of maximum volume the grain is green, the embryo almost completely formed and the cells of the endosperm contain a large amount of water. At this stage the grain is said to be "in the milk"; on squeezing it yields a white liquid in which float vast numbers of starch grains. In the "yellow ripe" or "dough" stage which follows, the grain has assumed its creamy or reddish tint—the chlorophyll of the cells of the pericarp having disappeared—and the endosperm now kneads like wax or dough. In two or three days the "ripe" stage is reached when the characteristic colour of the grain is clearly marked, its endosperm becomes harder and the flinty or mealy character is established.



FROM GROOM, "ELEMENTARY BOTANY" (G. BELL & SONS, LTD.)
FIG. 4.—FLOWER OF WHEAT

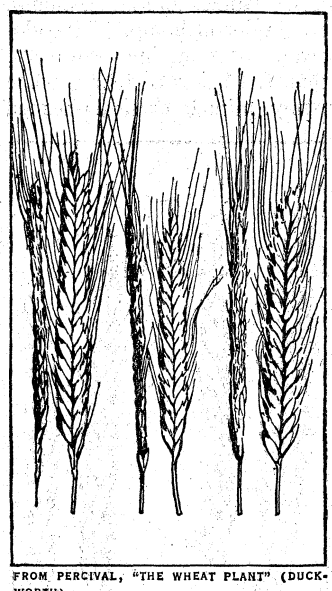


FROM GROOM, "ELEMENTARY BOTANY" (G. BELL & SONS, LTD.)
FIG. 5.—DISSECTED PART OF FLOWER

The time taken in the ripening process depends on the variety of the wheat, and the climate of the locality in which it is grown; in the south of England the time elapsing between the date of appearance of the ear from the leaf-sheath and the production of ripe grain is from 8 to 9 weeks for most wheats. In warm dry climates it is about 5 to 6 weeks.

Species and Races.—The classification of the vast number of forms of wheat is very complex, and many attempts have been made by botanists since the time of Linnaeus (1753), who recognized five species. Most of these schemes are based upon differences in the morphology of the ear, and the majority refer to a comparatively few of the known forms and these chiefly herbarium specimens. A comprehensive classification of the wheats of the world was made by Dr. K. A. Flaksberger and his associates in the U.S.S.R.

Group I. Wild Einkorn (*Triticum spontaneum*) and cultivated Einkorn (*T. monococcum*). Group II. Wild Emmer (*T. dicoccoides*); Timopheevi (*T. timopheevi*); Emmer (*T. dicoccum*); Durum wheat (*T. durum*); Abyssinian wheat (*T. abyssinicum*); Poulard, Rivet, or Cone wheat (*T. turgidum*). Polish wheat (*T. polonicum*) and Persian wheat (*T. persicum*). Group III. Spelt (*T. spelta*); Common or bread wheat (*T. vulgare*) (*T. aestivum*); Club wheat (*T. compactum*); Shot or Indian Dwarf wheat (*T. sphaerococcum*); and Macha wheat (*T. macha*). The diploid chromosome number of the wheats of group I is 14, that of group II is 28, while that of group III is 42.

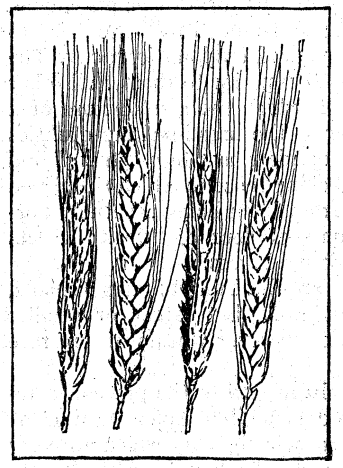


FROM PERCIVAL, "THE WHEAT PLANT" (DUCKWORTH)
FIG. 6.—EINKORN

Einkorn (German, one grain); Engrain (French; Small spelt). The wheats of this race have bearded, thin flat ears from 5–9 cm. long. The spikelets often contain only a single grain. The rachis of the ear when ripe is brittle and disarticulates at each node or joint when thrashed. The grains are small, laterally compressed and pointed at each end. It is an ancient race cultivated only by primitive peoples in Europe, Asia Minor and Morocco, and chiefly used as food for cattle and horses.

Wild einkorn has a very fragile rachis.

Emmer.—The ears of this race are flattened and bearded, the spikelets containing two grains which are narrow and generally pointed at each end. In the typical emmer the rachis is brittle, and the grain firmly held between the sharply keeled glumes can only be obtained free from the latter with difficulty. Archaeological evidence shows that emmer is one of the most ancient of the wheats; it was extensively grown by Neolithic peoples of central Europe and was the only wheat cultivated in Egypt in pre-dynastic and early dynastic times. By the 20th century it was grown for human food by primitive races in India, Iran, the U.S.S.R., Abyssinia and Morocco, and a small quantity in south Germany and the Basque districts of Spain. Small amounts are also grown in the United States and in other parts of the world for horse and cattle food.



FROM PERCIVAL, "THE WHEAT PLANT" (DUCKWORTH)
FIG. 7.—DURUM WHEAT

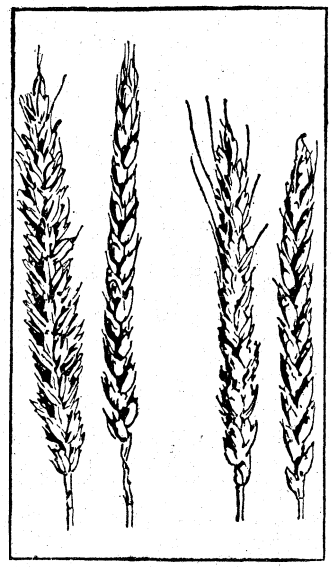
Wild emmer, native of Asia Minor, has a fragile rachis that causes the spikes to break up as soon as they mature. *Timopheevi* wheat resembles emmer and is found in the Russian Caucasus. It is resistant to several diseases and has been crossed with other wheats in a number of countries.

Durum or *macaroni* wheats are tall semisolid-strawed kinds with bearded ears and sharply keeled glumes. The grain usually is large, pointed at each end, with hard translucent endosperm specially suitable for the manufacture of macaroni and other similar pastes. These wheats have glabrous leaves. They are often resistant to rust and also give good crops of grain in districts with a low rainfall. They are cultivated throughout the Mediterranean region, in the U.S.S.R., central Asia, India, South Africa and the northern Great Plains and prairie regions of North America.

Abyssinian wheat has hard grains like durum. It is found in

Abyssinia, Eritrea and Egypt. Some varieties have short compact spikes, and a few have purple kernels. Some Abyssinian forms have short grains somewhat like those of emmer wheats, with which they appear to have relationship.

Poulard, rivet or *cone* wheats are tall semisolid-strawed forms with heavy bearded ears, sharply keeled glumes and large, plump, blunt-tipped grains with a characteristic dorsal hump. The endosperm of the grain is soft and starchy or sometimes corneous, more suited to the biscuit-maker than the baker of bread. Some varieties of rivet, often named mummy, miracle or seven-headed wheats, have branched ears. The rivet wheats have soft, velvety leaves and require a mild climate for full development. They are grown chiefly in countries along the northern side of the Mediterranean from Portugal to the Caucasus, though small amounts of some varieties are met with in Great Britain and parts of other countries.



FROM PERCIVAL, "THE WHEAT PLANT" (DUCKWORTH)

FIG. 8.—BREAD WHEAT

Polish wheat is a tall-strawed kind endemic in Spain and sporadically found in other countries along the Mediterranean and elsewhere; the origin of the name Polish is obscure. The empty papery glumes are of extraordinary length (occasionally 1–1½ in.); the grains of the common varieties which are very long and narrow are used for feed or occasionally for the manufacture of macaroni.

Persian wheat, like Abyssinian wheat, has spikes flattened on the face of the spikelets, thus distinguishing it from durum and poulard wheats. The rachis joints are narrow, making the spike flexible. Persian wheat is found in the Caucasus region.

Common or *Bread Wheat.*—This is by far the most important and most widely distributed species of wheat; included in it are all the kinds from which the bread supply of the world is derived. Both bearded and beardless varieties are found, and among the many hundreds of forms which are known there is seen the greatest variation in length and density of ear, form of empty glume, habit of growth, period of ripening, resistance to disease, adaptability to various climatic conditions, and cropping capacity. The gluten of the flour of these wheats is superior to that of all other races in the physical qualities upon which the manufacture of a large spongy loaf depends. So far as the bread-making qualities are concerned, millers and bakers divide wheat into "strong" and "weak" varieties. To the former belong those in which the gluten is highly elastic, the bread made from them being especially porous and digestible; similar amounts of flour of "weak" wheats give smaller, denser and less attractive loaves.

The great bread wheat countries are the United States, Canada, Russia, Argentina, India and Australia, but larger or smaller amounts are grown in all countries wherever wheats of any race can be cultivated.

Club Wheat.—This race is closely related to the preceding, resembling it in grain qualities and general morphological characters. The chief differences are seen in the ears which are very short—often not more than two inches in length—with densely packed spikelets containing three or more grains. Club wheats are widely distributed in mixture with the bread wheats, pure crops of them being uncommon except in central Asia, China and the northern Pacific states of America.

Indian Dwarf or *"Shot" Wheat.*—A remarkable race of few varieties, sometimes erroneously classified with the club wheats from which they are quite distinct. The straw is short and stiff, and the ears dense with inflated empty glumes in which are enclosed small round grains. These wheats are almost entirely confined to northern India, where they are found to resist drought well.

Spelt or *Dinkel.*—The term "spelt" has unfortunately been employed in two different senses by botanists. It is given to all wheats in which the ear has a brittle rachis; in this sense it includes einkorn, emmer and dinkel as well as the wild wheats mentioned below. It is also applied in a special sense to the dinkel race alone (*T. spelta*).

Typical dinkel or spelt (German, Spelz) has long, lax ears, which may be bearded or beardless. On threshing, the rachis breaks at the nodes, a single spikelet remaining attached to each internodal portion of the rachis. The spikelets usually contain two grains tightly enclosed in the glumes from which they can only be freed by special milling machinery. The grains resemble those of emmer. The empty glumes are tough, keeled and have a broad truncate apex.

Dinkel is a hardy wheat grown chiefly in south Germany, the Tirol, parts of Switzerland and northern Spain. The naked grains, removed from the hulls after the crop is harvested prematurely and dried, are called "grünkern" and are used in soups. To a lesser extent, the ripened grain is ground into flour for confectionery.

Macha wheat is a spelt-like type found in the Russian Caucasus. Some varieties have dense spikes resembling emmer. The glumes of macha wheat resemble those of bread wheat.

Origin of the Wheats.—The cultivation of one race or another of wheat extends far back into prehistoric times. In the earliest historic periods wheat growing was already an ancient industry and the origin of the crop a matter of tradition only. Obscurity still prevails and the ancestry of many of the races of wheat remains problematical. There is, however, no doubt that the cultivated einkorn has been derived from *Triticum aegilopoides,* a wild species of grass found in hilly districts in southeastern Europe and Asia Minor; the differences between the cultivated and wild plants are very small and their botanical relationships obvious.

The brittle-eared emmer closely resembles *Triticum dicoccoides,* a wild species of wheat found in the mountainous parts of Syria, and has doubtless descended from it. The other wheats of the emmer group have probably arisen by mutation and crossing within the group.

It is in regard to the origin of the wheats of the bread wheat group that the greatest obscurity and uncertainty exists, and no plant has yet been discovered which resembles any of these wheats. Some botanists have suggested that the wild ancestor has become extinct, others hope that it may possibly be found by further search in southwestern Asia. From a prolonged study of many hundreds of forms Professor John Percival and others formed the opinion that the bread wheat group with its vast number of varieties has arisen by hybridization of a wheat of the emmer group with some species of the genus *Aegilops,* wild grasses found in southern and eastern Europe and western Asia. These cross with emmer and bread wheats, and although the hybrids are usually sterile a few fertile hybrids have been obtained.

From very early times attempts have been made to improve the wheat crop, either in yield, quality of grain, earliness, disease resistance or some other desirable character. Among the ancient Romans mass selection was practised, a number of the best ears or largest grains being chosen annually and the produce used as seed for the succeeding crop; in this manner a high average yield was maintained. Some of the world's most famous improved wheats have been selections of single ears or plants exhibiting superior characters, such individuals being picked out of an ordinary crop, or found growing casually on roadsides, in hedges, or among other crops on cultivated ground.

Hybridization has also been practised with a view of obtaining improved wheats. At first crossing was carried out in order to secure a greatly varying offspring, from which it was hoped to select plants of superior merit. Since the discovery by Mendel of the laws of inheritance (*see* HEREDITY; MENDELISM), interest in hybridization has been greatly stimulated, and in all wheat-growing countries the crossing of wheats is being extensively pursued, the aim being to combine in one plant the good qualities found in two or more separate individuals. The most important

character from the point of view of the farmer is total yield of grain, a hereditary quality largely influenced by environment. Attempts to combine this character with earliness, baking quality, winter hardiness, disease resistance and other desirable qualities were successful.

Wheat is one of the most widely distributed of the cereals, and is grown in almost all countries of the world, except those in the hot and humid regions of the tropics. The great areas from which the world's supplies of wheat are derived lie between the latitudes of 30° and 60°, mostly in the northern hemisphere, but crops are grown near the equator in the mountainous parts of Africa and South America, and their cultivation extends as far north as the Arctic circle, or slightly beyond it in certain parts of Europe, Asia and North America (fig. 9).

Wheat may be grown at sea level or at elevations up to 10,000 feet or more in Tibet, Abyssinia and the highlands of Ecuador and Colombia.

Some varieties, when the plants are in a hardened condition, will withstand a temperature of 30° C. below freezing point without severe injury, and even colder temperatures if the plants are protected by a covering of snow. In countries with severe winters spring kinds are cultivated, the more prolific autumn sown varieties of western Europe being only adapted to districts with comparatively mild winters.

Wheat will thrive in almost any kind of soil except sands and wet peaty soils; it succeeds best, however, upon deep, well drained loams and clays.

The yield of grain per acre depends on a number of independent factors, such as the variety of wheat, climate and soil, time of sowing, amount of seed and other conditions, the maximum return being only obtained when all the conditions named are favourable and exerting their influence simultaneously—an extremely rare occurrence. In ordinary farm practice the yield of grain varies from about 10–20 bushels (600–1,200 lb.) in the warm countries of southern Europe, North Africa, Argentina, India and Australia, to 30 or 40 bushels (1,800–2,400 lb.) per acre in the United Kingdom and the adjacent countries of northwestern Europe. The average yields of the United States and Canada are about 15–20 bushels (900–1,200 lb.) per acre. In exceptional circumstances small areas of a few acres in extent have given more than 100 bushels (6,000 lb.) per acre.

Diseases and Parasites.—Like other crops, wheat is subject to the attacks of parasitic fungi which cause diseases. Among those formerly most feared by the wheat grower is the disease known as black stem rust, annual losses from which have amounted to many millions of dollars.

In early summer are seen narrow elongated rust coloured pustules on the stems and leaves; these are the sori of the rust fungus, *Puccinia graminis,* from which are shed vast numbers of reddish-yellow uredospores. When placed on the leaf or stem of the wheat plant the spores germinate and penetrate its tissues, giving rise in a short time to another sorus; in this manner the disease is spread rapidly through the crop during summer. Later in the season the sori are almost black, producing dark-brown teliospores which do not germinate until the following spring, when they give rise to small secondary spores; these cannot infect wheat but readily attack the leaves of the barberry (*Berberis vulgaris*). Within the leaves of the new host the fungus grows and bears aecia or cluster-cups, which break through the epidermis and shed large numbers of aeciospores; the latter are unable to reinfect the barberry, but when carried to a wheat plant germinate and penetrate the young leaves producing there an internal mycelium from which uredospores like those first mentioned are given off.

Numerous physiologic races of the black stem rust fungus are known, which though similar in morphological characters are different in their parasitism. Some races attack wheat, barley, rye and several wild grasses; others are parasitic only on oats and certain grasses, others live upon rye and barley and will not infect wheat or oats, while still others are only capable of using certain grasses as hosts. Within these racial groups a single race will attack some varieties and not others. Thus some 200 distinct physiologic races attacking wheat have already been recognized.

In districts or countries from which barberry is absent, successive crops of wheat are often very seriously infected with rust; the explanation for the prevalence of the disease under these circumstances is that the parasite persists from one season to another in the uredo stage upon stray wheat plants or wild grasses. Thus the rust spores overwintering in the southern United States and in Mexico are blown northward, and successive crops of spores spread the disease up into the northern United States and Canada. Widespread serious rust epidemics develop by this method. Local epidemics in the north usually spread from barberry bushes.

The remedy for stem rust, other than the eradication of the barberry host in local areas, is the use of resistant varieties. Resistant varieties have been bred in the United States, Canada and many other countries. Varieties such as Pilot, Rival, Thatcher, Apex and Renown have largely eliminated the drastic stem rust menace in northern United States and the prairie provinces of Canada.

Leaf rust (*Puccinia rubigo-vera*) also causes heavy damage to wheat. This fungus survives the winter in the colder regions. Stripe rust (*Puccinia glumarum* occurs in some countries but it is less injurious than the other rusts.

Another disease of serious import to the wheat grower is bunt or stinking smut, *Tilletia tritici* and *T. levis.* Bunted grains produced by diseased plants have a disagreeable odour of decaying fish, and are filled with a mass of black spores which are set free during the threshing process, becoming attached to the coats of the healthy grains. Germination of the bunt spores and the contaminated grains occur at the same time when sown, and the fungus infects the young plant soon after it makes its exit from the grain. The parasite lives in the wheat plant without destroying it, progressing upward in the stem and finally entering the developing grain where the mycelium of the fungus is transformed into a mass of bunt spores. The disease can be checked by dusting the seed grain with copper carbonate, diluted ethyl mercury phosphate, diluted ethyl mercury chloride, or other fungicides which destroy the spores on the contaminated grains without damaging the embryos within them.

Another disease is loose smut of wheat, *Ustilago tritici,* a parasite different from bunt in that it gains an entrance into its host through the flowers, and the infection is carried inside the seed. Loose smut destroys the entire head except for the rachis or central axis.

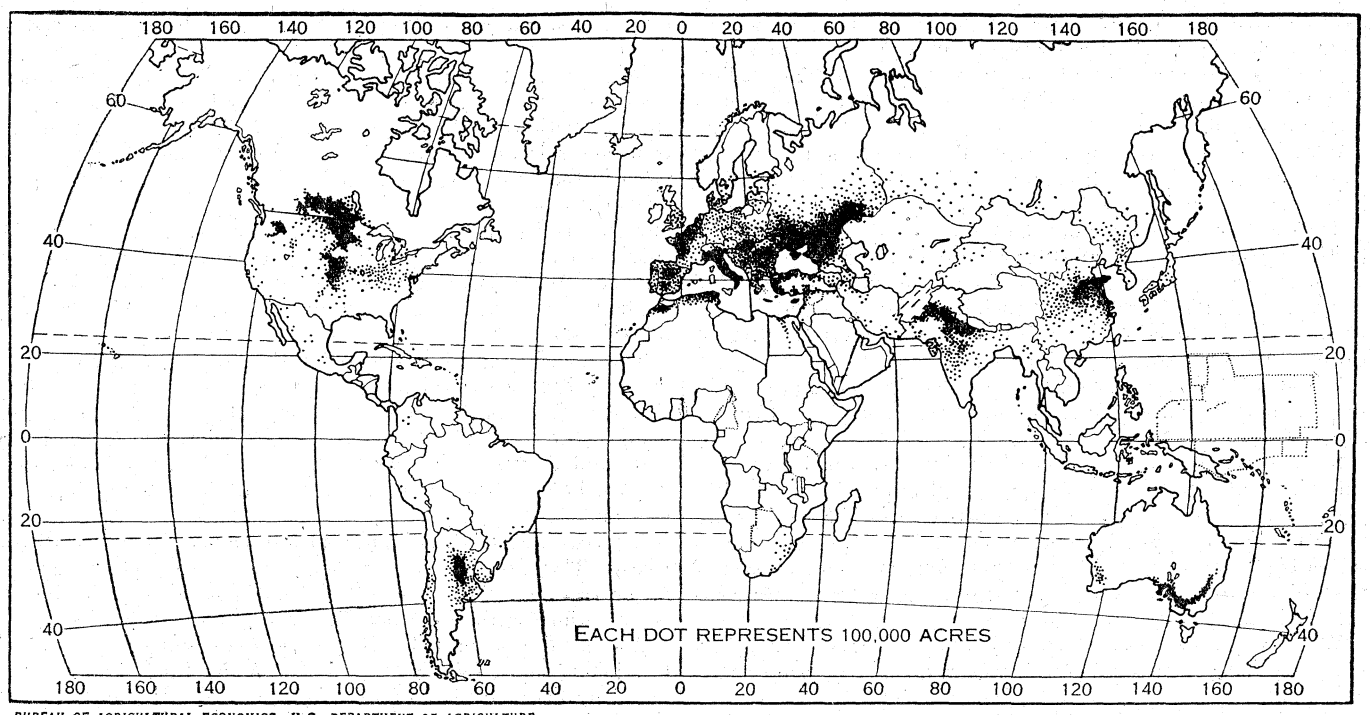
For further information consult *The Wheat Plant: a Monograph* by J. Percival (Gerald Duckworth & Co., Ltd., 1921).

(J. P.; J. H. Mn.)

PRODUCTION AND TRADE

After World War I appreciable changes occurred in the quantities of wheat exported or imported by producing and consuming countries. Thus, including flour in terms of grain, Canada by the time of World War II was exporting more than 200,000,000 bu. of wheat annually. Argentina about 150,000,000 bu., United States less than 100,000,000 bu. and Australia nearly as much. The quantities going to various countries have depended in large part upon trade agreements and domestic policies in the importing countries. Production, trade and price regulations, extended drought and changing farm practices reduced the quantity of wheat exported from the United States. In Canada, Argentina and the U.S.S.R., on the other hand, new lands were brought into wheat production after World War I.

Great Britain.—In 1939, wheat occupied only about one-sixth of the arable acreage in England and Wales as a whole and little more than one-seventeenth of the total cultivated area. These proportions are somewhat lower than those which obtained in the decade immediately preceding World War I. The proportion of the arable land devoted to this crop then became almost constant —varying mainly with soil and weather conditions at the time of sowing—until the beginning of World War II, when wheat-growing again expanded.



BUREAU OF AGRICULTURAL ECONOMICS, U.S. DEPARTMENT OF AGRICULTURE

FIG. 9.—WORLD WHEAT ACREAGE. AVERAGE 1930–31 — 1934–35

Although, from its peace-time position in British agriculture, wheat would hardly appear to be a crop of prime importance, the fluctuations in acreage must be observed with great interest; they largely indicate the prosperity or adversity of arable cultivation on heavy clay soils, particularly in the eastern and southern portions of England, where climatic conditions favour the ripening and harvesting of a good plump grain. Wheat is the principal source of revenue from arable crop production on heavy land. This class of soil is unsuitable for other cash crops, such as potatoes, sugar beets or barley, which enables the light-land farmer to continue arable cropping with more or less satisfactory financial results. The conversion of arable land to permanent grass in Great Britain has been closely associated with the abandonment of wheat cultivation on heavy soils.

The close connection between wheat prices and the area under tillage may be illustrated by the fact that in the years 1871–75, when wheat averaged 12*s.* 9*d.* per cwt., there were 14,766,000 ac. of arable land in England and Wales, of which nearly 25% were devoted to wheat. With the decline in price to 6*s.* 6*d.* per cwt. in 1901–05, however, the arable area had diminished to 11,914,000 ac., and of this less than 14% was cropped with wheat. Competition from the western hemisphere and Australia, where wheat is grown by low-cost extensive methods, was a large factor in the price decline. The percentage devoted to wheat in 1871–75 and 1901–05 respectively indicates that it is the wheat-growing class of land that has gone out of arable cultivation.

Wheat is regarded as a heavy land crop more because it excels the other cereals on strong soils than because of its preference for this class of land. By suitable manurial treatment heavy yields can be obtained from light soils also, as is the case in Norfolk, parts of Lincolnshire, Lancashire and the Lothians, where wheat occupies a regular place in light loam farming. Although her average yield is very high, Denmark has no land sufficiently strong to comply with the English conception of typical wheat and bean soil.

In Britain, wheat cultivation is conducted under the most favourable climatic conditions on the drier eastern side of the country. While conditions on the western side are favourable to the vegetative development of the plant, wet weather in August and September frequently impedes the harvesting of the crop and injures the milling quality of the grain. As regards temperatures, the warmer summer conditions of the southern counties of England cause the crop to ripen a little earlier here than in the Lothian counties of Scotland; and while this does not ensure a higher yield per acre, it produces a better quality of grain for milling or for seed, and the earlier removal of the crop favours autumn tillage operations.

Little wheat is grown in Britain as far north as Aberdeen because heavy rainfall and late ripening are not favourable to wheat growing, but in Scandinavia and the U.S.S.R. this cereal is cultivated in latitudes beyond that of the Shetland islands.

TABLE I.—*Average Annual Yields of Wheat in Various Countries for the 5-Year Period 1930–34*

Country	Yield per Hectare	Yield per Acre
United Kingdom	23 quintals	33.6 bushels
Denmark	29 "	43.0 "
Netherlands	30 "	44.2 "
Belgium	26 "	38.3 "
Germany	22 "	32.1 "
France	15 "	23.0 "
Canada	9 "	13.6 "
United States	9 "	13.5 "
Australia	8 "	12.2 "
India	7 "	10.7 "
Argentina	9 "	13.8 "
Russia	7 "	10.1 "

(1 quintal per hectare is equivalent to 1.487 bushels per acre; 1 bushel, U.S. legal standard, is 60 pounds.)

Comparative Wheat Yields.—The variations in yield indicated in Table I are in part due to differences in the intensity of cultivation, but climate is the chief factor affecting wheat yields. Countries showing low average yields of wheat contain large areas subject to drought and hot weather.

The world's wheat crop in each of the years 1939, 1940 and 1941 exceeded 160,000,000 long tons. Of the wheat harvested in 1939, the United States of America contributed 20,100,000 tons, the U.S.S.R. probably 24, Canada 13.8, India 10, France 7.3, Italy 7.8, Argentina 3.5, Spain 2.8, Germany 4.8, Australia 5.6, North Africa 4.0, Rumania 4.4 and Hungary 3.0. The most important changes in the output after 1909–13 were increases of 5,000,000 tons in the U.S.S.R., and more than 8,000,000 tons in the Canadian production.

Some of the most important producing countries, however, are large consuming centres, and either have little surplus to export or actually import wheat, mainly from North America, Argentina and Australia. The quantities exported in 1938 were as follows:

Canada 4,000,000 tons, United States 3,000,000, Argentina 3,000,000, Australia 2,500,000, other countries 3,000,000; total 15,500,000 tons. "Other countries" includes Hungary, the Balkans, North Africa, India, Chile and Uruguay.

The chief importing countries and the quantities received by each in 1938 were as follows: United Kingdom 6,000,000 tons, and Belgium, Brazil, and Germany about 1,000,000 tons each. The remaining 6,000,000 tons were imported by the following countries: the Netherlands, China, Italy, France, Ireland and Switzerland. There are, however, other importing countries including Greece, North Africa and Scandinavia.

Wheat Supply.—The question of when the production of foodstuffs will begin to lag behind the increasing needs of the swelling population of the world is not a new one. Between the time that Malthus issued his warnings in the 18th century and the fifth decade of the 20th century, the world population more than doubled without apparent danger of general food scarcity. The large world surplus of wheat that accumulated before the beginning of World War II indicated that wheat production might keep pace with world requirements for many years thereafter.

Although no statistical survey of the potential wheat growing possibilities of the world had been made by the time of World War II, it was evident that there were still vast areas of uncultivated or semicultivated land available for future development. Canada was estimated to have a total of 300,000,000 ac. that might be used for growing wheat, as against the actual 29,000,000 ac. under this crop. Argentina and Australia were pointed out as other countries with great possibilities in wheat production. Rapid as had been the expansion of wheat cultivation in Australia, from 3,500,000 ac. in 1895 to 12,300,000 ac. in 1941, only a small portion of the assumed available area had been brought into service. On the other hand, it must be recognized that the appearance of over-production prior to World War II was due in part to the fact that large sections of people were not able to exercise their demand for food, but owing to poverty were living at a low level of consumption.

The British Wheat Position.—Although in peace times the larger proportion of the wheat consumed in Great Britain is imported, the quantity of home-produced wheat is fairly considerable. It was officially estimated at the time of World War II that 75% of the total home crop is marketed. Marketings are much the heaviest in the autumn and winter, so that as a rule three-fourths of the total sales take place in the six months September to February, and there is very little British wheat on the market in the summer. Farmers offer their grain at the local markets throughout the country, the sales being by private treaty to millers and corn merchants. Formerly the grain was taken to the markets in bulk, but this practice was superseded by that of showing samples only. Of the wheat purchased from farmers by corn merchants, the bulk is ultimately made into flour, but there is a growing demand for British wheat for feeding to poultry, and individual farmers find this a useful market. With the increasing efficiency of the large mills, the smaller country mills become steadily fewer, so that an increasing proportion of home-grown wheat passes through the hands of merchants on its way to the larger mills.

About half the wheat produced in Great Britain is grown in the eastern counties, and it is in these counties that the most important markets for this grain are to be found. The quantity of wheat imported is approximately 6,000,000 tons per annum, to the value of about £60,000,000 sterling. Earlier, in the 1860s, imports of wheat were only about 1,500,000 tons, so that they had increased about fourfold at the time of World War II. Of the total imports of wheat into Britain, more than half comes from empire countries, Canada and Australia being the chief sources of supply within the empire. Argentina and the United States supply most of the remainder.

After the outbreak of World War II in 1939 normal movements of wheat were greatly upset. However, for some years before the war, rapid changes were taking place as a result of price controls and trade restrictions in various countries, together with programs of self-sufficiency in wheat supplies in countries such as Germany, France and Italy. Thus the average wheat acreage in Germany increased from 3,600,000 ac. in 1921–25 to more than 5,000,000 ac. 10 years later.

The trade in wheat during peace times is worldwide, prices in practically all countries, except where artificial price controls are established, being affected as much by the total world supplies as by the yields of local crops. In the latter half of the year the trade is chiefly influenced by the yields or prospective yields in Europe and North America, whereas in the early months of the year the crops of Argentina and Australia have an important effect on the trade. It is to be remembered that the trade is worldwide; that in every month of the year wheat is being harvested in some part of the globe; and that in very many countries wheat is sown in the autumn, so that the crop is subject to the good and bad influences of weather for long periods. For these reasons prices fluctuate daily according to the reports received on the markets regarding the changing prospects of the yields and the actual results of the harvests in different countries. Important changes in price levels, however, most often take place in the British summer and early autumn, when the crops of the northern hemisphere, which produces much the larger proportion of the world's yield, are being harvested. (J. H. Mn.)

WHEAT PRODUCTION IN THE UNITED STATES

Wheat was introduced to the infant English colonies in Virginia and Massachusetts soon after their settlement in 1607 and 1620, respectively. It had been introduced to Mexico by the Spanish, however, probably as early as 1530. Strangely enough, however, it was not wheat but maize, or Indian corn, that became the staple meal of these English colonists in America, and more than once saved them from starvation.

There were good reasons for the superiority of corn over wheat on the Atlantic coast. The soil and climate were better suited to it. Maize was much easier to plant, cultivate, and harvest in the rough clearings, among stumps and stones. Maize was more easily ground and cooked with primitive kitchen utensils.

Wheat production developed commercially with the westward progress of settlement to better wheat soils and climates, with the increasing of towns and cities, and with improved facilities for transportation and for handling the crop in field and mill. The first U.S. wheat belt stretched from Delaware and Maryland to central New York. This district still grows much wheat. The states of the Ohio valley were the next centre of commercial wheat production. They are a centre for the production of the soft red winter wheats. The opening of canals in the Potomac valley and New York enabled the movement of this wheat to the more populous eastern seaboard, and the building of railroads greatly speeded and extended the process.

The most rapid expansion of U.S. wheat production took place immediately after the Civil War, and occupied the period from 1866 to about 1890. It was due to three principal factors. First, the development of large-scale harvesting and threshing machinery, which had been the goal of inventors for years prior to the war. Secondly, the advance of settlement from the rolling forested lands of the east to the relatively level open prairies and plains of the great west, with their better wheat soils, and suitability to machine operations. Thirdly, the release of a large body of adventurous young spirits from the armies, with a desire for the strenuous life of the new frontiers.

Wheat was the dominant crop in this new inland empire. Favourable soil and climate, level open fields, and large machinery units made production profitable on low-priced land, much of it homesteaded. Wheat was a concentrated crop, readily storable under frontier conditions, and haulable by team for relatively long distances in summer or winter. Being a staple food crop, it always was readily saleable.

Distinct wheat-growing areas have developed, based on differences in the kinds of wheat grown, or in the methods of growing them. Most of the country grows winter wheat, but two classes of spring wheat are grown near the northern boundary. The five great commercial classes of wheat in the U.S.A. are: (1) Soft red winter, (2) hard red winter, (3) hard red spring (common), (4)

durum, and (5) white wheat, which consists of both winter and spring wheats, both club and common, but all having white kernels.

The soft red winter wheats occupy the humid eastern United States from the Atlantic ocean westward to about the line of 30-inch rainfall, which runs from eastern Texas to northwestern Iowa, and thence eastward to the Great Lakes. They are used primarily for making pastry flours, and for blending with the stronger hard wheats in the manufacture of bread flour.

The hard red winter wheats occupy the southern two-thirds of the Great Plains area, and also eastern Montana and some dry-land areas in Idaho and Oregon. These wheats are used directly for making bread flour for domestic use and for export as wheat or flour, or for blending with soft wheats for both domestic and export purposes.

The hard red spring wheats predominate in Minnesota, the Dakotas, eastern Montana, and far northward into Canada, where an isolated production district is found in the Peace River valley at about latitude 56° N. They are used alone or for blending with the winter wheats in the making of bread flours and command premium prices when protein content is high.

Durum wheat is produced in western Minnesota and the adjacent eastern portions of the Dakotas. These extra hard wheats are grown primarily for the making of semolina, a coarse meal from which are manufactured the various edible pastes such as macaroni, spaghetti, vermicelli and noodles. Much is milled and manufactured in the United States and some is exported.

The white wheats occupy a small district in New York and adjacent Ontario, and larger districts in the Pacific northwest and in California. They are used for cereal breakfast foods, for making pastry flours and for blending with harder wheats in the making of bread flours. Large quantities are exported.

The wheat-growing areas of the United States may be divided climatologically into eastern humid (more than 30 inches of precipitation), semi-arid Great Plains (15-30 inches), and western semi-arid region. In the humid areas, soft red winter wheat is grown in a rotation with corn and hay or pasture. In the semi-arid Great Plains area, the hard red winter wheat and the hard red and durum spring wheats are grown mostly in continuous culture or in rotation with oats or barley, but to considerable extent in rotation with corn or other crops. In the semi-arid region west of the Rocky mountains the land is bare-fallowed in the alternate season to conserve moisture and to release nitrates from soil humus for the succeeding crop. Other rotations are not very successful.

In general, wheat is a cool-weather plant. About two-thirds of the U.S. wheat crop is of winter varieties, germinating and making vigorous root growth with diminishing temperatures in the fall, and vigorous shoot growth with the slowly increasing temperatures in the spring and early summer. Spring wheats must be sown as early as possible, just as soon as the frost is out and the land can be worked, so that their early growth may be in cool weather. Ripening occurs in warm to hot weather.

The northern limit of successful production of winter wheat moved steadily northward, until North Dakota became the only one of the wheat-growing states of the northern boundary not producing winter wheat. The production of hard red winter wheat extends across the Canadian boundary from Montana into southern Alberta. The northern limit of spring wheat production also began moving north with the development of earlier varieties and better methods.

Wheat grows best on relatively heavy soils, such as clays, clay-loams, and loams, but does not do well on sandy loams, and sands, to which rye is much better adapted. In general, the higher the fertility of the soil the better the wheat yields.

The wheat crop is subject to many hazards during its growth and harvesting. Some are climatic; others are biologic. The chief climatic hazard is winterkilling, due to one or more of several causes, including fall drought, winter drought, alternate freezing and thawing, soil blowing and low temperatures without snow cover. Other causes of climatic injury are spring or summer drought, hot winds, hail storms and wind storms. Among the chief biologic factors are rodents, insects and fungous diseases. Rodents usually are not very destructive to wheat, although squirrels, rabbits and prairie dogs take their annual toll. Insects often cause heavy losses. The most destructive are Hessian fly, chinch bugs, aphids ("green bugs"), joint worms, grasshoppers, white grubs and wire worms. Fungous diseases may be tremendously destructive. The heaviest losses are caused by two stinking smuts, loose smut, stem rust, leaf rust, seedling blights, scab and foot-rots, although rust-resisting wheat is now cultivated.

Average yields of all wheat in the United States vary around 14.5 bushels per acre. This often is cited against the nation, because yields in England and Germany are rather more than double this quantity. England and Germany are both wholly in the cool humid climate favourable to wheat. The United States, with its enormous area, covers much territory which is relatively hot and dry, and where yields naturally are low. U.S. farmers, using large-scale machinery and much land, produce enormously more wheat per man than the farmers of Europe, where land is scarce, wages are lower and much hand labour is used.

Consumption of wheat per capita increased in the United States until about the end of the 19th century. This was due to increasing prosperity, abundance of cheap wheat, improved milling and baking, and increasing population in cities where bread was largely used in a somewhat restricted dietary. Later per capita consumption seemed to be decreasing. Among the causes were (a) increasing buying power of the workers in industry, (b) broadening dietary due to greater production of truck crops around cities, refrigerator transportation, cold storage, and household refrigeration, and (c) campaigns against white bread. While the influence of these different factors may vary in the future, it is doubtful if the per capita consumption ever will rise to its former level. On the other hand, many peoples in other lands, now subsisting chiefly on millets, grain sorghums, and rice, may eat more wheat when it is economically possible. (C. R. Bl.; X.)

Wheat Trade in the United States.—More than two-thirds of the wheat crop of the United States ordinarily enters into domestic trade. Exports formerly exceeded 200,000,000 bushels annually but did not equal 100,000,000 bushels between 1928 and the time of World War II. While the United States for many years never failed to have an export surplus, the droughts of 1934 and 1936 combined with government production controls resulted in net imports for three seasons but with the large crop of 1937 the export status was resumed.

Most of the wheat entering into trade is produced west of the Mississippi river. The Great Plains states from Texas north and Oregon, Washington and Idaho produce large quantities of wheat in excess of local requirements. Most of the surplus of the northern Great Plains moves to Minneapolis, a large milling centre, or to Duluth for shipment to eastern mills or to the Atlantic coast ports for export. Much of the grain from the central Great Plains moves through Chicago, St. Louis and Milwaukee for eastern milling centres and for export, and from the central and southern Great Plains to Kansas City or smaller primary markets for milling, or to New Orleans and Galveston for export. The most important concentration point on the Pacific coast is Portland.

Practically all the hard red spring wheat marketed through Minneapolis or Duluth is annually consumed within the United States. A large proportion of the durum marketed through Minneapolis and Duluth formerly was for export, mostly through Duluth. The most important hard red winter wheat market is Kansas City but large quantities of this wheat also move through Chicago, St. Louis, New Orleans and Galveston. There is nearly always a surplus of this wheat for export. A large proportion of the soft red winter wheat is consumed within or near the areas of production. St. Louis is an important primary market for this class of wheat. Considerable quantities are distributed through eastern markets and small quantities are exported. On the average, however, there is very little soft red winter wheat available for export. Small quantities are normally produced for export from the Pacific coast states. Most of the white wheat produced in the eastern states is used locally while considerable quantities of western white wheats are exported. In years of normal produc-

tion in all classes considerable quantities of hard red winter, durum and white wheats are exported, but only small amounts of soft red winter and hard red spring wheats.

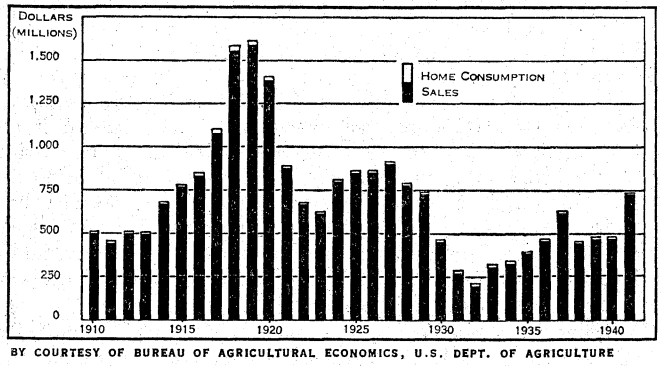
TABLE II.—*Wheat Exports from the United States, by Classes, 1929–40*

Year	Hard red spring 1,000 bushels	Durum 1,000 bushels	Hard red winter 1,000 bushels	Soft red winter 1,000 bushels	White 1,000 bushels	Total 1,000 bushels
1929	1,900	14,800	54,375	2,700	18,400	82,175
1930	600	12,100	47,365	2,600	13,700	76,365
1931	100	4,700	75,521	2,200	14,000	96,521
1932	*	1,700	16,987	*	2,200	20,907
1933	*	*	1,400	*	17,399	18,799
1934	*	*	170	10	2,839	3,019
1935	*	*	108	37	166	311
1936	*	*	424	49	2,695	3,168
1937	2,000	*	62,547	4,000	15,200	83,747
1938	3,000	2,000	58,000	2,000	19,000	84,000
1939	2,090	575	14,558	933	5,480	54,274
1940	157	362	1,671	*	8,620	40,670

*Less than 500 bushels.

Activities of the U.S. government in aid to the growing and marketing of wheat, and other farm crops, centred chiefly in the Federal Farm board, from 1929 to 1933, when it was succeeded by the Farm Credit administration, which in turn was succeeded by the Agricultural Adjustment administration and the Commodity Credit corporation.

The Federal Crop Insurance corporation was established in 1938 to insure a farmer's wheat crops for 50% or 75% of his normal yield. (O. C. S.; J. H. MN.)



BY COURTESY OF BUREAU OF AGRICULTURAL ECONOMICS, U.S. DEPT. OF AGRICULTURE

FIG. 10.—WHEAT: CASH AND GROSS FARM INCOME, UNITED STATES, 1910–41 (CALENDAR YEAR BASIS)

WHEATEAR, *Oenanthe oenanthe,* one of the earliest spring migrants, often reaching England by the end of February. The cock bird, with his bluish-grey back and light buff breast, set off by black ear-coverts, wings, and part of the tail, is rendered conspicuous in flight by his white rump. When alarmed both sexes have a sharp monosyllabic note that sounds like *chat.* The nest is placed underground; a large amount of soft material is collected, and on it from five to eight pale blue eggs are laid. Wheatears were formerly trapped for the table in enormous numbers on the Downs. The wheatear ranges throughout the Old World. It also breeds in Greenland and some parts of North America. About eight species are included in the European fauna; but the majority are inhabitants of Africa. Several of these are birds of the desert.

Among allied genera is *Saxicola* which includes two well-known British birds, the stonechat (*q.v.*) and whinchat (*q.v.*). The wheatear and its allies belong to the family *Turdidae,* the thrushes (*q.v.*).

WHEATON, HENRY (1785–1848), American lawyer and diplomat, was born at Providence, R.I., on Nov. 27, 1785. He graduated at Brown University in 1802, was admitted to the bar in 1805, and, after two years' study abroad, practised law at Providence (1807–12), and at New York city (1812–27). He was a justice of the marine court of the city of New York from 1815 to 1819, and reporter of the United States supreme court from 1816 to 1827. In 1825 he was a reviser of the laws of New York.

His diplomatic career began in 1827, with an appointment to Denmark as chargé d'affaires, followed by that of minister to Prussia, 1837 to 1846. During this period he had published a *Digest of the Law of Maritime Captures* (1815); twelve volumes of *Supreme Court Reports,* and a *Digest;* a great number of historical articles, and some collected works; *Elements of International Law* (1836), his most important work, of which a 6th edition with memoir was prepared by W. B. Lawrence and an eighth by R. H. Dana (*q.v.*); *Histoire du Progrès du Droit des Gens en Europe,* written in 1838 for a prize offered by the French Academy of Moral and Political Science, and translated in 1845 by William B. Lawrence as *A History of the Law of Nations in Europe and America;* and the *Right of Visitation and Search* (1842). The *History* took rank at once as one of the leading works on the subject of which it treats.

Wheaton's general theory is that international law consists of "those rules of conduct which reason deduces, as consonant to justice, from the nature of the society existing among independent nations, with such definitions and modifications as may be established by general consent." He died at Dorchester, Mass., on March 11, 1848.

WHEATON, a city of Illinois, U.S.A. Pop. (1920) 4,137 (88% native white); 7,258 in 1930; 7,389 in 1940 by the federal census. The city was founded in 1837, and incorporated in 1859.

WHEATSTONE, SIR CHARLES (1802–1875), English physicist and the practical founder of modern telegraphy, was born at Gloucester in Feb. 1802. Wheatstone was educated at several private schools. He became a musical instrument maker and carried out a number of experiments in acoustics. Wheatstone was so excessively shy that he was unable to lecture in public and many of his inventions were first described by Faraday in his Friday evening discourses at the Royal Institution. By 1834 his originality and resource in experiment were fully recognized, and he was appointed professor of experimental philosophy at King's College, London, in that year. About this time Wheatstone made his determination, by means of a revolving mirror, of the speed of electric discharge in conductors, a piece of work leading to enormously important results. The great velocity of electrical transmission suggested the possibility of utilizing it for sending messages; and, after many experiments and the practical advice and business-like co-operation of William Fothergill Cooke (1806–1879), a patent for an electric telegraph was taken out in their joint names in 1837.

Wheatstone's best work was in the invention of complicated and delicate instruments. He was interested in cryptography; he deciphered a number of the mss. in the British Museum, and invented a cryptographic machine. He wrote papers on the transmission of sound in solids, the explanation of Chladni's figures and the invention of new musical instruments, *e.g.,* the concertina (*q.v.*). He invented the kaleidophone which presented visible the movements of a sounding body and the stereoscope. He also wrote papers on the eye, the physiology of vision, binocular vision and colour. Wheatstone showed that the electrical sparks from different metals give different spectra. His most important inventions are in electricity; he played a prominent part in the development of telegraphy on landwires and carried out the first experiments with submarine cables. He devised the "A.B.C." telegraph instrument, an automatic transmitter, and various forms of electrical recording apparatus.

Wheatstone became F.R.S. in 1837; and in 1868, after the completion of his masterpiece, the automatic telegraph, he was knighted. He died on Oct. 19, 1875.

Wheatstone's *Scientific Papers* were collected and published by the Physical Society of London in 1879. Biographical notices of him will be found in the *Proc. Inst. C.E.,* xlvii. 283, and *Proc. Roy. Soc.,* xxiv., xvi. For his connection with the growth of telegraphy, see *Nature,* xi. 510, and xii 30 *seq.*

WHEATSTONE'S BRIDGE, a network of six conductors of which four, AB, BC, CD and DA form a closed circuit

while the others, AC and BD, contain a battery and a galvanometer respectively. When the resistances of the first four are so adjusted that no current from the battery in AC flows through the conductor BD containing the galvanometer it follows that the resistance of AB : that of BC :: the resistance of AD : that of DC. Hence the resistance of DC is determined if the ratio of the first pair (the "ratio arms") is known together with the exact magnitude of the third (AD). This is the principle of the Post Office Box, the Metre Bridge, the Carey Foster Bridge, the Callendar-Griffiths Bridge, and of many other devices for the comparison of resistances, inductances, and capacitances. The arrangement was devised by S. H. Christie in 1833, and used by Sir Charles Wheatstone in 1847 (*Scientific Papers,* p. 129, or *Phil. Trans.* 1847). (*See* INSTRUMENTS, ELECTRICAL.)

WHEEL, a circular frame or solid disc revolving on an axis, of which the function is to transmit or to modify motion. *See* MECHANICS. Vehicular wheels in the earliest times were circular discs, either cut out of solid pieces of wood or formed of separate planks of wood fastened together and then cut into a circular shape. Such may be still seen in use among primitive peoples to-day. The ordinary wheel consists of the nave (O. Eng. *nafu; cf.* Ger. *Nabe,* allied with "navel"), the central portion or hub, through which the axle passes, the spokes, the radial bars inserted in the nave and reaching to the peripheral rim, the felloe or felly. (O. Eng. *felge,* Ger. *Felge,* properly that which fitted together, Teut. *felhan,* to fit together.)

See also CARRIAGE; CHARIOT; MOTOR CAR; MOTORCYCLE; BICYCLE.

WHEEL, BREAKING ON THE, a form of torture (*q.v.*) or of execution formerly in use in France and Germany, where the victim was placed on a cart-wheel and his limbs stretched out along the spokes. The wheel was made to revolve slowly, and the man's bones broken with blows of an iron bar. Sometimes it was mercifully ordered that the executioner should strike the criminal on chest or stomach, blows known as *coups de grâce,* which at once ended the torture, and in France he was usually strangled after the second or third blow. A wheel was not always used. In some countries it was upon a frame shaped like St. Andrew's cross that the sufferer was stretched. The punishment was abolished in France at the Revolution. It was employed in Germany as late as 1827. A murderer was broken on the *row* or wheel at Edinburgh in 1604, and two of the assassins of the regent Lennox thus suffered death.

WHEELER, JOSEPH (1836–1906), American soldier, was born at Augusta, Ga., in 1836, and entered the U.S. cavalry from West Point in 1859. He resigned to enter the Confederate service. In a short time he became colonel of infantry and took part in the desultory operations of 1861 in Kentucky and Tennessee. He commanded a brigade at the battle of Shiloh, but soon afterwards he returned to the cavalry arm, in which he won a reputation second only to Stuart's. After the action of Perryville he was promoted brigadier general, and in 1863 major general. Thenceforward throughout the campaigns of Chickamauga, Chattanooga and Atlanta he commanded the cavalry of the Confederate army in the west, and when Hood embarked upon the Tennessee expedition, he left Wheeler's cavalry to harass Sherman's army during the "March to the Sea." In the closing operations of the war, with the rank of lieutenant general, he commanded the cavalry of Joseph Johnston's weak army in North Carolina, and was included in its surrender.

At the outbreak of the Spanish-American War, in 1898, President McKinley commissioned Wheeler as major general of United States volunteers. He commanded the cavalry in the actions of Guasimas and San Juan, was afterwards sent to the Philippines in command of a brigade, and in 1900 was commissioned a brigadier general in the regular army. He died on Jan. 25, 1906. He wrote *The Santiago Campaign* (1898).

See John Witherspoon Du Bose, *General Joseph Wheeler and the Army of Tennessee* (1912); W. C. Dodson, *Campaigns of Wheeler and his Cavalry (1899), from material furnished by Wheeler.*

WHEELER, WILLIAM ALMON (1819–1887), vice president of the United States from 1877 to 1881, was born at Malone, N. Y., June 30, 1819. He studied at the University of Vermont for two years and in 1845 was admitted to the bar. First as a Whig, and then, after 1856, as a Republican, he was prominent for many years in State and national politics. He was a member of the State assembly in 1849–50, a member and president *pro tempore* of the State Senate in 1858–59, and a member of the national House of Representatives in 1861–63, and again in 1869–1877. He was the author of the so-called "Wheeler Compromise," by which the difficulties between contending political factions in Louisiana were adjusted in 1875. Nominated for vice president by the Republicans in 1876 on the ticket with President Hayes, he was installed in office through the decision of the Electoral Commission. He died at Malone, June 4, 1887.

See biographical sketch in W. D. Howells, *Sketch of R. B. Hayes* (1876).

WHEELER, WILLIAM MORTON (1865–1937), American zoologist, was born at Milwaukee March 19, 1865. He graduated from the German-American Normal College in 1884; received the Ph.D. degree, 1892, from Clark University; Sc.D. from the University of Chicago, 1916. He was assistant professor of embryology, University of Chicago, 1896–99; professor of zoology, University of Texas, 1899–1903; curator of invertebrate zoology, American Museum of Natural History, 1903–08. In 1908 he was made professor of economic entomology and dean of Bussey, and in 1926 professor of entomology, at Harvard. He was a member of the National Academy of Sciences and was associate editor of the *Biological Bulletin, Journal of Morphology* and of the *Journal of Animal Behaviour.* His publications include: *Ants, Their Structure, Development and Behaviour* (1910); *Social Life Among the Insects* (1923); *Foibles of Insects and Men* (1928), and monographs on numerous species of ants. He also translated and annotated *The Natural History of Ants,* from the French of René Antoine F. de Réaumur (1926).

WHEELING, a city of West Virginia, U.S.A. Pop. 56,208 in 1920 (87% native white), and 61,099 in 1940 by the federal census. The city's area of 9.6 sq.mi. comprises a narrow strip of bottomland (640 ft. above sea level), hills rising behind it on the east and an island over a mile long. Bridges connect with Bellaire, Bridgeport and Martins Ferry, Ohio. In addition to several parks and 20 playgrounds within its limits, the city has a country recreation centre of 750 ac., bequeathed by E. W. Oglebay. There is a municipal market, combined with a large auditorium. The city operates under a council, elected by proportional representation, which appoints a city manager.

Wheeling is surrounded by vast coal fields, and is plentifully supplied with natural gas and steam-generated electric power. It has 104 diversified manufacturing plants, with an output in 1939 of $43,682,324, including iron, steel, tin plate, proprietary medicines, hand-rolled stogies, china and porcelain, nails, glass and paper. Bank debits in first quarter of 1941 were $100,000,000. The assessed valuation for 1940 was $125,951,450.

Wheeling was founded in 1769 by Col. Ebenezer Zane (1747–1811) of Virginia, and two brothers. In 1774 a strong stockade was built at the top of Main street hill, and named Ft. Fincastle in honour of the then governor of Virginia, but after 1776 called Ft. Henry, after Patrick Henry. Attacks from hostile Indians were frequent. During one of them (Sept. 1, 1777) when the ammunition in the fort failed, Elizabeth Zane, an 18 year old sister of the founder, faced the fire of the enemy to bring a keg of powder from a cabin 60 yd. away. In Sept. 1782, the fort was successfully defended by 42 inhabitants against a detachment of British soldiers and 250 Indians. The town was laid out by Col. Zane in 1793, incorporated in 1806 and chartered as a city in 1836. The national road was completed to this point in 1818, and for some years Wheeling was its western terminus as later it was for some years of the Baltimore and Ohio railroad. Wheeling was the headquarters of the Virginians opposed to secession, was the capital of the new state until 1869 and again from 1875 to 1885.

WHEELOCK, ELEAZER (1711–79), American educator, born at Windham, Conn., April 22, 1711. He graduated at Yale in 1733, studied theology, and in 1735 became a Congregationalist preacher at Lebanon, Conn. He also took young men into his

house to fit them for college. One of these was a Mohegan Indian, Samson Occum, who made such excellent progress, that Wheelock decided to found a free school where both whites and Indians could be educated. With aid from various sources he conducted such a school at Lebanon from 1754–67, but without a large attendance. Desiring a more favourable location, Eleazer accepted the offer of Gov. Wentworth of New Hampshire of a township of land on the Connecticut river. Thither he went with some 30 students in 1770, and with other settlers, they founded the town of Hanover. In recognition of the patronage of Lord Dartmouth the new college was named Dartmouth college. He died at Hanover, April 24, 1779.

His son, John Wheelock (1754–1817), succeeded him as president of Dartmouth.

WHELK, the name given to a large number of marine gastropod molluscs (*see* GASTROPODA; MOLLUSCA) with solid spiral shells, and in particular to the members of the genus *Buccinum* in which the common whelk (*Buccinum undatum*) is placed. *Fusus antiquus*, the "hard whelk" of British fishermen, is another common form of whelk. The rock whelks (*Murex*) and dog-whelks (*Purpura*) are allied forms. All these molluscs are placed in the sub-order Rachiglossa of the streptoneurous Gastropoda and are distinguished by their carnivorous and aggressive habits and the modification of their mouth-parts as an eversible proboscis. The *radula* (rasping tongue) is simple as compared with that of the plant-eating gastropods, and consists usually of three large teeth suited for tearing animal tissues. The nervous system is condensed by the approximation of the constituent ganglia and the shortening of the commissures. The eggs are deposited in horny capsules which are usually aggregated in clusters.

The common whelk has a wide distribution in the North Atlantic and ranges from the eastern seaboard of North America to the coast of Siberia. On the west side of the Atlantic the southern limit of its distribution seems to be the south end of the New Jersey coast. It is found at all depths from low water mark down to about 100 fathoms and on many kinds of bottom. Certain varietal forms are said to occur at greater depths. It is a carnivore, eating both living animals and carrion, especially other molluscs, *e.g.*, clams and scallops. Indeed Petersen considers that in Danish waters the whelks prey on the plaice when caught in nets. Danish fishermen have estimated that one-third of the year's catch is lost in this way. In the British Isles the whelk is caught by the use of wicker crab-pots baited with living crabs, by dredging and by "trotting" (line-fishing with crabs tied together as bait).

See W. J. Dakin, "Buccinum," *Proc. and Trans. Liverpool Biological Society* (1912). (G. C. R.; X.)

WHETSTONE, GEORGE (1551?–1587), British author, was a son of Robert Whetstone, prosperous London haberdasher. After Robert Whetstone's death (1557) his widow lived near Stamford. Thus young Whetstone came to know the Burghleys, to whom several of his works are addressed. After youthful escapades he joined a group of literary aspirants at the Inns of Court, whence his *Rocke of Regard* (1576) is subscribed. The preface of his *Promos and Cassandra* (1578) is among the earliest criticisms of Elizabethan drama, and the play became the chief source of Shakespeare's *Measure for Measure*. In 1578 Whetstone joined Sir Humphrey Gilbert's abortive voyage to America. After visiting Italy in 1580, he attempted in his *Heptameron of Civill Discourses* (1582) to promote Italian social graces in England. With his *Mirour for Magestrates of Cyties* and *Touchstone for the Time* (1584) he became chiefly a patriotic reformer prone to collect material from other writers—conspicuously the Frenchmen Gruget and Du Verdier. For Leicester's expedition to Holland he wrote *The Honourable Reputation of a Souldier* (1585). In *The English Myrror* (1586) he strove to unite England against her enemies. His *Censure of a Loyall Subject* (1587) recounts the execution of the Babington conspirators. In August 1587, Burghley made Whetstone a commissary of musters in Holland under Sir Thomas Digges, already unpopular with officers there. In September Whetstone was killed by Captain Edmund Udall in a duel at Bergen op Zoom.

See Thomas C. Izard, *George Whetstone* (1942). (T. C. I.)

WHEWELL, WILLIAM (1794–1866), British philosopher and master of Trinity, historian of science, was born on May 24, 1794, at Lancaster. He was an exhibitioner of Trinity college, Cambridge, second wrangler in 1816, became fellow and tutor of his college, and, in 1841, succeeded Dr. Wordsworth as master. He was professor of mineralogy from 1828 to 1832, and of moral philosophy (then called "moral theology and casuistical divinity") from 1838 to 1855. He died on March 6, 1866.

Whewell was a famous Cambridge figure of his day, and there are many amusing stories about him. His first work, *An Elementary Treatise on Mechanics* (1819), co-operated with those of Peacock and Herschel in reforming the Cambridge method of mathematical teaching; to him in large measure was due the recognition of the moral and natural sciences as an integral part of the Cambridge curriculum (1850). His philosophical reputation rests mainly on his *History of the Inductive Sciences, from the Earliest to the Present Time* (1837), which was intended as an introduction to the *Philosophy of the Inductive Sciences* (1840).

WHICKHAM, urban district in Durham, England. Pop. (1938) 22,530. Area 9.6 sq.mi. The church of St. Mary has Norman and Transitional portions, and in the neighbourhood is the mansion of Gibside (17th century).

WHIG and **TORY,** the names used to denote two opposing political parties in England, were nicknames introduced in 1679 during the heated struggle over the bill to exclude James, duke of York, from the succession to the crown. The term "Whig"—whatever be its origin in Scots Gaelic—was used of cattle and horse thieves and was thence transferred to Scottish Presbyterians. Its connotations in the 17th century were therefore Presbyterianism and rebellion; and it was applied to those who claimed the power of excluding the heir from the throne when they deemed it desirable. "Tory" was an Irish term suggesting a Papist outlaw and was applied to those who supported the hereditary right of James in spite of his Roman Catholic faith. The names were party badges until the 19th century. The Tories placed reliance on the crown; the Whigs on the greater nobility. It may be fanciful to trace this cleavage as far back as Magna Carta; but at least it must be remembered that the later ideals of popular or democratic government are entirely irrelevant to the creeds of Whig and Tory. The revolution of 1688–89 changed the position, forcing a majority of Tories to recognize allegiance to other than hereditary right to the crown; and for a time they were thrown back on their opposition to religious toleration and to foreign entanglements, the expression of two cardinal principles of the older Toryism. Again in 1714 the failure of the Tory ministers to act together and themselves to determine who should succeed Anne, and the subsequent flight of their leader, Bolingbroke, discredited the Tories as Jacobites, and gave 50 years of political power to the Whigs. During this period the Whig landowners, with no effective king to fear, secured their hold on parliament by controlling a large proportion of the borough representation; and the Tories came to advocate, not only an effective balancing force in the crown, but also the safeguard of a wider franchise and a purified electoral system.

When George III came to the throne in 1760 the name of Whig covered many personal factions, for their long prosperity had brought disunion; and the new king, attempting to restore the monarchy to influence, could easily attach to himself some of these groups. The following 25 years were complicated by the formidable body of "king's friends," who cannot properly be called by either name. Even the American revolution cannot be considered in terms of the two parties. The nation emerged from the mixing bowl in 1784, with a new Toryism, led by the younger Pitt and a new Whiggism, leavened by the industrial interests and by the beginning of a Radicalism which took up the demand for electoral and philanthropic reform. In contrast to Whig changes, the Tory party began to acquire the reputation of resistance to change; but the Reform bill of 1832 and the willingness of Canning and Peel to face change, even through party disunion, led to the transformation of Toryism into the Conservatism of Disraeli, which while retaining its devotion

to the crown and the established church, expanded its fervent nationalism into a wider imperial outlook, a legacy from those Chathamite Whigs who were rarely at ease within the ranks of their nominal allies. Meanwhile, the commercial and radical wing of the great Whig party, abandoned by its more conservative members, became the main body of the Liberal party, and Whiggism ceased to have any important political meaning. (*See* also CONSERVATIVE PARTY; LIBERAL PARTY.) (G. H. G.)

WHIG PARTY, a political party prominent in the United States from about 1824 to 1854. The name had been in use immediately before the Revolution and during that war to designate those who favoured the colonial cause and independence. The first national party system of the United States came to an end during the second war with Great Britain. The destruction of the Federalist party (*q.v.*) through a series of suicidal acts which began with the alien and sedition laws of 1798, and closed with the Hartford convention of 1814–15, left the Jeffersonian Republican (Democratic) party in undisputed control. Soon, however, the all-inclusive Republican party began gradually to disintegrate and a new party system was evolved, each member of which was the representative of such groups of ideas and interests, class and local, as required the support of a separate party. Each new party, disguised during the early stages of organization as the personal following of a particular leader or group of leaders, kept on calling itself Republican. Even during the sharply contested election of 1824 the rival partisans were known as Jackson, Crawford and Calhoun, or as Clay and Adams Republicans (*see* DEMOCRATIC PARTY). It was not until late in the administration of John Quincy Adams (1825–29), that the supporters of the president and Henry Clay, the secretary of state, were first recognized as a distinct party and began to be called by the accurately descriptive term National Republicans. But after the party had become consolidated, in the passionate campaign of 1828 and later, in opposing the measures of President Jackson, it adopted in 1834 the name Whig, which, through memorable associations both British and American, served as a protest against executive encroachments, and thus facilitated union with parties and factions, such as the Anti-Masonic party (*q.v.*). The new name announced not the birth but the maturity of the party, as the inaugural address and the messages to congress of President J. Q. Adams had set forth clearly its nationalizing, broad-construction program.

The ends for which the Whigs laboured were: first, to maintain the integrity of the union; second, to make the union thoroughly national; third, to maintain the republican character of the union; fourth, while utilizing to the full the inheritance from and through Europe, to develop a distinctly American type of civilization; fifth, to propagate abroad by peaceful means American ideas and institutions. Among the policies or means which the Whigs used in order to realize their principles were the broad construction of those provisions of the federal constitution which confer powers on the national government; protective tariffs; comprehensive schemes of internal improvements under the direction and at the cost of the national government; support of the Bank of the United States; resistance to many acts of President Jackson as encroachments on the legislative branch of the government and therefore hostile to republicanism; coalition with other parties in order to promote national as opposed to partisan ends; resort to compromise in order to allay sectional irritation and compose sectional differences; and the expression of sympathy with the liberal movement in other lands.

The activity of the Whig party together with the activities of the disparate elements which preceded their formation into a party, covered a period from the election of 1824 to the repeal of the Missouri Compromise in 1854. In two respects, namely, the rise of the new radical democracy under Andrew Jackson, and the growth of sectionalism over the slavery issue, this period was highly critical In view of these events the most difficult task of the Whigs, under the patriotic and conservative leadership of Henry Clay and Daniel Webster, was to moderate and enlighten, rather than antagonize, the new democracy and to attempt to overcome the disrupting influence of the slavery issue.

The election of 1828 gave to Andrew Jackson the presidency, and to the people, in a higher degree than ever before, the control of the government. Opposition to Jackson's radical policy brought about, under Whig leadership, a coalition of parties which influenced deeply and permanently the character, policy and fortunes of the Whig party. It became the champion of the bank, of the right of congress, and of the older and purer form of the civil service. In strict accord with their own principles, however, the Whigs supported the president during the nullification controversy (*see* NULLIFICATION). The majority of the northern Whigs, with the entire southern membership of the party, disapproved the propaganda of the abolitionists on the ground of its tendency to endanger the union, and many from a like motive voted for the "gag rules" of 1835–44 (*see* ADAMS, J. Q.), which in spirit, if not in letter, violated the constitutional right of petition. In the election of 1832 Clay was the nominee of the National Republican party for the presidency. Gen. W. H. Harrison was nominated by the anti-Jackson groups in 1836, and in 1840 purely on the grounds of expediency he was the nominee of the Whig party. The election of Gen. Harrison in the "log cabin and hard cider" campaign of 1840 proved a fruitless victory; the early death of the president and the anti-Whig politics of his successor, John Tyler (*q.v.*), shattered their legislative program.

In 1844 Clay was the Whig candidate, and the annexation of Texas, involving the risk of a war with Mexico, was the leading issue. The Whigs opposed annexation and the prospect of success seemed bright, until an injudicious letter written by Clay turned the anti-slavery element against him and lost him the presidency. The triumph of Polk in 1844 was followed by the annexation of Texas and by war with Mexico. The Whigs opposed the war largely for political reasons, but on patriotic grounds voted supplies for its prosecution. The vast territorial expansion, at the cost of Mexico, brought to the front the question of slavery in the new domain. The agitation that followed continued through the presidential election of 1848 (in which the Whigs elected Gen. Zachary Taylor), and did not subside until the passage of the "Compromise Measures of 1850" (*q.v.*). To its authors this compromise seemed essential to the preservation of the union; but it led directly to the destruction of the Whig party.

In the north, the fugitive slave law grew daily more odious, but a committal of the party to the repeal of the law would have driven the southern Whigs into the camp of the Democrats. In an endeavour to allay sectional strife, the national Whig convention of 1852, the last that represented the party in its entirety, gave to the northern Whigs the naming of the candidate—Gen. Winfield Scott—and to the southern the framing of the platform with its "finality" plank which committed the party to an acceptance of the laws regulating slavery as final. Two years later the repeal of the Missouri Compromise by the Kansas-Nebraska act demonstrated that "finality" could not be maintained, and that in committing the Whig party to the policy of its maintenance the convention of 1852 had signed the death-warrant of the party.

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WHINCHAT (*Saxicola rubetra*), a bird allied to the wheatear (*q.v.*) and stonechat (*q.v.*). The whinchat is a summer migrant, somewhat larger than the stonechat and preferring enclosed land. It ranges over Europe and West Asia, wintering in Africa.

WHIP, in English parliamentary usage, denotes a member, chosen by the leader or leaders of a political party for the special duty of securing the attendance of the other members of that party on all necessary occasions, the term being abbreviated from the whipper-in of a hunt. The name is also given to the summons urging members of the party to attend. Political party whips are always members of parliament, and for the party in power (*i.e.*, the government) their services are essential, seeing that the fate of an important measure, or even the existence of the government itself, may depend upon the result of a division in the house. The urgency or importance of the notice sent by the whips to their following is indicated by the number of lines

underscoring the notice, a four-line whip usually signifying the extremest urgency. The chief government whip also holds the office of patronage secretary to the treasury, so called because when offices were freely distributed to secure the support of members, it was his chief duty to dispose of the patronage to the best advantage of his party. He is still the channel through which such patronage as is left to the prime minister is dispensed. He is assisted by three junior whips, who are officially appointed as junior lords of the treasury; their salaries are £1,000 a year each, while the patronage secretary has a salary of £2,000. The parties not in office have whips who are unpaid. The whips also arrange for the "pairing" of such of the members of their party as desire to be absent with those members of the opposition party who also desire to be absent. The chief whips of either party further arrange in consultation with each other the leading speakers in an important debate, and also its length, and give the list of speakers to the speaker or chairman, who usually falls in with the arrangement. They take no part in debate themselves, but are constantly present in the house during its sittings, keeping a finger, as it were, upon the pulse of the house, and constantly informing their leader of the state of the house. When any division is regarded as a strictly party one, the whips act as tellers in the division.

An interesting account of the office of whip is given in A. L. Lowell's *Government of England* (1908), vol. i, c, xxv.

WHIPPING: *see* FLOGGING.

WHIP-POOR-WILL (*Antrostomus vociferus*), so called from its cry, is an American bird about a foot long, allied to the nightjars (*q.v.*), which it resembles in habits. It is common in the eastern United States.

WHIP SCORPION, a common name applied to any representative of the order Thelyphonida of the class Arachnida (*q.v.*). There is a certain superficial resemblance between true scorpions and whip scorpions, responsible for the name of the latter. But unlike scorpions they are not poisonous and their tail or flagellum is a harmless, tactile appendage. They have powerfully developed pedipalpi, by means of which they grasp beetles and other insects on which they feed, and with which they can inflict a painful prick if picked up carelessly. When irritated they produce a gaseous secretion from glands opening at the base of the tail. It is the odour of this secretion, resembling vinegar, which caused the Mexican people to give the name "vinegaroon" to *Mastigoproctus giganteus,* the common whip scorpion found in Mexico and the southwestern United States. The chemical composition of this secretion is not known, but it is highly irritating to mucous membranes and is quite effective as a means of defense. The first pair of legs is not used in locomotion, but like the tail is a tactile organ. Whip scorpions are inhabitants of tropical and hot countries. They live under stones, in crevices of rocks, in termite nests, in burrows in the ground and in dark or deserted buildings. The females carry the eggs in a glutinous secretion on the underside of the abdomen until they are hatched. The young climb on the back of their mother and stay there for five or six days when they moult and desert the parent to lead an independent life. It is not known how long they can live, but it is certain that their life lasts at least several years. Whip scorpions are a comparatively small order. Only ten genera are usually recognized and of these only two belong to the American continent. The rest are found in the eastern hemisphere. The oldest known of these is *Thelyphonus caudatus* from Java, first described by Linnaeus. Its defensive secretion smells of formic acid. It is a very active creature, half as large as the Mexican whip scorpion, and like the latter is occasionally found in dwellings. The courtship and mating of an allied species *Thelyphonus sepiaris,* of Ceylon and India, has been described by Gravely in the *Records* of the Indian Museum of Calcutta. (A. PH.)

WHISKY or **WHISKEY,** a potable alcoholic liquor distilled from cereal grains. The term is derived from the Celtic *uisque-beatha* afterwards contracted to *usquebaugh* meaning water of life. The distillation of alcoholic beverages from fermented liquors became general throughout the whole of Europe during the 16th and 17th centuries, but, while in the southern grape producing countries wine is the liquor which is subjected to distillation, various types of grain are used in the north. It is of interest that in all cases, doubtless owing to their stimulating properties, the same significance attaches to the terms generally applied to strong alcoholic liquors, e.g., *eau de vie* and *aqua vitae,* and Robert Burns uses these terms synonymously. At first *usquebaugh* referred not only to the plain spirit derived from grain but also to compounded beverages prepared by the addition to the spirit of sugar and flavourings such as saffron and nutmeg.

Whiskies are sometimes classified according to their geographical origin:—Scotch, Irish and American, but the chief differences are due to the secondary products—higher alcohols, esters, aldehydes, etc.

Manufacture.—The process of manufacture may be divided into three stages:

(1) Mashing or the preparation of the liquor known as wort.
(2) The fermentation of the wort to produce the wash.
(3) Separation of the spirit from the wash by distillation.

The wort is prepared by mixing various grains with malt, the nature and proportion being subject to considerable variation. In Irish pot still distilleries malted and unmalted barley, oats, wheat and rye are generally used, whilst for Scotch pot stills malted barley is practically the only material. In the patent still distilleries in both countries, the wort usually consists of maize, barley, rye (malted and unmalted) and oats, the first, which is seldom used in the pot still whiskies, being the principal ingredient.

The malt or mixture of malt and grain is crushed and raised to a suitable temperature with hot water, the diastase of the malt thus converting the starch into sugar. During this process other substances, the exact nature of which is not thoroughly understood, are obtained in solution. From these are derived the secondary constituents already referred to which impart to the various brands their distinctive flavour. The Scotch pot still or malt whiskies fall into four main types. (1) The Highland malts produced chiefly in the Speyside or Glenlivet district constitute one of the most popular. They possess a full ethereal flavour which affords evidence of the fact that the malt has been cured over peat fires. (2) The Lowland malts of the south, although possessed of an excellent full flavour, are not so distinctive as those produced in the north and approximate more closely in taste and smell to the patent still spirit. (3) Those produced in Islay have a particularly strong flavour, due in part to the "peated" malt, and are used to a considerable extent for blending purposes. (4) Those produced in Campbeltown are similar to the Islays but their flavour is more pronounced.

The patent still spirits do not display the great range and variety of flavour and bouquet observed in spirits of pot still origin. This is due in part to the fact that the patent stills render possible a much higher degree of rectification and also to the employment of malt which has not been cured over peat fires.

Pot Stills.—The pot stills used are not of standard design. In their most simple form they consist of a vessel in which the wash is boiled and to which is attached a pipe or "still head" to carry the vaporized ingredients of the wash to a condenser whence the distilled liquor falls into a receiver. The heat is supplied directly from a fire, or, in the more elaborate types, by means of steam coils or jackets. The neck was originally made long to prevent the boiling wash being mechanically carried over into the receiver by frothing or spraying. In effect it has a certain rectifying action condensing and returning to the retort the ingredients boiling at a higher temperature. This rectification is in many instances increased by the addition of baffle plates in the tube or small condensers so arranged that liquid condensed therein shall be returned to the retort and not passed into the receiver. This is often effected by an additional pipe or "lyne arm" connecting the rectifier with the retort. In Ireland the stills are usually larger than in Scotland, having a capacity up to 20,000 gallons. The method usually adopted, while varying in detail, is more complicated than that followed in Scotland. Three distillations take place. Strong low wines, weak low wines, strong feints and weak feints (*see* SPIRITS) are collected and the re-

sultant fraction has a higher strength, 24 to 30 overproof.

The still usually known as the "patent still" was originally devised by Aeneas Coffey in 1831. (*See* SPIRITS.) It consists essentially of two columns, the "rectifier" and the "analyser."

Each column is subdivided horizontally into a series of chambers by means of perforated copper plates. The columns are filled with steam passed in at the bottom of the analyser. The wash is pumped from the "still charger" through a pipe which passes from the top of the rectifier to the bottom and then to the analyser, where it is discharged on to the first plate. In its course through the rectifier the pipe traverses each chamber twice by means of a double bend. In this way the wash is heated almost to boiling point before it is discharged, the ascending steam and vapours in the rectifier being cooled at the same time by the descending wash. The wash cannot pass through the perforations of the plates in the analyser owing to the pressure of the steam and, by an ingenious device of a safety valve and a drop pipe fitted to each plate, an inch of wash accumulates on the plates before any can be discharged to the chamber below. By the continuous upward discharge of steam through the wash the latter is gradually deprived of its alcohol and other volatile constituents which are carried with the steam back to the rectifier where they are condensed. The temperatures of the chambers of the rectifier are successively cooler from bottom to top resulting in a separation of the condensed liquor into various fractions. At one point the temperature is approximately that at which strong ethyl alcohol condenses and the chamber at this point is fitted with a special arrangement for carrying off the liquor condensed therein. In the first and last stages of the distillation the spirit collected is not of sufficient strength and is returned to the still, whilst a further device facilitates the collection of the fusel oil, which is of use in commerce. Its value has been enhanced in recent years by the demand for solvents used in cellulose lacquers. Its composition varies considerably.

Composition.—As already indicated the proportion of secondary constituents is higher in the pot still than in the patent still spirits. This is particularly the case with the "higher alcohols" and "furfural."

The latter is almost invariably absent from the patent still product immediately after distillation, although a trace may be found after long storage. The proportion of these two ingredients may therefore be accepted as a basis for differentiation between the two types of spirit. The age of the spirit is an important factor.

Maturation.—The alterations in the character of a spirit during storage may be attributed to (*a*) the type of cask and method of storage, and (*b*) the interaction of various ingredients.

(*a*) The secondary constituents most affected by ageing—particularly in the pot still whiskies—are the volatile acids and the aldehydes. Pot still whisky is usually stored in sherry casks or in well seasoned casks which have formerly contained spirit. The wine or spirit in the cask slowly diffuses into the wood, the ethyl alcohol passing through and evaporating, whilst such ingredients as higher alcohols and esters are held. When the cask is emptied the alcohol remaining absorbed is transformed by oxidation into acids, aldehydes and esters. On the cask being refilled with the new spirit the constituents thus formed are partially extracted, particularly during the earlier period of storage. Whisky stored in bottle and commercial spirit of high strength stored in metal containers are not subject to the same alterations.

(*b*) The reactions which take place within the spirit are much more complex and difficult of explanation. They may in part be attributed to the unintentional presence of small quantities of impurities derived from external sources during the process of manufacture and dependent upon the varying conditions. Thus Thorpe found pyridine bases, allyl alcohol and allyl aldehyde probably derived from the peat, and acrolein due either to the oil extracted from the grain or to the soap which is occasionally added to the contents of the still to prevent frothing. In new pot still spirit Schidrowitz found evidence of the presence of pyrrole and phenolic and sulphurous bodies all of which would interact with the natural ingredients of the spirit to produce substances which would not otherwise be present.

Artificial maturing of spirit is sometimes attempted and various methods have been adopted, the object being to reduce the proportion of secondary ingredients, particularly aldehydes, and thus to eliminate the harshness of new spirit.

Blending.—During the past century the practice of blending has gradually extended, particularly in Scotland and now very little "self-whisky" or unblended whisky is sold. It serves two purposes.

(1) To produce a brand of standard flavour. This is particularly the case in the products of the pot still.

(2) To meet the popular demand for a cheap mild flavoured spirit.

The best brands usually consist of approximately half Highland and Lowland malts, a small quantity of Islay and the remainder patent still spirit. (F. G. H. T.; X.)

Consumption in the United Kingdom.—During the years 1936–38 the consumption of British-made spirits averaged about 8,000,000 proof gallons, a marked decrease from the 10,712,002 proof gallons of 1926–27, the 17,825,871 proof gallons of 1919–20, and the 26,794,739 proof gallons of 1913–14.

In 1938 the United Kingdom imported approximately 1,231,000 proof gallons of spirits and in the first nine months of that year distilled 61,515,688 proof gallons, of which 7,301,286 were for export.

WHISKY PRODUCTION IN THE U. S. A.

History.—The production of whisky in America originated with settlers, probably predominantly of Scotch origin in the new colonies, especially in western Pennsylvania in the latter part of the 18th century. Previously the popular distilled beverage was rum, which was produced almost entirely in the New England States from molasses imported from Cuba and the West Indies.

Classification.—The two most popular whiskies in the United States are "Bourbon" and "Rye" whisky. The choice of the grain and the design and operation of the equipment, especially the stills, are the determining factors in the type of whisky produced. Before the prohibition period (1919–1933) the distinctions were largely commercial and not very definite. Following the repeal of the prohibition amendment Dec. 5, 1933, all regulations (excepting those merely fiscal) concerning the alcoholic beverage industry and comprising "Standards of Identity" were taken over by the Federal Alcohol Administration (FAA).

These FAA regulations classify American whiskies as follows (slightly abbreviated):

Whiskey—"Whiskey" is an alcoholic distillate from a fermented mash of grain distilled at less than 190° proof in such manner that the distillate possesses the taste, aroma, and characteristics generally attributed to whiskey, and withdrawn from the cistern room of the distillery at not more than 110° and not less than 80° proof.

"Rye whiskey," "bourbon whiskey," "wheat whiskey," "malt whiskey," or "rye malt whiskey" is whiskey which has been distilled at not exceeding 160° proof from a fermented mash of not less than 51% rye grain, corn grain, wheat grain, malted barley grain or malted rye grain, respectively.

"Corn whiskey" is whiskey which has been distilled at not exceeding 160° proof from a fermented mash of not less than 80% corn grain, stored in uncharred oak containers or reused charred oak containers, and not subjected, in the process of distillation or otherwise, to treatment with charred wood.

Traditional American whisky, excepting "corn whisky," must be stored in charred new white oak containers. After such storage for at least two years it is designated as "straight" whisky. A further distinction is made according to whether the product consists of a single whisky or a combination of several whiskies, or of whisky with neutral grain spirits (ethyl-alcohol). Such mixtures are called "blended whiskies," and they may contain up to 2½% by volume of flavouring and colouring ingredients.

Manufacture.—The manufacture of American whisky is, except for a few basic differences, identical with that of Scotch or Irish whisky, and consists of three principal phases: (1) Mashing; (2) Fermentation; (3) Distillation. In each phase there are a number of variations peculiar to certain localities or individual producers. Distillation is carried out almost entirely in "continuous" (patent) stills, although in a few instances so-called "three-chamber stills" (a combination of three single pot stills) which at one time were generally employed, continue in use.

The basic difference from Scotch whisky, aside from the different grain formula, consists in the use of grain, malted or otherwise, that has not been "cured" or dried over open peat fires and therefore is entirely devoid of the "smoky" flavour characteristic of "Highland" Scotch. The other difference consists in the storage container, which is traditionally a barrel made of charred white oak usually of a capacity of about 48 gallons. From this container the whisky derives certain typical characteristics including a deep reddish-brown colour. The whisky undergoes a maturing period, usually from four to eight years, in well ventilated and, as a rule, heated warehouses.

Production and Consumption.—Prior to the prohibition period the production of whisky in the United States was between 60 and 80,000,000gal. per year and the consumption was within these figures or slightly higher. During prohibition no whisky was

Whisky production, consumption (tax withdrawals), and inventories in gallons (as of December 31 of each year)

Year	Production	Consumption	Inventory
1933	4,910,015	1,045,315	25,350,008
1934	107,900,758	38,423,225	91,629,512
1935	185,305,267	61,873,777	207,153,540
1936	245,477,487	72,473,910	374,467,136
1937	155,673,840	70,332,858	452,398,953
1938	95,220,687	69,297,228	466,809,071

produced until 1931, and all sale was, of course, illegal, except for medicinal purposes. From 1919–22 and 1929–33 small quantities for such purposes were authorized to replenish the almost exhausted supply. With repeal of the prohibition amendment, distilleries were reconditioned or newly constructed. Consumption rose to over 100,000,000 proof gallons in 1937, and a vast inventory of whisky maturing in warehouses was built up. (A. J. Li.)

WHISKY INSURRECTION, THE, an uprising in western Pennsylvania in 1794 against the federal government occasioned by the attempted enforcement of the excise law (enacted by congress, March 1791) on domestic spirits. The common prejudice in the United States against excise in any form was felt with especial strength in western Pennsylvania, Virginia and North Carolina where many small whisky stills existed. Albert Gallatin (*q.v.*) took a leading part in expressing resentment in a constitutional manner, but under the agitator David Bradford the movement soon developed into excesses.

The federal revenue officers in some cases were tarred and feathered; but in Sept. 1794, President Washington, using the new powers bestowed by congress in May 1792, despatched a considerable force of militia against the rebellious Pennsylvanians, who thereupon submitted without bloodshed, the influence of Gallatin being used to that end. Bradford fled to New Orleans; some of his more prominent supporters were tried for treason and convicted, but promptly pardoned.

In U.S. history this so-called "rebellion" is important chiefly on account of the emphasis it gave to the employment by the federal executive of the new powers bestowed by congress for interfering to enforce federal laws within the states. It is indeed inferred from one of Hamilton's own letters that his object in proposing this excise law was less to obtain revenue than to provoke just such a local resistance as would enable the central government to demonstrate its strength.

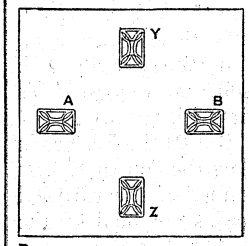
WHISPERING BELLS (*Emmenanthe penduliflora*), a North American herb of the water-leaf family (Hydrophyllaceae), known also as yellow bells and golden bells, is native to mountain slopes from central California to Utah and southward to Mexico. It is a low, much-branched, sticky-hairy annual, 10 in. to 20 in. high, with deeply cut leaves and bell-shaped cream-coloured or yellow flowers, ½ in. long, borne on slender, pendulous stalks in loose clusters. This characteristic plant of the chaparral (*q.v.*) is grown in gardens for its showy, persistent flowers. When dry after fruiting these give forth a slight rustling sound.

WHIST, eponymous member of a long line of card games embracing essential common features, much celebrated in history and legend. The essential features of whist-family games are: Four always play, two against two as partners; a full 52-card pack is dealt out evenly so that each player holds 13 cards; the object of play is to win *tricks*, each trick consisting of one card played by each player. The succession of whist-family games, from the earliest to the latest, has included triumph, trump, ruff and honours (or slam), whisk (or whist) and swabbers, whist, bridge, auction bridge and—latest and most popular member—contract bridge (*q.v.*).

It is generally conceded that whist is of English origin. Unmistakable references to triumph are found in a sermon preached by Hugh Latimer at Cambridge in 1529; in *Gammer Gurton's Needle;* in Shakespeare's *Antony and Cleopatra,* IV, 12, 12–20. In a poem (1621) by John Taylor, one line reads, "Ruffe, slam, trump, nody, whisk, hole, sant, new cut." Charles Cotton's *Compleat Gamester* (1674) says, "*Ruff and Honours* (alias *Slamm*) and *Whist,* are games so commonly known in England in all parts thereof, that every child almost of eight years old hath a competent knowledg (sic) in that recreation."

First a game of the lower classes, whist was taken up in the early 18th century by gentlemen in London's coffee houses. Primarily because of the publication in 1742 of Edmond Hoyle's *Short Treatise on Whist,* the game became an unprecedented success in fashionable circles, soon spreading to the continent and to America. Kings played it, and princes and the Emperor Napoleon; clubs were organized in devotion to it, the best minds pondered its strategy and legislation, and it developed an extensive literature. This pre-eminence among card games it never surrendered until replaced by its own progeny, bridge.

Procedure of Play.—All four players draw cards to determine partners, who face each other across the table. The player drawing the lowest card deals first, after which the turn to deal passes in rotation (which is always clockwise). The cards are shuffled, cut by the player at the dealer's right, and dealt one at a time, face down, in rotation until the last card is reached; this is turned up and every card of its suit becomes a *trump.* The dealer takes it into his hand when it becomes his turn to play to the first trick.



POSITIONS OF PLAYERS AT A WHIST TABLE, A & B BEING PARTNERS AGAINST Y AND Z, Z BEING THE DEALER

The player at the dealer's left plays first (*leads*). He may lead any card. Each player in rotation thereafter must play one card, *following suit* (playing a card of the suit led) if possible, but playing any card he chooses if he cannot follow suit.

The cards of each suit rank downward: Ace, king, queen, knave (jack), 10, 9, 8, 7, 6, 5, 4, 3 (trey), 2 (deuce). Any trick containing a trump is won by the highest trump; any trick not containing a trump is won by the highest card of the suit led. The winner of each trick leads to the next.

Scoring is possible only for the side which wins the *odd trick* (that is, its seventh trick out of 13). Each trick over six counts one point for that side.

Laws of Whist.—The first standard laws were those published by Hoyle in 1742; with minor revisions made in 1760, these laws were followed until revised in 1864 by the Arlington and Portland Clubs. A different code of laws issued in 1893 by the American Whist League became standard for the United States.

The principal difference was in scoring. Under English laws, 5 points constituted a game (*short whist,* as distinguished from the *long whist,* 10 points for the game, of Hoyle). The ace, king, queen and knave of trumps were *honours* and a side holding all four honours scored 4, and with three honours scored 2, in addition to the score for odd tricks; but a side having 4 points toward game could not score for honours. Final settlement was by *rubber points:* 3 for each game won 5 to 0; 2 for each game won 5 to 3 or less; 1 for any other game won; and 2 for being the first side to win two games.

In U.S. scoring, honours did not count; game was 7 points, and the first side to reach that figure scored the difference between its opponents' score and 7, there being no rubbers.

Other laws were more nearly in accord in the respective codes. A dealing irregularity, including failure to turn up the trump card, was a *misdeal* and lost the deal for the dealer. The penalty for a *revoke* in England was three tricks or points; in the U.S. it was two tricks, besides which a revoking side could not win the game on that deal. A card improperly exposed had to be left face up on the table and was *subject to call* (that is, the play of that card could be demanded by either adversary at any time, subject only to the holder's duty to play in turn and to follow suit).

Skilful Play.—The science of whist was complex but not profound. Its ponderous literature so devoutly embraced the established dogma that even minor changes in tactics were considered radical and any challenge of the prevailing strategy was considered too heretical to treat with gravity.

Hoyle and a group of worthy successors including William Payne (*Maxims,* 1770), Thomas Mathews or Matthews (*Advice to the Young Whist Player,* 1804), James Clay, Guillaume Deschapelles (according to his contemporaries, the finest of all whist players) and finally "Cavendish" (pseudonym of Henry Jones, best known and most respected authority and most prolific writer that whist produced)—all assumed the wisdom of playing a "long-suit game" and leading first from one's longest and strongest suit. Their analysis was therefore devoted to signalling devices wherewith partner might be informed of one's holdings.

The principal signalling device was the selection of a conventional card to lead; its nature gave information as to the leader's holding. "American leads," a complex schedule devised by Nicho-

las B. Trist in 1883, were enthusiastically supported by Cavendish and soon were generally adopted on both sides of the Atlantic because they revealed so many more specific combinations of cards than had the "English leads." As an example of the American leads: With four cards of a suit, A, K, Q, J, one would lead first the queen, then the ace; with a fifth card in the suit, however, his second lead would be the king instead of the ace; with six cards in the suit his second lead would be the knave.

The *trump signal,* proposed by Lord Henry Bentinck in 1834, was another standard device: By playing an unnecessarily high card, and later a lower card of the same suit, one requested his partner to shift to the trump suit at his first opportunity.

The *Rule of Eleven* was formulated by Robert F. Foster, in 1889, and was based on the custom of leading the fourth-highest card of a long suit. By subtracting the number of the card led from 11, one knew the number of higher cards not held by the leader.

Preoccupation with the development of signalling devices prevented adequate analysis of the best methods for winning tricks, so that even the best whist players sacrificed trick after trick without discernible care—usually without even noticing that by better play those tricks might have been won instead of lost. Paradoxically, the greatest improvement in whist play came after the turn of the century, when bridge, the successor game, had already arrived and whist was moribund.

Duplicate Whist.—Whist engenders a keen competitive spirit but in ordinary play there is no means of demonstrating the superiority of one player over another; any result can be attributed to luck. Remedies for this condition were sought during the first half of the 19th century, but the first recorded match at duplicate whist was arranged by Cavendish in 1851. He selected four "good" players (by his appraisal) and four "weak" players. First, two of the good players played the Y-Z hands of a series of 33 deals against two weak players holding the A-B hands (*see* figure on p. 571). The cards were preserved in original form and replayed, this time with the weak players holding the Y-Z hands against the good players seated A-B. The result was a margin of 11 points in favour of the good players.

Only occasional duplicate matches were held thereafter until 1889, when John T. Mitchell (largely by arranging schedules whereby dozens of pairs could compete) popularized duplicate whist in the United States; it never became popular elsewhere. In 1891 the American Whist league was formed; it held annual congresses, at which duplicate whist was played twice daily for four or more consecutive days. At the peak (1894) the league's congress was attended by 491 players representing 156 clubs in all parts of the country. Congresses continued through the waning years of whist, though in the 1940s attendance dropped to a dozen or so members each year.

There was no new book on whist published in the 20th century up to 1946. The lore of the game is assembled in *The Whist Reference Book* (1898), by William Mill Butler, a cyclopaedia of the game and its personalities. (E. Cul.; A. H. Md.)

WHISTLER, JAMES ABBOTT McNEILL (1834–1903), painter, was born at Lowell, Mass., U.S.A., in 1834, of Irish-American parents. His grandfather emigrated to the United States. He belonged to a family of soldiers. At the age of 17, after spending some time in St. Petersburg (Leningrad), where his father was acting as an engineer, the painter was entered at West Point Military academy, but left because his studies proved quite unsatisfactory. After trying to enter the navy he became a draughtsman in the coast survey department at Washington. The precision of the work was, however, more than he could bear, so in 1854 he sailed to England and then to France, in 1855, where he studied for two years in the Paris *atelier* of the then prominent painter, Charles Gabriel Gleyre. He then came to the conclusion that nothing further could be learned in such academic surroundings. Gleyre, who maintained the Ingres traditions, was accounted by Whistler a "bourgeois Greek" and when, later, the pupil offered a picture for the judgment of the official Salon, it was promptly refused. Nothing daunted in his independent spirit, he sent it to the Salon des Refusés, where it scored an unqualified success. Recognition of his genius came very tardily, England especially being extremely unsympathetic, an attitude provoked by the American's delight in mystifying the English painters, critics and public and in returning their ridicule. His contempt for the prevailing fashion was reflected in his dress, which was immaculate almost to dandyism, whilst his unpunctuality was a source of exasperation.

In painting, Whistler was closely affiliated to the French Impressionist movement. Sentiment and anecdote are nearly always absent from his work, which relies for its effect upon the sacrifice of minute detail and brilliant colouring to the exquisite arrangement of tones and upon the emphasis on the musical quality of colour. A study of his pictures will reveal the fact that, far from justifying Millais' description as "a man who had never learned the grammar of his art," he had invented a grammar more simple yet more capable of expression than anything known in the western hemisphere, a contrast to the more favoured pre-Raphaelites.

The art of Whistler was subjected to various influences, among them those of Courbet, Velasquez, Puvis de Chavannes, Hogarth and Tintoretto, but his own personality is always uppermost. The shops of Amsterdam provided the blue and white porcelain which before the days of eager collectors adorned his paintings. He was an admirer of Japanese colour-prints which, used as packing for other articles around the year 1860, were soon imported for their own decorative virtues. Whistler used them in such pictures as "The Balcony," "La Princesse du Pays de la Porcelaine" and "The Golden Screen." The result is the perfect modification of Eastern influences by European traditions and ideals. Here was a step towards a more abstract conception of art.

Lithography, the discovery of Senefelder, was perfected by Whistler, while his etchings are marvels of delicacy and bear out his own contention that the area covered should be in ratio to the strength of the means employed. His condemnation of the large plate as an abomination may be regarded as an admission of his own limitations. During the greater part of his life, he produced an average of 12 etchings or lithographs each year; yet he found time to write charming prose, reflecting the meticulous care which he bestowed upon his person and surroundings. Whistler's "Ten o'clock" lecture was a statement of his convictions concerning art, and, like his *Gentle Art of Making Enemies,* acted by its very brilliance as a goad to his adversaries. In 1883 Whistler exhibited 51 etchings and drypoints at the Fine Art Society, London, and in 1896, 70 lithographs were shown. During his lifetime he produced nearly 400 etchings and drypoints and probably 150 lithographs. At the Grosvenor gallery, newly opened in 1877 by Sir Coutts Lindsay, his paintings included some "nocturnes," and he was the first president of the International Society. Whistler took the utmost care in the tones used on the floor and walls of his studios, in the dresses worn by his sitters, and even went so far as to redecorate a room in the house, at Knightsbridge, of F. R. Leyland. This room has been transferred to the Freer museum, Washington. In 1886, Whistler was elected president of the Royal Society of British Artists. His failure to be re-elected caused no surprise. He remarked that "the artists had come out and the British had remained."

But the British museum bought his etchings and he was the recipient of honours from nearly every foreign government. A deep religious sympathy is evident in his paintings of "Miss Alexander" and "Carlyle." He died in London on July 17, 1903, at the age of 69 years. To Whistler must be credited the full realization of the analogy between music and colour in their powers of expression. He described his pictures as symphonies, harmonies, nocturnes and so forth, instead of adopting the story-telling titles or doggerel verse then usually employed. This new nomenclature caused at first much resentment and derision, but is today accepted as perfectly natural and appropriate. The values, or degrees of tone were, to this sensitive painter, almost the beginning and end of art. He was painfully aware of his weakness as a draughtsman, which deprived his drawing of that sureness which proclaims a master of line. Whistler held that a good arrangement of simple masses provides the most important features of a pic-

ture, and that attention to tone values ensures serenity, which a study of Velasquez, who always used a severely restricted palette, will reveal. He may also have been attracted to Vermeer of Delft, whose work possesses the same quality of quiet dignity. He considered, too, that to avoid completely any feeling of interruption, pre-Raphaelite detail must be shunned; and that, even in tone arrangements, extremes were not advisable for fear of over-accentuation. Thus many of his first paintings are executed in a middle key. Towns, where the atmosphere is often slightly thick and quiet greys prevail, have been the source of inspiration for many a "tone-painter" since Whistler produced his delightful Thames pictures.

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WHISTON, WILLIAM (1667–1752), English divine and mathematician, was born at Norton in Leicester on Dec. 9, 1667. He was educated privately and at Clare college, Cambridge where he studied mathematics and obtained a fellowship in 1693. He next became chaplain to John Moore, bishop of Norwich, from whom he received the living of Lowestoft in 1698. His *New Theory of the Earth* (1696) received the praise of both Newton and Locke. In 1701 he resigned his living to become deputy at Cambridge to Sir Isaac Newton, whom he succeeded, two years later, as Lucasian professor of mathematics. In 1707 he was Boyle lecturer. For several years Whiston continued to write and preach both on mathematical and theological subjects with considerable success. However, his study of the *Apostolical Constitutions* had convinced him that Arianism was the creed of the primitive church and his heterodoxy soon became notorious. In 1710 he was deprived of his professorship and expelled from the university, and thereafter his life was spent in incessant controversy. He vindicated his estimate of the *Apostolical Constitutions* and the Arian views he had derived from them in his *Primitive Christianity Revived* (5 vols., 1711–12). In 1713 he produced a reformed liturgy, and soon afterward founded a society for promoting primitive Christianity, lecturing in support of his theories at London, Bath and Tunbridge Wells. One of the most valuable of his books, the *Life of Samuel Clarke,* appeared in 1730. His useful and often reprinted translation of Josephus, with valuable notes and dissertations, was printed in 1737, and his *Primitive New Testament* appeared in 1745. Of all his opinions the best known is his advocacy of clerical monogamy, immortalized in the *Vicar of Wakefield.* He died in London on Aug. 22, 1752, leaving a memoir (3 vols., 1749–50) noteworthy both for its characteristic individuality and as a storehouse of curious anecdotes and illustrations of the religious and moral tendencies of the age.

WHITAKER, JOSEPH (1820–1895), English publisher, was born in London on May 4, 1820. In January 1858 he started the *Bookseller,* and in 1869 published the first issue of *Whitaker's Almanack,* the annual work of reference, which also met with immediate success. In 1874 he published the first edition of the *Reference Catalogue of Current Literature.* Whitaker died at Enfield on May 15, 1895.

WHITBREAD, SAMUEL (1758–1815), English politician, son of a wealthy brewery-owner. Educated at Eton and St. John's college, he began by entering the brewing business; but after his marriage with the daughter of the 1st Earl Grey in 1789 he took to politics, and in 1790 was elected for Bedfordshire as a Whig. He became known as a social and financial reformer and a constant assailant in parliament of all sorts of abuses. It was on his motion in 1805 that Lord Melville was impeached for financial maladministration of the navy, and he conducted the case for the prosecution. Whitbread continued to be a constant speaker in parliament, and the principal representative of Liberal criticism. He opposed the regency, championed the princess of Wales, and led the peace party. In 1809 he became chairman of the committee for rebuilding Drury Lane theatre, and for some time he was immersed in controversies connected with it, which apparently affected his mind. He committed suicide on July 6, 1815.

WHITBREAD, SAMUEL (1830–1915), English politician, born at Cardington, Beds., on May 5, 1830, the grandson of Samuel Whitbread, M.P. for Bedfordshire, was head of the brewery founded by his great-grandfather from 1867 to 1889, and then became chairman of the company to which it was transferred. Like his father and grandfather, he became Liberal M.P. for Bedford (1852–95). He died at Biggleswade on Dec. 25, 1915.

WHITBY, market town and urban district, North Riding of Yorkshire, England. Pop. (est. 1938) 11,500. Area 4.4 sq.mi. The town is situated on the cliff-bound northeast coast, at the mouth of the river Esk. The old town of narrow streets and picturesque houses stands on the steep slopes above the river, while the modern residential quarter is mainly on the summit of the west cliff. On the east cliff, which dominates the harbour, called of old Streoneshalh, the ruins of the famous abbey hold a commanding position. The existing ruins comprise parts of the Early English choir, the north transepts of slightly later date and a richly decorated nave. The west side of the nave fell in 1763 and the tower in 1830. On the south side are the foundations of cloisters and domestic buildings. Extensive excavations have been carried out.

Whitby is first mentioned by Bede, who states that a religious house was founded there in about 657. It included establishments for monks and, until the Conquest, for nuns of the Benedictine order, and under Abbess Hilda it acquired considerable celebrity. In the 9th century the town was destroyed by the Danes, but was later refounded and became the centre of a Danish colony; it was the most prosperous town in the district until laid waste by the conqueror. Henry I made a grant of a burgage to the abbot and convent of Whitby and, toward the end of the 12th century, the abbot granted the town a free burgage to the burgesses. In 1200, King John, bribed by the burgesses, confirmed this charter, but the following year, on being bribed by the abbot, he quashed it as injurious to the dignity of the church of Whitby. The struggle continued until the 14th century, when a trial resulted in judgment against the burgesses. In 1629, Whitby petitioned for incorporation on the ground that the town was in decay through lack of good government, and received letters patent giving it self-government. But in 1674–75 the crown restored to the lords of the manor all liberties ever enjoyed by the abbots of Whitby in Whitby and Whitby Strand, probably in gratitude for the part they played in the Civil War. Whitby became a parliamentary borough under the Reform act of 1832, returning one member until it was disfranchised under the Redistribution of Seats act 1885. At the beginning of the 14th century Sir Alexander Percy claimed the hereditary right of buying and selling in Whitby without payment of toll. The market was by tradition held on Sunday until the reign of Henry VI, who changed the day to Saturday, still the market day. A fortnightly cattle market was granted by Charles I and Henry I granted to the abbot of Whitby a fair at the feast of St. Hilda.

Whitby has been a port at least since the 12th century, ranking seventh in England in 1828. Here were constructed the ships for Captain Cook's voyages. The yard was used for building ferro-concrete boats during World War I. Wooden ships are still built, and rope and sail making is carried on. In mediaeval times herrings and cod from the North sea formed the only industries. Whale fishing began in 1753. The manufacture of alum

from rocks near Whitby was an important industry from the beginning of the 17th century to well into the 19th century. The Yorkshire Lias was the sole source in England. With the development of Cleveland iron, the trade declined, but alum is manufactured for medicines, tanning and dyeing. Jet was also mined. Adjoining the abbey is Whitby hall, built about 1580 from the materials of the monastic buildings, and enlarged and fortified about 1672. A little below the abbey is the parish church of St. Mary, originally Norman, but much altered. Whitby is the seat of a bishop suffragan in the diocese of York. The geological and antiquarian museums at Whitby are famous.

WHITCHURCH, urban district, N. Shropshire, England. Pop. (est. 1938) 6,328. Area 9.4 sq.mi. Whitchurch is mentioned as a borough in the 14th century. The parish extends into Cheshire. Whitchurch was famous for its turret clocks, many of those in the churches of N. Shropshire having been made there.

WHITE, ANDREW DICKSON (1832–1918), American educationalist and diplomat, was born in Homer (N.Y.) on Nov. 7, 1832. He graduated at Yale (A.B.) in 1853, studied at the Sorbonne in 1854, and at the University of Berlin in 1855–56, meanwhile serving as attaché at the U.S. Legation at St. Petersburg in 1854–55. He was professor of history and English literature in 1857–63, and lecturer on history in 1863–67 at the University of Michigan. He dreamed of a great university with professors in every field, rich libraries and museums and stately buildings, the whole free from denominational control, open to men and women alike. After approaching various men of wealth, his alliance during his state senatorship (1864–67) with Ezra Cornell, who promised to give such an institution a site and $500,000 endowment, enabled him with the addition of the New York landgrant, to establish at Ithaca (N.Y.) the present Cornell university, to which as first president and after 1885 as a member of the board of trustees and executive committee he devoted his best energies and much of his wealth. He combined in an unusual degree the qualities of scholar and man of affairs. He served on the commission to Santo Domingo, and on the commission on the Venezuela boundary, as United States minister to Germany in 1879–81 and to Russia in 1892–94, and as ambassador to Germany in 1897–1903. In 1899 he was president of the U.S. delegation at The Hague Peace conference. Although Dr. White listed numerous unfinished projects in his *Autobiography* (1905), his various activities did not prevent him from completing several works. The most outstanding are *A History of the Warfare of Science with Theology in Christendom* (1896), and *Seven Great Statesmen in the Warfare of Humanity with Unreason* (1910). He died at Ithaca (N.Y.) on Nov. 4, 1918. The Cornell school of history and political science appropriately bears his name, and the rich collection of books which he gave the university is housed in a special room in the main library.

WHITE, EDWARD DOUGLASS (1845–1921), U.S. jurist, was born on a plantation in the parish of Lafourche, La., Nov. 3, 1845, his father being 7th governor of Louisiana. He was educated at Mount St. Mary's, Md., Georgetown, D.C., college, and, after the outbreak of the Civil War, at the Jesuit college in New Orleans. During the latter part of the war he served as a private in the Confederate army. He studied law in the office of Edward Bermudez, later chief justice of Louisiana, was admitted to the bar in 1868, and practised law in New Orleans. In 1874 he was elected to the state senate, and four years later was appointed associate justice of the Louisiana supreme court. In 1891 he was elected to the U.S. senate, and before completing his term was appointed, in 1894, associate justice of the U.S. supreme court by President Cleveland. In 1910 he was appointed chief justice by President Taft.

Many of his notable opinions were delivered in connection with the Sherman antitrust law. Of special importance were his opinions requiring the dissolution of the Standard Oil company and the American Tobacco company in 1911. As chief justice he administered the oath of office to President Wilson in 1913 and 1917, and to President Harding in 1921. He died at Washington, D.C., May 19, 1921.

WHITE, SIR GEORGE STUART (1835–1912), British field marshal, was born in County Antrim on July 6, 1835. He was educated at Sandhurst, and in 1853 joined the Inniskillings, with which regiment he served in India during the Mutiny in 1857. In the second Afghan War (1878–80) he was second in command of the Gordon Highlanders, whom he led in their charge at the battle of Charasiah, receiving the Victoria Cross. In 1881 he assumed command of the Gordon Highlanders and took part in the Nile Expedition of 1884–85. As brigadier in the Burmese War (1885–87) he rendered fine service, and was promoted major-general; when Sir Frederick (afterward Lord) Roberts left Burma in 1887, White was left in command of the force charged with the duty of suppressing the dacoits and pacifying the country. This he accomplished with a thoroughness which earned the thanks of the government of India. He was in command of the Zhob expedition in 1890, and in 1893 he succeeded Lord Roberts as commander-in-chief in India; and during his tenure of this office directed the conduct of the Chitral expedition in 1895 and the Tirah campaign in 1897. Returning to England in 1898 he became quartermaster-general of the forces; and on the outbreak of the Boer War in 1899 he was given command of the forces in Natal. He defeated the Boers at Elandslaagte on Oct. 21, 1899, and at Reitfontein on the 24th; but the superior numbers of the Boers enabled them to invest Ladysmith, which Sir George White defended in a siege lasting 119 days, from Nov. 2, 1899 to March 1, 1900, in the course of which he refused to entertain Sir Redvers Buller's suggestion that he should arrange the terms of capitulation with the enemy forces. (*See* LADYSMITH: *Siege of.*) After the relief of Ladysmith, White, whose health had been impaired by the siege, returned to England, and was appointed governor of Gibraltar (1900–1904). King Edward VII, who visited the fortress in 1903, personally gave him the baton of a field marshal. In 1905 Sir George White was appointed governor of Chelsea Hospital, and decorated with the order of merit. He died in London on June 24, 1912.

See T. F. G. Coates, *Sir George White* (1900).

WHITE, GILBERT (1720–1793), English writer on natural history, was born on July 18, 1720, at Selborne, Hants. He was educated at Basingstoke under Thomas Warton, father of the poet, and at Oriel College, Oxford, where in 1744 he was elected to a fellowship. Ordained in 1747, he became curate at Swarraton the same year and at Selborne in 1751. In 1752 he was nominated junior proctor at Oxford and became dean of his college. In 1753 he accepted the curacy of Durley, and afterward received the college living of Moreton Pinkney, though he did not reside there. In 1761 he became curate at Faringdon, near Selborne, and in 1784 he again became curate in his native parish. He died in his home, The Wakes, Selborne, on June 26, 1793.

Gilbert White's daily life was practically unbroken by any great changes or incidents; for nearly half a century his pastoral duties, his watchful country walks, the assiduous care of his garden, and the scrupulous posting of his calendar of observations made up the essentials of a full and delightful life. His four brothers were all interested in science, and White corresponded with the chief botanists and antiquarians of his time. In 1771 he sketched out to Thomas Pennant the project of "a natural history of my native parish, an *annus historico-naturalis,* comprising a journal for a whole year, and illustrated with large notes and observations. Such a beginning might induce more able naturalists to write the history of various districts and might in time occasion the production of a work so much to be wished for—a full and complete natural history of these kingdoms." Yet the famous *Natural History and Antiquities of Selborne* did not appear until 1789. It was well received and is constantly reprinted.

White's is the first book which raised natural history into the region of literature, much as the *Compleat Angler* did for angling. Its charm lies in the sweet and kindly personality of the author, who on his rambles gathers no spoil, but watches the birds and field-mice without disturbing them from their nests, and quietly plants an acorn where he thinks an oak is wanted, or sows beechnuts in what is now a stately row. The encyclopaedic interest in nature, although in White's day culminating in the monumental synthesis of Buffon, was also disappearing before the analytic

specialism inaugurated by Linnaeus; yet the catholic interests of the simple naturalist of Selborne fully reappear a century later in the greater naturalist of Down, Charles Darwin.

The *Life and Letters of Gilbert White of Selborne,* by his great grand-nephew, Rashleigh Holt-White, appeared in 1901.

WHITE, HENRY (1850–1927), U.S. diplomatist, was born in Baltimore, Md. on March 29, 1850. He was educated privately and spent much of his early life in England, Italy, Germany and France. He entered the diplomatic service in 1883 as secretary at the United States legation in Vienna and in the following year was transferred to London where he served until 1893, and from 1897 to 1905. He was U.S. representative at the International conference in 1887–88, and in 1905 was U.S. delegate to the International Conference on Agriculture. He was appointed ambassador to Italy in March 1905 and from 1907 to 1909 served as ambassador to France. In 1910 President Taft appointed him chairman of the U.S. delegation to the 4th Pan-American conference in Buenos Aires. As a member of the U.S. delegation to the Paris Peace conference in 1918–19 he worked for U.S. entry into the League of Nations. He died on July 15, 1927.

WHITE, HENRY KIRKE (1785–1806), English poet, was born at Nottingham, the son of a butcher, on March 21, 1785. He was articled to a lawyer. Capel Lofft encouraged him to publish *Clifton Grove, a Sketch in Verse, with other Poems,* dedicated to Georgiana, duchess of Devonshire. The book was violently attacked in the *Monthly Review* (Feb. 1804), but White was in some degree compensated by a kind letter from Robert Southey. Through the efforts of his friends, he was entered as a sizar at St. John's college, Cambridge, spending a year beforehand with a private tutor. Close application to study induced a serious illness, and fears were entertained for his sanity, but he went into residence at Cambridge, with a view to taking holy orders, in the autumn of 1805. The strain of continuous study proved fatal, and he died on Oct. 19, 1806. He was buried in the church of All Saints, Cambridge. Much of his fame was due to sympathy inspired by his early death, but Byron agreed with Southey in forming a high estimate of the young man's promise.

His *Remains,* with his letters and an account of his life, were edited (3 vols., 1807–22) by Robert Southey. *See* prefatory notices by Sir Harris Nicolas to his *Poetical Works* (new ed., 1866) in the "Aldine Edition" of the British poets; by H. K. Swann in the volume of selections (1897) in the *Canterbury Poets;* and by John Drinkwater to the edition in the "Muses' Library." *See* also J. T. Godfrey and J. Ward, *The Homes and Haunts of Henry Kirke White* (1908).

WHITE, HORACE (1834–1916), U.S. journalist, was born in Colebrook, N.H. on Aug. 10, 1834. He graduated from Beloit college in 1853 and in the following year became city editor of the Chicago *Evening Journal.* He subsequently joined the editorial staff of the Chicago *Tribune,* serving as editor in chief from 1865 to 1874 when ill health compelled him to resign. In 1881 he became an executive of the New York *Evening Post* and in 1899 editor in chief, a position he held until his retirement in 1903. His book *Money and Banking, Illustrated by American History* (1895) became a standard textbook. Other publications include *The Roman History of Appian of Alexandria, Translated from the Greek* (1899); *The Life of Lyman Trumbull* (1913). He died on Sept. 16, 1916.

WHITE, HUGH LAWSON (1773–1840), U.S. statesman, was born in Iredell county (N.C.), Oct. 30, 1773. In 1787 he crossed the mountains into East Tennessee (then a part of North Carolina) with his father, James White (1737–1815). Hugh became in 1790 secretary to Governor William Blount, and in 1792–93 served under John Sevier against the Creek and Cherokee Indians, and according to the accepted tradition, killed with his own hand the Cherokee chief, Kingfisher. He studied in Philadelphia, and in 1796 he was admitted to the bar at Knoxville. He was a judge of the superior court of Tennessee (1801–07), a state senator (1807–09), and (1809–15) was judge of the newly organized supreme court of errors and appeals of the state. From 1812 to 1827 he was president of the State Bank of Tennessee, the only western bank that in the trying period during and after the War of 1812 did not suspend specie payments. In 1821–24 he was a member of the Spanish Claims commission and in 1825 succeeded Andrew Jackson in the U.S. senate, serving until 1840 and being president *pro tem.* in 1832–34. In the senate he supported in general the measures of President Jackson, though his opposition to the latter's indiscriminate appointments caused a coolness between himself and Jackson. In 1830, as chairman of the committee on Indian affairs, he secured the passage of a bill looking to the removal of the Indians to land west of the Mississippi. He was opposed to Van Buren, Jackson's candidate for the presidency in 1836, was himself nominated in several States as an independent candidate, and received the 26 electoral votes of Tennessee and Georgia. About 1838 he became a Whig in politics, and when the Democratic legislature of Tennessee instructed him to vote for Van Buren's subtreasury scheme he objected and resigned (Jan. 1840). His strict principles and his conservatism won for him the sobriquet of "The Cato of the United States senate." He died at Knoxville, April 10, 1840.

See Nancy N. Scott (ed.) *A Memoir of Hugh Lawson White* (Philadelphia, 1856).

WHITE, RICHARD GRANT (1822–1885), U.S. Shakespearean scholar, philologist and essayist, was born in New York city on May 23, 1822. He graduated at the University of the City of New York in 1839, studied medicine and then law, and was admitted to the bar in 1845. He contributed musical criticisms to the New York *Courier and Enquirer,* of which he was co-editor in 1851–58, and became a member of the staff of the New York *World,* when that paper was established in 1860. In 1853 he contributed anonymously, to *Putnam's Magazine,* an acute and destructive criticism of Collier's folio manuscript emendations of Shakespeare; and in the following year this criticism was republished (with other papers) in his *Shakespeare's Scholar: being Historical and Critical Studies of his Text, Characters, and Commentators; with an Examination of Mr. Collier's Folio of 1623.* During the Civil War he contributed to the *Spectator,* under the pseudonym, "A Yankee," a series of articles which greatly influenced English public opinion in favour of the north, while his clever and pungent satire, *The New Gospel of Peace; according to St. Benjamin,* in four books (1863–66) was an effective attack upon "copper-headism" and the advocates of "peace at any price." White's published works include critical discussions and annotated editions of Shakespeare, a novel and books on many other subjects.

He died in New York on April 8, 1885.

WHITE, STANFORD (1853–1906), U.S. architect, was born in New York city on Nov. 9, 1853. He was the son of Richard Grant White. He worked in Boston with Henry H. Richardson, whom he helped in designing Trinity church, of that city. In 1878 he went abroad for further study, particularly of the Gothic tradition in which he found his keenest satisfaction. In 1881 he became a member of the firm of McKim, Mead and White, New York city. He designed the Washington arch in Washington Square, the Century and Metropolitan clubs, the Tiffany and Gorham buildings, New York city, and the buildings of the New York university and the University of Virginia. He designed the pedestals for several of the statues of Augustus St. Gaudens, whose close friend he was, and a number of memorial monuments and stained glass windows. He was murdered by Harry Thaw in New York city, June 25, 1906. See *American Artists* by Royal Cortissoz, p. 299; *Sketches and Designs by Stanford White:* ed. Lawrence Grant White (1920), also *Letters of Stanford White,* vol. 30, *Architectural Record.*

WHITE, SIR THOMAS (1492–1567), founder of St. John's college, Oxford, was a son of William White, a clothier, and was born at Reading. He became a merchant in London and a member, and then master of the Merchant Taylors' company; growing wealthier he became an alderman and sheriff of the city of London. One of the promoters of the Muscovy company, he was knighted in 1553, and chosen lord mayor. He defended the city against Sir Thomas Wyat and his followers, and took part in the trial of the rebels, as he had done in the case of Lady Jane Grey. In 1555 White received a licence to found a college at Oxford, which, dedicated to the Virgin Mary and St. John Baptist, was opened in 1560. He died at Oxford on Feb. 12, 1567, and was buried

in the chapel of St. John's College. White had some share in founding the Merchant Taylors' School in London.

WHITE, WILLIAM ALLEN (1868–1944), American journalist, born at Emporia, Kansas, Feb. 10, 1868. He attended the University of Kansas but left to edit the El Dorado *Republican.* In 1891 he went to Kansas City and became an editorial writer on the *Star* and in 1895 purchased the Emporia *Daily* and *Weekly Gazette.* An editorial written in 1896 entitled "What's the Matter with Kansas?", an impassioned plea against populism, made him and his paper nationally known. He refused to run for political office. Three books of short stories, *The Real Issue* (1896), *The Court of Boyville* (1899), *Strategems* and *Spoils* (1901), and a volume of sketches, *In Our Town* (1906), gave him wide reputation as an interpreter of life in the country towns of the Middle-West. In 1909 he published his first novel, *A Certain Rich Man,* which passed through many editions. Then followed *The Old Order Changeth* (1910), political essays; *God's Puppets* (1916), short stories, and *In the Heart of a Fool* (1918), another successful novel. Turning to interpretative biography, he wrote a *Life of Woodrow Wilson* (1924), *Calvin Coolidge, the Man Who is President* (1925), *Masks in a Pageant* (1928) and *A Puritan in Babylon* (1938), his second biography of Coolidge. In 1937 he published the autobiographical *Forty Years on Main Street* and in 1939, *The Changing West.* Many of his best editorials are collected in *The Editor and His People* (1924).

White was sent to France by the American Red Cross as an observer in 1917 and was a delegate to the Russian conference at Prinkipo in 1919. In 1930 President Herbert Hoover appointed him a member of a commission sent to Haiti to outline methods for terminating U.S. occupation of that country. He founded and headed the Committee to Defend America by Aiding the Allies (1940). He died Jan. 29, 1944, in Emporia, Kansas.

WHITE, WILLIAM HALE (1829–1913): *see* RUTHERFORD, MARK.

WHITE, SIR WILLIAM HENRY, K.C.B., 1895 (1845–1913), English naval architect, was born at Devonport on Feb. 2, 1845, and at 14 became an apprentice in the dockyard there. After spending three years at the Royal School of Naval Architecture, South Kensington, he joined the constructive staff of the Admiralty, and acted as confidential assistant to the chief constructor, Sir Edward Reed, until Reed's retirement. In 1872 White was appointed secretary to the Council of Construction at the Admiralty, in 1875 assistant constructor, and in 1881 chief constructor. In April 1883 he left the service of the Admiralty, at the invitation of Lord (then Sir W. G.) Armstrong, to organize a department for the construction of warships of the largest size at the Elswick works. In October 1885 he returned to the Admiralty as director of naval construction, retaining that post until the beginning of 1902. More than 200 vessels of various types were added to the British navy, at a cost of about £100,000,000, and for the design and construction of these ships White was ultimately responsible. In addition to his work at the Admiralty, he was professor of naval architecture at the Royal School 1870–73, and when in the latter year it was moved to Greenwich to be merged in the Royal Naval College, he reorganized the course of instruction and acted as professor for eight years more. His *Manual of Naval Architecture* is a standard text-book. White was elected F.R.S. in 1888. He died in London Feb. 27, 1913.

WHITE ANT: *see* TERMITE; SOCIAL INSECTS.

WHITEBAIT (Fr. *Blanchaille*), the name given to the fry of the herring and sprat, and formerly erroneously thought to be a distinct species, *Clupea alba.* These young fish, which are much esteemed for the table, are found in large numbers in estuaries (Firth of Forth, Thames, etc.) and at certain times along the coast, but it appears that the large concentrations which make the fishery a commercial success occur only in estuaries.

In spite of the large numbers of whitebait caught, it is improbable that this has any noticeable effect on the subsequent herring fisheries. In America the young of a species of silverside (*Menidia beryllina*) are similarly sold as whitebait.

WHITEFIELD, GEORGE (1714–1770), English religious leader, was born on Dec. 16, 1714, at Gloucester. In 1733 he entered as a servitor at Pembroke College, Oxford, graduating in 1736. There he came under the influence of the Methodists (*see* WESLEY).

In 1736 he was invited by Wesley to go out as missionary to Georgia, and went to London to wait on the trustees. Before setting sail he preached in some of the principal London churches, and in order to hear him, crowds assembled at the church doors long before daybreak. On Dec. 28, 1737, he embarked for Georgia, which he reached on May 7, 1738. After three months' residence there he returned to England to receive priest's orders, and to raise contributions for the establishment of an orphanage. As the clergy did not welcome him to their pulpits, he began to preach in the open air. At Kingswood Hill, Bristol, his addresses to the colliers soon attracted crowds, and his voice was so clear and powerful that it could reach 20,000 folk. His fervour and dramatic action held them spell-bound, and his homely pathos soon broke down all barriers of resistance. "The first discovery of their being affected," he says, "was by seeing the white gutters made by their tears, which plentifully fell down their black cheeks." He again embarked for America in August 1739, and remained there two years, preaching in all the principal towns. He left his incumbency of Savannah to a lay delegate, and was suspended for ceremonial irregularities.

During his absence from England Whitefield found that a divergence of doctrine from Calvinism had been introduced by Wesley; and notwithstanding Wesley's exhortations to brotherly kindness and forbearance he withdrew from the Wesleyan Connexion. Thereupon his friends built for him near Wesley's church a wooden structure, which was named the Moorfields Tabernacle. A reconciliation between the two great evangelists was soon effected, but each thenceforth went his own way. In 1741, on the invitation of Ralph and Ebenezer Erskine, he paid a visit to Scotland, commencing his labours in the Secession meeting-house, Dunfermline. But, as he refused to limit his ministrations to one sect, the Seceders and he parted company, and without their countenance he made a tour through the principal towns of Scotland, and was everywhere received with enthusiasm. From Scotland he went to Wales, where on Nov. 14, he married a widow named James. The marriage was not a happy one. On his return to London in 1742 he preached to the crowds in Moorfields during the Whitsun holidays. After a second visit to Scotland, June–October 1742, and a tour through England and Wales, 1742–1744, he embarked in August 1744 for America, where he remained till June 1748. On returning to London he found his congregation at the Tabernacle dispersed; and his circumstances were so depressed that he was obliged to sell his household furniture to pay his orphan-house debts. Relief soon came through his acquaintance with Selina, countess of Huntingdon (*q.v.*), who appointed him one of her chaplains.

The remainder of Whitefield's life was spent chiefly in evangelizing tours in Great Britain, Ireland and America. It has been stated that "in the compass of a single week, and that for years, he spoke in general forty hours, and in very many sixty, and that to thousands." In 1748 the synods of Glasgow, Perth and Lothian passed vain resolutions intended to exclude him from churches; in 1753 he compiled his hymn-book, and in 1756 opened the chapel which bears his name in Tottenham Court Road, London. On his return from America to England for the last time the change in his appearance forcibly impressed Wesley, who wrote in his *Journal*: "He seemed to be an old man, being fairly worn out in his Master's service, though he had hardly seen fifty years." When health was failing him he placed himself on what he called "short allowance," preaching only once every week-day and thrice on Sunday. In 1769 he returned to America for the seventh and last time, and arranged for the conversion of his orphanage into Bethesda College, which was burned down in 1773. He died on Sept. 30, 1770, at Newburyport, Mass. He was buried before the pulpit in the Presbyterian church of the town where he died.

Whitefield's printed works convey a totally inadequate idea of his oratorical powers, and are all in fact below mediocrity. They appeared in a collected form in 1771–72 in seven volumes, the last containing *Memoirs of his Life,* by Dr. John Gillies. His *Letters* (1734–70)

were comprised in vols. i., ii. and iii. of his *Works* and were also published separately. His *Select Works*, with a memoir by J. Smith, appeared in 1850. See *Lives* by Robert Philip (1837), L. Tyerman (2 vols., 1876–77), J. P. Gledstone (1871, new ed. 1900), and W. H. Lecky's *History of England*, vol. ii. (1878–90).

WHITEFISH, the name of fishes of the genus *Coregonus* of the salmon family. These are silvery fishes with rather large scales, and with a small toothless or feebly toothed mouth; they feed on minute crustaceans. Marine species, entering rivers to breed, are chiefly arctic, but a number of fresh-water species inhabit Europe and North America, especially in lakes. Few species of *Coregonus* reach a length of more than 18 inches.

For the British species *see* GWYNIAD; POLLAN and VENDACE; *see* also SALMON AND SALMONIDAE.

WHITEHALL, a village of Washington county, New York, U.S.A., at the head (south end) of Lake Champlain, 65 mi. N. by E. of Albany. It is served by the Delaware and Hudson railway. Pop. (1940) 4,851. Founded by Maj. Phillip Skene in 1759, it was the first civilian settlement on the lake. The U.S. fleet was sunk at Whitehall after the battle of Plattsburg in 1812. During the War of 1812 the town was fortified and used as a base of supplies for operations against Canada.

WHITEHAVEN, seaport, market town, municipal borough, Whitehaven parliamentary division, Cumberland, England, 40 mi. S.W. of Carlisle on the L.M.S. railway. Pop. (est. 1938) 22,350; area 6.7 sq.mi. At the mouth of a river, the harbour is protected by two piers. It has a large dock and a tidal harbour and extensive quayage. Regular summer communications are maintained with the Isle of Man. The exports are principally coal, pig iron and ore, steel and stone. There are collieries near the town, the workings extending beneath the sea; engineering works, iron foundries, flour mills, saw mills and shipbuilding yards. From 1832 until 1918 it was a parliamentary borough returning one member. Whitehaven (*Witofthaven*) was a possession of the priory of St. Bees, which became crown property at the dissolution of the religious houses. It was acquired before 1644 by relatives of the earl of Lonsdale, who secured its prosperity by working the coal mines. The town, being largely dependent on coal, suffered severely during the depression of the 1930s, unemployment among insured men reaching over 50% in April 1932. In 1894 the municipal corporation was created. Paul Jones attacked the town in April 1778.

WHITEHEAD, ROBERT (1823–1905), English inventor, was born at Bolton-le-Moors, Lancashire, on Jan. 3, 1823, the son of James Whitehead, owner of a cotton-bleaching business. In 1837 he was apprenticed to a firm of engineers in Manchester, and in 1844 joined his uncle at the works of Philip Taylor and Sons, Marseilles. In 1847 he set up a business of his own in Milan, later joining the staff of the Austrian Lloyd Company at Trieste, where he was manager from 1850 to 1856. In 1856 he began to work for the Stabilimento Tecnico Fiumano, building several Austrian warships, and carrying out preliminary experiments for the Whitehead torpedo, completed in 1866. In 1872 Whitehead bought the Stabilimento Tecnico Fiumano, converting the works entirely to the production of torpedoes and their accessories. (*See* TORPEDOES.) In 1876 he improved his torpedoes with the "servo-motor," and gradually increased their speed. His work was perfected in 1896 by Obry's invention, subsequently acquired and improved by Whitehead, of the gyroscope, which guaranteed precision of aim.

See G. E. Armstrong, *Torpedoes and Torpedo Vessels* (1901).

WHITEHEAD, WILLIAM (1715–1785), English poet-laureate, son of a baker, was born at Cambridge, and baptized on Feb. 12, 1715. His father had extravagant tastes, and spent large sums in ornamenting a piece of land near Grantchester, afterwards known as "Whitehead's Folly." William was educated at Winchester college and Clare Hall, Cambridge. He became a fellow of Clare in 1742. At Cambridge Whitehead published an epistle "On the Danger of writing Verse" and other poems. In 1757 he was appointed poet-laureate in succession to Cibber. Whitehead's most successful play was the *School for Lovers* (Drury Lane, Feb. 10, 1762). David Garrick then made him his reader of plays. Whitehead died on April 14, 1785. He collected his *Plays and Poems* in 1774.

See memoirs by his friend William Mason, prefixed to a complete edition of his poems (York, 1788). His plays are printed in Bell's *British Theatre* (vols. 3, 7, 20) and other collections, and his poems appear in Chalmers's *Works of the English Poets* (vol. 17) and similar compilations.

WHITE HORSE, VALE OF, the name of the valley of the Ock, which joins the Thames from the west at Abingdon, Berkshire, England. The vale is flat and well wooded, its green meadows and foliage contrasting with the bald summits of the White Horse hills on the south. On the north a lower ridge separates it from the upper Thames valley; but local usage sometimes extends the vale to cover all the ground between the Cotswolds (on the north) and the White Horse hills. Wantage is the only town in the heart of the vale, but upon the hills villages are numerous. Towards the west, above Uffington, the hills reach a culminating point of 856 ft. in White Horse hill. In its northern flank, a gigantic figure of a horse is cut, the turf being removed to show the white chalky sub-soil beneath. This figure gives name to the hill, the range and the vale. It is 374 ft. long and of the rudest outline, the neck, body and tail varying little in width. Its origin is unknown. The figure, with others of a similar character elsewhere in England, is considered to be of high antiquity, dating from before the Roman occupation. Many ancient remains occur in the vicinity of the Horse. On the summit of the hill there is an extensive and well-preserved circular earthwork known as Uffington castle. Within a short distance are Hardwell castle, a square work, and, near Ashdown park, a small camp traditionally called Alfred's. A smooth, steep gully on the north flank of White Horse hill is called the Manger, and to the west of it rises a bald mound named Dragon's hill. The name, properly Pendragon, is a Celtic form signifying "chief of kings," and may point to an early place of burial. To the west of White Horse hill lies a dolmen called Wayland Smith's cave. The White Horse itself has been carefully cleared of vegetation from time to time, and the process, known as the "Scouring of the White Horse," was formerly made the occasion of a festival. A grassy track represents the ancient road or Ridge Way along the crest of the hills and other earthworks in addition to those near the White Horse overlook the vale, such as Letcombe castle above Wantage. Among interesting village churches in the vale is the fine Early English one at Uffington. The length of the vale is traversed by the main line of the G.W. railway, between Didcot and Swindon.

WHITE LEAD: *see* LEAD.

WHITELEY, WILLIAM (1831–1907), English "Universal Provider," was born at Agbrigg, near Wakefield, Yorkshire, on Sept. 29, 1831, the son of a corn-factor. In 1851 he made his first visit to London to see the Great Exhibition, and in 1852 he obtained a situation in a draper's establishment in the city. In 1863 he himself opened a small shop for the sale of fancy drapery in Westbourne Grove, Bayswater, London. He made a consistent practice of marking all goods in plain figures and of "dressing" his shop-window attractively, both unusual features in the retail trading of the time, and to this, coupled with the fact that he was satisfied with small profits, he largely attributed a success in which his own genius for organization and energy played a conspicuous part. In 1866 Whiteley added general drapery to his other business, opening by degrees shop after shop and department after department, till he was finally enabled to call himself the "Universal Provider," and boast that there was nothing which his stores could not supply. "Whiteley's" was, in fact, the first great instance of a large general goods store in London, held under one man's control. In 1899 the business, of which the profits then averaged over £100,000 per annum, was turned into a limited liability company, Whiteley retaining the bulk of the shares. On Jan. 23, 1907, he was shot dead, after an interview in his private office, by Horace George Rayner, who claimed (but, as was proved, wrongly) to be his illegitimate son and who had been refused pecuniary assistance. Rayner was convicted of murder, but the death-sentence was commuted to penal servitude.

WHITELOCKE, BULSTRODE (1605–1675), English lawyer and parliamentarian, eldest son of Sir James Whitelocke

was baptized on Aug. 19, 1605, and educated at Merchant Taylors' school and at St. John's college, Oxford, where he matriculated on Dec. 8, 1620. He was called to the bar in 1626 and chosen treasurer in 1628. He was M.P. for Stafford in the parliament of 1626 and had been appointed recorder of Abingdon and Henley. In 1640 he was chosen member for Great Marlow in the Long Parliament. He took a prominent part in the proceedings against Strafford. He drew up the bill for making parliaments indissoluble except by their own consent, and supported the Grand Remonstrance and the action taken in the Commons against the illegal canons; on the militia question, however, he advocated a joint control by king and parliament. On the outbreak of the Great Rebellion he took the side of the parliament. He was sent to the king at Oxford in 1643 and 1644 to negotiate terms, and the secret communications with Charles on the latter occasion were the foundation of a charge of treason brought against Whitelocke and Denzil Holles (*q.v.*) later. He was again one of the commissioners at Uxbridge in 1645. Nevertheless, he opposed the policy of Holles and the peace party and the proposed disbanding of the army in 1647, repudiated the claims of divine authority put forward by the Presbyterians for their Church, and approved of religious tolerance. He thus gravitated towards Cromwell and the army party. Under the Commonwealth he was nominated councillor of State and became a commissioner of the New Great Seal. In 1653 he went on a mission to Christina, queen of Sweden, to conclude a treaty of alliance and to secure the freedom of the Sound. On his return he again became a commissioner of the Great Seal, and also a commissioner of the Treasury. In 1654 and 1656 he sat as M.P. for Buckinghamshire.

As a lawyer, Whitelocke supported a bill introducing the use of English into legal proceedings, drafted a new treason law, and introduced modifications into chancery procedure. His resistance to the ill-considered changes in the court of chancery proposed by Cromwell and the council, however, led to his dismissal from the commissionership of the Great Seal. He still advised Cromwell on foreign affairs, and was chairman of the committee to urge Cromwell to accept the crown. In Dec. 1657 he became a member of the new House of Lords. He was again a commissioner of the Great Seal under Richard Cromwell, and was a member (May 14, 1659) and president (Aug. 1659) of the council of State. On the expulsion of the Long Parliament, in which he had a seat, he was included in the committee of safety which superseded the council. He again received the Great Seal on Nov. 1.

On the failure of his plan to persuade Fleetwood to forestall Monk by making terms with Charles, he retired to the country. He lived at Chilton, in Wiltshire, dying on July 28, 1675.

He was the author of *Memorials of the English Affairs from the beginning of the reign of Charles I.* . . . published 1682 and reprinted, largely a compilation from various sources, composed after the events and abounding in errors. His work of greatest value, his *Annals*, still remains in ms. in Lord Bute's and Lord de la Warr's collections (*Hist. Brit. Comm. III. Rep.*, pp. 202, 217; also Egerton mss. Brit. Mus. 997, add. mss. 4,992, 4,994); his *Journal of the Swedish Embassy* . . . was published 1772 and re-edited by Henry Reeve in 1885 (add. mss. 4,902, 4,991 and 4,995 and *Hist. MSS. Comm. III. Rep.*, 190, 217); *Notes on the King's Writ for Choosing Members of Parliament* . . . were published 1766 (*see* also add. mss. 4,993); *Memorials of English Affairs from the supposed expedition of Bruce to this Island to the end of the Reign of James I.*, were published 1709; *Essays Ecclesiastical and Civil* (1706); *Quench not the Spirit* . . . (1711); some theological treatises remain in ms., and several others are attributed to him.

See the article by C. H. Firth in the *Dict. Nat. Biog.*, with authorities there quoted; R. H. Whitelocke, *Memoirs of B. Whitelocke* (1860); H. Reeve's edition of the *Swedish Embassy;* Foss's *Judges of England; Eng. Hist. Rev.*, xvi. 737; Wood's *Ath. Oxon.*, iii. 1,042.

WHITE MOUNTAINS, the portion of the Appalachian mountain system which traverses New Hampshire (U.S.A.), between the Androscoggin and Upper Ammonoosuc rivers on the north and the lake country on the south. They cover an area of about 1,300m., are composed of somewhat homogeneous granite rocks, and represent the remnants after long-continued erosion of a region formerly greatly elevated. The geological formation is an igneous ejection of granite, burst through horizontal strata. The foundation seems to have lifted from the depths and bears upon its shoulders a huge covering of mica slate that often extends a quarter of a mile below the summit. The group is divided into two main portions by Crawford Notch, the valley of the Saco river. To the west of the notch are the Franconia mountains where Mt. Lafayette, the highest peak, stands 5,269 ft. above sea-level. To the east lies the Presidential range, so called because the chief summits are named after the U.S. Presidents. Of this group Mt. Washington is the highest peak, rising 6,293 ft. above the sea. Thirteen other summits have an elevation exceeding 5,000 feet. Some of the best known are Mt. Adams, 5,805 ft.; Mt. Jefferson, 5,725 ft.; Mt. Clay, 5,554 ft.; Mt. Monroe, 5,390 ft.; and Mt. Madison, 5,380 feet.

See the article NEW HAMPSHIRE; the *Guidebook*, part i. (Boston, 1907), published by the Appalachian Mountain Club; and *Appalachia*, (1876 *seq.*), a periodical published by the same club.

WHITE PLAINS, a city of New York, U.S.A., the county seat of Westchester county; 24 m. N.N.E. of the Grand Central station in New York city, on the Bronx river, midway between the Hudson and Long Island sound. It is served by the New York Central and electric railways and motor-bus lines. Pop. (1920) 21,031 (20% foreign-born white and 5% Negroes); 1940 by federal census 40,327. White Plains is a residential suburb and shopping centre, having a land area of 9.4 sq.mi., with the Bronx river, Hutchinson river and Central Westchester parkways running through it and three lakes (Silver, Kensico and Rye) in the vicinity. The city's assessed valuation for 1940 was $145,006,773.

The early traders called this region "the white plains" from the groves of white balsam which covered it. In Nov. 1683, a party of Connecticut Puritans came from Rye (in the territory then in dispute between New York and Connecticut), bought land from the Indians and established a settlement. Their title was contested by the heirs of John Richbell, and the controversy was not settled until 1722. In 1759 White Plains succeeded Westchester as the county seat. In the early summer of 1776 the Third Provincial Congress of New York met here, in the old court house on South Broadway (where an armory now stands). From the steps of this building the Declaration of Independence was officially read for the first time in New York on July 11, 1776, and here New York was first declared a State and the work of drafting its first Constitution was begun. In Oct. 1776, Washington withdrew his forces from the north end of Manhattan and concentrated them near White Plains. On Oct. 28 the Americans (about 1,600) defending rude earthworks on Chatterton's hill (on the west bank of the Bronx river) were attacked by 4,000 British and Hessians, and after making a stubborn resistance retreated in good order across the river. The American loss was about 125; the British, 250. The old Miller house, in North White Plains, was occupied at intervals by Washington as his headquarters before the battle and again in the summer of 1778. In 1779 a Continental force under Aaron Burr was stationed here for some months, and in July 1781, the Heights of Greenburgh, west and south-west of the city, were occupied by parts of Lauzun's and Rochambeau's French army. White Plains was incorporated as a village in 1866 and as a city in 1916.

WHITE RUSSIA (BELORUSSIA, BYELORUSSIA), a constituent republic of the U.S.S.R. Area 48,868 sq.mi. Pop. (1939) 5,567,976. Poland lies west; the Ukrainian S.S.R., south; the regions of Orel and Smolensk, east; and the Pskov district of the Leningrad region, north. In the north and west there are hills, the Lysaya Hills north of Minsk being the highest (over 1,000 ft.), but the south-east is a low and marshy plain sloping to the Pripet river, and the swamps and marshes lying south of it, and forming part of a great lacustrine depression. The Western Dvina flows through a morainic region and its bed is interrupted by waterfalls due to boulders and outcrops of harder rocks, as is that of the Dnieper. The Berezina canal links these two rivers and thus avoids some of these difficulties. Among the numerous streams of the Republic are the Drut, Berezina, Pripet and Sozh, tributaries of the Dnieper, and various streams flowing into the Niemen and the Western Dvina. Fishing in these streams and the numerous lakes is productive, and about 200 artificial breeding ponds exist. The chief kinds of fish are pike, bream, sandre, perch, dace, tench, crucian-carp, silurus and ling. Fishing for export ceased

during and immediately after World War I and did not begin again until 1923. By 1940 an old canal connecting the rivers Dnieper, Bug and Vistula was rebuilt; thus communication in White Russia was improved.

The forest wealth of the region was markedly diminished by the ruthless cutting of forest during 1914–21 for the conflicting armies. About 25% of the region is under forest, oak in the south and pine and fir in the north. Much timber is exported through Latvia for foreign markets, the rest going to the Ukraine, the Crimea and the Moscow region. In dependence on the forest there are sawmilling, woodworking, match and paper factories, but many were razed to the ground during the war period and production was much diminished.

A tenth of the surface is covered with bog, and peat working is increasing. This peat and the numerous waterfalls are potential sources of electrical energy, little developed as yet in the republic; a station at Osinovsk was erected on a peat bog. The soils in the republic are not very favourable to agriculture, being mainly of the ash-coloured forest type, with some clays and sands.

The climate is less continental than that of the rest of the U.S.S.R. and is under the influence of the Baltic and Atlantic; the rainfall averages about 30 in. per annum.

Frost lasts for 130 to 140 days, while the summer temperature averages 65.5° F.

Agriculture.—These climatic and soil conditions are favourable to stock-raising, which is carried on successfully, pig-breeding having developed lately. There is not much dairying except near the towns for local supply. Cattle diminished markedly in years of war (1914–21) and agricultural reorganization, and their progress towards more normal numbers was sharply set back by the slaughter of 1926–27 consequent on the bad harvest. However, cattle breeding began to increase steadily between the years 1934–38. In 1924–25 manuring for meadows was introduced in some places, with great benefit to the hay crop.

Agriculture is still pre-eminently of a grain character, though potato, flax and hemp cultivation began to increase. The chief crops are rye and oats. The region is, however, comparatively densely peopled and the local grain supply is limited, although by the end of 1937 the farms were collectivized, and their agricultural production showed a considerable increase in the same period.

The cutting off of the western regions from Russia after World War I altered the balance and direction of trade. In accordance with the long and tragic history of this region of struggle with difficult natural conditions and with perpetual invasions the standard of life was low and illiteracy common. Since 1921 a communist university and an institute of White Russian culture, with a Polish and a Jewish section as well as an agricultural academy have been established in Minsk. The population consists of White Russians 80%, Jews 8%, Great Russians 7%, Poles 2% with some Lithuanians, Ukrainians, Letts, etc. The capital is Minsk (*q.v.*). Other towns are Vitebsk, Gomel, Mogilev, Bobruisk, Polotsk, Orsha (*qq.v.*) and Borisov.

The White Russians are by Leroy Beaulieu considered to be the purest of the three great Slav divisions, Great Russians, Little Russians (Ukrainians) and White Russians. They took refuge from Tatar raids in the swamps and marshes. Their dialect is akin to Great Russian, but political causes separated the two races, and the White Russians, like the Ukrainians, were for some time under non-Russian rule. In physical type they are brachycephalic, average cephalic index 85, greater than that of the Great Russians, possibly because of intermixture with the Poles. Their hair is light brown or brown, with a decided reddish tinge and their eyes light brown. Apparently they received the name "White" Russians because of their costume, white smock, bast shoes with white leggings, and a white homespun coat.

History.—After the rise of Lithuania, the region became subject to the princes of that country and when the Lithuanian prince Wladislaus Jagiello, having married Queen Jadwiga of Poland in 1386, became king of Poland, the White Russian territory fell under Polish rule. The official documents of the Lithuanian grand dukes, however, continued to be written in White Russian for some time after this. Under Ivan the Great (1462–1505), part of the White Russian territory was wrested from Poland. Under Basil III (1505–1533), the power of Moscow extended to the Dnieper river, but during the "Time of Troubles" the territory was regained by Poland, and by the truce of Deulino, Poland retained Smolensk and all the territory west of it. The struggle between Russia and Poland continued at intervals, but White Russia remained in Polish hands until the treaty of Vilna 1656, when Poland ceded White Russia and the Ukraine to Russia. But war broke out again between the two countries and ended disastrously for Russia, though she retained the district of Smolensk, and the Ukraine east of the Dnieper. The deep division between the Poles and the Russians on the question of religion ultimately led to further troubles, and when in 1766 the Polish diet refused to grant equal rights and full liberty of conscience to non-Roman Catholic subjects, the flame of rebellion broke out at Slutsk in White Russia.

In 1772 the first partition of Poland between Russia, Prussia and Austria made the western Dvina and the Drut the Russian frontier, so that a portion of White Russia with 1,600,000 inhabitants came under Russian rule. By the second partition of Poland in 1793, Russia acquired all the rest of White Russia, a large part of Black Russia (the territory between the Pripet and the Niemen, west of the Berezina), and the Ukraine west of the Dnieper, and in 1795, by the third partition extended her territories to include Courland and all the rest of Lithuania and Black Russia. During this long struggle between Poland and Russia, the territory of the White Russians was repeatedly fought over and devastated, and a general low level of cultural and economic conditions in the region ensued. In 1812 the unfortunate country was crossed by Napoleon's army on its march to and from Moscow *via* Smolensk, and suffered further devastation, from which it had not recovered when war broke out in 1914. It then lay close to the war zone and shared in the disorder and disasters of the Russian retreat in 1916.

After the 1917 revolution a committee of workers, soldiers and peasants of the western front was formed and an attempt to establish a soviet system was thus made. But in February 1918 Minsk and the whole region as far as the Dnieper was occupied by German troops, withdrawn in November 1918, after the revolution in Germany. The soviet of workers and peasants then declared an independent White Russian republic and efforts were made to form a joint Lithuanian and White Russian republic. But early in 1919 war again broke out with Poland and Polish troops occupied the district. Finally, by the treaty of Riga, 1921, peace was declared between Poland, Russia and the Ukraine, the western part of White Russia passing under Polish rule. The soviet government in 1924 and 1926 extended the boundary of White Russia eastwards to include Vitebsk and Gomel and a strip of territory on the east bank of the Sozh. In November 1939, during the Polish-German war, the soviet union occupied the White Russian provinces of Poland and united them with the White Russian S.S.R. The republic was overrun by German armies in 1941 but by July 1944 had been retaken entirely by soviet troops.

WHITE SLAVE TRAFFIC. The movement for the suppression of the international traffic in women and children for immoral purposes may be said to some extent to date from the attempt, in the middle of the 19th century, to introduce what may be described as a system of state regulation of vice into England. This system owed its introduction to the remarkably high incidence of venereal disease at that period among soldiers and sailors, and as a result, in 1864, the first of the contagious diseases acts was passed. There were then, and still are, two bodies of opinion; in some cases the state recognized prostitution as a necessity which could not be overlooked, but which called for control by registration and sanitary supervision; in other countries a strong body of opinion favoured no such recognition. In 1875 a meeting was called by Josephine Butler in Geneva to consider white slave traffic from its international aspect and in its relation to state regulation, and as a result the International Federation for the Abolition of State Regulation of Vice was formed. In 1898 and 1899 William Alexander Coote, the secretary of the National Vig-

ilance Association of Great Britain, visited Germany, Holland, Belgium, France, Russia, Switzerland, Spain, Austria and the Scandinavian countries, and in the capital of each organized a national committee for the suppression of white slave traffic. An international congress was therefore held in London in June 1913, and at that congress the International Bureau for the Suppression of White Slave Traffic was constituted to co-ordinate the work of the national committees. The French Government had called an official conference in Paris in 1904, and an international agreement was drafted, under which the signatory powers undertook to appoint a central authority in each country charged with the co-ordination of all information relative to the traffic. The signatories undertook to ensure vigilance at ports and railway stations, to notify the arrival in each country of suspected persons, to take declarations from alien prostitutes, to protect and maintain the victims of the traffic pending repatriation (for which they also took the responsibility) and to supervise registry offices or agencies engaged in finding employment for women and girls abroad.

In 1910 a second governmental conference was called in Paris. A convention drawn up after this conference provided for the punishment of procurers for immoral purposes of girls and women, either minors or of full age, in whatever country the various acts constituting the offence might be committed. It provided also for the enactment, in those countries where needed, of the necessary legislation. In addition to the official conferences mentioned, the International Bureau was instrumental in calling together conferences and congresses in various parts of Europe.

The names of four persons will always be remembered for their active association with the early movement for abolition of the traffic in women and children: Josephine Butler and W. A. Coote (England), Senateur Beranger (France), and Alfred de Meuron (Switzerland).

Work of the League of Nations.—Such was the preliminary work done before the League of Nations came into existence on Jan. 10, 1920. Article 23 (c) of the Covenant states that members "will entrust the League with the general supervision over the execution of agreements with regard to the traffic in women and children." On the decision of the first assembly of the League, a questionnaire was sent to all Governments to ascertain the measures taken or proposed in the various countries to put an end to the traffic. The Council of the League was also invited to convene an international conference. Thirty-four States were represented at this conference, which was held in Geneva from June 30 to July 5, 1921. To it were invited, not only States parties to the previous international engagements, but all States willing to take part, and the meetings were open to the public. The conference examined the replies to the questionnaire, and a Final Act was adopted containing a number of recommendations requiring action by Governments. This Final Act was approved by the Council and, in Sept. 1921, the Assembly invited all Governments to authorize their delegates to sign forthwith a convention submitted by the British Government in which many provisions of the Final Act were given conventional form. This convention was open for signature on Sept. 30, 1921; it has been signed by 34 States, 28 of which (including the British Empire, the Dominions of Australia, Canada, New Zealand and South Africa and India) have ratified the convention. Twenty-seven British colonies and dependencies and the territory of 'Iraq (British mandated territory) have adhered.

The new convention was not intended to replace the earlier instruments, but to supplement them, and it is for that reason that the first article prescribes that the high contracting parties, if not already parties to the agreement of 1904 and the convention of 1910, shall ratify or adhere to them without delay. Other new provisions in the convention are that the punishments prescribed under the convention of 1910 for those who traffic in women and girls are made applicable to those who engage in the traffic of children of either sex. The punishment is required not only of those guilty of offences committed, but of attempts to commit the offence and, within legal limits, of acts preparatory to the committing of such offence. The minimum age under which it is an offence to procure a woman for immoral purposes, even with her consent, previously fixed at 20, is raised to 21. In addition, the provisions of the convention of 1921 relating to extradition go further than those of the convention of 1910, the parties agreeing that in cases where no extradition convention exists between two countries, they will take all measures in their power to extradite or provide for the extradition of persons accused or convicted of certain offences specified under the convention of 1910. They also undertake to prescribe such regulations as are required for the protection of women and children seeking employment in another country, if they have not already done so.

The Advisory Committee.—Another outcome of the conference of 1921 was the setting up of an advisory committee to the Council on all matters relating to the traffic in women and children. This committee sat for the first time in June 1922. It was composed of delegates of Governments, and of assessors appointed by international voluntary organizations. During its six meetings it had under special consideration the questions of employment of women abroad by theatrical, variety, concert and cinema agents, the moral welfare of women and children on emigrant ships; the consideration of the system of licensed houses; the employment of women police, and the consideration of the laws and regulations in force in various countries for suppressing the traffic.

Of these questions, one which has been given much importance is that of the system of the licensed house. Though it may be maintained that the regulation of vice in any country is purely an internal and national question, it was the opinion of a large number of members on the advisory committee that the licensed house stimulates immorality and encourages an international trade to supply a certain market. The committee gave special attention to the subject, and as a result of its investigations, the Council "recognizing the connection which may exist between a system of licensed houses and the traffic in women and children," invited States which had abandoned the system to explain the motives of their decision in abandoning it, in so far as they concern the traffic; and States which still maintain the system to indicate whether their experience leads them to believe that the system encourages the international traffic or otherwise.

The majority of answers received appear to indicate a strong movement for the abolition of the licensed house system, which some of the new States created by the Treaty of Versailles adopted and subsequently abandoned. The reasons given by these States and others for this abolition are various. It is said, for example, by some that the system has not justified expectation, and has tended to disseminate rather than diminish venereal disease. It is the opinion given by more than one State that the licensed brothel has proved itself to be a permanent factor in the traffic in women and children, in fact that the traffic owes its very life to the existence of the licensed brothel. The Dutch Government, in giving the reasons for the abolition of the system of regulation in that country, state that experience has shown that the traffic depends on the existence of the licensed brothel and that its abolition has almost killed the traffic. On the other hand certain countries, in replying, say that they maintain the system in the interests of public health. This is sometimes qualified by the statement that there is an obvious contradiction existing between the system of tolerance and the higher end of the State, or that the State has decided to give the matter serious attention in view of the growing public opinion in favour of abolition, and in other reports it is said that although the system is maintained, a scheme is in course of preparation for its suppression.

The Expert Investigation, 1924–1926.—To ascertain the extent of the world's traffic, the routes which it follows and the individuals or organizations connected with it, a small body of experts was nominated to make a world investigation on the spot with the consent of and in conjunction with the Governments concerned. This investigation was financed by the American Bureau of Social Hygiene.

The experts were chosen on the ground of special knowledge and qualifications, irrespective of nationality, the Social Section of the League of Nations supplying the secretarial assistance.

The principles laid down in conducting the enquiry were as follows:

(a) The enquiries must be carried on only by trained and experienced persons;
(b) Each enquiry should relate to a limited area;
(c) Each enquiry should be detailed and thorough;
(d) The enquiries should be begun, as far as possible, in cities and countries to which women are alleged to have been sent for purposes of prostitution.

The investigators visited some of the chief cities in 28 countries, including countries in Europe, countries in northern Africa bordering on the Mediterranean, countries in North America, Central America and countries on the Atlantic coast of South America.

In March 1927, the committee of experts presented the report of their investigations into the extent of the traffic in women and children to the Council. This report shows that a traffic in women and children exists beyond a doubt. They name those countries which appear to them to be the chief countries of demand or supply. The report lays special stress on the necessity for closer international co-operation and a more widespread knowledge of the position with the idea of creating a sound and vigilant public opinion. It recommends that increased penalties should be enforced for the person making a profit out of the moral degradation of another and it closes with a statement to the effect that "the difficulty of eliminating the third party element becomes greater in countries where the keeping of brothels is legal, where licensed houses exist and where the system of registering prostitutes is maintained." "The existence of licensed houses," say the experts, "is undoubtedly an incentive to traffic, both national and international." "It behoves all governments," the report goes on to say, "which place reliance on the older system of preventing the spread of venereal diseases to examine the question thoroughly in the light of the latest medical knowledge and practice and to consider the possibility of abandoning a system which is fraught with such dangers from the point of view of international traffic." (*See* also PROSTITUTION.)

BIBLIOGRAPHY.—*Reports* of the International Conference on Traffic in Women and Children (Geneva 1921); the *Reports* of the League of Nations Advisory Committee on Traffic in Women and Children (6 sessions, 1922, 1923, 1924, 1925, 1926, 1927); J. Butler, *Personal Reminiscences of a Great Crusade; Reports* of the International Bureau for the Suppression of Traffic in Women; *Report* of Experts on Traffic in Women and Children (Geneva 1927). (R. E. C.)

WHITE STAR LINE, the name by which the ships of the Oceanic Steam Navigation Company were known, was founded by T. H. Ismay in 1869. The pioneer steamer of the fleet, the "Oceanic" (3,877 tons), left Liverpool for New York in March 1871. Further vessels were subsequently added, outstanding vessels including the "Britannic" and "Germanic" (1889) and the second "Oceanic" commissioned in 1899.

An important development in the company's activities in 1899 was the inauguration of a passenger and cargo service to South Africa and Australia. Five 12,000 ton vessels were ordered for this trade. They were the "Afric", "Medic", "Persic", "Runic" and "Suevic."

Plans were also completed for the construction of a fleet of intermediate liners of large tonnage and moderate speed for the North Atlantic services. The first of the vessels, "Celtic" (21,000 tons), was commissioned in 1901, followed in turn by the "Cedric" (21,000 tons), "Baltic" (23,876 tons) and "Adriatic" (24,679).

The company became part of the American owned International Mercantile Marine Company in 1902.

In 1907 the mail service previously operated from Liverpool was transferred to Southampton whilst in 1909 the White Star Line combined with the Dominion Line in forming a joint service from Liverpool to Canada. The first steamers of this White Star Dominion Line service were the first "Laurentic" (14,892 tons) and the "Megantic" (14,878 tons).

The Southampton-New York service was reinforced in 1911 by the commissioning of the "Olympic" (46,439 tons). The "Britannic" (47,500 tons), ordered in 1914, was sunk during the War.

After the Armistice the company acquired the "Majestic" (ex-"Bismarck"), 56,551 tons, and the "Homeric" (ex-"Columbus"), 34,356 tons. These two vessels with the "Olympic" maintained the company's express service from Southampton and Cherbourg to New York. The Liverpool-New York service was carried out by the "Adriatic", "Baltic", "Cedric" and "Celtic." In 1923 the "Doric" (16,484 tons) and "Alberic" (18,940 tons) were commissioned.

An important event took place in 1926 when the shares of the Oceanic Steam Navigation Company, Limited were purchased from the International Mercantile Marine Company by the White Star Line Ltd. In the following year (1927) the White Star Line was sold to the Royal Mail Steam Packet Company.

The "Laurentic" (18,724 tons) was added to the fleet in 1928 being commissioned for the company's Canadian services. Subsequently two new motor vessels were ordered for the New York service. They were the "Britannic" (26,943 tons) completed in 1930 and the "Georgic" (27,759 tons) which entered the service in 1932. In 1934 the North Atlantic assets of the White Star Line comprising a fleet of ten liners representing a gross tonnage of 286,923 were merged with the North Atlantic assets of the Cunard Steamship Company.

Shortly after this merger seven of these steamers were withdrawn from service. They included the "Majestic" (now H. M. Training Ship "Caledonia"), "Olympic" and "Homeric." The remaining units which in 1939 formed part of the Cunard White Star Atlantic fleet were the "Georgic", "Britannic" and "Laurentic." *See* INTERNATIONAL MERCANTILE MARINE COMPANY and CUNARD WHITE STAR LINE. (L. C. M.; X.)

WHITETHROAT, a name given to two little birds belonging to the *Sylviidae* or warblers (*q.v.*). The common whitethroat or nettlecreeper, *Sylvia cinerea,* is widely spread over Great Britain, in some places common. It is a restless bird, and in spring the male often gives his song on the wing. The lesser whitethroat, *Sylvia curruca,* is less often seen. The plumage is smoky-grey above and white below. Its song is unusual, consisting of a series of repeated notes, the usual "warble" being reduced to a short preface inaudible at a little distance. The nests of each of these species are built of bents or other plant-stalks, and usually lined with horsehair; the eggs are spotted with olive-brown.

WHITGIFT, JOHN (1530?–1604), English archbishop, was the eldest son of Henry Whitgift, merchant of Great Grimsby, Lincolnshire, where he was born. He was educated by his uncle, Robert Whitgift, abbot of the neighbouring monastery of Wellow, then at St. Anthony's school, London, and finally at Cambridge, where he became a fellow of Peterhouse in 1555. Having taken orders in 1560, he became chaplain to the bishop of Ely, who collated him to the rectory of Teversham, Cambridgeshire. In 1563 he was appointed Lady Margaret professor of divinity at Cambridge, and in 1564 regius professor of divinity. He became master first of Pembroke Hall and then of Trinity. He had a principal share in compiling the statutes (1570) of the university, and in November of the same year was chosen vice-chancellor. Macaulay's description of Whitgift as "a narrow, mean, tyrannical priest, who gained power by servility and adulation," is unjust, but he was intolerant and arbitrary. Whitgift, with other heads of the university, deprived Thomas Cartwright in 1570 of his professorship, and in Sept. 1571, as master of Trinity, deprived him of his fellowship. In June of the same year Whitgift was nominated dean of Lincoln. In the following year he published *An Answere to a Certain Libel intituled an Admonition to the Parliament,* which led to further controversy with Cartwright. On March 24, 1577, Whitgift was appointed bishop of Worcester, and during the absence of Sir Henry Sidney in Ireland (1577) he acted as vice-president of Wales. In August 1583 he was appointed archbishop of Canterbury. Although he wrote a letter to Queen Elizabeth remonstrating against the alienation of church property, Whitgift always retained her special confidence. In his policy against the Puritans, and in his vigorous enforcement of the subscription test, he thoroughly carried out the queen's policy of religious uniformity. He drew up articles aimed at nonconforming ministers, and obtained increased powers for the Court of High Commission. In 1586 he became a privy councillor. His action gave rise to the Marprelate tracts, in which the bishops and clergy were bitterly attacked. Through Whitgift's vigilance the printers of the tracts were discovered and punished; and in order more effectually to check the publication of such opinions he got a law passed in 1593 making Puritanism an offence against the statute law. In the

controversy between Walter Travers and Richard Hooker he interposed by prohibiting the preaching of the former and he moreover presented Hooker with the rectory of Boscombe, Wilts., in order to afford him more leisure to complete his *Ecclesiastical Polity*, a work which, however, cannot be said to represent either Whitgift's theological or his ecclesiastical standpoint. In 1595 he, in conjunction with the bishop of London and other prelates, drew up the Calvinistic instrument known as the Lambeth Articles, which were not accepted by the church. Whitgift attended Elizabeth on her deathbed, and crowned James I. He was present at the Hampton Court Conference in Jan. 1604, and died at Lambeth on Feb. 29 of that year. He was buried in the church of Croydon. Whitgift was noted for his hospitality, and was ostentatious in his habits, sometimes visiting Canterbury and other towns attended by a retinue of 800 horsemen. His name is commemorated in the hospital for poor persons and the schools founded by him at Croydon in 1595.

Whitgift left several unpublished works, which are included among the mss. *Angliae*. Many of his letters, articles, injunctions, etc., are calendared in the published volumes of the "State Paper" series of the reign of Elizabeth. His *Collected Works*, ed. for the Parker Society by John Ayre (3 vols., Cambridge, 1851–53), include, besides the controversial tracts already alluded to, two sermons published during his lifetime, a selection from his letters to Cecil and others, and some portions of his unpublished mss.

A *Life* of Whitgift by Sir G. Paule (1612, 2nd ed. 1649) was embodied by John Strype in his *Life and Acts of Whitgift* (1718). There is also a life in C. Wordsworth's *Ecclesiastical Biography* (1810), W. F. Hook's *Archbishops of Canterbury* (1875), and vol. i. of Whitgift's *Collected Works*. *See* also H. J. Clayton, *Whitgift and his Times* (1911).

WHITHORN, royal and small burgh of Wigtownshire, Scotland, 12¼ mi. S. of Wigtown by the L.M.S.R. Pop. (est. 1938) 994. St. Ninian or Ringan, the first Christian missionary to Scotland, landed at the Isle of Whithorn, where he built (397) a stone church, which, out of contrast with the dark mud and wattle huts of the natives, was called Candida Casa, the White House. Ninian was buried in the church. The Magnum Monasterium, or monastery of Rosnat, was founded 100 years later and in the 8th century became the seat of the bishopric of Galloway. It was succeeded in the 12th century by St. Ninian's Priory, built for Premonstratensian monks by Fergus "King" of Galloway, of which only the chancel (used as the parish church till 1822) and other fragments remain. In Roman times Whithorn belonged to the Novantae, and Camden identified it with the Leukopibia of Ptolemy. (See *Whithorn Priory* [H.M.S.O. Edinburgh, 1928].)

WHITING, a city of Lake county, Indiana, U.S.A., on Lake Michigan and the Illinois State line, 17 m. S.E. of the Chicago "Loop." It is on Federal highways 20 and 41, and is served chiefly by the Baltimore and Ohio, the New York Central, the Pennsylvania and the Pere Marquette railways, and lake steamers. Pop. 10,880 in 1930; in 1940, 10,307 by the federal census. Whiting is the centre of the industrial region known as the Calumet District, and its boundaries touch those of Hammond and East Chicago. Its principal industry is the refinery of the Standard Oil Company of Indiana. The city's assessed valuation for 1940 was $24,265,355. Whiting was founded in 1881, incorporated as a town in 1895, and chartered as a city in 1903.

WHITING (*Gadus merlangus*), a silvery fish that ranges from Norway to the Mediterranean, and differs from the cod in having no barbel. It is valued as a food fish, and reaches a weight of about three pounds.

WHITLEY, JOHN HENRY (1866–1935), Speaker of the British House of Commons, was born at Halifax on Feb. 8, 1866, and educated at Clifton college and London university. He was elected Liberal M.P. for Halifax in 1900, and represented his native city for 28 years. From 1907 to 1910 he was junior lord of the treasury, and in 1910 became deputy chairman of ways and means. From 1911 to 1921 he was chairman of ways and means and deputy speaker. In 1916 he acted as chairman of the Reconstruction Committee on Relations between Employers and Employed, and his name has become associated with the joint industrial councils established for many industries as a result of the reports of that committee. Whitley was appointed Speaker in 1921, retiring in 1928 and declining a peerage. His urbane manner in dealing with delinquents was notably effective. In 1930 he became chairman of the British Broadcasting Corporation.

WHITLEY COUNCIL: *see* INDUSTRIAL RELATIONS.

WHITLOCK, BRAND (1869–1934), American diplomat and writer, was born at Urbana (O.), March 4, 1869. As a political reporter on the Chicago *Herald* and as assistant in the office of the Illinois secretary of state, Mr. Whitlock came in contact with John P. Altgeld, governor of Illinois who, like "Golden-Rule" Jones, mayor of Toledo, did much to develop his political idealism. He was admitted to the Illinois bar in 1894, and to the bar of Ohio in 1897. From that year until 1905 he practised law in Toledo and then as an Independent became mayor for four terms, in 1911 refusing nomination a fifth time. The record of his labours for the "Free City" of which he dreamed is told in his autobiography *Forty Years of It* (1914, new edition 1925).

In 1913 he was appointed U.S. minister (later ambassador) to Belgium. Before he had been in Belgium a year the World War broke out and the German invasion took place. Although the other diplomatic bodies followed the Belgian Court to Havre, Whitlock insisted on remaining in Brussels. It was largely due to his urgent advice that Brussels did not resist, and thus escaped devastation. In the early days of the war he gave protection to many German residents who had been unable to leave the country. By his firm attitude toward the German military officials he saved many innocent Belgians from death; but his activities on behalf of Edith Cavell were unavailing as he was misled at the last moment through false promises by the Germans. After the formation of the Commission for Relief in Belgium, its operations were placed wholly under his direction. His ceaseless work on their behalf won the gratitude of all Belgians and was rewarded by many honours. Mr. Whitlock resigned Feb. 1, 1922. An account of his experiences is given in *Belgium, a Personal Narrative* (1919).

Whitlock himself spoke of vacillating "between an interest in letters and an interest in politics," and there is no doubt that his early literary work, at least, reflected this duality of tastes. *The 13th District* (1902) revealed the insidiously corrupting influence of certain phases of politics; and *The Turn of the Balance* (1907), a poignant exposure of social injustices, was written "out of the contemplation of the misery, the pathos, the hopelessness of the condition" of the victims during his police court experiences. A fruit of his administrative work is the monograph *On the Enforcement of Law in Cities* (1913). His later novels, such as *J. Hardin and Son* (1923) and *Uprooted* (1926), are less concerned with ethical problems. His technique at all times, however, has revealed his admiration for the ideals and methods of William Dean Howells. In 1929 he published, *La Fayette*, a biography.

WHITMAN, WALT (1819–1892), American poet, was born near Huntington, Long Island, on May 31, 1819. His father, of 17th century English freeholding stock long settled in Huntington township, was a farmer and later a house-builder, democratic in politics and inclined toward Quaker liberalism in religion. Of robust Dutch and Welsh farming and seafaring descent was his "perfect mother," who, though possessing as little education as her husband, deeply impressed her son through her sanity, practicality, encompassing affection and intuitive spiritual nature. The family moved to the village of Brooklyn about 1824, where Walt attended the public schools until he was twelve. His real education, however, was acquired through wide and thoughtful reading of a great mass of current, romantic, classical and oriental literature; through intimate contacts with nature and the metropolis across the East river, where he had opportunities for constant attendance at lectures, exhibitions, theatres, concerts, operas and political gatherings and for associating with "powerful uneducated persons" like boatmen and omnibus drivers, as well as politicians, literary and artistic Bohemians, and more prominent persons; through several years of country school teaching on Long Island, "boarding round" among the honest, independent bourgeoisie; through travel, especially in the West and the South, which developed in him an enduring sympathy for all sections; and finally through long association with magazines and newspapers, as journeyman compositor, contributor of conventional prose and verse

or editor, an association which awakened in him literary ambitions and encouraged a national point of view.

An earnest of his future authorship was given as early as 1846–48, when, editing the democratic *Brooklyn Daily Eagle,* Whitman expressed the religio-patriotic enthusiasm he had inherited from revolutionary ancestors. He championed the sentimental and idealistic reforms popular in the "transcendental" period of American thought and voiced the adolescent spirit of nationalism in his demand for native manners, drama, opera and literature. In politics, temperament and philosophy always a staunch individualist, he opposed the extension of slavery into the new States of the Union so uncompromisingly as to lose his editorial position on the conservative *Eagle,* though for that same opposition he was shortly afterward put in charge of the *Brooklyn Daily Freeman.*

In 1855 Whitman published *Leaves of Grass.* This was a large, thin volume as odd in format and style as it was original in mood and thought, yet in it Emerson, himself a strong influence in its creation, perceived great promise as being "the most extraordinary piece of wit and wisdom America has yet contributed." Having absorbed his country until he thought himself fundamentally typical of it, Whitman here began a lifelong attempt not only to record himself, body and soul, in poetic autobiography, but also to create a character-epic of America. "Most of the great poets are impersonal," he said, "I am personal. . . . In my poems, all revolves round, concentrates in, radiates from myself. I have but one central figure, the general human personality typified in myself. But my book compels, absolutely necessitates, every reader to transpose himself or herself into the central position, and become the living fountain, actor, experiencer himself or herself, of every page, every aspiration, every line." Such a purpose naturally led him to discard conventional poetic methods, of form, atmosphere and allusion, and to rely upon the direct address of rhythmical declamation.

The book met a varied reception. At first there were few to rate it except according to the current standards from which Whitman appealed, though Thoreau, who visited him in Brooklyn, considered him "probably the greatest democrat that ever lived." Despite general neglect and frequent abuse, Whitman continued through life to complete the record of his inner growth and changes, often publishing poems or groups of poems separately, but finally incorporating them all in the parent volume, *Leaves of Grass.* Following the insistent, arrogant, if frequently sublime, egotism of the editions of 1855, 1856 and 1860 came a treatment of democracy *en masse,* a socializing result due to Whitman's personal contact with the armies in the national capital.

For ten years, 1863–73, Whitman lived in Washington acting as war correspondent and government clerk, but spending much of his time, means and strength during war years in daily ministrations to the wounded Northern and Southern soldiers in the hospitals. His reactions to, and interpretations of, the great struggle which was testing democracy, always to him more a religion than a political creed, are to be found in *The Wound-Dresser,* a volume of war-time letters to his mother, in *Drum-Taps,* a little volume of virile yet compassionate war poems, including the universally admired *When Lilacs Last in the Door-yard Bloom'd* on the death of Lincoln, and in parts of *Specimen Days,* picturesque descriptions of his activities and observations. Not only did the Civil War discipline his poetic art, making it objective as well as subjective, teaching him to sing of the nation as a nation, in terms of mature idealism, no longer as a mere land of opportunity affording "open roads" to individual self-realization; but it also laid the foundation for his influence as an international force by making him the prophet of a world at last united in peace. Whitman's most important essay, *Democratic Vistas,* if one except the famous preface of 1855 and *A Backward Glance O'er Travell'd Roads,* was likewise a result of the war.

Stricken with paralysis in 1873, partly as a result of hospital labours and exposure, Whitman went to spend his last 19 years of invalidism in Camden, N.J. His creative work was thus ended before his plan was complete, the sweet reasonableness of his maturity being less fully represented than the hopeful self-reliance, the exuberant spirit of his youth; nearly all the poems after 1873 betray a flagging imagination and a lowered vitality, though losing none of his cheerfulness or faith.

Gradually, at home and abroad, defenders of the poet took up his cause as something more than a literary fad: John Burroughs, his first biographer; William Douglas O'Connor, whose *Good Gray Poet,* castigating Secretary Harlan for dismissing Whitman from a Department of the Interior clerkship because of his authorship of *Leaves of Grass,* gave the gray-haired, gray-garbed poet his popular sobriquet; Dr. Richard Maurice Bucke, who cared for him as a patient, wrote the first considerable biography to present Whitman as a mystical superman, and edited several volumes of Whitman letters and notes; Horace Traubel, who in the poet's last years and later played the devoted but by no means sycophantic Boswell to him; William Michael Rossetti, whose volume of selections from Whitman's poems early (1867) and tactfully introduced him to the general English public; John Addington Symonds, who, like Stevenson, was stimulated and refreshed by the healthy spirit and universal sympathies of Whitman, declaring that the American bard had influenced his life more than any book save the Bible, and shortly after Whitman's death wrote an acute and sympathetic study of his work; and others in Germany, Denmark and France who translated Whitman and interpreted him to the Old World.

He had been long in overcoming the prejudice aroused by his conception of art, his "heroic nudity" in the treatment of nature in the human body, and what was taken to be his "egotism"; but when he died in his humble home in Mickle street, now a museum, it had already become a shrine where actors, artists and lovers of free letters were frequent pilgrims, and he, the cheerfulest poet of immortality, passed away content to believe that his vision of a larger life for man had been caught by others.

The Man.—Whitman and his works were as paradoxical as the age and land they sought to express. A large, healthy, hirsute body fond of nature and of sense enjoyments was no more characteristic of him than his womanly sensitiveness and quiet sympathy; his courageous imagination which might either express itself in terms of adolescent egotism or in haunting songs of those "eidolons" which ever lure on the race of hardy spiritual pioneers was no more fundamental than his engaging mystical naïveté which so strongly affected those who came into personal relations with him and made him the "caresser of life wherever flowing"; and his quest of ideal beauty always followed, even while decrying art for art's sake, was not pursued by turning his back on the realities of commonplace life or even the turbulence of modern industrialism. Having a highly developed artistic instinct, which was at times unmatched by any commensurate talent, and was still more often (especially in the early editions) thwarted by his impulse toward propaganda, he was, as he said, "both in and out of the game"—he could criticize as well as create. The hiatuses in the record and the mystical indefiniteness of his expression render a precise statement of his Hegelian philosophy difficult; it is more profitable, however, as he rightly divined, to treat his purpose as fundamentally religious, however suggestive its philosophical and aesthetic implications. "No one will get at my verses who insists upon viewing them as aiming mainly towards art or aestheticism," he insisted; and if there be less truth in the statement to-day than when it was made, it is largely due to his own influence in widening our conception of the function of literature and art.

If Whitman be to-day the most vital literary force America can show, it is because he began by sitting at the feet of the world's greatest masters of song, imbibing something from every philosophy, every religion. His art, his thought, his form is modern because it is fundamentally eclectic. Doubtless Homer, Sophocles, Euripides, Epictetus, Dante, Cervantes, Shakespeare, Goethe, Rousseau, Carlyle, Shelley, "Ossian," Scott, Bryant, the Hindu scriptures, Emerson and many others, each long and intimately studied, often in the midst of wild nature, and checked against a wide experience with modern American life, gave him that transcendental self-respect which had courage to respond when the

mystical call came to him. And yet such large perception as his, freed him at once from mere imitation and the dread of inconsistency. There is room for Nature here, as well as God. Underlying his poems is what he called an "implicit belief in the wisdom, health, mystery, beauty of every process, every concrete object, every human or other existence, not only considered from the point of view of all, but of each."

Religion.—Viewing the future of America, Whitman came to believe that the safety of his country lay in a renaissance of the religious spirit. This was to be brought about, not through institutionalism but by the dissemination of good will and friendship and the creation of realistic and imaginative poetry which would reduce the school, church and State to mere instruments of national self-expression. That the modern world demanded a new image of manly virtue he was persuaded through his welcome acceptance of two ideas already fermenting 19th century thought; one was the shifting of authority in politics, taste and economics, from the favoured few to the many, from the traditions of the past to the claims of the future; the other idea was the new conception of history as an evolutionary growth according to natural law, which, while giving prominence to the natural sciences that sought to explain the concrete and the real tried also to relate life at any given moment to an infinite scheme of progress.

In America Whitman saw a symbol of that spiritual pioneering which, seeking perpetually a passage to India, links each age to a larger one. His "Prayer of Columbus" is a fitting tribute to the discoverer of America from its self-appointed poet. Yet with his idealism he blended a certain pagan epicureanism; while recognizing personal and social imperfections, he saw in them the very necessity out of which aspiration grows. In his attempt through *Leaves of Grass* to show forth the spirit of his country made flesh, Whitman did not need to claim the ascetic perfection which was the boast of early Puritans and prophets. The modern man he conceived to be fit to dwell in a world evolving through democracy, was proud, arrogant, just, tolerant, friendly, willing to treat woman as his equal, glorifying progress yet scorning material achievement as an end, suspicious of extremists yet indulging an intemperate relish for life and an unbounded faith in the future.

His poetry is to-day read in 25 different translations and claims more space in each new anthology and study of American literature. Its indirect effect already appears in a younger generation of writers of verse, fiction and biography, who find the Whitman of Victorian days strangely contemporary with an age of psychoanalysis, realistic fiction, frank treatment of sex, enfranchised womanhood, proudly self-conscious labour, and a growing spirit of international good-will.

BIBLIOGRAPHY.—Full bibliographies may be found in O. L. Triggs, *Selections from Walt Whitman* (1906); *Cambridge History of American Literature* (1918); Carolyn Wells and Alfred F. Goldsmith, *A Concise Bibliography of Walt Whitman* (1922); W. S. Kennedy, *The Fight of a Book for the World* (1926). *The Complete Writings of Walt Whitman* (1902), has been supplemented by Emory Holloway, *The Uncollected Poetry and Prose of Walt Whitman* (1921); Cleveland Rodgers and John Black, *The Gathering of the Forces* (1921). Biographical and critical studies by those who knew Whitman personally include Richard Maurice Bucke, *Walt Whitman* (1883); Thomas Donaldson, *Walt Whitman: the Man* (1896); John Burroughs, *Whitman: A Study* (1896); Edward Carpenter, *Days with Walt Whitman* (1906); Horace Traubel, *With Walt Whitman in Camden* (1906, 1908, 1914); J. Johnston and J. W. Wallace, *Visits to Walt Whitman in 1890–1891* (1918); Elizabeth Leavitt Keller, *Walt Whitman in Mickle Street* (1921). *The Letters of Anne Gilchrist and Walt Whitman* was edited by Thomas B. Harned (1918). Other important studies are John Addington Symonds, *Walt Whitman: A Study* (1893); Henry Bryan Binns, *A Life of Walt Whitman* (1905); Bliss Perry, *Walt Whitman: His Life and Work* (1908); Léon Bazalgette, *Walt Whitman L'Homme et son Oeuvre* (1908); Basil de Selincourt, *Walt Whitman: A Critical Study* (1914); John Bailey, *Walt Whitman* (1926); Emory Holloway, *Whitman: An Interpretation in Narrative* (1926).

(E. HOL.)

WHITMAN, a town of Plymouth county, Massachusetts, U.S.A., 20 mi. S. by E. of Boston, adjoining Brockton; served by the New York, New Haven and Hartford railroad. Pop. in 1930 was 7,638; in 1940, 7,759. The town of South Abington was formed in 1875 from parts of Abington and East Bridgewater and in 1886 it changed its name to Whitman.

WHITNEY, ELI (1765–1825), American inventor, was born on a farm in Westboro (Mass.), on Dec. 8, 1765. He exhibited unusual mechanical ability at an early age and earned a considerable part of his expenses at Yale college, where he graduated in 1792. He soon went to Savannah (Ga.), and accepted the invitation of Mrs. Nathanael Greene, the widow of the revolutionary general, to spend some time on her plantation on the Savannah river, while deciding upon his future course. The construction by Whitney of several ingenious household contrivances led Mrs. Greene to introduce him to some gentlemen who were discussing the desirability of a machine to separate the short staple upland cotton from its seeds. In a few weeks Whitney produced a model, consisting of a wooden cylinder encircled by rows of slender spikes set half an inch apart, which extended between the bars of a grid set so closely together that the seeds could not pass, but the lint was pulled through by the revolving spikes; a revolving brush cleaned the spikes, and the seed fell into another compartment. The machine was worked by hand and could clean 50 lb. of lint a day. A patent was granted on March 14, 1794. Meanwhile Whitney had formed a partnership with Phineas Miller, and they built at New Haven (Conn.) a factory for the manufacture of the gins. They were unable to supply the demand for gins, and country blacksmiths constructed many machines. A patent, later annulled, was granted (May 12, 1796) to Hogden Holmes for a gin which substituted circular saws for the spikes. Whitney spent much time and money prosecuting infringements of his patent, and in 1807 its validity was settled. The South Carolina legislature voted $50,000 for the rights for that state, while North Carolina levied a licence tax for five years, from which about $30,000 was realized. Tennessee paid, perhaps, $10,000. Meanwhile Whitney, disgusted with the struggle, began the manufacture of fire-arms near New Haven (1798) and secured profitable government contracts; he introduced in this factory division of labour and standardized parts.

See Denison Olmsted, *Memoir* (1846); D. A. Tompkins, *Cotton and Cotton Oil* (Charlotte, N. C., 1901); and W. P. Blake, "Sketch of Eli Whitney," in New Haven Colony Historical Society *Papers*, vol. v. (1894).

WHITNEY, WILLIAM COLLINS (1841–1904), American political leader and financier, born at Conway, Mass., July 5, 1841. He graduated at Yale in 1863, studied law at Harvard, and began to practise in New York city. He actively allied himself with the anti-Tammany organization which successfully opposed the "Tweed Ring," and aided in the election of Samuel J. Tilden as governor in 1874. As corporation counsel of New York city (1872–82) he contested some 3,800 suits against the city, inherited from the Tweed régime, and he saved the municipality about $12,000,000. He did much in the way of organization to secure the election of Cleveland in 1884, and under him became Secretary of the Navy (1885–89). He played an important rôle in creating a more modern navy, especially in the building of armour-plated ships. After his term of office he reorganized the Manhattan street railways and established the Metropolitan Street Railway company. His work in 1892 overcame the efforts of T. C. Platt and Tammany Hall, through a "snap convention" to prevent the nomination of Cleveland for a second time. In 1896, disapproving of the "free-silver" agitation, he refused to support his party's candidate, William J. Bryan (*q.v.*). One of his last pieces of work was the organization of the New York Electric Light, Heat and Power company with a capital of $50,000,000. He died in New York city Feb. 2, 1904.

WHITNEY, WILLIAM DWIGHT (1827–1894), American philologist of New England stock, was born at Northampton, Mass., on Feb. 9, 1827. He graduated at Williams college with highest honours in 1845. Although he was at first interested in natural science, after 1848 he devoted himself with enthusiasm to Sanskrit, at that time a little-explored field of philological labour. After a brief course at Yale with Prof. Edward Elbridge Salisbury, then the only trained Orientalist in the United States, Whitney went to Germany (1850) and studied for three years

at Berlin and at Tübingen. In 1854 he was appointed professor of Sanskrit at Yale, and in 1869 professor of comparative philology also. In 1870 he received from the Berlin Academy of Sciences the first Bopp prize for the most important contribution to Sanskrit philology during the preceding three years—his edition of the *Tāittirīya-Prātiçākhya* (*Journal of the American Oriental Society,* vol. ix.). He died at New Haven, Conn., on June 7, 1894.

Whitney edited, with Professor Roth, the *Atharva-Veda-Sanhitā* (1855–56); published, with a translation and notes, the *Atharva-Veda-Prātiçākhya* (1862); made important contributions to the great Petersburg lexicon; issued an index verborum to the published text of the *Atharva-Veda* (*Journal of the American Oriental Society,* 1881); made a translation of the *Atharva-Veda,* books i.–xix., with a critical commentary, which he did not live to publish (edit. by Lanman, 1905); and published a large number of special articles upon various points of Sanskrit philology. His most notable achievement in this field, however, is his *Sanskrit Grammar* (1879). Whitney was editor-in-chief of *The Century Dictionary* (1889–91).

For a bibliography of Whitney's writings and for tributes to him see *The Whitney Memorial Meeting* edit. by C. R. Lanman (1897) and the *Journal of the American Oriental Society* (vol. xix. May 1897). *See* also the *Atlantic Monthly* (March 1895) for an article by C. R. Lanman.

WHITNEY, MOUNT, a peak near the southern extremity of the high Sierra Nevada in Inyo and Tulare counties, California. It is the highest (14,501 ft. above sea-level) summit of the United States, excluding Alaska. From its granite crest can be seen innumerable spires but little lower than its own, segregated by canyons of tremendous depth. Much of the ruggedness and beauty of the regions is due to the erosive action of many alpine glaciers that once existed on the higher summits. Only small patches of ice and snow now exist on its north side. Mt. Whitney was sighted in July 1864 by members of the California State Geological Survey, and was named in honour of their chief, Professor Josiah Dwight Whitney. The first ascent was made on Aug. 18, 1873 by John Lucas, Charles D. Begole and A. H. Johnson, all of Inyo county, Calif. In the same year, Sept. 19, it was climbed by Clarence King, who had failed by only a few hundred feet in 1864, while a member of the State Geological Survey.

See C. King, *Mountaineering in the Sierra Nevada* (1907); and John Muir, *The Mountains of California* (9th ed., 1911).

WHITSTABLE, a watering place and urban district of Kent, England, on the north coast at the east end of the Swale, 6 mi. N.N.W. of Canterbury, on the S. railway. Pop. (est. 1938) 15,590. Area, 12.9 sq.mi. The railway connecting Whitstable with Canterbury, one of the earliest in England, opened in 1830, was closed to passengers in 1930. Whitstable has long been famous for its oyster beds. The urban district includes Tankerton, a resort.

WHITSUNDAY or PENTECOST, one of the principal feasts of the Christian Church, celebrated on the fiftieth (πεντηκοστή) day after Easter to commemorate the descent of the Holy Spirit on the disciples. The day became one of the three baptismal seasons, and the name Whitsunday is now generally attributed to the white garments formerly worn by the candidates for baptism on the vigil, as in the case of the *Dominica in albis.* The festival is the third in importance of the great feasts of the Church and the last of the annual cycle commemorating the Lord. It is connected with the Jewish Pentecost (*q.v.*), not only in the historical date of its origin (*see* Acts ii.), but in idea; the Jewish festival is one of thanks for the first-fruits of the earth, the Christian for the first-fruits of the Spirit. In the early Church the name of Pentecost was given to the whole fifty days between Easter and Whitsunday, which were celebrated as a period of rejoicing (Tertullian, *De idolatr.* c. 12, *De bapt.* 19, *De cor. milit.* 3, *Apost. Canons,* c, 37, *Council of Antioch,* A.D. 341, *can.* 20). As the designation of the fiftieth day of this period, the word Pentecost occurs for the first time in a canon of the council of Elvira (*c.* 305), which denounces as an heretical abuse the tendency to celebrate the 40th day (Ascension) instead of the 50th. There is plentiful evidence that the festival was regarded very early as one of the great feasts; Gregory Nazianzen (*Orat.* xliv. *De Pentec.*) calls it the "day of the Spirit" (ἡμέρα τοῦ Πνεύματος), and in 385 the *Peregrinatio Silviae* (*see* Duchesne, *Origines,* App.) describes its elaborate celebration at Jerusalem.

In the middle ages the Whitsun services were marked by many curious customs. Among those described by Durandus (*Rationale div. off.* vi. 107) are the letting down of a dove from the roof into the church, the dropping of balls of fire, rose-leaves and the like. Whitsun is one of the Scottish quarter-days, and though the Church festival is movable, the legal date was fixed for the 15th of May by an act of 1693. Whit-Monday, which, with the Sunday itself, was the occasion for the greatest of all the mediaeval church ales, was made an English Bank Holiday by an act passed on the 25th of May 1871.

See Duchesne, *Origines du culte Chrétien* (1889); W. Smith and Cheetham, *Dic. of Christian Antiquities* (1874–1880); Herzog-Hauck, *Realencyklopädie* (1904), xv. 254, s.v. "Pfingsten." For the many superstitions and observances of the day *see* P. H. Ditchfield, *Old English Customs* (1897); Brand, *Antiquities of Great Britain* (Hazlitt's edit., 1905); B. Picart, *Cérémonies et coutumes religieuses de tous les peuples* (1723).

WHITTIER, JOHN GREENLEAF (1807–1892), abolitionist and poet, was born Dec. 17, 1807, son of John Whittier, a farmer, on the family homestead, near the town of Haverhill, Essex county, Massachusetts. His ancestor, Thomas Whittier, who had Huguenot blood in his veins, came to America in 1638 with the Puritans. Through the marriage of Thomas's youngest son to a Quakeress, the branch of the family from which the poet was descended became Quakers. The poet had a further accession of Huguenot blood through his paternal grandmother, of the Greenleaf family, some members of which were Indian fighters in colonial days. His mother, Abigail Hussey Whittier, was a Quakeress. Thus the infusion of three different strains had an influence on him, producing a sort of martial pacifist and invoking memories not only of the persecuted but of the persecutor—in the latter case the Puritan. Whittier was the second child, the first being a girl, Mary. His brother, Matthew Franklin, and sister, Elizabeth Hussey, were born later.

Whittier attended district schools, his first teacher being Joshua Coffin, while another, George Haskell, is described in *Snow-Bound.* As a boy he became familiar with nature, and read the books in the house which included not only the Bible and volumes of Quaker history and doctrine, but some works of travel and biography. A volume of Burns's poems, however, lent to him when he was about 15 by Coffin, aroused his ambition to become a poet. From then on he began composing poems and was already writing on themes that occupied him later, in which he voiced hatred of tyranny. Byron also became one of his favourite poets, though with reserve. Whittier appeared in print for the first time by accident. His sister Mary sent a poem of his called "The Exile's Departure" to the *Newburyport Free Press,* edited by William Lloyd Garrison. It was published in the issue of June 8, 1826. Other poems by Whittier appeared and soon the editor visited the poet. The beginning of a friendship that boded well for American literature and history thus began. Garrison published about 19 poems by Whittier during the rest of the year. Then Abijah W. Thayer, editor of the *Haverhill Gazette,* soon to be called the *Essex Gazette,* introduced him in its columns in Jan. 1827. They both recommended a further education for him to his father, and as a result Whittier entered the Haverhill academy in the late spring of 1827—a new school for which he wrote the dedication poem. Whittier spent another term here the following year. At the same time he was extending his small audience, for Nathaniel Greene, editor of the *Boston Statesman* also published his poems prefixing an extravagant eulogy of him to one of them. As early as Jan. 1828 Thayer sought to publish Whittier's poems in book form under the name *The Poems of Adrian,* "Adrian" being one of the pseudonyms used by the poet, but the plan fell through. During the year 1828, poems of his were appearing in both Thayer's and Greene's newspapers, and several other publications. Some of his poems were even being copied in Philadelphia and elsewhere.

Through Garrison's offices Whittier became editor in 1829 of a Henry Clay paper in Boston, the *American Manufacturer.* For

nearly the eight months during which he was here he wrote not only more poems, but prose editorials on literature and politics. Whittier, the political partisan, thus emerged.

In the fall he returned to Haverhill but was soon in the editorial saddle again, for his friend Thayer offered him a position as editor of the *Essex Gazette*. Whittier accepted and remained here a little over a half a year writing more editorials and poems. His father died in the early summer of 1830 and he returned home to take care of the farm. But it seemed to be ordained that he should still be an editor, for during the same summer he was called to head the *New England Review* in Hartford, Conn., to which its former editor George D. Prentice recommended him, since he himself had been summoned to Kentucky to write a life of Henry Clay, who was to become a presidential candidate on the National Republican ticket for the 1832 election. Whittier spent a year and a half on the magazine and did here some notable work, seeking to foment anti-Jackson sentiment. He engaged in several controversies, but also found an outlet for numerous sketches, short stories, essays and more poems. One of the latter, "New England," was very widely copied but he did not include it among his collected poems. He was for a brief time in New York helping gather material for Prentice's biography of Clay. He also first appeared as an original author of a book in the early part of 1831 with *Legends of New England,* made up of short stories and poems, most of the latter of which had appeared in the *Essex Gazette* when he was employed there the previous year. He left Hartford in the fall of 1831 and owing to illness never returned. He was meanwhile chosen as a delegate to the National Republican convention but while making an effort to attend it, he had to forego the trip.

A crisis in his life was now developing, brought about largely by a long-drawn-out love affair that showed itself in his poetry at the time. Lugubrious love poems had been appearing in the *New England Review* as indeed they had appeared in the *American Manufacturer* and other papers. A Boston contemporary reproached him for writing too much love poetry in the *Review.* Most of the poems had a common note—rejection by a girl who had trifled with the lover's affections. These were more than merely poetic exercises and the story behind them was that of his love for Mary Emerson Smith.

Whittier had met Mary, to whom he was distantly related, in his early teens, and was attracted to her. When they were classmates at the Haverhill academy his love grew and he believed for a while that it was returned, at least partly. This love held him while he was employed as editor of the various papers and persisted for about seven or eight years. He believed Mary had trifled with him and would not marry him because socially she was above him. He was only a poor farmer boy who "fed her father's kine," as he wrote years later in the poem "My Playmate," which with his beautiful poem "Memories" was inspired by her. Out of this episode developed a preoccupation with a motif figuring often in later poems—the possibility of marital happiness in spite of social barriers. When Mary went to Ohio he contemplated going there. During the early part of 1832 he was in a singularly nervous state. His short poem *"Moll Pitcher"* was published at this time, but he wrote very little the rest of the year, though he edited *The Literary Remains of John G. C. Brainard.*

During the year he entered politics by supporting Caleb Cushing for congress, but as there was a deadlock he sought the candidacy himself by keeping Cushing's candidacy alive till he himself attained the age of 25, the age of eligibility. His plans were not realized. Soon an idealistic mood overtook him. This was fanned into a devotion to the cause of abolition by William Lloyd Garrison during the following spring. Garrison personally influenced the poet to enter the arena, and this Whittier did in June when he published his pamphlet *Justice and Expediency; or Slavery Considered with a View to its Rightful and Effectual Remedy, Abolition.*

Thus the year 1833 marks a turning point in the poet's life. His sacrifices began, for he lost a nomination as state senator in the fall by one vote because of his new alignment. He now no longer sang of favourite colonial themes. He could look back upon a career of eight years in which he had published about 275 poems. His antislavery poems soon began to appear, though he had written poetry in this vein at least once before his conversion in his celebrated poem "To William Lloyd Garrison." He became a delegate to the first meeting of the American Anti-Slavery convention in Philadelphia in Dec. 1833 and signed the declaration of sentiments; and as he said in later years, he was prouder of his signature on this than on the title page of any book. He was now to be engaged in propaganda work in connection with the cause. Two of his early antislavery poems "The Hunters of Men" and "Expostulation," (*"What ho! our fellow countrymen in chains"*) received wide circulation. He persuaded Caleb Cushing, again a candidate for congress in the fall of 1834, to comply with the demands of the abolitionists though he was not an abolitionist, and thus the poet succeeded in bringing about his election. Whittier himself ran for the senate in the state legislature and was elected. It was the only time he occupied political office. He ran a second time successfully but found himself too ill to serve.

In the fall of 1835 he was mobbed with the English visitor, George Thompson, in Concord, N.H.

In the latter half of 1836 he was again editor of the *Essex Gazette,* filling it with as much abolition literature as he was permitted. The only book of a literary nature he published at this time was *Mogg Megone,* an Indian poem composed years previously. In the summer he sold the farm at Haverhill and moved with his mother, sister and aunt to his new home at Amesbury. During the year he became much interested in the subject of free speech as attempts were made to suppress the abolitionists. He wrote poems and editorials on the subject, deriving much inspiration from Burke and Milton. His activities were multifarious. He travelled to Philadelphia, Harrisburg, Boston and New York on various missions connected with the interests of the movement. He settled in New York for half a year from the spring of 1837 to the fall when he acted as one of the corresponding secretaries of the American Anti-Slavery society.

In June 1837 some of his abolitionist friends in Boston published, without his authorization, a volume of his antislavery poems with an unsigned introduction said to be by Garrison. Though he wrote some better antislavery poems later, it marked a new epoch in his literary life. The volume was called *Poems Written During the Process of the Abolition Question in the United States Between the Years 1830 and 1838.* It contained only 21 poems (two more were added in a second issue) of which one was by his sister and three others had nothing to do with slavery. "Clerical Oppressors" was one of the strongest.

Whittier's next important work was as editor of the *Pennsylvania Freeman* in Philadelphia from March 15, 1838, to Feb. 20, 1840. Here took place one of the most exciting events in his life when Pennsylvania Hall, the new building where abolitionists had just been meeting and to which the offices of the *Freeman* had been transferred, was burned to the ground by a mob on May 17. Whittier wrote for the paper numerous vigorous and pointed articles, and contributed some abolition poems. He was often away from the city because of illness. During this time, in 1838, another volume *Poems* appeared in Philadelphia containing 50 poems. A few poems of the 1837 edition were not included here but some later antislavery poems were substituted, two of them among his best, the one later called "Pastoral Letter" and "The Farewell of a Virginia Mother to her Daughters, Sold into Southern Bondage." Altogether there were 24 abolition poems and 26 miscellaneous poems, nearly all of the latter collected now for the first time in book form and including early as well as recent poems of his from newspapers and periodicals.

He attended various gatherings in New York, Salem, Harrisburg and Albany, and Washington, for different purposes. In Albany his object was to smooth out difficulties that arose over the question of dealing with slavery by political methods. Garrison was opposed to all political means but Whittier favoured the use of the ballot though not as yet by a separate political party.

In March 1840 Whittier returned to Amesbury, poor in health

and depleted in finances. The American Anti-Slavery society was disrupted in May 1840, and a new branch, the American and Foreign Anti-Slavery society, was formed. Whittier joined this organization. His breach with Garrison, who would not work within the framework of our constitution because it recognized the existence of slavery, was widening. Whittier was as yet only giving passive adherence to the new Liberty party, but he nevertheless supported its first candidate for president, James G. Birney, in the election of 1840.

Throughout the years 1841 and 1842 he did what he could for the new organization, and for several months he edited some of their periodical antislavery publications. He was a candidate for congress in the fall of 1842 on the Liberty party ticket and could have been elected had he wanted to be. Soon he attracted attention by his notable poem "Massachusetts to Virginia"—a poem that grew out of the George Latimer case in which it was held that a runaway slave must be returned to his master without right of trial by jury.

In 1843 Whittier temporarily returned to pure literature, with which he had been flirting for several years by contributing to leading magazines. He published a volume of poems, *Lays of My Home,* in which he harked back to his old legends and other non-slavery themes though he included some abolition poems. From a literary point of view this was his best book so far. His ballad "Cassandra Southwick" showed him in his most powerful vein. The book also contained "Memories," "Lucy Hooper" and the poem "Lines Written in the Book of a Friend," later called "Ego."

Nevertheless, his antislavery activities increased. The year 1844 was important for him as it was the year of a presidential election and of the agitation for the annexation of Texas to the United States. Moreover he was again invested with editorial office, this time in Lowell, Mass., where he became editor of the *Middlesex Standard* during the summer and where he remained till the following spring. He endorsed Birney who ran again on the Liberty party ticket and he fought the annexation of Texas. His editorials were strongly partisan but he contributed to the paper some of his best prose, subsequently gathering a few related essays in 1845 into the volume called *The Stranger in Lowell.*

Whittier was opposed to the Mexican War which he believed was in the interests of slavery and he wrote against our entry into it. He took a part in the 1846 New Hampshire elections and swung the Liberty party votes so that John P. Hale was chosen to the United States senate. Though Hale was not an abolitionist he was the first member of the senate in sympathy with the antislavery cause.

In 1846 Whittier's abolition poems were collected in a volume called *Voices of Freedom* by friends in Philadelphia, but Whittier made changes in the text. In the volume were reprinted all the abolition poems of his 1838 *Poems* except one, and those in the *Lays of My Home* of 1843. There were included antislavery poems he had written since; among them "The Branded Hand" which had been used on a leaflet as propaganda after the conviction of Jonathan Walker. Walker had been imprisoned and had his palm branded S.S. (slave stealer) for having tried to free some slaves in Florida. After writing sporadic editorials for the *Essex Transcript,* Whittier, in Jan. 1847, became corresponding editor of the *National Era* published at Washington, and to this he contributed his best poems and essays in the course of the next 13 years. Here he sponsored the candidacy of John P. Hale for president on the Liberty party ticket, but when Martin Van Buren, the former Democratic president, was nominated by the Free Soil party and Hale was dropped as a candidate when the Liberty party was merged in the Free Soil party, Whittier, though he at first opposed Van Buren, supported him in 1852, but Franklin Pierce was elected.

More and more Whittier's thoughts were turning to his old love, literature, and the year 1849 is memorable in his life for the first collected edition of his poems and the publication in book form of his New England fictionized work *Leaves from Margaret Smith's Journal.*

During the 1850s Whittier continued to engage in literary work in the midst of important political activities. The decade was to mark the end of his active career as a propagandist but it was one in which his fame increased. His stinging poem "Ichabod" gave him great prestige among many northern groups for its castigation of Daniel Webster who aroused their fury because of his "Seventh of March" speech in favour of the proposed new Fugitive Slave law. Whittier did what he could to arouse sentiment against the Fugitive Slave law by his powerful "A Sabbath Scene" but he could not prevent the law from passing. His most resolute endeavours at this time were in getting Charles Sumner to become a candidate, and so remain, for the United States senate. From the early summer of 1850 till April of the next year when Sumner was finally chosen by the Massachusetts legislature, Whittier was active in various ways in bringing about this result. He advised Sumner and spurred on Henry Wilson, the president of the state senate who was leading the fight for Sumner. He also was one of the first to see the need of a new political party, the Republican party, and he did his share in promoting it. He also wrote some bold poems on the subject of governmental participation in sending fugitive slaves back to the south under the new law, on the occasion of the order for the return to slavery of Thomas V. Sims in 1851, and Anthony Burns in 1854, but he was opposed to the use of force and violent rescue. His literary work was, however, not neglected and ripe volumes of prose and poetry flowed from his pen. The prose volumes of essays and sketches were *Old Portraits and Modern Sketches* (1850) and *Literary Recreations and Miscellanies* (1854). The poems were *Songs of Labor* (1850), *The Chapel of the Hermits* (1853), and *The Panorama* (1856), which contained two of his most popular poems "The Barefoot Boy" and "Maud Muller."

After the presidential election in 1856, in which Whittier wrote poems to help the Republican candidate, John C. Fremont, who was defeated by James Buchanan, Whittier ceased political activities on a large scale and propaganda work in behalf of abolition except for the writing of a few more antislavery poems. In 1857 his publishers issued an authorized edition of his collected poems in two volumes in which the long, weak poem "Mogg Megone" headed the list. He began contributing poems to the new *Atlantic Monthly* and to the *Independent.* His next volume, *Home Ballads and Poems* (1860), contained some of his finest poems and ballads, among them "Telling the Bees," "My Playmate" and "Skipper Ireson's Ride."

In 1859 he came nearer to marrying than at any other time in his life. An old friendship with a poetess, Elizabeth Lloyd of Philadelphia, who had become a widow, was renewed. Chiefly because of some remarks against her own Quaker sect, the poet set forth reasons in a letter to her why he could never make a good husband to her, illness and old habit being among them. He thus virtually gave her to understand that they were not to marry though at one time he loved her. She smarted under the blow but they kept up a cooling friendship. Whittier was put out by his own instability. He had in the past displayed that failing in friendships with other girls, in the cases of Evelina Bray at the Haverhill academy and of Lucy Hooper, a poetess he saw when he was employed in New York but with whom he broke a few years later. From now on his friendships with women were of a Platonic character as far as he was concerned, but he attracted many woman poets and writers, among them Lucy Larcom and Gail Hamilton.

When the Civil War broke out Whittier was in a dilemma, as to his course. He had been a member of the electoral college which elected Lincoln, but when South Carolina and other states seceded he was opposed to coercing the southern states. After Fort Sumter was fired on he approved of the war but he was still a pacifist in principle. Yet he did his share towards shaping its purpose by his early war poem "Ein feste Burg ist unser Gott" which called for the destruction of slavery. It was known as "The Furnace Blast" from a phrase in the first verse and was also called the "prohibited song," because the Hutchinson singers were ordered to stop singing it to the soldiers. Lincoln countermanded the order. Its sentiments were those which he later endorsed by his Emancipation proclamation. Whittier's chief war poem, of course, was "Barbara Frietchie," a patriotic poem of courage that is one of the outstanding popular achievements in our literature—irrespective of whether the incident recorded therein ever happened or not. These and others were collected in his *In War Time* (1864). During the Civil War his sister Elizabeth Hussey Whittier died, and he lost his most sympathetic companion.

On the occasion of the passing of the 13th amendment by congress he wrote "Laus Deo." When the war was over he saw the cause for which he fought for over 30 years triumph. Henceforth he could with a clear conscience devote himself to writing ballads, tales of colonial lore, sketches with rural scenes, stories of common life, and above all religious poems. His greatest literary triumph came in 1866 when he was 58 years old with the publication of his *Snow-Bound.* The picture of winter farm life, the account of the old house, and the portraits of the members of his family and others, won the hearts of the American people. Though it depicted a life partly outmoded by the coming of modern conveniences like the automobile and telephone, not to mention the radio, it still is of perennial interest, typically American in its appeal. It has often been compared to Burns's *Cotter's Saturday Night.* He became more popular than ever and even financially successful. His works in prose appeared in a collected edition during the year, and another volume of poetry containing a few good poems was ready at the beginning of the next year, *The Tent on the Beach* which contains his best known religious poem "Eternal Goodness."

From this time on dates the transformation of his fame from that of a martial prophet who had defied church and state in the cause of freedom to that of the innocuous singer of harmless themes that made him the favourite of women and children. The valiant, aggressive bard became in popular repute a meek and mild saint. For a time both these conceptions of him struggled in the mind of the public and a correct estimate of him was not possible. He kept on producing volume after volume of poetry. They may not have added greatly to his reputation but they kept it alive and at times revealed a spark of the old fire and a gleam of the old beauty. In fact some of the later poems were more artistic productions than his old. The volumes continued appearing at intervals during the '70s and '80s, the poems being gathered usually from periodicals where they first saw publication. They were *Among the Hills* (1869), *Miriam,* which contained his inno-

cent but beloved child poem "In School-Days" (1871), *The Pennsylvania Pilgrim* (1872), *Hazel Blossom,* in which he published some of his sister's poems (1875), *Mabel Martin* (1876), *The Vision of Echard* (1878), *The King's Missive* (1881), *The Bay of Seven Islands* (1883) and *Saint Gregory's Guest* (1886). He also edited several works, among them *The Journal of John Woolman* (1871), *Child Life; a Collection of Poems* (1871), *Child Life in Prose* (1874) and *Songs of Three Centuries* (1876).

After the Civil War he received various honours. Harvard college gave him an honorary title of Doctor of Laws and two years later Brown university made him a member of the board of trustees.

He continued to take an interest in international as well as national affairs. In 1870 he voiced his views on Italian union and he favoured the withdrawal of the temporal power of the pope.

He was not active in politics but was consulted by members of the Republican party. He voted on the Republican party ticket for the rest of his life, even when candidates were not above criticism. His chief activity in his later years was on the occasion when in the early '70s he successfully undertook to have the Massachusetts legislature rescind its vote of censure against Charles Sumner for his motion in the United States senate that regimental flags should not bear the names of the battles in which they were carried.

He no longer sided with the liberals. He was opposed to the railroad strike in 1877 and wrote a poem, "The Problem," in which he called labour leaders "demagogues." In Nov. 1887 he refused to join in any move to have the sentence of the Chicago anarchists commuted.

From 1876 on, almost to the end of his life, he lived in a mansion at Oak Knoll, Danvers, the home of Col. Edmund Johnson, a widower who had married a cousin of the poet and who had three daughters. Whittier retained his voting residence at Amesbury. He took vacations usually in New Hampshire—in its mountains or on its beaches—and the result was some excellent poetry.

His 70th birthday celebration is remembered today because Mark Twain made a speech in which, by a story he invented, he treated the New England writers with irreverence—an episode that was considered a breach of decorum at that time. His 80th birthday was celebrated by a banquet in Boston by the Essex club, with testimonials from the leading statesmen of the country. The poet remained at Oak Knoll. In later life he met distinguished people who came to see him, often visitors from foreign countries, among them in 1876 Dom Pedro II, king of Brazil, an admirer. He met Charles Dickens, Charles Kingsley and Matthew Arnold. He became friends with Paul Hayne, the southern poet.

A complete edition of his poetry as well as his prose appeared in 1888–89, in seven volumes. He classified his poems according to the subject matter. "Mogg Megone" and a few other poems were relegated to an appendix. In the new divisions, such as "narrative and legendary poems," "personal poems," "occasional poems," etc., the development of the poet was lost sight of. *At Sundown* was his final volume, printed privately in 1889 and published more fully in 1892. The last poem he wrote was one on Oliver Wendell Holmes.

The best index of how Whittier's reputation as a militant trumpeter in the cause of freedom had almost disappeared in the '80s is shown in the fact that in the three booklets of nearly 60 selections from his poems which were printed in the *Riverside Literature Series* for study in the public schools, only one abolition poem—and a very mild one, "The Kansas Immigrants"—was included. The first attempt to revive the poet's reputation as an antislavery poet was by William Sloane Kennedy in his second book on Whittier, *John G. Whittier, The Poet of Freedom,* published in the year of the poet's death.

Whittier died on Sept. 7, 1892, at Hampton Falls, N.H., after a paralytic stroke several days previous, and was buried in Amesbury.

Whittier was once ranked among the most favourite American poets, but he was at various periods of his life recommended for different aspects of his work. He was generally criticized for his limited art resources, for his uniformity of metrical measures and for lack of imaginative vision. He took such criticism gracefully and even assented to it. His popularity was at its height in the periods following the Civil War and his death, respectively. In the 20th century his reputation declined, but signs of its being revived have appeared.

In considering him as a poet one must concede his versatility in choice of theme even if there was scant variety of treatment. He excelled in numerous features. He was probably our supreme balladist, even though he often resorted to colonial episodes which pointed a moral. His poetry shows behind it the reformer, the radical, the Quaker, the preacher, the farmer, the moralist, the lover, the elegist, the nature-lover, the prophet, the patriot, the democrat, the hymn composer, the social philosopher and the psychologist. There is enough in his verse to satisfy any or all tastes. He deserves still to be regarded as he wanted to be, in his "Proem" (1847), prefixed to all collected editions of his work, as an intense hater of tyranny and as deep and strong a lover of freedom as Milton and Marvell. He sought also to be considered an artistic poet. In his poem "The Tent on the Beach," he wrote that when he left the Muses' haunts to turn "the crank of an opinion mill,"

> "He heard the fitful music still
> Of winds that out of dream-land blew."

He was really both a dire prophet and a gentle poet.

He has left numerous poems that have become the heritage not only of New England but of America. He suffered, it is true, from provincialism and from Puritanism. His love of justice and admiration of heroism, however, permeate many of his poems. He may not be as much loved as Longfellow was, but he stands with the very man he disliked, Walt Whitman, as one of the leading advocates of American democracy in all its forms. True, in the latter part of his life he was not in the frame of mind to understand or sympathize with the new currents sweeping the country, but he had done his work in the most crucial period of American history, and in old age he sought the rest which had been denied him and which even then he did not get fully because of ill health.

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WHITTIER, a city of Los Angeles county, California, U.S.A., 13 mi. S.E. of the business centre of Los Angeles, on the slopes of the Puente hills, at the entrance to Turnbull Canyon. Pop. (1940) 16,115. Whittier is primarily a residential city and a shipping point for oranges, lemons, walnuts, avocados and oil. It is the seat of the state school for boys, and of Whittier college (non-sectarian; established by the Society of Friends in 1901). The city was founded by Quakers, in 1887, and was named after John Greenleaf Whittier. It was incorporated as a city in 1898.

WHITTINGHAM, CHARLES (1767–1840), English printer, was born on June 16, 1767, at Caludon, Warwickshire, and was apprenticed to a Coventry printer. In 1789 he set up a printing press in London, started a paper-pulp factory in Chiswick in 1809, and in 1811 founded the Chiswick press. He was a pioneer of cheap reprints of the classics, was the first to use proper overlays in printing woodcuts, and was also the first to print a fine or "Indian paper" edition. He died at Chiswick on Jan. 15, 1840. His nephew and partner, Charles Whittingham (1795–1876), removed the whole business to London in 1852. Under him the Chiswick press increased its reputation.

WHITTINGTON, RICHARD (d. 1423), mayor of London, described himself as son of William and Joan (Dugdale, *Monasticon Anglicanum,* vi, 740). This enables him to be identified as the third son of Sir William Whittington of Pauntley in Gloucestershire, who married after 1355 Joan, daughter of William Mansel, and widow of Thomas Berkeley of Cubberley. Richard was a mercer by trade, and entered on his commercial career under favourable circumstances. He married Alice, daughter of Sir Ivo Fitzwaryn, a Dorset knight of considerable property; his wife predeceased him. Whittington sat in the common council as a representative of Coleman Street ward, was elected alderman of Broad street in March 1393, and served as sheriff in 1393–1394. When Adam Bamme, the mayor, died in June 1397, Whittington was appointed by the king to succeed him, and in October was elected mayor for 1398. He had acquired great wealth and much commercial importance, and was mayor of the staple at London and Calais. He made frequent large loans both to Henry IV and Henry V, and according to the legend, when he gave a banquet to the latter king and his queen in 1421, completed the entertainment by burning bonds for £60,000, which he had taken up and discharged. Henry V employed him to superintend the expenses for completing Westminster abbey. But Whittington

took no great part in public affairs. He was mayor again in 1406–1407, and in 1419–1420. He died in March 1423 bequeathing his vast fortune to charitable and public purposes. He joined in procuring Leadenhall for the city, and bore nearly all the cost of building the Greyfriars Library. In his last year as mayor he had been shocked by the foul state of Newgate prison, and one of the first works undertaken by his executors was its rebuilding. His executors, chief of whom was John Carpenter, the famous town clerk, also contributed to the cost of glazing and paving the new Guildhall, and paid half the expense of building the library there; they repaired St. Bartholomew's hospital, and provided bosses for water at Billingsgate and Cripplegate. But the chief of Whittington's foundations was his college at St. Michael, Paternoster church, and the adjoining hospital. The college was dissolved at the Reformation, but the hospital or almshouses are still maintained by the Mercers' Company at Highgate. Stow relates that his tomb in St. Michael's church was spoiled during the reign of Edward VI., but that under Mary the parishioners were compelled to restore it (*Survey*, i. 243). There is no proof that he was ever knighted. A writer of the next generation bears witness to his commercial success in *A Libell of English Policy* by styling him "the sunne of marchaundy, that lodestarre and chief-chosen flower."

> Pen and paper may not me suffice
> Him to describe, so high he was of price.

Popular legend makes Dick Whittington a poor orphan employed as a scullion by the rich merchant, Sir Hugh Fitzwarren, who ventures the cat, his only possession, on one of his master's ships. Distressed by ill-treatment he runs away, but turns back when he hears from Holloway the prophetic peal of Bow bells. He returns to find that his venture has brought him a fortune, marries his master's daughter, and succeeds to his business. The legend is not referred to by Stow, who would assuredly have noticed it if it had been well established when he wrote. The first reference to the story comes with the licensing in 1605 of a play, now lost, *The History of Richard Whittington, of his lowe byrth, his great fortune.* "The legend of Whittington," probably meaning the play of 1605, is mentioned by Beaumont and Fletcher in 1611 in *The Knight of the Burning Pestle.* When a little later Robert Elstracke, the engraver, published a supposed portrait of Whittington with his hand resting on a skull, he had in deference to the public fancy to substitute a cat; copies in the first state are very rare. Thomas Keightley traced the cat story in Persian, Danish and Italian folk-lore as far back as the 13th century.

BIBLIOGRAPHY.—Important early references are in R. R. Sharpe's *Calendar of Letter-book H.* (1907); H. T. Riley's *Memorials of London* (1868); and *Political Songs*, ii 178 (Rolls series). For his charities *see* Stow's Survey of *London* (ed. C. L. Kingsford, 1908). For documents relating to Whittington College *see* Dugdale, *Monasticon Anglicanum* (1693; 1846), vi 740 and the *Calendar of Patent Rolls, Henry VI* (1900); ii 214–217. Samuel Lysons collected the facts but accepted the legend in *The Model Merchant of the Middle Ages* (1860). The *Life* (new ed. 1894) by W. Besant and J. Rice does not improve on Lysons. There are useful references in J. H. Wylie's *History of England under Henry IV* (4 vol. 1884–98). For the legend *see* T. Keightley's *Tales and Popular Fictions*, pp. 241–286 (1834), and H. B. Wheatley's preface to his edition of *The History of Sir Richard Whittington* (first published 1656). (C. L. K.)

WHITTINGTON, a village and ecclesiastical parish in the borough of Chesterfield, Derbyshire, England. It has two stations on the L.M.S.Ry. Pop. (1931) 3,161. A stone cottage known as the "Revolution House," formerly an inn called "The Cock and Pynot," was the scene of the planning of the revolution of 1688 by the duke of Devonshire, the earl of Danby and John D'Arcy. The chair in which the duke presided is preserved at Hardwick hall. The cottage belongs to the Chesterfield corporation.

WHITTLESEY, a town and urban district in Isle of Ely, England, 5¼ mi. E. of Peterborough, on the L.N.E.R. Pop. (1938) 8,235. Area 36.5 sq.mi. To the north is the artificial cut carrying the waters of the river Nene; the neighbourhood is intersected with other navigable "drains." Whittlesey Mere is 6 mi. S.W., in Huntingdonshire. It was a lake until modern times, when it was included in a scheme of drainage. The town manufactures bricks and tiles, and has considerable agricultural trade.

WHITWORTH, SIR JOSEPH, BART. (1803–1887), English engineer, was born at Stockport, near Manchester, on Dec. 21, 1803. On leaving school at fourteen, he was placed with an uncle who was a cotton-spinner, with a view to becoming a partner; but this occupation did not suit his mechanical tastes, and after about four years he gave it up. He then spent some time with various machine manufacturers in the neighbourhood of Manchester, and in 1825 moved to London.

In 1833 he returned to Manchester and started business as a tool-maker. In 1840 at the meeting of the British Association at Glasgow, he read a paper on the preparation and value of true planes which indicated an accuracy of workmanship far ahead of what was considered possible in mechanical engineering at that time. In 1841, in a paper read before the Institute of Civil Engineers, he urged the necessity for the adoption of a uniform system of screw threads in place of the various heterogeneous pitches then employed. His system of standard gauges was also widely adopted, and his principles of exact measurement and workmanship were strictly observed in his own factory, with the result that in the Exhibition of 1851 he had a show of machine tools far ahead of that of any competitor.

It was doubtless this superiority in machine construction that caused the government three years later to request him to design, and estimate the cost of making the machinery for producing rifled muskets at the new factory at Enfield. He did not agree to the proposal in this form, but it was ultimately settled that he should construct the machinery for the barrels only. Finding that there was no established practice to guide him, he began a series of experiments to determine the best principles for the manufacture of rifle barrels and projectiles. He ultimately arrived at a weapon in which the necessary rotation of the projectile was obtained, not by means of grooving, but by making the barrel polygonal in form, with gently rounded angles, the bullets also being polygonal and thus travelling on broad bearing-surfaces along the rotating polygon. It is reported that at the trial in 1857 weapons made according to these principles excelled the Enfield weapons in accuracy of fire, penetration and range to a degree "which hardly leaves room for comparison." He also constructed heavy guns on the same lines; these were tried in competition with Armstrong's ordnance in 1864 and 1865, and in their inventor's opinion gave the better results, but they were not adopted by the government. In constructing them Whitworth found difficulty in getting large steel castings of suitable soundness and ductility, and thus in 1870 was led to devise his compressed steel process, in which the metal was subjected to high pressure while still in the fluid state, and afterwards forged in hydraulic presses, instead of by hammers.

In 1868 he founded the Whitworth scholarships, setting aside an annual sum of £3,000 to be given for "intelligence and proficiency in the theory and practice of mechanics and its cognate sciences," and in the following year he was created a baronet. He died at Monte Carlo on Jan. 22, 1887. In addition to giving £100,000 for the permanent endowment of 30 Whitworth scholarships, his residuary legatees, in pursuance of what they knew to be his intentions, expended over £500,000 on charitable and educational objects, mainly in Manchester and the neighbourhood.

WHOOPING-COUGH or HOOPING-COUGH (syn. *Pertussis*, Chin-cough), a specific infective disease starting in the respiratory mucous membrane, depending on a cocco-bacillus described by Bordet and Gengon in 1906 (*see* PARASITIC DISEASES), and manifesting itself by frequently recurring paroxysms of convulsive coughing accompanied with peculiar sonorous inspirations (or whoops). Although specially a disease of childhood, whooping-cough may occur at any time of life. There is a distinct period of incubation variously estimated at from two to ten days.

The *first stage* is characterized by the ordinary phenomena of a catarrh, but the presence of an ulcer on the fraenum linguae is said to be diagnostic. The catarrhal stage usually lasts from ten to fourteen days. The *second stage* is marked by abatement of the catarrhal symptoms, but increase in the cough, which now occurs in irregular paroxysms both by day and by night. This stage of the disease usually continues for from one to two months. Pos-

sible complications are bronchopneumonia (*see* BRONCHITIS) and convulsions. When, however, the disease progresses favourably, the cough becomes less frequent and generally loses in great measure its "whooping" character.

There is no specific treatment for whooping-cough; sunlight or, in its absence, ultra-violet light, with plenty of open air, is beneficial.

WHYMPER, EDWARD (1840–1911), British artist, explorer and mountaineer, was born in London on April 27, 1840. The son of an artist, he was at an early age trained to the profession of a wood engraver. In 1860 he was commissioned to make a series of sketches of Alpine scenery, and undertook an extensive journey in the Central and Western Alps. Among the objects of this tour was the illustration of an attempt, which proved unsuccessful, made by Professor Bonney's party, to ascend Mont Pelvoux, at that time believed to be the highest peak of the Dauphiné Alps. He successfully accomplished the ascent in 1861—the first of a series of expeditions that threw much light on the topography of a district at that time very imperfectly mapped. From the summit of Mont Pelvoux he discovered that it was overtopped by a neighbouring peak, subsequently named the Pointe des Écrins, which, before the annexation of Savoy added Mont Blanc to the possessions of France, was the highest point in the French Alps. Its ascent by Whymper's party in 1864 was perhaps the most remarkable feat of mountaineering up to that date. The years 1861 to 1865 are filled with a number of new expeditions in the Mont Blanc group and the Pennine Alps, among them being the ascent of the Aiguille Verte and the crossing of the Moming Pass. Professor Tyndall and Mr. Whymper emulated each other in fruitless attempts to reach the summit of the Matterhorn by the southwestern or Italian ridge. Mr. Whymper, six times repulsed, determined to attempt the eastern face, convinced that its precipitous appearance when viewed from Zermatt was an optical illusion, and that the dip of the strata, which on the Italian side formed a continuous series of overhangs, should make the opposite side a natural staircase. His attempt (the seventh) by what is now the usual route was crowned with success (July 14, 1865); but on the descent four of the party slipped and were killed, and only the breaking of the rope saved Whymper and the two remaining guides from the same fate.

The account of his attempts on the Matterhorn occupies the greater part of his *Scrambles among the Alps* (1871), in which the illustrations are engraved by the author himself. He visited Greenland in 1867, with a view to crossing the interior. Another expedition in 1872 convinced him that the enterprise was too great for a private expedition, but his visits resulted in valuable collections of fossils, trees and shrubs.

He next organized an expedition to Ecuador, designed primarily to collect data for the study of mountain sickness and of the effect of diminished pressure on the human frame. He took as his chief guide Jean-Antoine Carrel, whose subsequent death from exhaustion on the Matterhorn after bringing his employers into safety through a snowstorm forms one of the noblest pages in the history of mountaineering. During 1880 Whymper on two occasions ascended Chimborazo, whose summit, 20,702 ft. above sea level, had never before been reached; spent a night on the summit of Cotopaxi, and made first ascents of half-a-dozen other great peaks. In 1892 he published the results of his journeys in a volume entitled *Travels amongst the Great Andes of the Equator,* in which he made useful observations, among other things, on mountain sickness. The collections of rock specimens and volcanic dust brought back from this journey were described by Dr. Bonney in the *Proc. Roy. Soc.* (Nos. 229–234). In 1901–1905 he undertook an expedition in the region of the Great Divide of the Canadian Rockies. Whymper died at Chamonix on Sept. 16, 1911.

See articles by T. G. Bonney in *Alpine Journal* (Feb. 1912) and by D. W. Freshfield in the *Dict. Nat. Biog.* (Second Supplement).

WHYTE, ALEXANDER (1837–1921), Scottish divine, was born at Kirriemuir in Forfarshire on Jan. 13, 1837, and was educated at the University of Aberdeen and at New college, Edinburgh. He entered the ministry of the Free Church of Scotland and after serving as colleague in Free St. John's, Glasgow (1866–70) removed to Edinburgh as colleague (1870–73) and successor (1873–1916) to Dr. R. S. Candlish at Free St. George's. In 1898 he was elected moderator of the general assembly. In 1909 he became principal of New college, Edinburgh, a post which he held until 1918. He received the freedom of the city of Edinburgh in 1910. He died in London on Jan. 6, 1921.

Among his publications are *Characters and Characteristics of William Law* (1893); *Bunyan Characters* (3 vols., 1894); *Samuel Rutherford* (1894); *An Appreciation of Jacob Behmen* (1895); *Lancelot Andrewes and his Private Devotions* (1895); *Bible Characters* (7 vols., 1897); *Santa Teresa* (1897); *Father John of Cronstadt* (1898); *An Appreciation of Browne's Religio Medici* (1898); *Cardinal Newman, An Appreciation* (1901). *See* G. F. Barbour, *Life of Alexander Whyte* (1923).

WHYTE-MELVILLE, GEORGE JOHN (1821–1878), English novelist, son of John Whyte-Melville of Strathkinness, Fifeshire, and grandson on his mother's side of the 5th duke of Leeds, was born on June 19, 1821. Whyte-Melville received his education at Eton, entered the army in 1839, became captain in the Coldstream guards in 1846 and retired in 1849. After translating Horace (1850) in fluent and graceful verse, he published his first novel, *Digby Grand,* in 1853. The unflagging verve and intimate technical knowledge with which he described sporting scenes and sporting characters at once drew attention to him as a novelist with a new vein. He was the laureate of fox hunting; all his most popular and distinctive heroes and heroines, Digby Grand, Tilbury Nogo, the Honourable Crasher, Mr. Sawyer, Kate Coventry, Mrs. Lascelles, are or would be mighty hunters. *Tilbury Nogo* was contributed to the *Sporting Magazine* in 1853 and published separately in 1854. He showed in the adventures of Mr. Nogo—and it became more apparent in his later works—that he had a surer hand in humorous narrative than in pathetic description. He lost his life in the hunting field on Dec. 5, 1878.

The Gladiators was perhaps the most famous of his numerous historical novels. He also wrote *Songs and Verses* (1869) and a metrical *Legend of the True Cross* (1873).

WICHITA, a city of Kansas, U.S.A., on the Arkansas river at the mouth of the Little Arkansas, 200 mi. S.W. of Kansas City and 1,300 ft. above sea level; the county seat of Sedgwick county and the second city of the state in size. It is on federal highways 54 and 81 and the airway from Chicago to Mexico and the Gulf; has a municipal airport a mile square; and is served by the Frisco, the Kansas City, Mexico and Orient, the Midland Valley, the Missouri Pacific, the Rock Island and the Santa Fe railways and bus lines. Pop. (1940) 114,966 by federal census. It is the commercial, financial and industrial metropolis of southern Kansas and northern Oklahoma. Its banking transactions, whether on the basis of clearings ($160,363,374 in 1940) or of debits to individual accounts ($559,495,911), are greater by far than those of any other city in the state. Its stockyards handle 25,000 carloads and 75,000 truck loads of livestock in a year; its packing plants send out 150,000,000 lb. of meat products; and its flour mills have a daily capacity of 11,000 bbl. Wichita is a leading centre for the manufacture of aeroplanes. Three aeroplane plants in 1940 employed about 6,500 persons. The total output of its industries in 1937 was $53,910,346. Since 1909 the city has operated under a commission-manager form of government. A municipal university was established in 1926, to which were transferred the properties of Fairmount college. Friends university, in the western part of the city, was founded and is supported by the Kansas Yearly Meeting of Friends. The city's assessed valuation of property for 1940 was $142,128,105.

Wichita was the name of a tribe of Indians. The city was founded in 1870 and chartered in 1871. In 1880 it had a population of only 4,911.

WICHITA FALLS, a city of northern Texas, U.S.A., 100 mi. N.W. of Fort Worth, on the Wichita river near the Red river, at an altitude of 946 ft.; the county seat of Wichita county and one of the principal trading centres of the southwest. It is on federal highways 82, 277, 281 and 287, and is served by the Fort Worth and Denver City, the Missouri-Kansas-Texas, the Wichita Falls and Southern, and the Wichita Valley railways. The population in

1940 for the city proper was 45,112 and 53,804 for the greater Wichita Falls by federal census. Wichita Falls is surrounded by extensive gas and oil fields and an agricultural region devoted to stock raising, dairying and the cultivation of cotton, wheat, corn and fruit. Its manufactures (including 14 oil refineries) are numerous and varied, with an output in 1939 valued at $15,729,255. There are many oil field supply houses and large wholesale and jobbing firms. The city's assessed valuation of property for 1940 was $32,227,000. The city was founded in 1874 and incorporated in 1876.

WICK, royal and small burgh, seaport and county town of Caithness, Scotland. Pop. (est. 1938) 7,550. It is situated at the head of Wick bay, on the North sea, 327 mi. N. of Edinburgh, by the L.N.E. and L.M.S. railways. It consists of the old burgh and Louisburgh, its continuation, on the north bank of the river Wick, and of Pulteneytown, the commercial quarter, on the south side. Wick is the chief Scottish centre of the herring fisheries. The harbour was built by Telford in 1800. Wick (Vik or "bay") is mentioned as early as 1140 and became a royal burgh in 1589.

WICKHAM, SIR HENRY (1846–1928), English pioneer and explorer, was born on May 29, 1846, and later went to Brazil as a planter. He was led to experiment with rubber trees, but found great difficulty in obtaining financial support for his schemes. In 1872 he published his book *A Journey through the Wilderness,* and as a result the India office employed him to collect seeds of the *Hevea braziliensis.* He evaded the vigilance of the Brazilian government, and brought back a large number of seeds which were planted in the glasshouses of Kew gardens, and eventually formed the basis of the whole plantation rubber industry of the east. Wickham held posts as inspector of forests and commissioner of crown lands in India, police inspector and magistrate in British Honduras, and for 50 years explored Central America, Australia, New Guinea, and the Pacific islands, establishing many pioneer rubber plantations. In 1911 he received 1,000 guineas and an annuity from the rubber growers and planters' associations of London, Ceylon and Malaya, and in 1920 was knighted. He died on Sept. 27, 1928.

WICKLOW, a county of Eire in the province of Leinster, bounded east by St. George's channel, north by the county of Dublin, south by Wexford and west by Carlow and Kildare. The area is 500,250 ac. or about 782 sq.mi. Pop. (1936) 58,569. The coast is very dangerous of approach owing to sandbanks. The harbour at Wicklow has a considerable trade; but that of Arklow is suitable only for small vessels. The central portion of the county is occupied by a granitic mountain range, running from northeast to southwest, the highest summits being Kippure (2,473 ft.), Duff Hill (2,364), Table Mountain (2,416) and Lugnaquilla (3,039). The range rises from the north by a succession of ridges intersected by deep glens, and subsides towards the borders of Wexford and Carlow. To the north its foothills enter Co. Dublin, and add attraction to the southern residential outskirts of the capital. Water supply of Dublin comes partly from an artificial lake on the first plateau of the foothills at Roundwood.

In the valleys there are many instances of old river terraces, especially at the lower end of Glenmalure and the lower end of Glendalough. Among the more famous of the glens are Glendalough, Dargle, Glencree, Glen of the Downs, Devil's Glen, Glenmalure and the beautiful vale of Avoca or Ovoca. The principal rivers are the Liffey, on the northwestern border; the Vartry, which passes through Devil's Glen to the sea north of Wicklow Head; the Avonmore and the Avonbeg, which unite at the "meeting of the waters" to form the Avoca, which is afterwards joined by the Aughrim and falls into the sea at Arklow; and the Slaney, in the west of the county, passing southwards into Carlow. The principal lakes are Loughs Dan, Bray and Tay or Luggelaw, and the loughs of Glendalough. The trout fishing is generally fair.

Wicklow was not made a county until 1606. It was the last Irish ground shired, for in this mountainous district the Irish were long able to preserve independence. Wicklow sided with the royal cause during the Cromwellian wars, but on Cromwell's advance submitted to him without striking a blow. During the rebellion of 1798 there were skirmishes at Aughrim and at Arklow.

Of the ancient cromlechs there are three of some interest, one near Enniskerry, another on the summit of Lugnaquilla and a third at Donaghmore. The ruins in the vale of Glendalough, known as the "seven churches," including a round tower, owe their origin to St. Kevin, who lived in the vale as a hermit, and is reputed to have died in 618. Of the old fortalices or strongholds those of special interest are Black Castle, near Wicklow, originally founded by the Norman invaders, but taken by the Irish in 1301, and afterwards rebuilt by William Fitzwilliam; the scattered remains of Castle Kevin, the stronghold of the O'Tooles, by whom it was probably originally built in the 12th century; and the ruins of the castle of the Ormondes at Arklow, founded by Theobald Fitz-Walter (d. 1285), and demolished by Cromwell in 1649, and now containing within the interior of its ruined walls a constabulary barrack. The mansion of Powers-court occupies the site of an old fortalice founded by De la Poer, one of the knights who landed with Strongbow; in the reign of Henry VIII it was taken by the O'Tooles and O'Brynes.

The lower land is fertile; and the higher districts, covered with heath and turf, afford good pasturage for sheep. There is a considerable extent of natural timber as well as artificial plantations. The principal crops of oats and potatoes decrease considerably, but the numbers of sheep, cattle, pigs and poultry are well maintained.

A considerable amount of gold has been extracted from the valley-gravels north of Croghan Kinshela on the Wexford border. Tinstone has also been found in small quantities. Lead ore is raised west of Laragh, and the mines in the Avoca valley have been worked for copper, lead and sulphur, the last-named being obtained from pyrite. Paving-setts are made from the diorite at Arklow, and granite is extensively quarried at Ballyknockan on the west side of the mountain chain.

Owing to its proximity to Dublin and its accessibility from England, the portions of the county possessing scenic interest have been opened up to great advantage. Bray in the north is a seaside resort. Inland tourist centres are Enniskerry, west of Bray, and near the pass of the Scalp; Laragh, near Glendalough, from which a military road runs southwest across the hills below Lugnaquilla; and, on the railway south of Wicklow, Rathdrum, Woodenbridge in the Vale of Avoca and Aughrim.

The Great Southern railway skirts the coast by way of Bray and the town of Wicklow, touching it again at Arklow, with a branch line from Woodenbridge junction to Shillelagh. Another branch from Sallins (Co. Kildare) skirts the west of the county by Baltinglass.

The administrative county of Wicklow returns three members to Dáil Eireann.

WICKLOW, a seaport, and county town of Co. Wicklow, Eire, at the mouth of a lagoon which receives the River Vartry and other streams, 28¼ mi. S. of Dublin by the Great Southern railway. Pop. (1936) 3,183. The harbour can accommodate vessels of 1,500 tons and has two piers, with quayage. The name shows the town to have been a settlement of the Norsemen.

WIDGEON, an abundant species of duck, *Anas penelope,* breeding in Europe and northern Asia and reaching northern Africa and India in winter. Intermediate in size between the teal and the mallard, the widgeon drake is a handsome bird with cream forehead, chestnut head and neck, pencilled gray flanks and green and black speculum (wing bar). Its whistling cry has given it the local name of "whew duck." The widgeon collects in huge flocks on tidal waters in winter and is shot for market in large numbers. When on land it often eats grass. Two allied species occur in America, of which *A. americana,* the baldpate, inhabits northern America, reaching Central America and Trinidad in winter; it differs in that the head is green, with the top of the head white. The other species, *A. sibilatrix,* is South American.

WIDMANN, JOSEPH VICTOR (1842–1911), poet, dramatist, novelist and literary critic, was born at Nennowitz (Moravia) on Feb. 20, 1842, and died at Bern on Nov. 6, 1911. In 1880 he became *feuilleton* editor of the *Berner Bund,* and in this capacity he exercised for 30 years an authoritative sway as critic of German and German-Swiss literature. Among the

most important of his own works are *Arnold von Brescia* (1867), a tragedy; *Buddha* (1869), a philosophic epic, which might be described as a forerunner of Nietzsche's *Also Sprach Zarathustra* and Spitteler's *Prometheus und Epimetheus; Mose und Zipora* (1874), an idyll; *Oenone* (1880), a drama; *Die Patriezerin* (1888), a novel of life in Bern; *Die Maikäferkomödie,* "Cockchafer Comedy" (1897), a charming allegorical play, which may possibly have furnished Rostand with the idea of *Chantecler;* and *Der Heilige und die Tiere* (1905), another dramatic poem in which his interest in the animal world and its right to poetic existence are demonstrated. The last is his profoundest poetical utterance. Widmann was one of the first to champion the genius of Carl Spitteler (*q.v.*), with whom his friendship dated from childhood days at Liestal.

See the *Life* by E. and M. Widmann (2 vols.; 1922–24); the studies by Maria Waser (1927), Prof. Jonas Fränkel (1918), W. Scheitler (1925); and the *Briefwechsel Keller-Widmann* (1922).

WIDNES, municipal borough, Widnes parliamentary division of Lancashire, England, on the Mersey, 12 mi. S.E. from Liverpool on the L.M.S.R. Pop. (est. 1938) 43,700. Area 9.7 sq.mi. It is wholly of modern growth, for in 1851 the population was less than 2,000. There are capacious docks on the river, which is crossed, and the town connected with Runcorn, by a railway bridge and a transporter bridge owned by the corporation. Widnes is one of the principal seats of the alkali and soap manufacture and has also greaseworks for locomotives and wagons, copper works, iron foundries, oil and paint works and sail-cloth manufactories. The barony of Widnes in 1554–55 was declared to be part of the duchy of Lancaster. The town was incorporated in 1892.

WIDOWS' PENSIONS: *see* NATIONAL INSURANCE: WIDOWS' AND ORPHANS' PENSIONS.

WIDUKIND or **WITTEKIND** (d. *c.* 807), leader of the Saxons, belonged to a noble Westphalian family. He probably fought the Franks before and during 776. In 778 he returned from exile in Denmark to lead a fresh rising, and in 782 the Saxons at his instigation drove out the Frankish priests, and plundered the border territories. His movements in 783–84 are uncertain; but in 785 he was reconciled to Charlemagne at Attigny and baptized, the king acting as his sponsor and loading him with gifts. The details of his later life are unknown. He probably returned to Saxony. Many legends have gathered around his memory. He is reported to have been duke of Engria, to have been a devoted Christian, and to have fallen in battle in 807. Royal houses have sought to establish descent from him, but except in the case of Matilda, wife of the German king, Henry I. the Fowler, without success.

See W. Diekamp, *Widukind der Sachsenführer nach Geschichte und Sage* (Münster, 1877); J. Dettmer, *Der Sachsenführer Widukind nach Geschichte und Sage* (Würzburg, 1879).

WIDUKIND, Saxon historian, was the author of *Res gestae Saxonicae.* He was a monk at the Benedictine abbey of Corvey, and he died about 1004. His *Res gestae Saxonicae,* dedicated to Matilda, abbess of Quedlinburg, who was a daughter of Otto the Great, is divided into three books, and the greater part of it was undoubtedly written during the lifetime of the emperor, probably about 968. Starting with the origin of the Saxons, the history comes down to the death of Otto in 997. Many quotations from the Vulgate are found in his writings, and there are traces of a knowledge of Virgil, Ovid and other Roman poets. The earlier part of his work is taken from tradition, but he wrote on contemporary events as one familiar with court life and the events of the day.

The best edition of the *Res gestae* is that edited by G. Waitz in the *Monumenta Germaniae historica. Scriptores,* Band iii. (Hanover and Berlin, 1826). A good edition published at Hanover and Leipzig in 1904 contains an introduction by K. A. Kehr.

See R. Köpke, *Widukind von Corvey* (Berlin, 1867); J. Raase, *Widukind von Korvei* (Rostock, 1880); and B. Simson, "Zur Kritik des Widukind" in the *Neues Archiv der Gesellschaft für ältere deutsche Geschichte,* Band xii. (Hanover, 1876).

WIELAND, CHRISTOPH MARTIN (1733–1813), German poet and man of letters, was born at Oberholzheim, a village near Biberach in Württemberg, on Sept. 5, 1733. His father, who was pastor in Oberholzheim, and subsequently in Biberach, took great pains with the child's education, and sent him to the gymnasium at Klosterberge, near Magdeburg. Under the influence of a first love-affair, with Sophie Gutermann, he planned his first ambitious work, *Die Natur der Dinge* (1752), a didactic poem in six books. In 1750 he went to Tübingen to study law, but his time was mainly taken up with literary studies. The poems he wrote at the university—*Hermann,* an epic (published by F. Muncker, 1886), *Zwölf moralische Briefe in Versen* (1752), *Anti-Ovid* (1752)—are pietistic in tone and dominated by the influence of Klopstock. They attracted the attention of J. J. Bodmer, who invited Wieland to visit him in Zürich in the summer of 1752. After a few months, however, Bodmer felt himself as little in sympathy with Wieland as, two years earlier, he had felt himself with Klopstock, and the friends parted; but Wieland remained in Switzerland until 1760, residing, in the last year, at Berne where he obtained a position as private tutor. Here he stood in intimate relations with Rousseau's friend Julie de Bondeli. Meanwhile a change had come over Wieland's tastes; the writings of his early Swiss years—*Der geprüfte Abraham* (1753), *Sympathien* (1756), *Empfindungen eines Christen* (1757)—were still in the manner of his earlier writings, but with the tragedies, *Lady Johanna Gray* (1758), and *Clementina von Porretta* (1760)—the latter based on Richardson's *Sir Charles Grandison*—the epic fragment *Cyrus* (1759), and the "moral story in dialogues," *Araspes und Panthea* (1760), Wieland, as Lessing said, "forsook the ethereal spheres to wander again among the sons of men."

Wieland's conversion was completed at Biberach, whither he had returned in 1760, as director of the chancery. He had access to the library at Warthausen of Count Stadion. Here he met once more Sophie Gutermann, who had meanwhile become the wife of Hofrat Laroche, then manager of Count Stadion's estates. The former poet of an austere pietism now became the advocate of a light-hearted philosophy, from which frivolity and sensuality were not excluded. In *Don Sylvio von Rosalva* (1764), a romance in imitation of *Don Quixote,* he held up to ridicule his earlier faith and in the *Komische Erzählungen* (1765) he gave his extravagant imagination only too free a rein. More important is the novel *Geschichte des Agathon* (1766–1767), in which, under the guise of a Greek fiction, Wieland described his own spiritual and intellectual growth. This work, which Lessing recommended as "a novel of classic taste," is a landmark in the development of the modern psychological novel. Of equal importance was Wieland's translation of twenty-two of Shakespeare's plays into prose (8 vols., 1762–1766); it was the first attempt to present the English poet to the German people in something approaching entirety. With the poems *Musarion oder die Philosophie der Grazien* (1768), *Idris* (1768), *Combabus* (1770), *Der neue Amadis* (1771), Wieland opened the series of light and graceful romances in verse which acted as an antidote to the sentimental excesses of the subsequent *Sturm und Drang* movement.

Wieland married in 1765, and between 1769 and 1772 was professor of philosophy at Erfurt. In the last-mentioned year he published *Der goldene Spiegel oder die Könige von Scheschian,* a pedagogic work in the form of oriental stories; this attracted the attention of duchess Anna Amalie of Saxe-Weimar, who appointed him tutor to her two sons, Karl August and Konstantin, at Weimar. With the exception of some years spent at Ossmannstedt, where in later life he bought an estate, Weimar remained Wieland's home until his death on Jan. 20, 1813. Here, in 1773, he founded *Der Deutsche Merkur,* which under his editorship (1773–1789) became the most influential literary review in Germany. Of the writings of his later years the most important are the admirable satire on German provinciality—the most attractive of all his prose writings—*Die Abderiten, eine sehr wahrscheinliche Geschichte* (1774), and the charming poetic romances, *Das Wintermärchen* (1776), *Das Sommermärchen* (1777), *Geron der Adelige* (1777), *Die Wünsche oder Pervonte* (1778), a series culminating with Wieland's poetic masterpiece, the romantic epic of *Oberon* (1780). His later work included novels, translations of Horace, Lucian and Cicero, and the editing of the *Attisches Museum* (1796–1803).

Without creating a school in the strict sense of the term, Wieland influenced very considerably the German literature of his time. Modern editions of Wieland's *Sämtliche Werke* are those of H. Düntzer (4 vols., 1879–82), and the critical edition issued by the Prussian Academy (1909, etc.).

There are numerous editions of selected works, notably W. Bölsche (4 vols., 1902). Collections of Wieland's letters were edited by his son Ludwig (1815) and by H. Gessner (1815–16); his letters to Sophie La Roche by F. Horn (1820). *See* J. G. Gruber, *C. M. Wielands Leben* (4 vols., 1827–28); H. Döring, *C. M. Wieland* (1853); J. W. Loebell, *C. M. Wieland* (1858); H. Pröhle, *Lessing, Wieland, Heinse* (1876); L. F. Ofterdinger, *Wielands Leben und Wirken in Schwaben und in der Schweiz* (1877); R. Kiel, *Wieland und Reinhold* (1885); F. Thalmeyr, *Über Wielands Klassizität, Sprache und Stil* (1894); M. Döll, *Wieland und die Antike* (1896); C. A. Behmer, *Sterne und Wieland* (1899); W. Lenz, *Wielands Verhältnis zu Spenser, Pope und Swift* (1903); L. Hirzel, *Wielands Beziehungen zu den deutschen Romantikern* (1904). *See* also M. Koch's article in the *Allgemeine deutsche Biographie* (1897). (J. G. R.)

WIELICZKA, a mining town in Poland, 9 mi. S.E. of Cracow; occupied by Germany in 1939. It is built on the slopes of a hill which half encircles the place, and over the celebrated salt-mines of the same name. These mines are the richest in Poland, and among the most remarkable in the world. They consist of seven different levels, one above the other, and have eleven shafts, two of which are in the town. The levels are connected by flights of steps, and are composed of a labyrinth of chambers and passages, whose length aggregates over 65 m. The length of the mines from E. to W. is 2½ m., the breadth from N. to S. is 1,050 yd. and the depth reaches 980 ft. Many of the old chambers, some of which are of enormous size, are embellished with portals, candelabra, statues, etc., all hewn in rock-salt. There are also two large chapels, containing altars, ornaments, etc., in rock-salt, a room called the dancing saloon, where the objects of interest found in the mines are kept. In the interior of the mines are sixteen ponds, of which Przykos is 195 ft. long, 110 ft. broad, and 10–26 ft. deep. The mines employ over 1,000 workers, and yield about 60,000 tons annually. The salt of Wieliczka is well known for its purity and solidity, but has generally a grey or blackish colour. The date of the discovery of the mines is unknown, but they were already worked in the 11th century. The mines suffered from inundations in 1868 and 1879, and the soil on which the town is built shows subsidence. Pop. (1931) 8,668.

WIEN, WILHELM (1864–1928), German physicist, was born on Jan. 13, 1864, at Gaffken (East Prussia). He studied at the universities of Göttingen, Heidelberg and Berlin, and in 1890 entered the Physico-Technical Institute as assistant to Helmholtz. In 1896 he was appointed professor at the technical high school, Aix-la-Chapelle; in 1899 he went to Giessen, in 1900 to Würzburg, and in 1920 to Munich. Wien's researches covered almost the whole sphere of physics. He wrote on optical problems; on radiation, especially black-body radiation, for which in 1911 he was awarded the Nobel prize; on water and air currents, on discharge through rarefied gases, cathode rays, X-rays and positive rays. Wien's most important contributions to black-body radiation are contained in the two laws named after him. He developed a formula for the energy density associated with a definite wave length at a certain temperature, and from this obtained what is known as Wien's displacement law, which states that the product of the wave length at which the energy density is a maximum and the absolute temperature is a constant. Wien also developed a formula for the energy distribution of black-body radiation; this was found to hold for short wave lengths only but is important as a link in the chain which led to Planck's formula. His work on positive rays is of great importance; he showed that these rays underwent electrostatic and magnetic deflection as early as 1898 and continued his researches on this subject. In 1913 he lectured at Columbia University in New York on problems of modern theoretical physics. He died on Aug. 30, 1928.

Wien was the editor of the *Annalen der Physik* from vol. 21 (1906). His chief works are: *Lehrbuch der Hydrodynamik* (1900); *Neuere Probleme der theoretischen Physik* (1913); *Die Relativitäts-theorie vom Standpunkte der Physik und Erkenntnislehre* (1921).

WIENER-NEUSTADT, a town in Lower Austria (after 1938 the *Reichsgau* Niederdonau), at the divergence of routes from Vienna to the Semmering pass and to Hungary via the Sopron gate. The town was founded in 1192. It is essentially modern in appearance, owing to rebuilding in 1834, following almost complete destruction by fire. But there remains a 12th century castle built by Duke Leopold V, converted by Maria Theresa in 1752 into a military academy and, since 1919, a school for boys; the 13th century Romanesque Liebfrauen church, with Gothic choir and transepts added in the 15th century; and the 15th century Cistercian abbey with its rich library and museum. Helped by its situation, Wiener-Neustadt became an industrial town with special interests in locomotives and railway stock, machinery, textiles and leather goods, to which may be added sugar-refining, paper-making and the manufacture of pottery. A flourishing trade is facilitated by a canal to the capital, chiefly used for the transport of coal and timber. Pop. (1939) 40,368.

WIESBADEN, a town and watering-place in the Prussian province of Hesse-Nassau, Germany. Pop. (1939) 172,039. It is one of the oldest watering-places in Germany. The springs mentioned by Pliny as *Fontes Matthiaci* were known to the Romans, who fortified the place *c.* 11 B.C. The wall known as the *Heidenmauer,* was probably part of the fortifications built under Diocletian. The name *Wisibada* ("meadow bath") appears in 830. Under the Carolingian monarchs it was the site of a palace, and Otto I gave it civic rights. In the 11th century the town and district passed to the counts of Nassau, and in 1355 Wiesbaden became with Idstein capital of the county Nassau-Idstein. It suffered from the ravages of the Thirty Years' War and was destroyed in 1644. In 1744 it became the seat of government of the principality Nassau-Usingen, and was from 1815 to 1866 the capital of the duchy of Nassau, when it passed with that duchy to Prussia. It is situated under the southwestern spurs of the Taunus range, 5 mi. N. of Mainz, 3 mi. from the Rhine (at Biebrich), and 25 mi. W. of Frankfurt-on-Main by rail.

Wiesbaden's prosperity is mainly due to its hot alkaline springs and mild climate, which have rendered it a winter as well as summer resort. There is a large trade in wine and small manufactures of surgical instruments, artificial manures, furniture, cement and chocolate.

WIESER, FRIEDRICH VON (1851–1926), Austrian economist and sociologist, professor at the universities of Prague and Vienna, was minister of commerce, 1917–18. His economic teachings are fully presented in *Theorie der gesellschaftlichen Wirtschaft* (Social Economics, translated by A. Ford Hinrichs, 1927); his collected essays were edited by F. A. v. Hayek (1929), viz., *Gesammelte Abhandlungen.* His main sociological treatise was *Das Gesetz der Macht* (1926). Wieser died July 24, 1926. (L. VON M.)

WIG, short form for "periwig." An artificial head of hair, worn as a personal adornment, disguise or symbol of office. The wearing of wigs is of great antiquity, and Egyptian mummies have been found so adorned. In Greece wigs were used by men and women. A reference in Xenophon to the false hair worn by Cyrus's grandfather "as is customary among the Medes," and also a story in Aristotle, would suggest that wigs were introduced from Persia, and were in use in Asia Minor. The elaborately frizzled hair worn by some of the figures in the frescoes found at Knossos makes it probable that the wearing of artificial hair was known to the Cretans. Lucian, in the 2nd century, mentions wigs of both men and women as a matter of course. The theatrical wig was also in use in Greece, the various comic and tragic masks having hair suited to the character represented. A. E. Haigh (*Attic Theatre,* pp. 221, 239) refers to the black hair and beard of the tyrant, the fair curls of the youthful hero, and the red hair characteristic of the dishonest slave of comedy. These conventions appear to have been handed on to the Roman theatre.

At Rome wigs came into use certainly in the early days of the empire. They were also known to the Carthaginians; Polybius says that Hannibal used wigs as a means of disguise. The fashionable ladies of Rome were much addicted to false hair, and we learn from Ovid and Martial that the golden hair imported from

Germany was most favoured. Juvenal shows us Messalina assuming a yellow wig for her visits to places of ill-fame. The chief names for wigs were *galerus, galericulum, corymbium, capillamentum, caliendrum,* etc. *Galerus* meant in the first place a skull-cap, or coif, fastening under the chin, and made of hide or fur, worn by peasants, athletes and *flamines*. The first men's wigs then would have been tight fur caps simulating hair, which would naturally suggest wigs of false hair. Women continued to have wigs of different colours as part of their ordinary wardrobe, and Faustina, wife of Marcus Aurelius, is said to have had several hundred. An amusing development of this is occasionally found in portrait busts, *e.g.* that of Plautilla in the Louvre, Paris, in which the hair is made removable, so that by changing the wig of the statue from time to time it should never be out of fashion.

The periwig of the 16th century merely simulated real hair, either as an adornment or to supply the defects of nature. It was not till the 17th century that the peruke was worn as a distinctive feature of costume. The fashion started in France. In 1620 the abbé La Rivière appeared at the court of Louis XIII. in a periwig made to simulate long fair hair, and four years later the king himself, prematurely bald, also adopted one and thus set the fashion. Louis XIV., who was proud of his abundant hair, did not wear a wig till after 1670. From Versailles the fashion spread through Europe. In England, under Charles II., the wearing of the peruke became general. Pepys records that he parted with his own hair and "paid £3 for a periwigg," and on going to church in one he says "it did not prove so strange as I was afraid it would." It was under Queen Anne, however, that the wig attained its maximum development, covering the back and shoulders and floating down over the chest.

This differentiation of wigs according to class and profession explains why, when early in the reign of George III. the general fashion of wearing wigs began to wane and die out, the practice held its own among professional men. It was by slow degrees that doctors, soldiers and clergymen gave up the custom. In the Church it survived longest among the bishops. At the coronation of Queen Victoria the archbishop of Canterbury, alone of the prelates, still wore a wig. Wigs are now worn as part of official costume only in Great Britain, their use being confined, except in the case of the speaker of the house of commons and the clerks of parliament, to the lord chancellor, the judges and barristers.

See F. W. Fairholt, *Costume in England,* 2 vols., ed. Dillon (1885); C. F. Nicolai, *Über den Gebrauch der falschen Haare und Perrücken* (1801); the articles "Coma" and "Galerus" in Daremberg and Saglio's *Dictionnaire des antiquités. See* also Diderot's *Encyclopédie* (1765), vol. xii., *s.v.* "Perruque," and James Stewart, *Plocacosmos, or the Whole Art of Hairdressing* (1782).

WIGAN, market town; municipal, county and parliamentary borough of Lancashire, England, 194 mi. N.N.W. of London by the L.M.S.R.; also served by the L.N.E.R. Pop. (1938) 82,530. Area 7.9 sq.mi. It is probable that the town covers the site of a Roman post or fort, Coccium. Wigan (Wygan, Wigham) is not mentioned in Domesday, but three townships, Upholland, Dalton and Orrel are named. After the Conquest Wigan was part of the barony of Newton, and the church was endowed with a carucate of land, the origin of the manor. Before Henry III's reign, the baron of Newton granted to the rector of Wigan the manorial privileges. In 1246 Henry III granted a charter to John Mansel, parson of the church, by which Wigan was constituted a free borough and the burgesses permitted to have a gild merchant. It is the oldest borough in Lancashire. In 1680 Ogilby observes that the town was "noted for its iron works." Pottery, pewter and bell-founding were important trades. Manufacture of woollens, especially of blankets, was carried on in the 18th century. The cotton trade developed rapidly after the introduction of the cylindrical carding machine. During the Civil War the town, from its vicinity to Lathom house and the influence of Lord Derby, adhered staunchly to the king. On April 1, 1643, the Parliamentarians captured Wigan (*see* LANCASHIRE). The following month Lord Derby regained it for the Royalists, but Colonel Ashton soon retook it. In 1651 Lord Derby marched through Preston to Wigan and at Wigan Lane, on Aug. 25, the Royalist forces were defeated and Lord Derby was wounded. During the rebellion of 1745 Prince Charles Edward spent one night (Dec. 10) here. In 1295 Wigan returned two members to parliament and again in 1307; the right then remained in abeyance till 1547, but from that time till 1885, except during the Commonwealth, the borough returned two members, and since 1885 one member. The list of rectors is complete from 1199; the list of mayors goes back to 1370, town clerks to 1350, and recorders to 1600.

Wigan lies on the small river Douglas, which flows into the estuary of the Ribble. There is connection by canal with Liverpool, Manchester, etc. The town has coal mines which are famous for cannel coal, and which employ a large proportion of the inhabitants and supply the factory furnaces. The chief manufactures are cotton fabrics and linen fabrics; the town also possesses iron forges, iron and brass foundries, oil, grease and chemical works, railway waggon factories, and bolt, screw and nail works. The borough includes the important district of Pemberton.

WIGGIN, KATE DOUGLAS (1856–1923), American novelist, daughter of Robert N. Smith, a lawyer, was born in Philadelphia (Pa.), Sept. 28, 1856, whence her family removed to Hollis (Maine). She was educated at home and at various seminaries including Abbot academy, Andover (Mass.), and when 17 years of age joined her family in California. Having been a member of Miss Marwedel's pioneer training class, she was called from her teaching in Santa Barbara to establish in San Francisco the first free kindergarten on the western coast (1878), and organized her own California kindergarten training school in 1880. She married, in 1881, Samuel B. Wiggin, who died in 1889. In 1895 she married George C. Riggs, but continued to write under the name of Wiggin. She died in England, Aug 24, 1923. Her interest in children's education was shown in numerous books, but her literary reputation rests rather on her prose fiction: *The Birds' Christmas Carol* (1888), the Penelope series (5 vols.); *Rebecca of Sunnybrook Farm* (1903); *New Chronicles of Rebecca* (1907); and *The Story of Waitstill Baxter* (1913). Several of these were dramatized with the assistance of collaborators. An autobiographical volume is *My Garden of Memory* (1923).

A uniform "Quillcote" edition of her books appeared in ten vols. Several of them have been translated into many languages. *See* also Nora Archibald Smith, *Kate Douglas Wiggin as Her Sister Knew Her* (1925).

WIGGLESWORTH, MICHAEL (1631–1705), American clergyman, physician and poet, was born in England (probably in Yorkshire) Oct. 18, 1631. His father, persecuted for his Puritan faith, emigrated with his family to New England in 1638 and settled in New Haven. In 1651 Michael graduated at Harvard, where he was a tutor (and a Fellow) in 1652–54 and again in 1697–1705. Having fitted himself for the ministry, he preached at Charlestown in 1653–54, and in spite of ill health, was pastor at Malden from 1656 until his death, June 10, 1705. Wigglesworth is best known as the author of *The Day of Doom; or a Poetical Description of the Great and Last Judgment* (1662), a lurid exposition of Calvinistic theology, which children were made to learn like the catechism.

WIGHT, ISLE OF, off the south coast of England, part of Hampshire, separated from the mainland of Hampshire by the Solent and Spithead. It is 22½ m. from east to west and 13½ m. from north to south. The area is 147 sq.m. The south coast is chiefly cliff-bound and there is beautiful scenery both inland and along the northern shores. The climate is mild and healthy. As a result there are numerous watering places. Chalk downs range from east to west, terminating in the Culver cliffs and the Needles. These downs are from 400 to 700 ft. high. North of this ridge the chalk dips beneath Tertiary rocks with heavy soils, which support extensive areas of trees.

Three rivers, the eastern Yar, Medina and western Yar, drain the island. The Medina bisects the island. The structure of the island is that of a simple monocline, the central chalk ridge forming an almost vertical limb. To the south of this, the dip of the beds is southward at a very low angle and there is a second range of downs, in the extreme south, between St. Catherine's Point and Dunnose, which exceed 800 ft. in St. Catherine's Hill. Below these heights on the seaward side occurs the remarkable tract known as the Undercliff, a terrace formed by the sliding of the

Chalk and Upper Greensand upon the unctuous surface of the Gault clay. The upper cliffs shelter this terrace and the climate is remarkably mild. This part of the island affords a winter resort. Along the south coast the action of small streams on the soft rocks has hollowed out steep gullies. Many of these are of great beauty; the most famous are Shanklin and Blackgang chines. The western peninsula shows the finest development of sea-cliffs. Off the westernmost promontory rise three detached masses of chalk about 100 ft. high known as the Needles, exposed to the full strength of the south-westerly gales. During a storm in 1764 a fourth spire was undermined and fell.

Newport at the head of the Medina estuary is the chief town; Cowes at the mouth, the chief port. The principal resorts are Cowes (headquarters of the Royal Yacht Squadron) Ryde, Sandown, Shanklin, Ventnor, Freshwater Gate and Yarmouth. Others are Totland Bay, Gurnard (Cowes), Seaview and Bembridge (Ryde). The principal communications with the mainland are between Cowes and Southampton, Ryde and Portsmouth, and Yarmouth and Lymington. The island is well supplied with railways and roads. The island shares in the defenses of the Solent, and the entry to Portsmouth; there are batteries at Puckpool, on the eastern foreland, and the west coast. Osborne House, near Cowes, a residence and scene of the death of Queen Victoria, was presented to the nation by King Edward VII in 1902.

The island is divided into the liberty of East Medina and the hundred of West Medina, excluding the boroughs of Newport and Ryde; and contains the urban districts of Cowes, Sandown-Shanklin and Ventnor. The island has for many centuries belonged to the see of Winchester. Pop. (1938) 85,750.

History.—Relics of the Roman occupation following the conquest by Vespasian in A.D. 43, are the villas at Brading and Carisbrooke, the cemetery at Newport, and remains of foundations at Combly Farm, Gurnet, and between Brixton and Calbourne. The Jutes probably settled here and in 661 it was annexed by Wulfhere to Wessex and subsequently bestowed on the king of Sussex. In 998 it was the headquarters of the Danes.

From the 14th to the 16th century the island was under fear of invasion by the French, who in 1377 burnt Yarmouth and Francheville (the latter being subsequently rebuilt and known as Newtown), and so devastated Newport that it lay uninhabited for two years. In 1419, a French force landed and demanded tribute in the name of King Richard and Queen Isabella, which was refused, and the French returned home. Another raid was attempted in 1545 when a French fleet of 225 ships drew up off Brading Harbour and wrought much destruction. As a result an organized system of defense was planned. Forts were constructed at Cowes, Sandown, Freshwater and Yarmouth. Charles I was imprisoned in Carisbrooke castle in 1647–48 and, in 1650, his two children, the princess Elizabeth and the Duke of Gloucester, the former dying there.

The lordship of the island was granted by William the Conqueror to William Fitz-Osbern, but escheated to the crown. It was bestowed by Henry I on Richard de Redvers, whose descendant Isabella de Fortibus sold it to Edward I in 1293.

In the Domesday Survey 29 mills are mentioned, and saltworks at Boarhunt, Bowcombe, Watchingwell and Whitfield. The island quarries have been worked from remote times, that of Quarr supplying material for Winchester cathedral. Alum and sand for glass-making were formerly obtained at Alum Bay.

One member is returned to parliament for the whole island. Antiquities include British pit villages (Rowborough), prehistoric tumuli on several of the chalk downs, the so-called Long Stone at Mottiston, a lofty sandstone monolith, well-preserved examples of tesselated Roman pavements near Brading, Carisbrooke Castle, a beautiful ruin built upon the site of an ancient British stronghold, and remains of Quarr Abbey near Ryde. The most noteworthy ancient churches are those of Bonchurch (Norman), Brading (transitional Norman and Early English), Shalfleet (Norman and Decorated), and Carisbrooke, of various styles.

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WIGTOWNSHIRE (sometimes called WEST GALLOWAY), south-western county, Scotland, bounded north by Ayrshire, east by Kirkcudbrightshire and Wigtown bay, south by the Irish sea and west and north by the North channel. Including the island of St. Helena, at the head of Luce bay, its land area is 311,984 ac., or 487.5 sq.mi. On the eastern boundary the estuary of the Cree expands into Wigtown bay, between which and Luce bay extends the promontory of the Machers, terminating in Burrow head. By the indentation of Luce bay on the south and Loch Ryan on the north the hammerheaded peninsula of the Rinns is formed, of which the Mull of Galloway, the most southerly point of Scotland, is the southern, and Milleur point the northern extremity. The coast has many inlets, but most are exposed and beset with rocks. Loch Ryan is a natural harbour of which Stranraer is the port.

A line north-east from the coast about 3 m. south of Portpatrick divides the county so that practically all the rocks on the northern side are of Ordovician age, while those on the south are Silurian. This line coincides with the general direction of the strike of the beds throughout the county. Glacial moraines and drumlins are widespread and are well seen between Glenluce and Newton Stewart and south of Wigtown. On the coasts of Luce bay and Loch Ryan raised beaches are found at levels of 25 ft. and 50 ft. above the sea. Towards the Ayrshire border, hills reach 1,000 ft. in height. The chief rivers are the Cree, forming the boundary with Kirkcudbrightshire, and the Bladenoch, issuing from Loch Maberry and falling into Wigtown Bay at Wigtown after a course of 22 m. Most of the numerous lochs are small.

History and Antiquities.—The history of Wigtownshire is hardly distinguishable from that of Galloway (*q.v.*). Evidences of the Pictish occupation are prevalent in the form of hill forts, cairns, standing stones, hut circles and crannogs or lake dwellings. There are so few Roman remains that it has been concluded they effected no permanent settlement in West Galloway. Ninian, the first Christian missionary to Scotland, landed at Isle of Whithorn in 396 to convert the natives. His efforts were temporarily successful. A monastery was built at Whithorn, and, though the bishopric founded in the 8th century was shortly afterwards removed, it was established again in the 12th, when the priory erected by Fergus, "king" of Galloway, became the cathedral church of the see of Galloway.

Malcolm MacHeth, who had married a sister of Somerled, lord of the Isles, headed about 1150 a Celtic revolt against the intrusion of Anglo-Norman lords, but was routed at Causewayend near the estuary of the Cree. In the disorder of the realm during David II.'s reign east Galloway had been surrendered to Edward III. (1333), but Wigtownshire, which had been constituted a shire in the previous century and afterwards called the Shire to distinguish it from the Stewartry of Kirkcudbright, remained Scottish territory. In 1372 the then earl of Wigtown sold his title and estates to the 3rd earl of Douglas, and under that family in 1426, the region came under the general law. Soon after the fall of the Douglases (1455) the Kennedy family, long established in the Ayrshire district of Carrick, obtained a preponderating influence in Wigtownshire, and in 1509 David Kennedy was created earl of Cassillis. Gilbert, the 4th earl held the shire for Mary, queen of Scots, when she broke with the Lords of the Congregation, but could do little for her cause. He profited by the Reformation himself, however, to acquire by fraud and murder the estate of Glenluce abbey (about 1570).

Among ancient castles are the cliff towers, possibly of Norse origin, of Carghidown and Castle Feather near Burrow Head; the ruins of Baldoon, south of Wigtown, associated with events which suggested to Sir Walter Scott the romance of *The Bride of Lammermoor;* Corsewall near the northern extremity of the Rinns; the Norse stronghold of Cruggleton, south of Garliestown; Dunskey, south of Portpatrick, built in the 16th century, occupying the site of an older fortress; the fragments of Long castle at Dowalton loch, the ancient seat of the MacDonells; Myrton, the seat of the MacCullochs, in Mochrum parish; and the ruined tower of Sorbie, the ancient keep of the Hannays.

Agriculture and Industries.—Much of the shire consists of

stony moors, rendering the work of reclamation difficult. The gravelly soil along the coast requires heavy manuring, and in the higher arable quarters a rocky soil prevails, better adapted for grass and green crops than for grain. Much of the surface is black top reclaimed from the moors, and in some districts loam and clay are found. Half of the shire is, however, under cultivation, and the standard of farming is as high as that of any county in Scotland. In 1938 the chief crop was oats, with 23,997 ac., followed by turnips and swedes (9,320 ac.) and potatoes (1,934 ac.). Ayrshire cattle are the favourite breed for dairying, with black-polled Galloways in the eastern districts. Cattle raising (64,433 animals in 1938) is extensive. The sheep are principally black-faced on the hill farms, and in other parts Leicester and other long-woolled breeds, wool being an important product. Many pigs are kept. Of the 1,276 holdings in the same year over 43% were larger than 100 ac. The shire has acquired some reputation for its horses, chiefly Clydesdale. There is regular communication by mail steamer between Stranraer and Larne in Co. Antrim, Ireland.

The population was estimated in 1938 at 29,723. In 1931 Gaelic and English were spoken by 100 persons. The four small burghs are Newton-Stewart (pop. 1,993), Stranraer (7,192), Whithorn (994) and Wigtown (1,278) (all 1938 est.), the last three being royal burghs.

WIGWAM, a term loosely adopted as a general name for the houses of North American Indians. It is, however, strictly applied to a particular dome-shaped or conical hut made of poles lashed together at the tops and covered with bark. The skin tents of many of the Plains Indians are called *tepees*. The word "wigwam" represents the Europeanized or Anglicized form of the Algonkian *wēkou-om-ut, i.e.,* "in his (their) house."

WIHTRED, king of Kent (d. 725), son of Ecgberht, nephew of Hlothhere and brother of Eadric, came to the Kentish throne in 690 after the period of anarchy which followed the death of the latter king. Bede states that Wihtred and Swefheard were both kings in Kent in 692, and this statement would appear to imply a period of East Saxon influence (*see* KENT), while there is also evidence of an attack by Wessex. Wihtred, however, seems to have become sole king in 694. At his death in 725, he left the kingdom to his sons Aethelberht, Eadberht and Alric. There is still extant a code of laws issued by him in a council held at a place called Berghamstyde (Barham?) during the fifth year of his reign (probably 695).

See Bede, *Hist. Eccl.* ed. C. Plummer (Oxford, 1896); *Anglo-Saxon Chronicle,* ed. Earle and Plummer (Oxford, 1899).

WILAMOWITZ-MÖLLENDORFF, ULRICH VON (1848–1931), German scholar, was born on Dec. 22, 1848 at Markowitz in Posen. He studied at Bonn and Berlin, and afterwards travelled in Italy and Greece (1872–74). In the latter year he took a post as lecturer in Berlin, and afterwards became a professor in Greifswald and Göttingen. In 1897 he was appointed professor of ancient philology in the University of Berlin. Wilamowitz proved himself not only an excellent editor and witty commentator on the Greek tragedies of Aeschylus, Euripides and Aristotle, but also a brilliant translator of Greek verse. Sharply attacked by Friedrich Nietzsche in his youth, Wilamowitz became one of the first authorities of modern times in the field of Greek philology. He died Sept. 27, 1931.

Among his numerous works are: *Aeschyli Tragoediae* (Greek and German 1914); *Euripides' Herakles,* with an introduction to the Greek tragedy and German annotations (1889); *Die Textgeschichte der griechischen Lyriker* (1900); *Bucolici Graeci* (Oxford, 1905); *Die Ilias und Homer* (1916); *Platon,* (1919); *Hellenistische Dichtung* (1924); *Griechische Verskunst* (1921); *Pindaros* (1922); *Die Heimkehr des Odysseus* (1927).

WILBERFORCE, SAMUEL (1805–1873), English bishop, third son of William Wilberforce, was born at Clapham Common, London, on Sept. 7, 1805. He graduated from Oriel College, Oxford, in 1826, taking a first class in mathematics and a second in classics. He was ordained in 1828, and in 1830 became rector of Brightstone, Isle of Wight. Although a High Churchman Wilberforce held aloof from the Oxford movement, and in 1838 his divergence from the "Tract" writers became so marked that J. H. Newman declined further contributions from him to the *British Critic,* not deeming it advisable that they should longer "co-operate very closely." In 1838 Wilberforce published, with his elder brother Robert, the *Life* of his father, and two years later his father's *Correspondence.* In 1839 he also published *Eucharistica* (from the old English divines), to which he wrote an introduction, *Agathos and other Sunday Stories,* and a volume of *University Sermons,* and in the following year *Rocky Island and other Parables.* In March 1844 he was made dean of Westminster, and in October bishop of Oxford.

The bishop in 1847 became involved in the Hampden controversy, and signed the remonstrance of the thirteen bishops to Lord John Russell against R. D. Hampden's appointment to the bishopric of Hereford. He also endeavoured to obtain satisfactory assurances from Hampden; but, though unsuccessful in this, he withdrew from the suit against him. The publication of a papal bull in 1850 establishing a Roman hierarchy in England brought the High Church party, of whom Wilberforce was the most prominent member, into temporary disrepute. His diary reveals a devout private life which has been overlooked by those who have only considered the versatile facility and persuasive expediency that marked the successful public career of the bishop, and earned him the sobriquet of "Soapy Sam."

His attitude towards *Essays and Reviews,* 1861, against which he wrote an article in the *Quarterly,* won him the special gratitude of the Low Church party, and latterly he enjoyed the full confidence and esteem of all except the extreme men of either side and party. On the publication of J. W. Colenso's *Commentary on the Romans* in 1861, Wilberforce sought a private conference with the author; but after the publication of the first two parts of the *Pentateuch Critically Examined* he drew up the address of the bishops which called on Colenso to resign his bishopric. Though opposed to the disestablishment of the Irish Church, yet, when the constituencies decided for it, he advised that no opposition should be made to it by the House of Lords. After twenty-four years' labour in the diocese of Oxford, he was translated by Gladstone to the bishopric of Winchester. He was killed on July 19, 1873, by the shock of a fall from his horse near Dorking, Surrey.

See *Life of Samuel Wilberforce, with Selections from his Diary and Correspondence* (1879–82), vol. i., ed. by Canon A. R. Ashwell, and vols. ii. and iii., ed. by his son R. G. Wilberforce, who also wrote a one-volume Life (1905). One of the volumes of the "English Leaders of Religion" is devoted to him, and he is included in Dean Burgon's *Lives of Twelve Good Men* (1888).

WILBERFORCE, WILLIAM (1759–1833), English philanthropist whose name is chiefly associated with the abolition of the slave trade, was descended from a Yorkshire family which possessed the manor of Wilberfoss in the East Riding from the time of Henry II. till the middle of the 18th century. He was the only son of Robert Wilberforce, member of a commercial house at Hull, by his wife Elizabeth, daughter of Thomas Bird of Barton, Oxon, and was born at Hull on Aug. 24, 1759. At the age of 9 he lost his father and was transferred to the care of a paternal uncle at Wimbledon; but in his 12th year he returned to Hull, and was placed under the care of the master of the endowed school of Pocklington. Here he neglected his studies, but he entered St. John's college, Cambridge, in Oct. 1776. Left by the death of his grandfather and uncle the possessor of an independent fortune under his mother's sole guardianship, he was somewhat idle at the university, though he acquitted himself in the examinations with credit; but in his serious years he "could not look back without unfeigned remorse" on the opportunities he had then neglected. In 1780 he was elected M.P. for Hull. He soon found his way into the fast political society of London, and at the club at Goosetrees renewed an acquaintance begun at Cambridge with Pitt, which ripened into a close friendship. In the autumn of 1783 he set out with Pitt on a tour in France; and after his return his eloquence proved of great assistance to Pitt in his struggle against the majority of the House of Commons. In 1784 Wilberforce was elected for both Hull and Yorkshire, and took his seat for the latter constituency.

A journey to Nice in the autumn of the same year with Dr. Isaac Milner (1750–1820), who had been one of his masters at Hull grammar school, and afterwards became president of

Queens' college, Cambridge, and dean of Carlisle, led to his conversion to Evangelical Christianity. The change had a marked effect on his public conduct. In the beginning of 1787 he busied himself with the establishment of a society for the reformation of manners. About the same time he met Thomas Clarkson, and began the agitation against the slave trade. Pitt recommended Wilberforce to undertake the guidance of the project as a subject suited to his character and talents. While Clarkson conducted the agitation throughout the country, Wilberforce took every opportunity in the House of Commons of exposing the evils and horrors of the trade. For the history of the various motions introduced by Wilberforce *see* the article SLAVERY. It was not till 1807, the year following Pitt's death, that the first great step towards the abolition of slavery was accomplished. When the anti-slavery society was formed in 1823, Wilberforce and Clarkson became vice-presidents; but before their aim was accomplished Wilberforce had retired from public life, and the Emancipation Bill, which was the culmination of his life-work, was not passed till Aug. 1833, a month after his death.

In May 1797 he married Barbara Ann Spooner and took a house at Clapham, where he became one of the leaders of the "Clapham Sect" of Evangelicals, including Henry Thornton, Charles Grant, E. J. Eliot, Zachary Macaulay and James Stephen. In connection with this group he planned a religious periodical which should admit "a moderate degree of political and common intelligence," the result being the appearance in January 1801 of the *Christian Observer*. He also interested himself in a variety of schemes for the social and religious welfare of the community. In parliament he was a supporter of parliamentary reform and of Roman Catholic emancipation. In 1812, on account of failing health, he exchanged the representation of Yorkshire for that of Bramber, Sussex. In 1825 he retired from the House of Commons, and the following year settled at Highwood Hill, near Mill Hill. He died at London on July 29, 1833, and was buried in Westminster Abbey.

In 1797 Wilberforce published *A Practical View of the Prevailing Religious System of Professed Christians in the Higher and Middle Classes of this Country Contrasted with Real Christianity,* which within half a year went through five editions and was translated into French, Italian, Dutch and German.

The chief authorities of the career of William Wilberforce are his *Life* (5 vols., 1838) by his sons, Robert, Isaac and Samuel, and his *Correspondence* (1840) also published by his sons. A smaller edition of the *Life* was published by Samuel Wilberforce in 1868. *See* also *The private papers of William Wilberforce,* edited by A. M. Wilberforce (1897); Sir James Stephen, *Essays in Ecclesiastical Biography* (1849); J. C. Colquhoun, *Wilberforce, His Friends and Times* (1866); John Stoughton, *William Wilberforce* (1880); J. J. Gurney, *Familiar Sketch of Wilberforce* (1838); J. S. Hartford, *Recollections of W. Wilberforce* (1864) and R. Coupland, *Wilberforce* (Oxford, 1923).

WILBUR, RAY LYMAN (1875–), American educationist, was born at Boonesboro, Ia., on April 13, 1875. He graduated at Stanford university in 1896, proceeding thence to Cooper Medical college, San Francisco, and later continued his studies at London, Frankfurt and Munich. He began his teaching at Stanford in 1900, becoming professor of medicine in 1909 and dean of the medical school in 1911. In 1915 he was appointed president. He was chief of the division of conservation of the U.S. Food Commission, and a member of the California State Council of Defence 1917. On March 4, 1929, he became secretary of the interior in the cabinet of President Hoover.

WILBYE, JOHN (1574–1638), English madrigal composer, was born at Diss, Norfolk, in 1574, the date of his baptism being March 9. Until recently nothing was known of his life but many facts have now come to light. His father was a well-to-do landowner, Matthew Wilbye. Through his early acquaintance with the Cornwallis family at Brome Hall John became resident musician at Hengrave Hall, the seat of Sir Thomas Kytson, whose wife was Elizabeth Cornwallis. The inventories of Hengrave give the items of furniture in Wilbye's rooms and the Hengrave Letter Book II. contains a letter from Wilbye to a friend, which has been reproduced in volume VI. of *The English Madrigal School.* In 1628 Lady Kytson died, and Wilbye retired to Colchester, where he lived in the house of Lady Rivers, a daughter of the Kytsons. This house was still standing in 1927. Wilbye died there in Sept. 1638, in his sixty-fifth year.

Wilbye's madrigals are the most famous of the English school. He had in a supreme degree the quality of style and he obtained wonderful effects of contrast by his skill in grouping the voices. His *First Set of English Madrigals to 3, 4, 5, and 6 voices* was published in 1598, bearing the date April 12, and was dedicated to Sir Charles Cavendish, son-in-law of Sir Thomas Kytson. It contains 30 numbers, including the famous "Flora gave me fairest flowers." The madrigals of the *Second Set,* dedicated to Lady Arabella Stuart, which appeared in 1609, are even more finished in style. Among them are "Draw on, Sweet Night"; "Stay, Corydon"; and "Sweet honey-sucking bees."

Both sets have been reprinted by the Musical Antiquarian Society, and for the English Madrigal School (vol. vi., with biographical details) and vii. Two Latin motets are in Arkwright's *Old English Edition* (1889–1902; 1922, etc.); Leighton's *Teares or Lamentacions* (1614) contains 2 numbers by Wilbye, "I am quite tired" (a 4) and "O God the Rock" (a 5). A six-part madrigal, "The Lady Oriana," is in the "Triumph of Oriana" (1601). Most of the English collections include one or more of Wilbye's madrigals. *See* also Rev. E. H. Fellowes, *English Madrigal Composers* (1921), and the article by him in Grove's *Dictionary,* 3rd ed.

WILD, JONATHAN (*c.* 1682–1725), English criminal, was born about 1682 at Wolverhampton, where his father was a wig-maker. After a term of imprisonment he set up as a receiver of stolen goods. Wild built up an immense business, posing as a recoverer of stolen goods, the thieves receiving a commission on the price paid for recovery. A special act of parliament was passed by which receivers of stolen property were made accessories to the theft, but Wild's professed "lost property office" had little difficulty in evading the new law, and became so prosperous that two branch offices were opened. Wild went on to arrange robberies himself, and he devised and controlled a huge organization, which plundered London and its approaches wholesale. Such thieves as refused to work with him received short shrift. The notorious Jack Sheppard, wearied of Wild's exactions, at last refused to deal with him, whereupon Wild secured his arrest, and himself arrested Sheppard's confederate, "Blueskin." In return for Wild's services in tracking down such thieves as he did not himself control, the authorities for some time tolerated the offences of his numerous agents. If an arrest were made, Wild had a plentiful supply of false evidence at hand to establish his agents' *alibi,* and he obtained the conviction, by similar means, of such thieves as refused to recognize his authority. Such stolen property as could not be returned to the owners with profit was taken abroad in a sloop purchased for this work. At last he was arrested, tried at the Old Bailey, and after being acquitted on a charge of stealing lace, found guilty of taking a reward for restoring it to the owner without informing the police. He was hanged at Tyburn on May 24, 1725.

BY COURTESY OF THE IOWA GEOLOGICAL SURVEY

WILD CARROT (DAUCUS CAROTA), A COMMON WEED BEARING DENSE CLUSTERS OF WHITE FLOWERS

WILDBAD, a watering-place of Germany, in the *Land* of Württemberg, 1,475 ft. above the sea, in the gorge of the Enz in the Black forest, 28 mi. W. of Stuttgart and 14 mi. E. of Baden-Baden by rail. Pop. 5,307. Its thermal alkaline springs have a temperature of 90°–100° F.

WILD CARROT (*Daucus carota*), a biennial herb of the parsley family (Umbelliferae, *q.v.*), native to Europe, northern Africa and Asia and extensively naturalized in North America as a weed, often exceedingly pernicious in pastures, meadows and fields. It is the parent species of the common root vegetable from which it differs chiefly in the size and quality of the root. The wild carrot springs from a deep, fleshy, conical root, with an erect stem, 1–3 ft. high, bearing much-dissected, hairy leaves and a great many small white flowers crowded in a large globose or flat-topped cluster (compound umbel), often 3–5 in. across, the central flower of each umbel often purple. The ripening seed-vessels, which are

small and bristly hairy, often form a concave cluster, suggestive of a bird's nest. Because of this the plant is popularly called crow's-nest or bird's-nest. It is also known as Queen Anne's lace because of the appearance of the flower clusters. Dairy products from cattle grazing on wild carrot are frequently tainted with a "carrot flavour."

WILDE, OSCAR FINGALL O'FLAHERTIE WILLS (1856–1900), English author, son of Sir William Wilde, a famous Irish surgeon, was born in Dublin on Oct. 15, 1856; his mother, Jane Francisca Elgee, was well known in Dublin as a graceful writer of verse and prose, under the pen-name of "Speranza." Having distinguished himself in classics at Trinity college, Dublin, Oscar Wilde went to Magdalen college, Oxford, in 1874, and won the Newdigate prize in 1878 with his poem "Ravenna," besides taking a first-class in classical Moderations and in Literae Humaniores. At Oxford he adopted what to undergraduates appeared the effeminate pose of casting scorn on manly sports, wearing his hair long, decorating his rooms with peacock's feathers, lilies, sunflowers, blue china and other *objets d'art,* which he declared it his desire to "live up to," affecting a lackadaisical manner, and professing intense emotions on the subject of "art for art's sake"—then a new-fangled doctrine which J. M. Whistler was bringing into prominence. Wilde made himself the apostle of this new cult. At Oxford his behaviour procured him a ducking in the Cherwell, and a wrecking of his rooms, but the cult spread. Its affectations were burlesqued in Gilbert and Sullivan's travesty *Patience* (1881). As the leading "aesthete," Oscar Wilde became one of the most prominent personalities of the day; his affected paradoxes and his witty sayings were quoted on all sides, and in 1882 he went on a lecturing tour in the United States, where he wrote a drama, *Vera,* which was produced in New York. In 1884 he married Constance Lloyd. He had already published in 1881 a selection of his poems, which, however, only attracted admiration in a limited circle. In 1888 appeared *The Happy Prince and Other Tales,* illustrated by Walter Crane and Jacomb Hood. This charming volume of fairy tales was followed up by *Lord Arthur Savile's Crime, and Other Stories* (1891), and later by a second collection of fairy stories *The House of Pomegranates* (1892), acknowledged by the author to be "intended neither for the British child nor the British public." *The Picture of Dorian Gray* (1891) was the mirror of the new aesthete. In 1891 his tragedy in blank verse, *The Duchess of Padua,* was produced in New York. But Wilde's first real success with the larger public as a dramatist was with *Lady Windermere's Fan* (St. James's Theatre, 1892), followed by *A Woman of No Importance* (1893), *An Ideal Husband* (1895) and *The Importance of Being Earnest* (1895). The wit and brilliance of these pieces helped them to keep the stage, and they are still occasionally revived. In 1893 the licenser of plays refused a licence to Wilde's *Salome,* but it was printed in French in 1893, and produced in Paris by Sarah Bernhardt in 1894, and was translated into English in the same year by Lord Alfred Douglas.

His success as a dramatist had by this time gone some way to disabuse hostile critics of the suspicions as regards his personal character which had been excited by the apparent looseness of morals which since his Oxford days it had always pleased him to affect; but to the consternation of his friends, who had ceased to credit the existence of any real moral obliquity, in 1895 came fatal revelations as the result of his bringing a libel action against the marquis of Queensberry; and at the Old Bailey, in May, Wilde was sentenced to two years' imprisonment with hard labour for offences under the Criminal Law Amendment Act. He went bankrupt soon after. It was a melancholy end to a singularly brilliant career. After leaving prison in 1897 he lived mainly on the Continent, at Berneval and later in Paris under the name of "Sebastian Melmoth." He died in Paris on Nov. 30, 1900. In 1898 he published his powerful *Ballad of Reading Gaol.* His *Collected Poems,* containing some beautiful verse, had been issued in 1892. While in prison he wrote an apology for his life which was placed in the hands of his executor and published in 1905.

BIBLIOGRAPHY.—Oscar Wilde's works were edited in 13 vols. (1908) by Robert Ross, and two small collections of letters to Ross, *After Reading* (1921) and *After Berneval* (1922), were published. *See* also A. Gide, *Oscar Wilde* (1905); A. Ransome, *Oscar Wilde* (1912); F. Harris, *Oscar Wilde, His Life and Confessions* (2 vols., N.Y. 1918); E. Bendz, *Oscar Wilde: a Retrospect* (Vienna, 1921); Frances Winwar, *Oscar Wilde and the Yellow 'Nineties* (1940).

WILDERNESS, a large forest in Spotsylvania county, Virginia, U.S.A., on the south bank of the Rapidan, extending from Mine Run on the west to Chancellorsville on the east. It is famous in military history for the battles of Chancellorsville (1863) and Wilderness (1864) during the American Civil War.

Chancellorsville.—In May 1863 a three days' battle was fought at Chancellorsville between the Army of the Potomac, under Gen. Hooker, and Gen. *Lee's* army of Northern Virginia, which had stemmed the previous tide of invasion in the east by holding successfully a position on the heights along the right or south bank of the Rappahannock. Gen. Burnside had suffered a severe repulse in front of the Confederate position at Fredericksburg in Dec. 1862, and his successor resolved to adopt the alternative plan of turning *Lee's* flank and so gaining the road to Richmond. *Lee* was at the time weakened through having, by direction of the War Department, detached *Longstreet's* two divisions and three cavalry brigades to collect provisions from the neighbourhood of Suffolk, 120m. distant. Hooker had now at his disposal 12,000 cavalry, 400 guns, and 120,000 infantry and artillery, organized in seven corps (I. Reynolds, II. Couch, III. Sickles, V. Meade, VI. Sedgwick, XI. Howard, XII. Slocum). *Lee* counted only 55,000 men of all arms effective. Hooker detached 10,000 cavalry, under Stoneman, to sweep round *Lee's* left, destroy the railways in *Lee's* rear and cut his line of retreat, and the I. and VI. corps under Sedgwick (40,000) to cross below Fredericksburg and pin *Lee* in his entrenched position, while with the remainder he himself turned *Lee's* left by a wide manoeuvre. Hooker moved up the Rappahannock, crossed that river and afterwards the Rapidan, and on April 30 fixed his headquarters at Chancellorsville, a farmhouse in the Wilderness. *Lee's* cavalry under *Stuart* had duly reported the Federal movements and *Lee,* judging that Sedgwick's advance was only a feint, called up *"Stonewall" Jackson's* four divisions from below the Massaponax as soon as Sedgwick's corps crossed the river at Fredericksburg. At Chancellorsville, *Anderson's* division was in position, and *McLaws* was sent to support him, while *Jackson* took three divisions to the same point, leaving *Early's* division (10,000) to observe Sedgwick. At 11 A.M. on May 1, Hooker began his advance towards Fredericksburg, an advance which was intended to be a hammer crushing *Lee* against Sedgwick's anvil. But when he encountered the columns of the Confederates, also advancing, in the forest tracts of the Wilderness, the absence of all but a fraction of his cavalry meant an absence of information. Believing that the whole of *Lee's* army was upon him, he fell back to Chancellorsville, where he had cleared and entrenched a position in the forest. This was almost impregnable to attack from the east or south—and Hooker decided to invite such an attack. *Lee,* however, discovered a route by which the Federals might be attacked from the north and west, and arranged with *Jackson* to execute the turning movement and fall upon them. At 4 A.M. on May 2 *Jackson* marched westward with his corps of 26,000 men and by a détour of 15m. passed round the Federal right flank, then moved to take the Federals in reverse, while *Anderson* and *McLaws* with 17,000 men demonstrated in front of Hooker's army and so kept 70,000 men idle behind their earthworks. One of *Stuart's* cavalry brigades neutralized Stoneman's 10,000 horsemen. Sedgwick was being contained by *Early. Jackson's* attack at 6 P.M. surprised the Federals, who fled in panic at nightfall, but *Jackson* was mortally wounded, and with his fall the attack lost impetus and the chance of an annihilating victory. Next day the attack was resumed under the immediate direction of *Stuart,* who was reinforced by *Anderson,* while *McLaws* now threatened the left flank of the Federals and *Fitz Lee's* cavalry brigade operated against their line of retreat. Hooker finally gained the shelter of an inner line of works covering the ford by which he must retreat. Meanwhile *Early* had checked Sedgwick, who had already abandoned his attack when *Lee,* on receiving word that *Early* was

hard pressed, ceased to press Hooker's retreat and moved to *Early's* aid. Thus on May 4 Sedgwick was assailed by *Early, McLaws* and *Anderson,* and driven over the Rappahannock to join the remainder of Hooker's beaten army, which had recrossed the Rapidan on the night of May 5 and marched back to Falmouth. That day *Lee* had once more countermarched to concentrate afresh against Hooker, but his attack, delayed by rain, found that his quarry had slipped away. Phisterer's *Record* puts the Federal loss at 16,000 and the Confederates at 12,000 men.

See A. C. Hamlin, *The Battle of Chancellorsville* (1896); G. F. R. Henderson, *Stonewall Jackson* (1902); W. B. Wood and J. E. Edmonds, *The Civil War in the United States* (1905); *Battles and Leaders of the Civil War and Official Records of the War of Secession.*

Grant's Campaign of the Wilderness and Cold Harbor.—On the evening of May 3, 1864, after dark, the Army of the Potomac, commanded by Meade and consisting of the II., V. and VI., and Cavalry Corps, left its winter quarters about Culpeper to manoeuvre across the Rapidan with a view to fighting a battle at or near New Hope church and Craig's church. The army and the IX. Corps (Burnside), which was an independent command, were directed by Lieut.-Gen. Grant, the newly appointed commander of the armies of the United States, who accompanied Meade's headquarters. The opposing Army of Northern Virginia under *Lee* lay in quarters around Orange Court house (*A. P. Hill's* Corps), Verdiersville (*Ewell's* Corps) and Gordonsville (*Longstreet's* Corps). The respective numbers were; Army of the Potomac, 98,000; IX. Corps, 22,000; Army of Northern Virginia, rather less than 70,000.

The crossing of the Rapidan was made at Germanna and Ely's fords, out of reach of *Lee's* interference, and in a few hours the two leading corps had reached their halting-places—V. (Warren), Wilderness tavern; and II. (Hancock), Chancellorsville. The VI. (Sedgwick) followed the V. and halted south of Germanna ford. Two of the three divisions of cavalry preceded the march and scouted to the front and flanks. Controversy has arisen as to whether the early halt of the Union army in the midst of the Wilderness was not a serious error of judgment. The reason assigned was the necessity of protecting an enormous wagon train, carrying 15 days' supplies for the whole army, that was crossing after II. Corps at Ely's ford. Burnside's corps was far to the rear when the advance began, but by making forced marches it was able to reach Germanna ford during May 5. On that day the manoeuvre towards Craig's church was resumed at 5 A.M., covered by Wilson's cavalry division, while Gregg's unit moved towards Fredricksburg.

Grant's intention of avoiding a battle until he was clear of the Wilderness was not achieved, for Confederate infantry appeared on the Orange turnpike east of Mine Run, where on his own initiative Warren had posted a division of the V. Corps overnight as flank-guard, and some cavalry, judiciously left behind by Wilson at Parker's store, became engaged a little later with hostile forces on the Orange Plank road. This led to the suspension of the whole manoeuvre—wherein Grant's object was to place himself between *Lee* and Richmond. The first idea of the Union headquarters was that *Lee* was falling back to the North Anna, covered by a bold rear guard, which Grant and Meade arranged to cut off and destroy by a convergent attack of Warren and Sedgwick. But the appearance of infantry on the Plank road as well as the Pike had shown that *Lee* intended to fight in the Wilderness, and Hancock (II. Corps) was called in from Todd's tavern, while one division (Getty's) of the VI. was hurried to the intersection of the Brock and Plank roads to hold that point until Hancock's arrival. Getty arrived just in time, for Confederate skirmishers were found dead and wounded only 30yd. from the cross roads. The division then formed up to await Hancock's arrival up the Brock road, practically unmolested, for *Lee* had only two of his corps on the ground (*Hill* on the Plank road, *Ewell* on the Pike), and did not desire to force a decision until *Longstreet's* distant corps should arrive.

Meanwhile Warren had been slowly forming up his attacking line with great difficulty in the woods. Grant appears to have used bitter words to Meade on the subject of Warren's delays, and Meade passed these on to Warren, who in turn forced his subordinates into premature action. The result of the attack by the V. and later the VI. Corps, delivered piecemeal owing to the difficulties of direction and touch in the woods, on *Ewell* was completely unsatisfactory, and for the rest of the battle these corps were used principally as reservoirs to find supports for the offensive wing under Hancock, who arrived on the Plank road 2 P.M.

Hancock's divisions, as they came up, entrenched themselves along the Brock road. In the afternoon he was ordered to attack whatever force of the enemy was on the Plank road in front of him, but was unwilling to do so until he had his forces well in hand. Finally Getty was ordered to attack "whether Hancock was ready or not." This may have been an attempt to force Hancock's hand by an appeal to his soldierly honour, and as a fact he did not leave Getty unsupported. But the disjointed attacks of the II. Corps on *Hill's* entrenchments, while forcing the Confederates to the verge of ruin, were not so successful as the preponderance of force on the Union side ought to have ensured. For four hours the two lines of battle were fighting 50yd. apart, until at nightfall the contest was given up through mutual exhaustion.

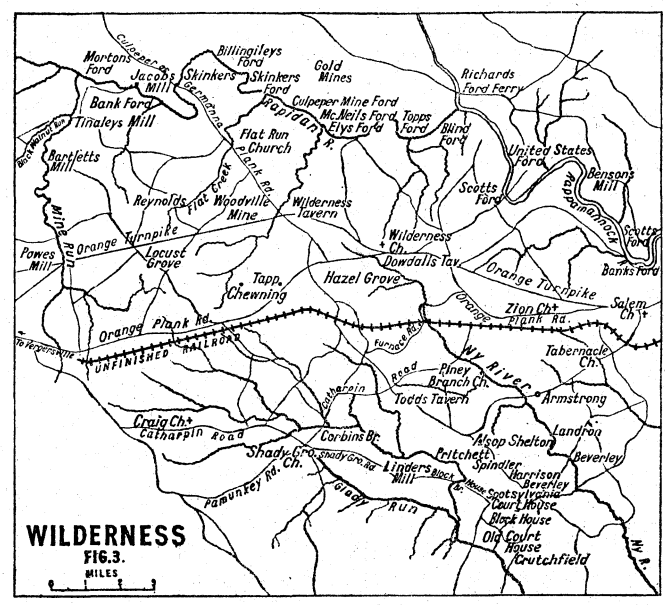
The battle of the 6th was timed to begin at 5 A.M., and Grant's attack was wholly directed on Parker's store, with the object of crushing *Hill* before *Longstreet* could assist him. If *Longstreet,* instead of helping *Hill,* were to attack the extreme Union left, so much the better; but the far more probable course for him to take was to support *Hill* on or north of the Plank road, and Grant not only ordered Hancock with six of the eleven divisions of Meade's army to attack towards Parker's store, but sent his own "mass of manoeuvre" (the IX. Corps) thither in such a way as to strike *Hill's* left. The cavalry was drawn back for the protection of the trains, for "every musket" was required in the ranks of the infantry. Wilson's division, in its movement on Shady Grove church on the 5th, had been cut off by the enemy's advance on the Plank road and attacked by some Confederate cavalry. But it extricated itself and joined Gregg, who had been sent to assist him, at Todd's tavern. Warren and Sedgwick were to hold *Ewell* occupied on the Pike by vigorous attacks. At 5 o'clock Hancock advanced, drove back and broke up *Hill's* divisions, and on his right Wadsworth attacked their left rear. But after an hour's wood fighting the Union attack came to a standstill, and at this moment, the critical moment for the action of the IX. Corps, Burnside was still more than a mile away, having scarcely passed through Warren's lines into the woods. Then *Longstreet's* Corps, pushing its way in two columns of fours through *Hill's* retreating groups, attacked Hancock with the greatest fury and forced him back some hundreds of yards. But the woods broke the force of this attack too, and by 7.30 the battle had become a stationary fire-fight. After an interval in which both sides rallied their confused masses, *Longstreet* attacked again and gained more ground. Persistent rumours came into the Union headquarters of a Confederate advance against the Union left rear, and when Grant realized the situation he broke off one of Burnside's divisions from the IX. Corps column and sent it to the cross-roads as direct reserve to Hancock. At this moment the battle took a very unfavourable turn on the Plank road. *Longstreet* had sent four brigades of infantry by a détour through the woods south of the Plank road to attack Hancock's left. This was very effective, and the Union troops were hustled back to the cross-roads. But *Longstreet,* like *Jackson* a year before in these woods, was wounded by his own men, and the battle again came to a standstill (2.30 P.M.).

Burnside's Corps, arriving shortly before 10 A.M. near Chewning's house, the position whence it was to have attacked *Hill's* left in the early morning, was about to attack, in ignorance of Hancock's repulse, when fortunately an order reached it to suspend the advance and to make its way through the woods towards Hancock's right. This dangerous flank march, screened by the woods, was completed by 2 P.M., and Burnside began an attack upon the left of *Longstreet's* command (*R. H. Anderson's* fresh division of *Hill's* Corps). But Hancock being in no condition to support the IX. Corps, the whole attack was, at 3 P.M., postponed by Grant's order until 6 P.M. Thus there was a long respite for both sides, varied only by a little skirmishing. But *Lee* was determined, as always, to have the last word, and about 4.15–4.30 a fierce assault was delivered amidst the burning woods upon Han-

cock's entrenchments along the Brock road. For a moment, aided by the dense smoke, the Confederates seized and held the first line of works, but a counter-stroke dislodged them. Burnside, though not expecting to have to attack before 6, put into the fight such of his troops as were ready, and at 5.30 or thereabouts the assaulting line receded into the woods. Grant cancelled his order to attack at 6, and at the decisive point the battle was at an end. But on the extreme right of the Union army a sudden attack was delivered at sunset upon the hitherto unmolested VI. Corps, by *Gordon,* one of *Ewell's* brigadiers. This carried off two generals and several hundred prisoners, and caused a panic to ensue which affected all the Union forces on the Pike and lasted until after nightfall.

Lee, therefore, had the last word on both flanks, but in spite of this and of the very heavy losses[1], Grant had already resolved to go on, instead of going back like his various predecessors. To him, indeed, the battle of the Wilderness was a victory, an indecisive victory indeed, but one that had given him a moral superiority which he did not intend to forfeit. His scheme, drafted early on the morning of the 7th, was for the army to march to Spotsylvania on the night of the 7th–8th, to assemble there on the 8th, and thence to undertake a fresh manoeuvre against *Lee's* right rear on the 9th. This movement required the trains with the fighting line to be cleared away at once from the roads needed for the troops and *Lee* promptly discovered that a movement was in progress. He mistook its object, however, and assuming that Grant was falling back on Fredericksburg, he prepared to shift his own forces to the south of that place so as to bar the Richmond road. This led to a race for Spotsylvania, which was decided more by accidents to either side than by the measures of the two commanding generals. On the Union side Warren was to move to the line Spotsylvania Court house–Todd's tavern, followed by Hancock; Sedgwick was to take a roundabout route and to come in between the V. and II. Corps; Burnside to follow Sedgwick. The cavalry was ordered to watch the approaches towards the right of the army. The movement began promptly after nightfall on the 7th. But ere long the head of Warren's column, passing in rear of Hancock's line of battle, was blocked by the headquarters escort of Grant and Meade. Next, the head of the V. Corps was again checked at Todd's tavern by two cavalry divisions which had been sent by Sheridan to regain the ground at Todd's tavern[2], given up on the 6th, and after fighting the action of Todd's tavern had received no further orders from him. Meade, greatly irritated, ordered Gregg's division out towards Corbin's bridge and Merritt's to Spottsylvania. On the latter road the Union cavalry found themselves opposed by *Fitz Lee's* cavalry, and after some hours of disheartening work in the woods, Merritt asked Warren to send forward infantry to drive the enemy. This Warren did, although he was just preparing to rest and to feed his men after their exhausting night-march. Robinson's division at the head of the corps deployed and swiftly drove in *Fitz Lee.* A little beyond Alsop's, however, Robinson found his path barred by entrenched infantry. This was part of *Anderson's* (formerly *Longstreet's*) corps. That officer had been ordered to draw out of his (Wilderness) works, and to bivouac, preparatory to marching at 3 A.M. to the Court house, but, finding no good resting-place, he had moved on at once by way of the Catharpin road and Corbin's bridge. At or near Block House bridge the corps halted to rest, but *Stuart* (who was with *Fitz Lee*) called upon *Anderson* for assistance and the march was resumed at full speed. Sheridan's new orders to Gregg and Merritt did not arrive until Meade had given these officers other instructions, but Wilson's cavalry division, which was out of the line of march of the infantry, acted in accordance with Sheridan's plan of occupying the bridges in front of the position that the army intended to occupy at Spottsylvania Court house, and seized that place, inflicting a smart blow upon a brigade of *Stuart's* force.

The situation about 9 A.M. on the 8th was therefore curious. Warren, facing east, and opposed by part of *Anderson's* corps, was seeking to fight his way to Spotsylvania Court house by the Brock road. Wilson facing south, was holding the Court house and driving *Fitz Lee's* cavalry partly westward on to the backs of the infantry opposing Warren, partly towards Block House bridge, whence the rest of *Anderson's* infantry was approaching. All the troops were weary and hungry, and Sheridan ordered Wilson to evacuate the Court house and to fall back over the Ny. Warren fruitlessly attacked the Confederate infantry at Spindler's, Robinson being severely wounded and his division disorganized. The other divisions came up by degrees, and another attack was made about 11. It was pressed close up to, and in some places over, the Confederate log-works, but it ended in failure like the first. A third attempt in the evening dwindled down to a reconnaissance in force. *Anderson* was no longer isolated. *Early's* division observed Hancock's corps at Todd's tavern, but the rest of *Ewell's* and all *Hill's* corps went to Spotsylvania and prolonged *Anderson's* line northward towards the Ny. Thus the re-grouping of the Union army for manoeuvre, and even the running fight or strategic pursuit imagined by Grant when he found *Anderson* at Spotsylvania, were given up, and on the 9th both armies rested. On this day Sedgwick was killed by a long-range shot from a Confederate rifle. His place was taken by H. G. Wright. On this day also a violent quarrel between Meade and Sheridan led to the departure of the cavalry corps on an independent mission. This was the so-called Richmond raid, in which Sheridan defeated *Stuart* at Yellow tavern (where *Stuart* was killed) and captured the outworks of Richmond, but, having started with empty forage wagons[3], had then to make his way down the Chickahominy to the nearest supply depots of the Army of the James, leaving the Confederate cavalry free to rally and rejoin *Lee.*



Finding the enemy thus gathered in his front, Grant decided to fight again on the 10th. While Hancock opposed *Early,* and Warren and Wright faced *Hill* and *Anderson,* Burnside was ordered by Grant to work his way to the Fredericksburg-Spotsylvania road, thence to attack the enemy's right rear. The first stage of this movement of the IX. Corps was to be made on the 9th, but not the attack itself, and Burnside was consequently ordered not to go beyond a placed called "Gate" on the maps used by the Union staff. This, it turned out, was not the farm of a person called Gate, as headquarters supposed, but a mere gate into a field. Consequently it was missed, and the IX. Corps went on to Gale's or Gayle's house, where the enemy's skirmishers were driven in[4].

[1]The Union losses in the battle were 18,000, the Confederates at least 11,500.

[2]In consequence of a mistaken order that the trains which he was protecting were to move forward to Piney Branch church,

[3]Owing to the circumstances of his departure, the angry army staff told him to move out at once with the forage that he had, and Sheridan, though the army reserve supplies were at hand, made no attempt to fill up from them.

[4]A further source of confusion, for the historian at least, is that on the survey maps made in 1867 this "Gayle" is called "Beverly."

The news of an enemy opposing Burnside at "Gate," which Grant still supposed to be the position of the IX. Corps, at once radically altered the plan of battle. *Lee* was presumed to be moving north towards Fredericksburg, and Grant saw an opportunity of a great and decisive success. The IX. Corps was ordered to hold its position at all costs, and the others were to follow up the enemy as he concentrated upon Burnside. Hancock was called in from Todd's tavern, sent down to force the fords on the Po at and below Tinder's mill, and directed upon Block House bridge by an officer of Grant's own staff, while Warren and Wright were held ready. But once more a handful of cavalry in the woods delayed the effective deployment of the moving wing, and by the time that the II. Corps was collected opposite Block House bridge it was already night. Still there was, apparently, no diminution of force opposite Burnside, and Hancock was ordered to resume his advance at early dawn on the 10th.

Meade, however, had little or no cognizance of Grant's orders to the independent IX. Corps, and his orders, conflicting with those emanating from the Lieutenant-General's staff, puzzled Hancock and crippled his advance. At 10 the whole scheme was given up, and the now widely deployed Union army closed on its centre as best it could for a direct attack on the Spotsylvania position. At 4, before the new concentration was complete, and while Hancock was still engaged in the difficult operation of drawing back over the Po in the face of the enemy, Warren attacked unsupported and was repulsed. In the woods on the left Wright was more successful, and at 6 P.M. a rush of 12 selected regiments under Col. Emory Upton carried the right of *Lee's* log-works. But for want of support this attack too was fruitless, though Upton held the captured works for an hour and brought off 1,000 prisoners. Burnside, receiving Grant's new orders to attack from Gayle's towards Spotsylvania, sent for further orders as to the method of attack, and his advance was thus made too late in the day to be of use. *Lee* had again averted disaster, this time by his magnificent handling of his only reserve, *Hill's* (now *Early's*) corps, which he used first against Hancock and then against Burnside with the greatest effect.

This was the fourth battle since the evening of May 4. On the morning of the 11th Grant sent his famous message to Washington, "I purpose to fight it out on this line if it takes all summer." The 12th was to be the fifth and, Grant hoped, the decisive battle. A maze of useful and useless entrenchments had been constructed on both sides, especially on the Union side, from mere force of habit. Grant, seeing from the experience of the 10th that his corps commanders were manning these entrenchments so strongly that they had only feeble forces disposable for the attack, ordered all superfluous defences to be given up. Three corps were formed in a connected line (from right to left, V., VI., IX.) during the 11th, and that night Hancock's corps moved silently to a position between Wright and Burnside and formed up in the open field at Brown's in an attacking mass of Napoleonic density—three lines of divisions, in line and in battalion and brigade columns. Burnside was to attack from Gayle's (Beverly's on the map) towards McCool's. Warren and Wright were to have at least one division each clear of their entrenchments and ready to move.

Up to the 11th *Lee's* line had extended from the woods in front of Block House bridge, through Perry's and Spindler's fields to McCool's house, and its right was diffused and formed a loop round McCool's. All these works faced north-west. In addition, Burnside's advance had caused *Early's* corps to entrench Spotsylvania and the church to the south of it, facing east. Between these two sections were woods. The connection made between them gave the loop round McCool's the appearance from which it derives its historic name of The Salient. Upon the northern face of this salient Hancock's attack was delivered.

On the 11th the abandonment of Burnside's threatening advance on his rear and other indications had disquieted *Lee* as to his left or Block House flank, and he had drawn off practically all *Ewell's* artillery from the McCool works to aid in that quarter. The infantry that manned the Salient was what remained of *Stonewall Jackson's* "foot cavalry," veterans of Antietam, Fredericksburg and Chancellorsville. But at 4.35, in the mist, Hancock's mass swept over their works at the first rush and swarmed in the interior of the Salient, gathering thousands of prisoners and seizing the field batteries that *Lee* had sent back just too late.

The thronging and excited Federals were completely disordered by success, and the counter-attack of one or two Confederate brigades in good order drove them back to the line of the captured works. Then, about 6, there began one of the most remarkable struggles in history. While *Early,* swiftly drawing back from Block house, checked Burnside's attack from the east, and *Anderson,* attacked again and again by parts of the V. Corps, was fully occupied in preserving his own front, *Lee,* with *Ewell's* corps and the few thousand men whom the other generals could spare, delivered all day a series of fierce counter-strokes against Hancock. Nearly all Wright's corps and even part of Warren's (in the end 45,000 men) were drawn into the fight at the Salient, for Grant and Meade well knew that *Lee* was struggling to gain time for the construction of a retrenchment across the base of it. If the counter-attacks failed to gain this respite, the Confederates would have to retreat as best they could, pressed in front and flank. But the initial superiority of the Federals was neutralized by their disorder, and keeping the fight alive by successive brigade attacks, while the troops not actually employed were held out of danger till their time came, *Lee* succeeded so well that after twenty hours' bitter fighting the new line was ready and the Confederates gave up the barren prize to Hancock. *Lee* had lost 4,000 prisoners as well as 4,500 killed and wounded, as against 7,000 in the Army of the Potomac and the IX. Corps.

There were other battles in front of Spotsylvania, but that of the 12th was the climax. From the 13th to the 20th the Federals gradually worked round from west to east, delivering a few partial attacks in the vain hope of discovering a weak point. *Lee's* position, now semicircular, enabled him to concentrate on interior lines on each occasion. In the end the Federals were entrenched facing east, between Beverly's house (Burnside's old "Gayle") and Quisenberry's, *Lee* facing west from the new works south of Harrison's through the Court house to Snell's bridge on the Po. In the fork of the Po and the Ny, with woods and marshes to obstruct every movement, Grant knew that nothing could be done, and he prepared to execute a new manoeuvre. But here as in the Wilderness, *Lee* managed to have the last word. While the Union army was resting in camp for the first time since leaving Culpeper, *Ewell's* corps suddenly attacked its baggage-train near Harris's house. The Confederates were driven off, but Grant had to defer his intended manoeuvre for two days. When the armies left Spotsylvania, little more than a fortnight after breaking up from winter quarters, the casualties had reached the totals of 35,000 out of an original total of 120,000 for the Union army, 26,000 out of 70,000 for the Confederates.

The next manoeuvre attempted by Grant to bring *Lee's* army to action "outside works" was of an unusual character, though it had been foreshadowed in the improvised plan of crushing *Lee* against Burnside's corps on the 9th. Hancock was now (20th) ordered to move off under cover of night to Milford; thence he was to march south-west as far as possible along the Richmond and Fredericksburg railroad and to attack whatever force of the enemy he met. It was hoped that this bold stroke by an isolated corps would draw *Lee's* army upon it, and the rest of the Army of the Potomac would, if this hope were realized, drive down upon *Lee's* rear while Hancock held him up in front. Supposing, however, that *Lee* did not take the bait, the manoeuvre would resolve itself into a turning movement with the object of compelling *Lee* to come out of his Spotsylvania lines on pain of being surrounded.

Hancock's corps started on the night of the 20th-21st. The alarm was soon given. At Milford, where he forced the passage of the Mattapony, Hancock found himself in the presence of hostile infantry from Richmond and heard that more had arrived at Hanover junction. He therefore suspended his advance and entrenched. The main army began to move off, after giving *Lee* time to turn against Hancock, at 10 A.M. on the 21st, and marched to Catlett's, a place a few miles south-west of Guinea's bridge, Warren leading, Burnside and Wright following. But no news came in from Hancock until late in the evening, and the develop-

ment of the manoeuvre was consequently delayed, so that on the night of the 21st–22nd *Lee's* army slipped across Warren's front *en route* for Hanover junction. The other Confederate forces that had opposed Hancock likewise fell back. Grant's manoeuvre had failed. Its principal aim was to induce *Lee* to attack the II. Corps at Milford, its secondary and alternative purpose was, by dislodging *Lee* from Spotsylvania, to force on an encounter battle in open ground. But he was only offered the bait—not compelled to take it, as he would have been if Hancock with two corps had been placed directly athwart the road between Spotsylvania and Hanover junction—and, having unimpaired freedom of action, he chose to retreat to the junction. The four Union corps, therefore, could only pursue him to the North Anna, at which river they arrived on the morning of the 23rd, Warren on the right, Hancock on the left, Wright and Burnside being well to the rear in second line. The same afternoon Warren seized Jericho ford, brought over the V. Corps to the south side, and repulsed a very sharp counter-stroke made by one of *Lee's* corps. Hancock at the same time stormed a Confederate redoubt which covered the Telegraph Road bridge over the river. Wright and Burnside closed up. It seemed as if a battle was at hand, but in the night reports came in that *Lee* had fallen back to the South Anna; and as these were more or less confirmed by the fact that Warren met with no further opposition and by the enemy's retirement from the river bank on Hancock's front, the Union generals gave orders, about midday on the 24th, for what was practically a general pursuit. This led incidentally to an attempt to drive *Lee's* rearguard away from the point of passage, between Warren's and Hancock's, required for Burnside, and in the course of this it became apparent that *Lee's* army had not fallen back but was posted in a semicircle to which the North Anna formed a tangent. On the morning of the 25th this position was reconnoitred and found to be more formidable than that of Spotsylvania. Moreover, it divided the two halves of the Union army that had crossed above and below.

Grant gave up the game as drawn and planned a new move. This had as its objects, first, the seizure of a point of passage on the Pamunkey; secondly, the deployment of the Army of the Potomac and of a contingent expected from the Army of the James, and thirdly, the prevention of *Lee's* further retirement, which was not desired by the Union commanders, owing to the proximity of the Richmond defences and the consequent want of room to manoeuvre. On the 27th Sheridan's cavalry and a light division of infantry passed the Pamunkey at Hanover town, and the two divided wings of the Army of the Potomac were withdrawn over the North Anna without mishap—thanks to exactitude in arrangement and punctuality in execution. On the 28th the Army of the Potomac had arrived near Hanover town, while at Hawes's shop, on the road to Richmond, Sheridan had a severe engagement with the enemy's cavalry. *Lee* was now approaching from Hanover junction via Ashland, and the Army of the Potomac swung round somewhat to the right so as to face in the presumed direction of the impending attack. The Confederate general, however, instead of attacking, swerved south, and planted himself behind the Totopotomoy. Here he was discovered, entrenched as always, on the 29th, and skirmishing all along the line, varied at times by more severe fighting, occupied that day and the 30th. On the morning of the 31st the Union army was arranged from right to left in the order VI., II., IX. and V. Corps, Sheridan having drawn off to the left rear of the infantry.

Now, for the last time in the campaign, the idea of a hammer and anvil battle was again taken up, the "anvil" being Smith's XVIII. Corps, which had come up from the James river to White house on the 30th; but once more the lure failed because it was not made sufficiently tempting.

The last episode of the campaign centred in Cold Harbor, a village close to the Chickahominy, which Sheridan's cavalry seized on the 31st. Here, contrary to the expectation of the Union staff, a considerable force of Confederate infantry—new arrivals from the James—was met; and in the hope of bringing on a battle before either side had time to entrench, Grant and Meade ordered Sheridan to hold the village at all costs and directed Wright's (VI.) Corps, from the extreme right wing, and Smith's (XVIII.), from Old Church, to march thither with all possible speed, Wright in the night of May 31 and Smith on the morning of June 1. *Lee* had actually ordered his corps commanders to attack, but was too ill to enforce his wishes, and in the evening Wright and Smith themselves assaulted the Confederate front opposite Cold Harbor. The assault, though delivered by tired men, was successful. The enemy's first or skirmish line was everywhere stormed, and parts of the VI. Corps even penetrated the main line. Grant at once prepared to renew the attack, as at Spotsylvania, with larger forces, bringing Hancock over from the right of the line on the night of the 1st and ordering Hancock, Wright and Smith to assault on the next morning. But *Lee* had by now moved more forces down, and his line extended from the Totopotomoy to the Chickahominy. Hancock's corps, very greatly fatigued by its night march, did not form up until after midday, and meanwhile Smith, whose corps, originally but 10,000 strong, had been severely tried by its hard marching and fighting on the 1st, refused to consider the idea of renewing the attack. The passive resistance thus encountered dominated Grant's fighting instinct for a moment. But after reconsidering the problem he again ordered the attack to be made by Wright, Smith and Hancock at 5 P.M. A last modification was made when, during the afternoon, *Lee's* far distant left wing attacked Burnside and Warren. This, showing that *Lee* had still a considerable force to the northward, and being, not very inaccurately, read to mean that the 6m. of Confederate entrenchments were equally—*i.e.*, equally thinly—guarded at all points, led to the order being given to all five Union corps to attack at 4:30 A.M. on June 3.

The resolution to make this plain, unvarnished frontal assault on entrenchments has been as severely criticized as any action of any commander in the Civil War, and Grant himself subsequently expressed his regret at having formed it. But such criticisms derive all their force from the event, not from the conditions in which, beforehand, the resolution was made. The risks of failure were deliberately accepted, and the battle—if it can be called a battle—was fought as ordered. The assault was made at the time arranged and was repulsed at all points with a loss to the assailants of about 8,000 men. Thereafter the two armies lay for ten days less than 100yd. apart. There was more or less severe fighting at times, and an almost ceaseless bickering of skirmishers. Owing to Grant's refusal to sue for permission to remove his dead and wounded in the terms demanded, *Lee* turned back the Federal ambulance parties, and many wounded were left to die between the lines. It was only on the 7th that Grant pocketed his feelings and the dead were buried.

This is one of the many incidents of Cold Harbor that must always rouse painful memories—though to blame *Lee* or Grant supposes that these great generals were infinitely more inhuman here than at any other occasion in their lives and takes no account of the consequences of admitting a defeat at this critical moment, when the causes for which the Union army and people contended were about to be put to the hazard of a presidential election.

The Federal army lost, in this month of almost incessant campaigning, about 50,000 men, the Confederates about 32,000. Though the aggregate of the Union losses awed both contemporaries and historians of a later generation, proportionately the losses of the South were heavier (46% of the original strength as compared with 41% on the Union side); and whereas within a few weeks Grant was able to replace nearly every man he had lost by a new recruit, the Confederate Government was near the end of its resources.

See A. A. Humphreys, *The Campaign of Virginia, 1864–65* (New York, 1882); Military History Society of Massachusetts, *The Wilderness Campaign; Official Records of the Rebellion,* serial numbers 67, 68 and 69; and C. F. Atkinson, *The Wilderness and Cold Harbor* (London, 1908). (C. F. A.; X.)

WILDGANS, ANTON (1881–1932), Austrian poet and dramatist, was born in Vienna on April 17, 1881, began and completed a course of legal studies in Vienna university and was artistic manager of the celebrated Burgtheater there 1921–24. In 1909 he attracted notice by a book of verses *Herbstfrühling,* and in a series of lyrical volumes he gave expression to erotic

passion, to deep sympathy with nature and with human suffering. Wildgans appears to be connected with the Hofmannsthalists, although maintaining his independence. His plays, *Armut* (1914), *Liebe* (1916) and *Dies Irae* (1918) begin in an atmosphere of realism, culminating in that of symbolism or mysticism. As a counterpart to this *bürgerliche* trilogy another of mythological or religious character was planned, the first part of which, *Kain*, was acted in 1921. An epic poem, written in hexameters, *Kirbisch* (1927), depicts Austrian mentality as influenced by World War I.

WILD GINGER (*Asarum canadense*), called also Canada snakeroot and colicroot, a small North American herb of the birthwort family (Aristolochiaceae), native to rich woods from New Brunswick to Manitoba and southward to North Carolina and Kansas. It is a stemless perennial with a creeping aromatic rootstock having the flavour of ginger. From this usually rise two large kidney-shaped or heart-shaped leaves, 4 in. to 7 in. broad, on nearly erect leafstalks 6 in. to 12 in. long. On a short stalk between the bases of the two leafstalks is borne a single somewhat bell-shaped, brownish-purple flower, about an inch broad, with three small more or less pointed lobes on the rim. About 9 other species of wild ginger are found in the United States, and 3 species are native to the Pacific coast. Among these are the halberd-leaved wild ginger (*A. arifolium*), found from Virginia and Tennessee southward, and the western wild ginger (*A. caudatum*), native to the coast redwood belt of California and northward to British Columbia. The European species (*A. europaeum*) is asarabacca (*q.v.*).

WILDLIFE CONSERVATION AND MANAGEMENT. Beginning about 1915, wildlife conservation and management in the United States grew from the status of an interest for a limited number of people to an integral part of a national program for the management of renewable resources. It is inseparably connected with the planned management of lands and waters and of the forest products, crops and other valuables that are taken from them each year. The management goal is maintenance of optimum abundance, permitting a maximum harvest from those forms which furnish food or other considerations of value to the human race. The present tendency is to keep high populations of species that are not actively injurious to man. This policy is supported by various interests for a variety of reasons, but fundamentally it is sound management to maintain the biological community as a whole, as it is healthiest when composed of all of the forms natural to it. There are many types of life which furnish the objectives for conservation and management programs, but modern treatment is restricted to game animals and fur-bearers, birds and mammals that are beneficial in their feeding upon injurious insects and rodents, and to species having notable aesthetic values.

It should be clearly understood that management is for the benefit of the human population. We attempt to change the number of a species up or down according to the values which man attaches to it. Thus, efforts are made to maintain large populations of species regarded as game or valuable for their fur or other products. Conversely, definite efforts are made to reduce, and to hold at low levels, populations of rodents and birds that are destructive to crops, or of predators upon poultry, livestock, or even upon other wild forms which man may regard as more valuable to him than are the predators concerned. Various methods have been used in attempting to carry out these conservation and control programs, none of which, however, is a complete solution for all of the problems.

PROTECTIVE LAWS

The oldest of these methods is that of protective laws. The enactment of laws to protect game and other species began early in the United States, and indicated partial understanding even then of some of the fundamentals of management. There were laws in 1623 in the Plymouth Colony, dealing with hunting and fishing rights; laws providing a certain amount of protection for deer go back almost as far.

For many years protective laws were regarded as the only device necessary for maintaining desirable populations of wild animals. With the growth of agriculture, accompanied by clearing and draining, plowing of grassland and the building of roads and towns, home range for wildlife was restricted and protective laws no longer sufficed to conserve it in abundance. So long as the country was more or less primitive and thinly populated, laws served very well, but the combination of land development and increased human population made other measures necessary. Before that fact was generally realized, some forms were exterminated and others brought to the verge of extirpation. Belatedly it was recognized that protective laws alone can maintain wildlife populations only where the environment remains undisturbed, and where the human toll added to the natural drains do not take more than the annual production.

United States and Canada.—In the United States, ownership of wild game or animals *ferae naturae*, so far as susceptible of ownership, is in the state, not as proprietor but in its sovereign capacity as the representative, and for the benefit, of all of its people in common. Game is not an object of private ownership, except insofar as the people may elect to make it so, and they may absolutely prohibit the taking of it or traffic and commerce in it. (*Geer* v. *Connecticut*, 161 U.S. 519.) In accordance with these principles, laws for the protection and preservation of game have been enacted by the various states and by the federal government prescribing when, how, to what extent and for what uses possession may be had by an individual. Likewise, the individual's qualified ownership is recognized as being in him who reduces the game to possession, and not in the landowner on whose property it is taken. This is true even when the owner of privately-owned property may exercise the privilege of hunting to the exclusion of other persons, for this latter right depends not on the ownership of the game, but on that of the land.

Common to nearly all game laws are the following provisions: Establishment of, or authorization of the establishment of, open and closed seasons on designated species; requirement that licences be obtained for all or certain types of hunting; and restrictions on the following: the number of a species that may be taken and possessed daily or during a season; the means by which game may be taken and its use for purposes other than for food. In addition, there are restrictions on, or prohibitions of, the transportation of game from one state to another.

Regulation of the right to take game is exercised primarily by the states, and in many instances with little regard to uniformity between states. Under the provisions of the Migratory Bird Treaty act, however, the federal government regulates the taking, possession and transportation of all migratory birds specified in the convention of Aug. 16, 1916, between the United States and Great Britain for the protection of migratory birds, and in the U.S.-Mexican convention of Feb. 7, 1936, for the protection of migratory birds and game mammals. In Alaska the protection, preservation and regulation of game is exercised by the federal government under the provisions of the act known as the Alaska Game law and certain other special legislation. To implement further the authority of the states within their respective jurisdictions and to prevent illicit interstate traffic in game, the transportation of game from, to or through any state contrary to the laws of the place in which taken, or from, to or through which transported, has been made a federal offense. Federal laws also regulate the importation of wild birds and animals.

The hunting and trapping of wild animals for fur is an industry that has grown throughout the history of the United States, and although the ownership of these animals is subject to the same principles previously noted, the laws relating to these species recognize and protect the interests of the trapper in the fur and provide for its proper disposition. Marketing the pelts (and sometimes the flesh) of fur-bearers is the sole exception to the general proposition that wild game animals may not be dealt in commercially.

Game laws of a regulatory nature are designed principally to protect wild animals and birds against the ever-increasing hunting pressure. In addition, however, many states and the federal government have enacted legislation to foster conservation, management, development and increase of wildlife through the es-

tablishment of protected areas, the development of habitat, and other means. Representative of this class of legislation are: the Migratory Bird Conservation act of 1929, under which a large system of breeding, nesting, feeding and resting areas has been established; the Migratory Bird Hunting Stamp act of 1934, requiring all hunters of migratory birds to obtain a $1 stamp or licence, the proceeds from which must be used in management and development of sanctuaries and other wildlife protection areas; and the Federal Aid to Wildlife Restoration act of 1937, authorizing federal contributions to the states for use in wildlife restoration. The last-mentioned act and the Migratory Bird Hunting Stamp act are unique among federal laws in that the funds made available for carrying out the purposes of the acts are obtained from the hunters—for the Stamp act through a direct licence fee, and for the Federal Aid bill from an excise tax on arms and ammunition.

The Dominion of Canada has a general law prohibiting the export of deer carcasses, wild turkey, quail, partridge, prairie fowl and woodcock. The Migratory Birds Convention act is supplemented by regulations similar to those governing the Migratory Bird Treaty act in the United States. Full text of the regulations will be found in an annual publication of the commissioner of national parks of Canada, Ottawa.

Each Canadian province makes its own laws and regulations for hunting game. All nonresidents must have licences, the cost of which varies according to the kind of game; residents' fees are lower, and in Manitoba no licence is required of a resident hunting on his own property. There are special regulations for guides, and, in the case of hunting big game, in Manitoba and Saskatchewan the costume worn by the hunter must be white. The licencee is required to report the number of big game and game-birds killed.

The laws governing the sale of game vary in all the provinces. In Ontario, some native game may be sold; in Nova Scotia, little game except rabbits in a certain season; in Prince Edward Island all game lawfully killed (except migratory birds) may be sold; the same is true of Quebec, birch or spruce partridge being excepted also; New Brunswick forbids the sale of all game except that a licensed hunter may sell moose or deer lawfully killed by him; in Alberta, only heads of big game may be sold under special sale fees.

The export of all protected game is prohibited, except in Yukon and Quebec and, except for geese and brant, in Prince Edward Island; special permits, however, may be obtained from the commissioner. Deer raised on private lands may be exported; all birds so raised must be killed by other means than shooting, and so tagged before they can be sold. Most of the provinces allow game raised in captivity to be bought, sold and exported for propagation purposes.

For open seasons on game for the United States, Canada, Newfoundland and Mexico, for bag limits and possession, and regulations regarding sale and interstate transportation of game, *see* bulletins issued annually by state and provincial game commissioners and publications on game laws, compiled by the United States department of the interior. Minor exceptions in individual states and provinces may be found by consulting the game laws published by each. (I. N. G.)

Great Britain.—In Great Britain, by common law, wild animals are property only when reduced into possession by being killed or captured. Hence statutes were required to protect sporting rights. Royal rights were protected by special laws (*see* FOREST LAWS), but where royal rights do not exist the right to take or kill wild animals is incidental to the ownership or occupation of the land on which they are found. In England the chief statutes are the Night Poaching acts, 1828 and 1841, Game act, 1831, Poaching Prevention act, 1862, Ground Game acts, 1880 and 1906, and acts for the protection of wild birds such as the Protection of Lapwings act, 1928.

Pursuit of game on another's land without his consent is a trespass for which the pursuer is civilly liable, although when deer or hares are hunted with hounds or greyhounds there is no criminal liability. In other cases trespassers may be prosecuted, but the game taken by a trespasser belongs to him unless it was both started and killed on the land of the one owner, when it belongs to such owner. Even so, killing and taking it away as part of one continuous act is not larceny (*R.* v. *Townley,* 1871, L.R. 1 C.C.R. 315). The young of wild animals, before they can fly or run away, belong to the owner of the land on which they are.

Wild animals are classified for purposes of sport in England as follows:

(1) Beasts of royal forest (hart and hind, boar, wolf and all beasts of venery); (2) beasts of chase (a forest in the hands of a subject) and park (an enclosed chase), viz., buck and doe, fox, marten and roe; (3) beasts of warren (roe, hare, rabbit, partridge, pheasant, woodcock, quail, rail and heron); (4) game as defined by the Night Poaching act, 1828, and the Game act, 1831, *i.e.,* pheasant, partridge, black game, grouse or red game, bustard and hare; (5) wild fowl not mentioned above; *e.g.,* duck, snipe, plovers; (6) other wild birds, protected by the Wild Birds Protection acts.

Rights of chase, park and free warren depend on crown grant or prescription founded on lost grant. Free warren is quite different from ordinary warrens, in which hares or rabbits are bred by the owner of the soil for sport or profit. Ground game in such warrens is protected under the Larceny act, 1861, s. 17, as well as by the game laws. In manors, the lord by his franchise had the sporting rights over the manor, but this right later became restricted to the commons and wastes of the manor, the freehold whereof is in him, and does not extend to enclosed freeholds nor as a general rule to enclosed copyholds, unless at the time of enclosure the sporting rights were reserved to him by the Enclosure act or award (*Sowerby* v. *Smith,* 1873, L.R. 8 C.P. 514). The Game act 1831 gives lords of manors and privileged persons certain rights as to appointing gamekeepers with special powers to protect game within the district over which their rights extend (ss. 13, 14, 15, 16). The game laws in no way cut down the special privileges as to forest, park, chase or free warren (1831, s. 9), and confirm the sporting right of lords of manors on the wastes of the manor (1831, s. 10). On lands not affected by these rights, the right to kill or take game is presumably in the occupier. On letting land the owner may, subject to the qualifications hereinafter stated, reserve to himself the right to kill or take "game" or rabbits or other wild animals concurrently with or in exclusion of the tenant. Where the exclusive right is in the landlord, the tenant is not only liable to forfeiture or damages for breaches of covenants in the lease, but is also liable to penalties on summary conviction if without the lessor's authority he pursues, kills or takes any "game" upon the land or gives permission to others to do so (1831, s. 12). In effect he is made criminally liable for game trespass on lands in his own occupation, so far as relates to game, but not if he takes rabbits, snipe, woodcock, quails or rails.

The net effect of the common law and the game laws is to give the occupier of lands and the owner of sporting rights over them, the following remedies against persons who infringe their right to kill or take wild animals on the land. A stranger who enters on the land of another to take any wild animals is liable to the occupier for trespass on the land and for the animals started and killed on the land by the trespasser. He is also criminally liable for game trespass if he has entered on the land to search for or in pursuit of "game" or woodcock, snipe, quail, landrails or rabbits. If the trespass is in the daytime, the penalty may not exceed 40*s.*, unless five or more persons go together, in which case the maximum penalty is £5. If a single offender refuses his name or address or gives a false address to the occupier or to the owner of the sporting rights or his representatives or refuses to leave the land, he may be arrested by them, and is liable to a penalty not exceeding £5, and if five or more concerned together in game trespass have a gun with them and use violence, intimidation or menace, to prevent the approach of persons entitled to take their names or order them off the land, they incur a further penalty up to £5.

See Oke's *Game Laws* (5th ed., 1912); Nolan, *Sporting Rights* (1914). (W. F. C.; F. G.)

RESTOCKING

When it became obvious that protective laws alone could not maintain wildlife populations in the face of increased hunting,

other methods were tried. Among the first was the pen propagation and release of game species. For many years this was regarded as a cure-all which would restore depleted populations and assure maximum productivity. It succeeded in raising game populations especially on privately controlled and protected hunting preserves and is still used on many such properties to augment the supply of shootable game. Later it was realized that, while game farms and pen-supplied restocking have a definite place in game management, by themselves they are totally inadequate to maintain the populations necessary to provide public hunting. A growing tendency to revaluate the results obtained from stocking resulted in a reduction in the number of state game farms and in the output of those farms. Greatest success was achieved in the United States with ring-necked pheasants and bob-white quail. With few other species has game farming demonstrated any real value in furnishing quantities of game for release, though it has yielded limited numbers for stocking small areas. Restocking may be carried on without artificial propagation, and many state conservation departments began replenishing areas which had become depleted because of climatic catastrophes, overshooting, or other cause, by trapping wild stock from undepleted tracts and releasing it in the understocked area. Careful studies indicate that a much larger survival is obtained in this way than from the release of pen-reared game. Deer, antelope, elk, wild turkeys, raccoons, beavers, muskrats and rabbits are among the species that have been successfully restocked by this method.

Nevertheless, the role of artificial propagation of game birds and mammals in management programs had not been fully determined by 1946. It was, of course, obvious that it would continue to play some part, particularly in the introduction of species in areas from which they had long been absent or in which they had never occurred. In the period 1925–45, modifications of methods of planting showed some value in insuring a greater percentage of survival than did the older practice of taking the birds from the game farm and releasing them at once in the area in which it was hoped they would establish themselves. Methods of accustoming the birds to their new homes were introduced. These practices, which are generally similar, have been most frequently used with game birds. The birds to be planted are confined in a cage or at least in a limited space, and are fed for a time to make them feel established in that particular locality. After several days the doors of the enclosure are opened, allowing the birds to go in and out, but feeding is continued for a time. This provides for a gradual dispersal and favours establishment of a nesting colony in the immediate vicinity of the point of release, particularly if it has been wisely chosen.

PREDATOR CONTROL

Warfare against predatory enemies of livestock and poultry is as old as the domestication of useful mammals and birds. Its intensity and importance vary widely according to the type of animal husbandry practiced and to the abundance and kinds of predators involved. In North American farming districts where poultry raising is general, it takes the form of sporadic warfare against hawks and owls and the smaller mammals such as weasels, minks, skunks and opossums. Efforts to control such predators tend to vary in intensity almost in direct proportion to the loss sustained and seldom develop into concerted community action. On the range lands of the western United States where larger predators, particularly coyotes, are involved and the losses of sheep and cattle are often serious, organized control by the combined efforts of the federal and state governments, the local communities and individual livestock men, are the rule. Only by united action has it been found possible to hold losses to a reasonable minimum.

Predator control in protection of man's animal husbandry is a tradition which tends to turn every man's hand against the despoilers. It still largely prevails, not only against predators whose activities have been proved beyond a doubt, but also against creatures which may be innocent of any depredations and even actually helpful to man's interests.

There is an abundance of carefully collected, scientific evidence to show that most of the hawks and owls are not harmful to man's interest, but through their normal habits of feeding on crop-destroying rodents, both native and introduced, are actually man's allies. Similarly, skunks—though occasional killers of poultry—are normally great consumers of insects destructive to growing crops and, therefore, are usually of more value than harm. All skunks get a bad name from the few marauders that invade the poultry yards.

With this traditional warfare as a background, it was inevitable, as stocks of game decreased, that predator control would be advanced as a method of restoring them. It is practised both sporadically by individuals and occasionally through organized effort which may approach the status of a crusade. Every hunter and fisherman has seen an occasional predator capture a bird or a fish which was the object of his own quest. As the supply of game and fish decreases, such incidents loom larger in mind and may lead to a fixed belief that all game scarcity is due to predators.

Despite the wide belief that predator control is of vital importance in the management of wildlife, the evidence as to the truth of that belief is neither clear nor convincing. Practically all scientific investigations into the relationships of predators to other forms of wildlife have thrown doubt on the simple formula that if predators are killed, the species upon which they feed will automatically increase.

There were, however, certain basic concepts beginning to emerge in the 1940s which seemed to reflect with reasonable accuracy the relationship between predator control and wildlife population.

Under normally stabilized conditions over a wide range, predators generally live upon surplus populations of prey species, and their activities in the aggregate have little or no effect upon the breeding stock needed for the succeeding season. Local readjustments in accordance with varying conditions are often desirable to maintain a balance, though this can never be perfect; the observed *average* stability of animal populations emphasizes this point.

Under special conditions, either favourable to the predator or unfavourable to the prey, predators may become an important factor in decreasing populations or in preventing recovery following a decline in population. The effect of predation upon populations is more evident when the predator is a more prolific species than the prey. Where the reverse is true, the effect is at least obscured by the fact that the victim has a greater reproductive capacity than the predator. Generally the agency of predators in reducing large populations is minor compared with the more vital one of available food, supply of suitable cover, correct interspersion of these two essentials and disease. Any one of these, or factors unknown, may be more effective than predation in limiting numbers.

The numerical ratio of game animals and game birds to their natural predators may be disturbed when human hunters in large numbers enter the field. Utilization of the game crop by man, therefore, may necessitate some reduction in numbers of predatory species, if a supply of game is to be maintained.

Repressive efforts against predators for the purpose of protecting livestock and for building up other desirable forms of wildlife are usually intermingled, and the influence of groups interested in both phases is usually combined in advocating and carrying out repressive measures. These may take the form of the so-called "vermin" control campaigns or the payment of bounties for the destruction of offending animals. Both of these commonly advocated measures have the defect of being nonselective. Effective predation against game species is usually local and most frequently is the work of one or at most a very few species of predators. An unusual abundance of predators, a greater than normal concentration of the game species involved, or a shortage of normal food and cover which may force game to seek less favourable environment are deviations from the normal which produce noticeable predation.

There is no wildlife topic which produces more controversy than that of predator-prey relationships. Those who deny that

there is any need of predator control and those who carry the warfare against predators to the point of fanaticism are, on the basis of knowledge in the 1940s, equally mistaken. There are occasions when predator control is abundantly justified for the sake of better wildlife management. There are, however, frequent efforts at "vermin" control which are not justified by available information and which may do actual harm. Those interested in sane wildlife conservation and management believe that before control is undertaken there should be, first, adequate investigation of the extent of losses caused by predation and, second, appraisal of the probable results of attempted control.

There are certain circumstances which usually indicate that predator control will contribute to better management. Among these is excessive depletion of the numbers of a species. When that has occurred, the desirability of preserving as many individuals as possible justifies the elimination of all predators. For example, the trumpeter swan, once of wide distribution and considerable numbers in the United States, was reduced by 1935 to a total population of 75 in Yellowstone National park and the Red Rock Lakes National Wildlife refuge and adjoining lakes. Every effort was made to prevent losses, including elimination of coyotes in the vicinity of the Red Rock lakes nesting areas, as well as careful protection from human molestation. The steady increase in this population to a total of 283 in 1944 indicated the success of a program designed to save every possible individual.

Small herds of antelope, deer and elk have responded to predator control by rapid increase in a number of cases where adequate food and water for a greater number of animals was available, and where predation was an important repressive factor. Efforts to increase by predator control large herds of big game in territory where no great surplus of food was available have failed to show measurable results. Obviously efforts to augment the food supply might well have been more productive.

Predator control may be necessary in areas where efforts are made to maintain populations of game species above a normal level, as on lands devoted to the production of grouse, pheasants and quail. Both tradition and practice on such establishments go back to those prevailing on shooting estates in England. There the attempt is made to produce maximum shootable surpluses to be taken during the hunting season. Natural reproduction is maintained at the highest possible level and is supplemented in varying degrees by the release of pen-propagated birds. Along with this there is usually a predator control program aimed at every species which might conceivably interfere even slightly with maximum production.

As applied to hunting preserves in North America, however, these methods were not especially successful. In fact, managers of such areas found that predator control was often unnecessary and occasionally undesirable in building and maintaining game bird populations. The tendency among the more observant U.S. game preserve managers by 1946 was to place more emphasis on other factors and less on predator control.

Predator control or predator exclusion, whichever is more feasible, is usually necessary at game farms and fish hatcheries where efforts are made to produce quantities of individuals for release. The mere presence of large numbers of small fishes or young birds acts as a magnet to draw unusual numbers of predators, and positive action is often necessary to prevent high losses. Such action may include the shooting or trapping of predatory forms or efforts to exclude them by fencing and other devices. The comparative cost and efficiency of such operations should be the tests to determine which should be used. However, the innate desire to shoot and the understandable resentment of a caretaker who sees the birds or fishes he is endeavouring to propagate being killed, result in a shooting and trapping program even where fences or screens would be adequate to prevent damage.

Less frequently there are other combinations of conditions which make predator control a necessary and unprofitable practice in wildlife management. It is, however, a two-edged sword, which when used indiscriminately may do more harm than good. When and where it should be employed are questions to be answered by obtaining facts and judging those facts carefully and accurately. Certainly predator control as a means of building or maintaining game stocks has a limited value and is by no means the "cure-all" that its more enthusiastic advocates believe.

WILDLIFE REFUGES

Wildlife refuges play an important part in modern game management. The first refuge in the United States, so far as available records disclose, was established by the legislature of California on what is now Lake Merritt in the city of Oakland on March 18, 1870. It is assumed that prior to this time there were refuges maintained by private citizens on their own land under trespass laws, but this was the first one officially created by legislative enactment.

The first U.S. national park—Yellowstone—was established on March 1, 1872. All national parks are in fact wildlife refuges, but wildlife protection did not become a part of the park law until 1894. Until that time, Yellowstone National park, while a park for the protection of scenic resources, was open to hunting.

The first federal wildlife refuge was established by executive order by President Theodore Roosevelt on tiny Pelican Island off the east coast of Florida in 1903. Thus, the refuge idea grew rather slowly at first. While California established the first state refuge in 1870, it was not until 1903 that the second state, Indiana, started a refuge system. The period 1903–25, however, saw a rapid increase of both national parks and state wildlife refuges. Some of the state refuges were on a magnificent scale, but in many cases they were neither adequately posted nor patrolled. During these years the federal wildlife refuge system grew somewhat more slowly. In 1909 the National Bison range was created by a special act of congress which provided the first appropriation by congress for establishing a wildlife refuge. In 1915, money was voted for the purchase of pasture to feed the elk in Jackson Hole, Wyo. In 1924, the Upper Mississippi Wildlife and Fish refuge was established by an act of congress which authorized an appropriation of $1,500,000 for the purchase of land within the boundaries defined in the act. In 1928, the Bear River Migratory Bird refuge was established in Utah, also by a special act of congress. These individual appropriations were followed in 1929 by the Norbeck-Andresen Migratory Bird Conservation act, which authorized the establishment of a nation-wide system of migratory bird refuges, the purchase of land, and appropriation of monies therefor. During the period 1934–40 considerable funds were appropriated for the expansion of the refuge system, and in 1934 the Migratory Bird Hunting Stamp act, which provided that everyone over 16 years of age who hunts migratory waterfowl must purchase a $1 stamp to be attached to his state hunting licence, became a law. The act provided that 10% of the funds raised by the sale of these stamps could be used for the administration of the law and that the remainder must be devoted to the purchase, development and maintenance of a permanent system of migratory bird refuges.

The great expansion in refuge systems, particularly those of the states, came during a period of rapid decline of such big game species as deer, elk, antelope and moose. It had become increasingly obvious that protective laws were not in themselves sufficient to check the decline, and the refuge idea spread rapidly, appearing for a time as the solution of all wildlife problems. Later experience demonstrated that while refuges do have a major value, they also have definite limitations and, instead of being a complete solution to all the problems of wildlife preservation, restoration and maintenance, are only another useful tool in a general program.

A wildlife refuge may be defined as an area of land, or water, or both, set aside for the use of one or more species of wildlife in need of protection. The area may be small or large, depending upon circumstances and upon the needs of the species to be conserved.

Refuges have two functions: First, to furnish adequate protection to wildlife; and second, (often more important than the saving of individual animals or birds) to restore or preserve a suitable habitat in which animals and birds can lead natural lives. As industrial and agricultural development proceeds, the reserva-

tion of wildlife habitat becomes of increasing importance in the more heavily populated sections of a country.

U.S. Refuges.—No definition could accurately comprise all of the types of refuges in use in the United States, but the classification used for the national wildlife refuges serves fairly well. They are classified as special-purpose refuges, big-game refuges, migratory waterfowl refuges and general wildlife refuges.

Special-purpose refuges are created for the protection of a single colony or group of colonies of birds or mammals. They may also be for the protection of a single species. Such refuges are frequently, but not necessarily, small. The majority are islands either in coastal waters or in lakes set aside for the protection of non-game water birds. They vary from low sandy islets with or without vegetative cover to rocky pinnacles in whose crevices and crags seafowl find acceptable living quarters.

Big-game refuges have frequently been established to furnish protection to certain endangered herds. Those in the federal refuge system have been provided primarily for antelope, mountain sheep, elk and deer. Many of the refuges, of course, shelter more than one species of big game. Some of the more extensive state refuges also would be classed as big-game refuges.

Migratory waterfowl refuges consist of lands or waters, or combined land and water areas, on which cover and food can be maintained to meet the special needs of waterfowl. They may vary from natural lakes or marshes, maintained and patrolled for the use of the birds, to those artificially developed where suitable cheap land and a water supply are available. Waterfowl refuges fall into three natural classes: (1) Breeding areas; (2) resting and feeding areas; and (3) wintering grounds, all equally necessary to the welfare of the birds.

There are few waterfowl refuges that are exclusively of one type. Their major value may be as breeding areas, wintering grounds, or nesting, or feeding areas, but the breeding areas in the northern states also serve as resting and feeding areas for birds from farther north during the spring and fall migrations. Some wintering ground refuges also serve as way stations for birds that go on to more southern wintering grounds, and there are few that do not have small numbers of migratory game birds nesting on them, although their value as breeding grounds may be nominal.

General wildlife refuges have been widely used by the states in developing their wildlife programs but are comparatively few in the federal refuge system. The more important in 1946 were the Aleutian Islands refuge, established primarily for the protection of sea otters, foxes and sea bird colonies; Lake Mead, above Boulder dam on the Colorado river; and Okefenokee swamp in Georgia, which protects a great variety of resident wildlife, and furnishes a wintering ground for several species of waterfowl.

The total number of refuges in the U.S. National refuge system in 1945 was 275, with a total of 17,620,526 ac. About 8,046,975 ac. of this area were in Alaska, Hawaii and Puerto Rico, and the remainder in the continental United States. About 46 of these refuges were classed as special-purpose refuges, 16 as big-game refuges, 188 as migratory waterfowl refuges and 25 as general wildlife refuges.

A refuge classified in any one of these categories is seldom exclusively used by the species for which created. Many of the refuges which are major waterfowl breeding, feeding or wintering grounds are also of value in protecting deer, fur-bearing animals, non-game water birds and song and insectivorous birds. Likewise, some of the big-game refuges also contain marshes and lakes which have been developed to serve the needs of migratory waterfowl. The fact that the waterfowl areas are scattered adds to, rather than detracts from, their value as long as protection can be maintained and the marsh lands kept in good condition.

Some of the outstanding refuges in each category are as follows:

Special Refuges.—The Great White Heron refuge in Florida, which provides protection for the only breeding population of this bird within the United States; Three Arch Rocks off the Oregon coast, which has vast colonies of murres, puffins, cormorants and others; and the Farallon islands in California, which also have great colonies of sea birds.

Big Game Refuges.—National Bison range (Mont.), Wichita Mountains Wildlife refuge (Okla.), for bison, elk, deer, wild turkeys, etc.; Niobrara refuge (Neb.), bison, elk, etc.; National Elk refuge (Wyo.); Hart Mountain refuge (Ore.), Charles Sheldon refuge (Nev.), antelope, mule deer, elk, sage hens; Desert Game range (Nev.), Kofa Game range and Cabeza Prieta Game range (Ariz.), and San Andreas Game range (N.M.), mountain sheep.

General Wildlife Refuges.—Aleutian Islands refuge (Alaska), Lake Mead (Nev.-Ariz.), Moosehorn refuge (Me.), Carolina Sandhills refuge (S.C.), Piedmont refuge (Ga.), Okefenokee refuge (Ga.), Noxubee refuge (Miss.) and Kentucky Woodlands refuge (Ky.).

Waterfowl Refuges.—Breeding ground refuges—Seney (Mich.); Rice lake, Tamarac, Mud lake (Minn.); Upper Souris, Lower Souris, Des Lacs, Arrowwood (N.D.); Sand lake, LaCreek (S.D.); Crescent lake, Valentine (Neb.); Medicine lake, Red Rock lakes (Mont.); Camas (Ida.); Bear river (Utah); Ruby lake (Nev.); Turnbull (Wash.); Malheur (Ore.); Feeding and resting refuges—Montezuma (N.Y.); Chautauqua (Ill.); Upper Mississippi (Ia., Ill., Wis. and Minn.); Squaw creek, Swan lake (Mo.); Salt plains (Okla.); Lower Klamath, Tule lake (Calif.); Wintering refuges—Brigantine (N.J.); Bombay Hook (Del.); Back bay (Va.); Mattamuskeet, Pea Island (N.C.); Cape Romain (S.C.); St. Marks (Fla.); Delta, Lacassine, Sabine (La.); Aransas (Tex.); Bosque del Apache (N.M.) and Sacramento (Calif.).

Canadian Refuges.—The Canadian refuge system parallels closely that developed by the United States. Both have been carried on as a part of the management program called for by the Migratory Bird treaty between the two countries. The chief difference is that, so far as migratory waterfowl are concerned, the provinces have played a somewhat larger part than the dominion government in extending the development of this type of refuge. The Canadian government started to develop a great migratory waterfowl refuge system, but on May 30, 1930, when many of the federally-owned lands were returned to the provinces, 12 migratory waterfowl refuges, totalling 473,000 ac., were returned to Saskatchewan, and six refuges of 133,587 ac. to Alberta, thus becoming part of the provincial wildlife refuge system.

Canadian parks are all wildlife refuges. The first was established in 1885; by 1945 the Canadian system contained 19 parks with a total of 7,937,920 ac. Some of these are important big game sanctuaries. The dominion refuge system contained 58 wildlife refuges in 1945, with a total of 819,237 ac. Most of these are special-type refuges to protect colonies of nesting birds, but a number are of major importance for migratory waterfowl. In addition, Canada prohibits sport shooting in vast areas of the north country, reserving the hunting and trapping privileges for the Eskimos and Indians. This, in effect, makes partial refuges of huge areas on the Arctic slope, and aids greatly in the systematized management of the waterfowl resources of the continent.

Mexico's national park system embraced 42 areas in 1945, containing approximately 1,357,187 ac.; management was still in the embryonic stage and little protection and patrol was afforded. There were no wildlife refuges as such in Mexico in that year, despite the need, especially in the east and west coastal marshes.

MAINTENANCE OF ENVIRONMENT

To be successful, the restoration and improvement of wildlife environment must be based on accurate knowledge of the needs of the wildlife in the actual locality where management is attempted. This has stimulated much research, the results of which have made management programs in the United States feasible for an increasing number of species.

For resident game, U.S. practices have included the planting of suitable food and cover patches near enough together to be within the normal feeding radius of the species. There has been more successful application of this practice to the development of suitable habitat for quail than for any other single species. Generally in the southeastern states there is plenty of suitable cover to meet the needs for nest sites and for shelter from predators or winter storms. Deficiency in the late winter food supply is a frequent cause of scarcity of quail in a given territory. In such a place, planting of crops which hold seeds well into the winter and of others producing in early spring has resulted in an immediate increase in the number of quail. In other cases it has been possible to get a better crop of natural winter foods by burning off or disking plants which were useless as food but which occupied the ground to the exclusion of the more desirable species which appear as soon as their competitors are removed.

In the middle western states, especially in those near the northern edge of the normal range of the bob-white, the situation is often reversed. Winter food in the form of waste grain and weed seed is often plentiful but is unusable by the birds because clean farming has eliminated winter cover. Under such conditions, developing patches of cover plants on bits of unused land and along fence rows is often successful in building up a bob-white population far in excess of that previously present.

Perhaps the first successful large-scale use of the restoration of environment to build up game in the United States was that of the Pennsylvania deer herd. The basis of the program was the purchase of lands to serve as refuges, the introduction of deer to these lands, and the provision of adequate patrol to provide protection. The game program coincided with a reforestation program which went far to restore suitable food and cover for the deer, both on the lands being managed primarily for game and on those devoted to reforestation. The actual program thus incorporated a variety of measures but did include the restoration of suitable environment.

The continent-wide waterfowl restoration plan was much more complicated because of the north and south-lying flyways. Thus preservation and development of food and cover good the year round and over the length of the continent was required. Whereas a landowner can put into effect on his own property all the practices necessary to provide for a resident species, similar practices for migratory waterfowl may often be needed on areas thousands of miles apart.

Basically, however, the needs are the same, including the provision of suitable food in year-long supply, nesting sites adjacent to good feeding range for the young, adequate shelter from storms and protection from predators. The requirements of food and shelter vary widely. Bob-whites use thickets of briars and vines, the fallen tops of pines or dense patches of other vegetation for protection from storms and safety from predators. Waterfowl, except when young, need comparatively little protection from storms, though many seek the shelter afforded by protected bays, woodland pools or small ponds in the dense vegetation of marshes. Without such protection and adequate food supplies, all but the hardiest kinds are quickly driven out by bad weather.

The U.S. waterfowl restoration program, made necessary by the drastic decline in continental waterfowl populations to an all-time low in 1935, was based on protection together with restoration of environment. The waterfowl had declined largely because of three repressive factors—overshooting, drainage and drought. There is much difference of opinion as to the relative importance of these factors but little dispute as to the disastrous effect of the combination.

The drainage craze which swept the U.S. reached its peak between 1910 and 1930. During the time it was under way, approximately 100,000,000 ac. of land were drained. This alone certainly had an adverse effect on the total waterfowl population; some of the finest waterfowl feeding and breeding areas were ruined. A drought cycle which began about 1915 and continued with only occasional breaks until 1938 destroyed, by its cumulative effect, a vast part of the remaining waterfowl breeding area. Thus, an ever-growing army of hunters was hunting a declining waterfowl population, concentrated on a constantly and, in the later years of the drought, rapidly decreasing water area; it is not surprising that the result was a rapid decline of the waterfowl flocks.

The restoration program started in 1929 with the passage of the Migratory Bird Conservation act but not until 1935 was it fully under way. It called for two things—a reduction of the kill, and a large-scale restoration of areas suitable for waterfowl. The first was handled by a drastic tightening of the shooting regulations in both Canada and the United States; the second by a program of marsh restoration which involved areas drained, dried up by drought, or damaged by other causes. Several million acres were involved (the United States Fish and Wildlife service alone acquired and restored nearly 3,000,000 ac. of feeding and breeding grounds). These two activities began to turn the tide in 1937, and the first noticeable increase in the north-bound migration occurred in that spring. In 1937 there was also a lessening of the intensity of the drought, particularly on the breeding grounds in the northern states and the Canadian prairie provinces. During that and succeeding years a steady program of construction effected a gradual accumulation of water with a consequent development of marshes. This restoration work, participated in by many public and private agencies, had a favourable effect on the waterfowl population. The shooting regulations were made in both countries to hold the kill below the numbers of waterfowl annually produced. Each succeeding year a larger flight of birds returned to the breeding grounds and, when the drought cycle finally broke in 1940, there were enough birds to take advantage quickly of the expanding water areas. By 1944 the waterfowl population had increased five-fold and was causing damage to farm crops where concentrations developed in agricultural areas, despite a steady liberalization of the shooting regulations as the population increased.

Historically, the manipulation of food and cover plants for the benefit of game species is old. It has been long practised on the large European estates and game preserves and for a shorter period, of course, on shooting areas in the United States. Its application to public lands in an effort to improve public shooting, however, is comparatively new.

Many states and the federal government by 1946 were practising some environmental control on game lands, and to a more limited extent on land managed primarily for forestry or grazing. The sum expended per acre was limited, and dependence was therefore placed on long-time management programs. For example, on many waterfowl refuges it would be possible to drain marsh units and cultivate and seed them to the plants desired; it has been done many times experimentally on a small scale. Similarly, the marginal lands could be planted to desired combinations of food and cover plants for both waterfowl and upland game birds. On a large scale, however, the cost would be prohibitive. Therefore, the same result is gradually obtained by manipulation of water levels, by the use of controlled burning, by grazing or hay cutting, and by the occasional plowing and planting of small tracts of land. From the viewpoint of wildlife management it is essential that these management devices be fitted in with the life cycles of the species concerned in order to avoid harm. Overgrazing is disastrous but controlled grazing at the proper season can often be used to reduce fire hazards. Hay cutting could be devastating if carried on during the nesting season on a bird refuge; after the nesting season, however, it often improves late summer and fall feeding areas. It can also be used to reduce fire hazards. Fire itself is an effective management tool on certain types of marsh lands. It must be used at the proper season and under proper conditions to have best effects.

Manipulation of water levels is an exceedingly effective agent in developing marshes and maintaining them at the desired stage of vegetative succession. Many marsh plants are limited in their tolerance of changing water conditions, a fact which is used to advantage in this type of management. The lowering or raising of the minimum water level a few inches on a salt marsh, for example, can completely change the distribution and relative abundance of the plants present.

On forest lands, where it is often impossible to spend even such limited amounts as are disbursed on wildlife areas, improvements can be made by the application of suitable forestry practices. Selective cutting, for example, can greatly increase the available food supply for deer if carried out with some consideration of that need. The stocks of small fur and game mammals can be guided up or down by regulating the number of nut-bearing and den trees. A cutting rotation in blocks of reasonable size also tends to insure a continuous food supply for deer. After big-game herds reached a low point in the period 1910–20, foresters had a growing concern for the welfare of deer and elk and other forest game.

When, comparatively late, control was established over the public grazing land, most of it was overgrazed. A long-time management policy began to produce results. Along with this vegetative improvement there was an increase of the game species, which as well as livestock, are dependent upon it.

Needless to say, there is much to learn as to the application of environmental control to vast areas of public lands. Management of food and cover has been overemphasized, just as protection, restocking and predator control were overvalued in the past. Environmental management can help to provide the basic necessities for wildlife, consistent with the climate and the existing soil and water conditions, but it can do no more. There is, moreover, a definite limit on the total amount of wildlife that can be produced on any area. Wildlife managers are aware of these limitations and try to make the best use of food and cover conditions possible under prevailing circumstances. In addition they attempt to improve conditions gradually, restock to the extent necessary, provide adequate protection, see that the total number of game birds and mammals lost from all causes does not exceed that produced, and undertake such predator control as may be necessary. (I. N. G.)

INTERNATIONAL SURVEY OF WILDLIFE

The need for international co-operation in preserving wildlife has probably never been so great as during the 20th century. In response to this need, a number of international organizations have been established; and many additional organizations, while no more than national in name, have derived mutual encouragement from similar bodies in other countries, and have contributed toward international co-operation by the exchange of news and views and even by the donation of funds. Very many birds and some mammals are projected into the international picture by their migratory habits.

The International Office for the Protection of Nature, with headquarters in Brussels, has exerted a wide influence, especially among old world countries, with its correspondence and its files of information. The Society for the Preservation of the Fauna of the Empire, with headquarters in London and a regularly published *Journal,* has watched over conservation needs in the British commonwealth of nations. The National Audubon society, with headquarters in New York (official organ, *The Audubon Magazine*), while especially active in bird and mammal protection in the United States, has occasionally sent representatives to international conferences. The American Committee for International Wild Life Protection, with headquarters in New York, has promoted various investigations and publications, including *The Organisation of Nature Protection in the Various Countries* (G. A. Brouwer, 1938) and two volumes on extinct and vanishing mammals of both hemispheres (Glover M. Allen, 1942; Francis Harper, 1945). International Ornithological congresses and Pacific Science congresses, held at intervals of a few years, include nature protection in their discussions and publications. In 1932 Britain and Italy agreed to co-operate in suppressing ivory smuggling in Africa. The North American Wildlife conferences discuss the progress and results of conservation research and administration all over the continent, and publish annual *Transactions.* A Convention on Nature and Wildlife Protection in the Western Hemisphere came into force in 1942.

The 1933 London Convention for the Protection of the Fauna and Flora of Africa was of far-reaching importance. The conference was attended by representatives of the nine countries having territories in Africa. The convention became effective in 1936. Among the measures agreed upon were the establishment of national parks and nature reserves, the regulation of traffic in animals, and the prohibition of encircling fires and (wherever possible) of the use of poison, dazzling lights, nets and traps for hunting animals. The Annex to this convention listed as class A species, 17 mammals, 3 birds and 1 plant, for which rigid protection was agreed upon. It also listed as class B species, 13 mammals and 9 birds which might be taken only under special licence. The number of mammals so protected was actually much larger than indicated in the above list; for example, the 40 forms of Madagascar lemurs counted as only a single item.

Great advances have been made in the protection of wildlife in reserves (*see* WILDLIFE RESERVES; GAME RESERVES.) In the United States, in 1945, there were 27 national parks (area, 17,282 sq.mi.) and 84 national monuments (area, 14,509 sq.mi.) (*see* NATIONAL PARKS AND MONUMENTS); in Canada, in 1946, there were 25 national parks (area, 11,700 sq.mi.). In 1946 there were 291 national wildlife refuges in the United States (area, 27,843 sq.mi.), and many state reserves as well; in Canada, more than 478 national and provincial wildlife refuges (area, more than 101,000 sq.mi.). A great reserve about the mouth of the Rhône in France protects one of the largest concentrations of waterfowl in western Europe. Prior to World War II plans were being made for two international parks on the borders of Czechoslovakia, Poland and Rumania. Additional nature reserves are maintained by most European countries, and by the Soviet government in Asia as well as Europe. In 1935 there were approximately 150 game reserves and national parks well distributed over Africa; of these, Kruger National park in the Transvaal is best known. There were 77 nature reserves in the Netherlands Indies in 1929; and a few similar areas have been established in Malaya, Australasia, Japan, Hawaii and Chile.

Mammals.—Investigations sponsored by the American Committee for International Wild Life Protection show what mammals have been lost by extinction during the Christian era, what species are threatened with the same fate, what factors contribute to the progressive depletion of the world's mammalian faunas, and what measures have been, or may be, undertaken for their preservation. During this period about 106 species and subspecies have become extinct. Up to 1800 about 32 forms had been lost; all but 6 of these were restricted to the West Indies and were scarcely known in life to civilized man. Each half-century period after 1800 showed a steadily increasing rate of extinction. About 38% of the total losses took place after 1900. More than 600 mammals require consideration as vanishing or threatened forms.

In Australia conditions are exceptional, in that its predominantly marsupial fauna is so lowly organized as to be quite unfitted for coping with aggressive introduced species, such as European red fox, domestic cat, European rabbit, house rats and house mouse. Grazing, cultivation of the land, bush fires, the fur trade, epizootic disease and the use of poisoned bait for rabbits (with disastrous effects on native species) are also serious factors in the depletion of the native fauna. The rapidly growing list of extinct forms numbers at least 11, including Leadbeater's opossum, three rat kangaroos and two wallabies. Altogether, the situation in Australia has gotten largely beyond human control.

The only two indigenous land mammals of New Zealand, the short-tailed and the long-tailed bats, have become extirpated there, perhaps through epizootic disease.

The Malay archipelago, containing the richest insular faunas of the entire world, has fared comparatively well. Only three forms (two rats and a shrew), all from tiny Christmas Island, have become extinct. The generally increasing human population and the expansion of cultivation are among the most serious factors affecting the mammals. In the Netherlands Indies many good protective measures were adopted before World War II. Special concern is felt for such vanishing forms as the orang-utan, Sumatran elephant, Javan and Sumatran rhinoceroses, Javan banteng, dwarf buffalo of Mindoro, two anoas of Celebes and Sumatran serow.

The fauna of Asia has been safeguarded in part by the sparsity of human population over vast wilderness, desert or mountain areas in Siberia, Mongolia, Chinese Turkestan, Tibet, Iran and Arabia. On the other hand, there has been increasing use of modern rifles, and even pursuit of desert animals by motor car. The Asiatic rhinoceroses, the saiga antelope, the wapiti and other deer, and even the lowly pangolins have been victimized merely because of the apparently wholly mythical value of the horns, scales and other parts of the body in the Chinese pharmaceutical trade. Even in countries far from China, protection of rhinoceroses and other species in similar demand is made extraordinarily difficult by the fabulous prices offered. The Siberian sables have been subjected to severe pressure by the fur trade. Only three Asiatic mammals were known to have been exterminated up to 1945: Japanese wolf, Syrian wild ass and Schomburgk's deer. Notable among the threatened forms were the Indian cheetah, Asiatic lion, Przewalski's horse, Transcaspian and Indian wild

asses, Javan and Asiatic two-horned rhinoceroses, Persian fallow deer, Yarkand stag, McNeill's and white-lipped deer, Malayan gaur and at least three forms of wild sheep.

In view of the generally devastating effect of the European type of culture upon native faunas throughout the rest of the world, it is gratifying to find the mammalian fauna of Europe itself no more impoverished than it is. The greatest changes are apparent in the densely populated countries of western Europe. And yet only six recent mammals seem to have been exterminated: European lion, European wild horse, aurochs, Caucasian bison, Pyrenean ibex and Portuguese ibex. While the replacement of forests with habitations, transportation systems and crop and pasture lands has inevitably resulted in a retrogression of the European fauna, the most direct human pressure has been exerted through hunting. The big game animals, furnishing valuable meat and hides, have been the principal sufferers. In Europe, however, where hunters form a smaller proportion of the total population than in North America, the rate of extermination has been slower. Furthermore, Europeans have been less ruthless than Americans in attempting to exterminate any animal conflicting with human interests. Consequently, such predatory animals as wolves and brown bears have been able to survive in many parts of Europe. The wildcats on the mainland and their insular representatives in Crete, Sardinia, Corsica and Scotland have become extremely scarce; perhaps their greatest danger lies in extinction by dilution through interbreeding with feral domestic cats. The European beaver remains in only a few isolated colonies. There is some doubt as to whether the Finland and the Novaya Zemlyan reindeer have survived. The last natural refuge of the Lithuanian bison was overrun in World Wars I and II, but about 60 survived in 1946 in preserves in Poland, Germany, The Netherlands, Sweden and England. The fate of the two remaining races of Spanish ibex became uncertain during the civil war disturbances. The stock of Cyprian muflon has become precariously small.

Prior to general colonization of Africa by Europeans, its animal life was in a virtual state of equilibrium. The introduction of firearms sounded the death knell of a large proportion of the population of large mammals. The Atlas bear, Barbary and Cape lions, quagga, Burchell's zebra, Algerian wild ass, bubal hartebeest, rufous gazelle and blaauwbok disappeared completely. The Boer hide-hunters decimated the remarkable antelope and zebra fauna of South Africa during the middle 1800s. Meanwhile native populations have increased under the white man's rule, and their demands for a meat diet have seriously affected the dwindling supply of animals. Encircling fires are one of their most destructive hunting methods. Professional hunters employed by great industrial enterprises, especially in the Belgian Congo, have wiped out much game. Ill-considered campaigns for the control of the tsetse fly have destroyed multitudes of large game animals. Among the mammals whose status requires careful watching are: Barbary lynx, South African bush elephant, African manatee, Cape mountain zebra, Nubian and Somali wild asses, white rhinoceros, Barbary stag, several giraffes, Cape buffalo, Egyptian and Libyan aruis, Nubian and Abyssinian ibexes, Cuvier's, slender-horned, and mhorr gazelles, white oryx, giant sable antelope, addax, nyala, and Senegambian and Congo giant elands.

The mammalian fauna of Madagascar is noteworthy for its high degree of endemism and for the preponderance of lemurs. One of the 40 forms in this group, the hairy-eared mouse lemur, is apparently extinct, and special care should be exercised to safeguard the following seven from further decrease: gray lemur, broad-nosed gentle lemur, Crossley's mouse lemur, Coquerel's dwarf lemur, diademed sifaka, Major's sifaka and aye-aye. Two peculiar endemic carnivores, fossane and fossa, also deserve consideration. Perhaps the greatest danger to mammals in Madagascar lies in the steady reduction of the forest areas by the natives.

North America, despite its comparatively recent settlement by Europeans, has the most unenviable record of any continent in the extermination of mammals. About one-fourth of the approximately 106 extinct recent forms belong to North America, and most of these to the United States alone. The following 29 mammals are now virtually or completely extinct: Gull Island meadow mouse, long-eared kit fox, 4 forms of wolves, 16 forms of grizzly bears, sea mink, eastern cougar, eastern and Arizona wapiti, eastern and Oregon bison and badlands bighorn. Nearly all of these belong to two categories: large carnivores and large game animals of the deer and cattle families. The sea mink was a victim of the fur trade.

Hunting with firearms is doubtless practiced on a larger scale in the United States and Canada than in any other region of the world. About 6,000,000 licensed hunters, and probably several additional millions of unlicensed hunters, normally take to the field every year in the United States. Trappers have seriously depleted the stock of such furbearers as the wolverine, fisher, marten and otter. The black-footed ferret is passing as its food supply, the prairie dog, is poisoned out of existence. Hunters in federal and state employ are engaged in a warfare of extermination against bears, wolves, coyotes, cougars and wildcats. State game commissions blacklist such valuable furbearers as foxes and skunks, and such important checks on rodent pests as weasels. Mammals in the United States are being destroyed at an unprecedented rate, chiefly by means of poison in the hands of federal employees. Protests by conservation organizations against this wholesale slaughter, on the grounds that it is biologically, economically and educationally unsound, have been emphatic, repeated, but in vain. The U.S. Biological Survey (*see* FISH AND WILDLIFE SERVICE) announced that, during the fiscal year 1938–39, 35,465,078 ac. were treated with poisoned bait, 104,076 large predators were killed and $2,772,939 was spent in the work of destruction. The attack has been directed not only against predatory mammals but also against such rodents as woodchucks, ground squirrels, prairie dogs, pocket gophers, kangaroo rats, cotton rats, field mice, porcupines, jack rabbits and snowshoe hares. Millions of other mammals, and birds as well, succumb as unintended victims of the poison.

Among the North American mammals whose existence is more or less threatened, particular mention may be made of: Newfoundland and Carolina beavers, the various wolves, grizzly bears and cougars, fisher, the Labrador, woodland, Queen Charlotte and Newfoundland caribou, wood bison (as a pure race) and Gaillard's and Texas bighorns.

Most of the notable losses by extinction among the recent mammals of the West Indies are not chargeable directly to civilized man. Only a few of the lost species appear to have succumbed to the introduced mongoose, old world rats, and perhaps introduced human enemies. These agencies, however, remain a constant threat to the surviving mammals. It is significant that the West Indies are virtually lacking in native predatory mammals, which, in other parts of the world, play a fairly essential role in eliminating weak and diseased individuals among the species they prey upon, thereby maintaining the vitality of the species. In the absence of such vitalizing predators, the West Indian mammals may be succumbing to evolutionary senility. The forms that have become extinct in the past 2,000 years include approximately 7 insectivores, 7 bats, 4 ground sloths and 23 rodents.

South America has been the happiest of the continents in the preservation of its native mammals. This is probably due to the large proportion of its total area remaining in a fairly natural condition. Not more than one or two mainland mammals appear to have become extinct: the Patagonian giant ground sloth and perhaps the southern vicuña. Among the mammals in need of special protection are the chinchillas (reduced by the fur trade), the Peruvian vicuña and several deer.

On the Falkland Islands the Antarctic wolf was exterminated by 1876 because of its attacks upon sheep.

The Galápagos Islands, with their unique and extraordinarily interesting fauna, have suffered sadly from man and his associated domestic animals. Despite protective laws of the Ecuadorian government, there is apparently no local interest in conserving wildlife. Two endemic rice rats may have been exterminated by introduced house rats.

The blubber, flesh and hides of whales, seals, walruses, dugongs, sea cows and manatees have made these mammals objects of pur-

suit by man from very early times. After the old-fashioned whalers in their sailing vessels had greatly depleted the stock of certain species, the invention of the harpoon gun and the construction of "floating factories" for the conversion of raw products bade fair to reduce still other species to the verge of extinction. By 1930 the annual slaughter had reached a total of 30,000 whales; by 1938, 54,664. This situation on the high seas called for international action. A convention that was concluded at Geneva in 1931 and became operative in 1935 forbade the capture of any right whale, of any immature whale and of any female whale accompanied by a young one. Another conference, held at London in 1937, reached an agreement, subject to ratification, that there should be an annual closed season of nine months for pelagic whaling, and of six months for shore stations; that the killing of baleen whales should be prohibited between latitudes 40° S. and 20° or 35° N. (varying with the longitude); that right whales and gray whales should be protected at all times; and that full protection should be given blue whales of less than 70 ft., fin whales of less than 55 ft., and humpbacks and sperm whales of less than 35 ft. It was thus hoped that economical utilization would replace wasteful exploitation. Conferences were held again in 1938 and 1939; among several new provisions, most of the Arctic was closed to whalers. Yet Sherman S. Hayden concluded (1942) that the entire effort to protect whales had been almost ineffectual.

In 1911 a convention between Russia, Japan, Great Britain and the United States provided for the stopping of all pelagic hunting of the Alaska fur seal. Management of the herd on the Pribilof Islands was vested in the United States; Canada and Japan were to share in the harvest to the extent of 15% each. This herd, reduced by 1910 to 130,000, increased to 3,155,268 by 1945.

Apparently the only marine mammal that has definitely become extinct within historical times is Steller's sea-cow. Restricted to the Commander Islands, it was exterminated by Russian hunters within 27 years of its discovery in 1741. The Greenland whale, southern fur seal, Kurile Islands fur seal, and West Indian seal have been brought close to extinction.

The primary factor in the depletion of the world's mammalian faunas is civilized man, operating either directly through excessive hunting and poisoning, or indirectly through destroying natural habitats, placing firearms in the hands of primitive peoples, or introducing aggressive foreign mammals into such places as Australia and various islands. Except in the West Indies, few species seem to have died out within the past 2,000 years from natural causes. The chief hope for the survival of the larger mammals of the world lies in the maintenance of a sufficient number of sanctuaries. In Australia, however, even sanctuaries will not avail unless they are made proof against introduced foxes, cats, rabbits and rats. So perhaps the darkest picture today, as far as the future of mammals is concerned, is to be found in Australia. Almost equally dark, however, is the outlook in the United States, where government agencies are making a determined effort to wipe out, with poison, many native carnivores and rodents.

Birds.—The opposing agencies of destruction and protection have long been affecting birds much as they affect mammals. Here again civilized man, with his increasingly effective weapons, his increasing devastation of natural areas, his insatiable demand for the flesh and feathers of birds and his antipathy toward predatory species, is the arch enemy. The hunting of game birds, so far as it is carried on within reasonable limits and does not consume more than the annual surplus, is generally recognized as defensible; the concern of conservationists is to keep it within such limits. The migratory habits of numerous species give them an international status. The demands of European milliners for the feathers of South American, African or East Indian birds are of international concern. The annual trapping of multitudes of ducks in the Netherlands, and of millions of small migratory birds for the market in Belgium, and likewise in Italy and other Mediterranean countries, has international implications.

The widely recognized need for the conservation of bird life has resulted in the organization of many protective societies, the conducting of educational campaigns, the passage of numerous laws, and the establishment of a great number of sanctuaries. Among the benevolent organizations are the national and state Audubon societies, the annual North American Wildlife conferences, and the Emergency Conservation committee in the United States; the Royal Society for the Protection of Birds in Great Britain; the Ligue Française pour la Protection des Oiseaux and the Société Nationale d'Acclimatation in France; and similar bodies in various European countries and in South Africa. In still other countries numerous organizations for the study of natural history devote attention to the cause of bird protection.

An outgrowth of these local and national societies has been the formation of an International Committee for Bird Protection. International conferences were held in 1902 and 1923 (Paris), 1928 (Geneva), 1930 (Amsterdam), 1934 (Oxford) and 1935 (Brussels). An international convention for the protection of birds useful to agriculture was signed at Paris in 1902; it became operative in 1905, and by 1936 it was in effect in 13 countries of western Europe. In 1933 a volume was published entitled *Synoptic Summary of Principal Legislative Measures concerning Bird Protection in Europe and North Africa.*

A Migratory Bird treaty, consummated by Great Britain and the United States in 1916, represented a notable advance in the cause of conservation. Under its provisions, Canada and the United States prohibited the sale and the spring shooting of migratory game birds, regulated open seasons, bag limits and shipments, established the means for law enforcement, and gave total protection to most song and insectivorous birds. A similar treaty between Mexico and the United States became effective in 1937.

In 1913 the United States prohibited the importation of the plumage of wild birds except for scientific and educational purposes. Canada passed a similar law in 1915. In France more than 50,327 tons of bird plumage were imported between 1890 and 1929. Among the chief sufferers from this trade were egrets, hummingbirds, parrots, tanagers, birds of paradise and goura pigeons.

Oil discharged from ships at sea has caused the death of countless maritime birds by saturating their feathers and rendering them incapable of flight. Legislation aimed at restricting this menace has been enacted in Great Britain, the United States and certain other countries; the results have been beneficial, but have not remedied the situation completely. A plan to prohibit the discharge of oil from ships within 50 mi. of shore met with failure at an international conference in Washington in 1926, although some steamship lines adopted the recommendations.

Walter Rothschild (1907), in the only comprehensive report on extinct birds of the world, dealt with those that had vanished within the previous 600–700 years, and also with others on the verge of extinction; the total number included in his report is about 210. He regarded man and his domestic animals as the worst agents in destroying avifaunas, although some species have disappeared without apparent reason. John C. Phillips (1929) classified extinct and vanishing birds of the western hemisphere as follows: certainly extinct, 31; probably extinct, 19; rare or vanishing, 44; unsatisfactory status, 16; unknown status, 38. More of these were from the West Indies than from any other part of the hemisphere; there man and the introduced mongoose were the chief enemies. Rodolphe M. de Schauensee (1941) presented an incomplete list of 113 rare and extinct birds; he considered that the chief sufferers are highly specialized forms confined to small areas, such as islands. Among the more famous extinct species are: Labrador duck, heath hen, great auk, passenger pigeon, and Carolina paroquet (North America); Pallas's cormorant (north Pacific); several moas (New Zealand); and two dodos (islands in Indian ocean).

Reptiles.—The conservation of reptiles appeals to zoologists more than to the general public, with its deep-rooted antipathy to snakes. There is general tolerance of lizards, and likewise of turtles except for certain species of predatory habits or of food value. In the latter category are various marine turtles and their

eggs, and some fresh-water species. The hawksbill turtle furnishes the tortoise shell of commerce. The diamondback terrapin of the United States has been greatly reduced by market demands. The giant tortoises of the Galápagos Islands, though protected by law, are threatened by man and dogs, and some races are already extinct. The giant tortoises of certain islands in the Indian ocean have also been severely reduced. The American alligator, comparatively harmless but in demand for its hide, has suffered reduction in range and numbers. The skins of vast numbers of snakes are utilized annually in the leather trade; pythons and the karung of southern Asia and the East Indies are the chief victims.

The destruction of man-eating crocodiles in the tropics, and of poisonous snakes in settled areas, is inevitable. Estimates of annual human deaths from snake-bite are: in the United States, 100–200; in Brazil, before the introduction of antivenomous serum, 4,800; in India, 20,000 (probably too high).

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WILDLIFE RESERVES. The name wildlife reserve has been applied in the United States rather vaguely to any area withdrawn from ordinary human interference so that the flora and fauna, as well as the physical changes of ground, may follow their natural course. In Great Britain such areas are known as nature reserves. Motives for reservation include the desire to preserve remnants of unique vegetations, breeding-grounds of particular species of birds, sanctuaries for birds and big game or landscapes.

The movement in favour of U.S. wildlife reserves, which had its historic origin in 1832, when the congress of the United States set aside Hot Springs reservation (Ark.), has grown in strength. An important landmark was the establishment of the Yellowstone National park in 1872, followed in 1890 by Sequoia reservation, by which several groves of ancient and world-famous trees (*Sequoia gigantea*) were withdrawn from the danger of destruction. The United States, undoubted pioneer in this field, had in 1945, 27 national parks, 84 national monuments and other types of reserves to a total of 169, with an area of 20,455,014 ac. In 1941, the greatest travel year prior to World War II, 8,388,909 persons visited these areas.

In addition to national parks and monuments, there was in the United States and Alaska on June 30, 1944, a Federal wildlife refuge system embracing 279 refuges with an area of 17,628,122 ac. These refuges, the first of which was the Pelican Island refuge established in Florida in 1903, developed along several distinct lines. Some were big game refuges designed particularly to preserve herds of antelope, mountain sheep and elk which were threatened with extinction. Others were small islands or groups of islands along the coasts of Alaska and the United States. The island refuges provide protection for important colonies of nesting birds, usually water birds. Special colonies of birds such as gulls, kittiwakes, terns, murres, puffins, auklets, murrelets, herons, cormorants and pelicans, are protected. Most of these refuges are preserved intact, including vegetation and other natural conditions. In addition, there are several fenced refuges which preserve herds of bison and a great system of waterfowl refuges. Some of the waterfowl refuges are areas of natural marsh, and others are marshes which have been re-established by the flooding of unsuccessful drainage projects, or new marshes where cheap land and water were available in combination. These refuges have been managed so that they might be restored rapidly to the best possible condition for the use of waterfowl; they have been responsible for the re-establishment of many species of both game and nongame birds in territories from which they had long been absent.

A third category of wildlife reserves consists of primitive areas upon the national forests which have been set aside and in which no development is to take place because they are to be preserved as nearly as possible in their natural condition. Usually these are areas of especial beauty and interest on the summits of some of the greater mountain ranges. There were in 1945 in the United States a total of 75 such areas aggregating 13,896,507 ac.

In addition to the federal system of wildlife reserves in the United States, there are a growing number of state parks and reserves which add to the number of those available for public use and enjoyment. The state areas are usually somewhat smaller than national areas of the same character, but some are exceedingly important, both locally and nationally, as a part of the general movement to retain as much of the wild beauty and wildlife of the country as possible under changing industrial and agricultural conditions.

Canada has a system that parallels that of the United States, comprising, in 1945, 19 national parks with 7,937,920 ac. These parks usually have been set aside as outstanding scenic areas, but also serve as wildlife refuges. In addition, the Canadian government had 58 wildlife refuges in 1945, containing 819,237 ac. Most of these are small island refuges for the purpose of protecting colony-nesting seafowl, including gannets and auks as well as many of those mentioned in the preceding paragraphs on United States refuges. There are a few large ones, the most notable being those established around James bay for the protection of the great flights of geese which congregate there during the fall. In addition to the dominion refuges, the provincial governments also maintain systems of refuges and parks turned over to them by the dominion for administration and protection.

The setting aside of national reserves has been practised on a much smaller scale in Mexico, although in 1945 there were 42 national parks containing 1,357,187 ac. set aside in that country. The system of protection of the Mexican parks, however, has not advanced as far as in the United States and Canada, and logging and other exploitation of the park areas still continues.

In Great Britain the authorities range from single individuals or groups, local societies and town and county councils (or the like), to the National Trust, a society founded in 1895 and incorporated in 1907 "for the preservation of Places of Historic Interest or Natural Beauty." This body administers a number of separate stations, many of historic interest and others of scenic beauty (mountains, downs, coast lines). A definite minority, including Wicken fen (Cambs.), Blakeney point and Scolt head (Norfolk), Hawksmoor (Staffs.) and other areas are nature reserves, and are administered and used for study and research. In an old and settled country like England large areas of virgin territory, comparable to the Yellowstone park, are out of the question, but smaller parcels are continually being acquired.

In recent years attention has been paid to the protection of birds' breeding grounds, especially sea-birds, as in the case of the Farne Islands, Blakeney point and Scolt head. Thus Blakeney point, presented to the National Trust in 1912 for its representative shingle, dune and salt-marsh vegetations, possesses perhaps the finest ternery in the British Isles, where five species regularly breed, including large numbers of Sandwich terns.

In other parts of the British empire great efforts have been made for the provision of worthy reservations. This applies to Canada, South Africa, with its Paul Kruger reserve (a sanctuary for big game), Australia and New Zealand, with innumerable scenic reserves, and the Otari "open-air native plant museum"—a remnant of virgin forest near Wellington where a living collection of plants indigenous to New Zealand is established.

Other countries, especially Poland, Germany, the Netherlands, the Scandinavian group and Japan, are outstanding for their sanctuaries. *See* also BIRD SANCTUARIES; FISH AND WILDLIFE SERVICE; GAME MANAGEMENT; GAME RESERVES; NATIONAL PARK SYSTEM; WILDLIFE CONSERVATION AND MANAGEMENT.

(I. N. G.)

WILDMAN, SIR JOHN (*c.* 1621–1693), English agitator, was educated at the University of Cambridge, and during the Civil War served for a short time under Sir Thomas Fairfax. He became prominent, however, not as a soldier but as an agitator, being in 1647 one of the leaders of that section of the army which objected to all compromise with the king. In a pamphlet, *Putney Projects,* he attacked Cromwell; he was responsible for *The Case of the Army Stated,* and he put the views of his associates before the council of the army at a meeting in Putney church in Oct. 1647. In Jan. 1648 he and John Lilburne were imprisoned, but he was released in the following August. He was for a time associated with a party known as the levellers and later became an officer in the army. He was a large buyer of the land forfeited by the royalists, and in 1654 he was sent to the house of commons as member for Scarborough. In the following year he was arrested for conspiring against Cromwell, and after his release four months later resumed his career of plotting, intriguing alike with royalists and republicans for the overthrow of the existing régime. In 1659 he helped to seize Windsor castle for the Long Parliament, and in Nov. 1661 he was again a prisoner on some suspicion of participating in republican plots. For six years he was a captive, only regaining his freedom after the fall of Clarendon in Oct. 1667.

In or before 1681 Wildman became prominent among those who were discontented with the rule of Charles II, being especially intimate with Algernon Sydney. He was undoubtedly concerned in the Rye House plot, and under James II he was active in the interests of the duke of Monmouth, but owing to some disagreements, or perhaps to his own cowardice, he took no part in the rising of 1685. He found it advisable, however, to escape to Holland, and returned to England with the army of William of Orange in 1688. In 1689 he was a member of the convention parliament.

Wildman was postmaster general from April 1689 to Feb. 1691, when some unpleasant rumours about his conduct brought about his dismissal from office. Nevertheless, he was knighted by William III in 1692. He died in the following year on June 2. Sir John was the author of many pamphlets dealing with the political issues of his day. He left an only son, John, who died childless in 1710.

WILEY, HARVEY WASHINGTON (1844–1930), U.S. chemist, was born in Kent, Indiana, Oct. 18, 1844. He was educated at Hanover (Ind.) college, Indiana Medical college and Harvard. He served as state chemist of Indiana and professor of chemistry at Purdue university (1874–83), and in 1883 became chief of the bureau of chemistry in the U.S. department of agriculture. This position he held with signal success until his resignation in 1912. He was the chief force behind the passage of the Pure Food and Drugs act in 1906, and devoted his energies to its enforcement. Pressure was exercised in 1911 to obtain his dismissal on the technical charge that an expert in his department had received recompense exceeding the legal rate. President Taft wholly exonerated him. Dr. Wiley resigned in 1912, thereafter devoting himself largely to the cause of pure food by lecturing and writing. From 1899 on he was professor of agricultural chemistry at George Washington university.

He died June 30, 1930.

Besides some 60 government pamphlets and several hundred scientific papers he wrote: *The Sugar Industry of the United States* (1885); *Principles and Practice of Agricultural Analysis* (3 vol. 1894–97; rev. ed., 1906–14); *Foods and Their Adulterations* (1907, 3rd ed., 1917); *The Lure of the Land* (1915); *Not by Bread Alone; The Principles of Human Nutrition* (1915); *1001 Tests of Foods, Beverages and Toilet Accessories* (1916); and *Beverages and Their Adulteration* (1919). He also edited a series of *Health Readers for Schools* in 1919.

WILFRID (*c.* 634–709), English archbishop, born in Northumbria. He attracted the notice of the queen, Eanfled, who placed him in care of an old noble, Cudda, then a monk at Lindisfarne. Later on Eanfled enabled him to visit Rome in the company of Benedict Biscop. On leaving Rome he spent three years with Annemund, archbishop of Lyons. After the murder of his patron he returned to England, where he received a monastery at Ripon, and then took priest's orders.

He was probably already regarded as the leading exponent of the Roman discipline in England when his speech at the council of Whitby determined the overthrow of the Celtic party (664). About a year later he was consecrated to the see of York, not, however, in England, where perhaps he could not find the fitting number of orthodox prelates, but at Compiègne. On his return journey he narrowly escaped the pagan wreckers of Sussex, and reached England to find Ceadda (St. Chad) installed in his see.

The rest of his life is largely a record of wandering and misfortune. For three years (665–668) he ruled his monastery at Ripon in peace, though acting as bishop in Mercia and Kent during vacancies in sees there. On Archbishop Theodore's arrival (668) he was restored to his see, and spent in it nine years of ceaseless activity, especially in building churches, only to be driven out through the anger of King Ecgfrith's queen (677).

After Ecgfrith's death (May 20, 685) Wilfrid was restored to York (much circumscribed), and Ripon (686–687). He was once more driven out in 691–692, and spent seven years in Mercia. A great council of the English Church held in Northumbria excommunicated him in 702. He again appealed to Rome in person, and obtained another decision in his favour (703–704). He died at Oundle in Northamptonshire as he was going on a visit to Ceolred, king of Mercia (709). He was buried at Ripon.

Wilfrid's is a memorable name in English history, not only because of the large part he played in supplanting the Celtic discipline and in establishing a precedent of appeal to papal authority, but also by reason of his services to architecture and learning. At York he renewed Paulinus's old church, roofing it with lead and furnishing it with glass windows; at Ripon he built an entirely new basilica with columns and porches; at Hexham in honour of St. Andrew he reared a still nobler church, over which Eddius grows eloquent. In the early days of his bishopric he used to travel about his diocese attended by a little troop of skilled masons. He seems to have also reformed the method of conducting the divine services by the aid of his skilled chanters, Aedde and Aeona, and to have established or renewed the rule of St. Benedict in the monasteries. On each visit to Rome it was his delight to collect relics for his native land; and to his favourite basilica at Ripon he gave a bookcase wrought in gold and precious stones, besides a splendid copy of the Gospels.

Wilfrid's life was written shortly after his death by Eddius at the request of Acca, his successor at Hexham, and Tatbert, abbot of Ripon—both intimate friends of the great bishop. Other lives were written by Frithegode in the 10th, by Folcard in the 11th, and by Eadmer early in the 12th century. *See* also Bede's *Hist. Eccl.* v. 19, iii, 25, iv, 13, etc. All the lives are printed in J. Raine's *Historians of the Church of York,* vol. i, "Rolls" series.

WILHELMINA [WILHELMINA HELENA PAULINE MARIA OF ORANGE-NASSAU] (1880–), queen of the Netherlands, was born at The Hague on Aug. 31, 1880. Her father, William III (Willem Paul Alexander Frederik Lodewijk), had by his first wife, Sophia Frederika Mathilde of Württemberg, two sons, both of whom predeceased him. Having been left a widower on June 3, 1877, he married on Jan. 7, 1879, Adelheid Emma Wilhelmina Theresia (1858–1934), second daughter of Prince George Victor of Waldeck-Pyrmont, and Wilhelmina was the only issue of that union. She succeeded to the throne on her father's death, which took place on Nov. 23, 1890, but until her 18th year, when she was "inaugurated" at Amsterdam on Sept. 6, 1898, the business of the state was carried on under the regency of the queen mother. On Feb. 7, 1901, Queen Wilhelmina married Henry Wladimir Albert Ernst, duke of Mecklenburg-Schwerin (b. 1876, d. 1934). The queen's only child, Princess Juliana (b. April 30, 1909), married on Jan. 7, 1937, Prince Bernhard zu Lippe-Biesterfeld (1911–), and gave birth to the princesses Beatrix (Jan. 31, 1938), Irene (Aug. 6, 1939) and Margriet Francisca (Jan. 19, 1943). *See* HOLLAND: *History.*

WILHELMSHAVEN, a town in the *Land* of Oldenburg and chief German naval station on the North sea; as such it played an important part in World War I, and in World War II it was very frequently and heavily bombed by British and U.S. planes. It is situated on the northwest shore of the Jade Busen. Pop. (1939) 118,193. The ground on which it stands (4 sq.mi.)

was purchased by Prussia from the grand-duke of Oldenburg in 1853, when the Prussian navy was being formed, but was returned to Oldenburg by Hitler after 1933.

The construction of the harbour and town began in 1855, and the former was opened in 1869. The harbour consists of three large basins and seven smaller ones as well as a basin for shipbuilding.

There are six dry docks. The harbour has three entries and locks are 260 metres long and 40 metres wide, with a depth of from 6½ to 10 metres at the quays. The establishment is defended by strong fortifications. The commercial harbour lies at the east end of the Ems-Jade canal.

WILKES, CHARLES (1798–1877), American naval officer and explorer, born in New York city April 3, 1798. He entered the U.S. Navy as a midshipman in 1818 and became a lieutenant in 1826. In 1830 he was placed in charge of the division of instruments and charts, and in 1838 was appointed to command an exploring and surveying expedition to the South Seas, authorized as the first of its kind by Congress in 1836. The expedition, including naturalists, botanists, mineralogists, taxidermists, a philologist, etc., left Hampton Roads Aug. 1838, stopped at various ports in South America and visited the Paumotu group of the Low Archipelago, the Samoan islands, and New South Wales. From Sydney, Wilkes sailed into the Antarctic ocean and along the Antarctic barrier from 150° to 97° E., reporting land at a number of points in the region which has subsequently been known as Wilkes Land. He visited the Fiji group and the Hawaiian islands in 1840, and in 1841 explored the west coast of the United States. The findings were timely in view of the dispute with Great Britain over the Oregon territory. He visited San Francisco bay, and the Sacramento river, and crossing the Pacific he called at the Philippine islands, Sulu archipelago, Borneo, Singapore, Polynesia and the Cape of Good Hope, reaching New York in June 1842, having sailed around the world. He served on the Coast Survey 1842–43 and in the latter year was advanced to the rank of commander. In 1844–61 he was chiefly engaged in preparing the report of the expedition. Twenty-eight volumes were planned but only 19 were published. Of these Wilkes wrote the *Narrative* (6 vols., 1844); and the volumes *Hydrography* (1851) and *Meteorology* (1851). At the outbreak of the Civil War Wilkes was assigned to the command of the "San Jacinto" to search for the Confederate commerce destroyer "Sumter." On Nov. 8, 1861, he stopped the British mail packet "Trent," and took off the Confederate commissioners to Europe, James M. Mason and John Slidell. Though he was officially thanked by Congress, his action was later disavowed by President Lincoln. Wilkes was commissioned commodore in 1862, and placed in command of a squadron sent to the West Indies to protect the U.S. commerce in that region. On July 25, 1866, he was promoted to the rank of rear-admiral on the retired list. He died at Washington Feb. 8, 1877.

In addition to many shorter articles, reports, etc., he published *Western America, including California and Oregon* (1849); *Voyage Around the World* (1849); and *Theory of the Winds* (1856). "The Diary of Wilkes in the Northwest" (E. S. Meany, ed.) appeared in the *Washington Historical Quarterly*, vol. 16–17 (1925–26).

WILKES, JOHN (1727–1797), English agitator and reformer, was born in St. John's Square, Clerkenwell. His father, Israel Wilkes, a successful malt distiller, came from a yeoman family of Leighton Buzzard. John was the second son; his elder brother, Israel, emigrated to America and became the grandfather of (Admiral) Charles Wilkes (*q.v.*).

John Wilkes was schooled at Hertford and afterwards privately by the Rev. F. Leeson, a dissenting minister of Aylesbury, under whose charge he went to Leyden university in 1744. Here he learnt little—"Jack has great variety of talk, Jack is a scholar, Jack has the manners of a gentleman," said Dr. Johnson. He became close friends with Andrew Baxter and D'Holbach (*qq.v.*).

On his return to England, he married Miss Mary Mead, an Aylesbury heiress. "In my nonage," he says, "to please an indulgent father, I married a woman half as old again as myself; of a large fortune—my own being that of a gentleman. It was a sacrifice to Plutus, not to Venus. I stumbled at the threshold of the temple of Hymen:

"The god of love was not a bidden guest,
Nor present at his own mysterious feast."

Their marriage, uneventful for a time, and even successful while they lived at Aylesbury (they had one child, Mary), was broken up soon after Wilkes entered into politics, and they separated by mutual consent. Mrs. Wilkes had hardly any affection for either her husband or daughter, and she was scandalized by Wilkes' loose life and companions. He had been introduced by Thomas Potter, a finished profligate, to the society of Sir Francis Dashwood, chief of the "Medmenham Monks," of whom he became a member. This was a secret fraternity, which met occasionally in the summer in the ruins of St. Mary's abbey at Medmenham, for obscene orgies, in which it parodied Roman Catholic ritual. Dashwood, Lord Sandwich, Paul Whitehead, Potter, Wilkes and perhaps Charles Churchill the poet were among the ringleaders; the "order," whose reputation for indecency probably exceeded even the reality, was broken up by a practical joke of Wilkes', who unexpectedly released from a box a baboon disguised as a devil during a prayer addressed to Satan by Lord Orford, who nearly went out of his mind in the belief that his supplication was answered.

Partly under the encouragement of these friends, Wilkes had entered politics as a follower of Richard, Lord Temple (*q.v.*). He unsuccessfully fought Berwick in 1754, having bribed a captain to land a shipload of opposition voters from London in Norway instead of Berwick, but in 1757 by a complicated arrangement with Potter and Pitt, which was made to cost him the absurd sum of £7,000, he was elected M.P. for Aylesbury. In 1762, with the aid of Churchill and the countenance of Temple, he began to publish the *North Briton*. The wit and virulence of its attacks on Lord Bute, the Tory favourite of the King, silenced the *Auditor* and *Briton*, the ministerial papers, and were chiefly responsible for the wave of indignation which carried Bute from office on Mar. 8, 1763. Wilkes then held his hand, but when Pitt and Temple read an advance copy of the King's speech sent to them by George Grenville, the new Premier, they decided that Grenville's ministry was no more than a camouflage of the same autocratic power, and encouraged Wilkes to publish (April 23) the famous "No. 45" of the *North Briton*, which was a devastating attack on the statements in the King's speech, which he described as false. Though he had carefully prefaced his attack by the remark "the King's speech has always been considered by the legislature and by the public at large as the speech of the Minister," George III. chose to consider Wilkes' article as a personal insult, and instigated immediate proceedings. A "general warrant" (one that did not name the persons to be arrested) was issued over the signatures of Lords Halifax and Egremont, secretaries of State, and 48 persons were seized by the authorities before Wilkes was arrested (April 30). He was thrown into the Tower and for a short while kept in the closest confinement. To the public delight, however, Lord Chief Justice Pratt on May 6 released Wilkes on the ground that his arrest was a breach of privilege. Actions against Under-Secretary Woods (who was fined £1,000), against Halifax (who by repeated evasions adjourned the case till 1769 when he was fined £4,000), and against minor agents, established the illegality of general warrants.

A second attack was now more carefully prepared by Wilkes' one-time friend Sandwich, now a member of the Government. By bribery and theft P. Carteret Webb, an under-secretary, secured from Wilkes' private press the proofsheets of an obscene parody written by himself and Potter years before on Pope's *Essay on Man*, called the *Essay on Woman*. Wilkes had commenced, but never completed printing twelve copies of this, probably for the Medmenham monks. This disgusting work, together with notes purporting to be by the Bishop of Gloucester, was read aloud with relish on Nov. 15 by Sandwich to the Lords, who voted it a libel and a breach of privilege. The Commons at the same time declared "No. 45" a seditious libel. To face the forthcoming trial before Lord Mansfield after these pronouncements would have been extremely hazardous. Wilkes, who had been gravely wounded in a duel with Samuel Martin, M.P., one of the vehicles of government bribery, withdrew to Paris, and

sent to the Speaker (Jan. 11, 1764), when a motion for his expulsion was brought forward, a certificate of his ill-health. The Speaker declared that this certificate was not sufficiently authenticated, and though triple authentication was forthwith provided, Wilkes was expelled (Jan. 19). In these circumstances, Wilkes, who believed that life sentence would be pronounced against him, decided not to stand his trial and was consequently outlawed (Nov. 1). He spent the next four years on the Continent, chiefly in "amorous delights." The fall of Grenville in 1765 and the accession of the Whigs to power under Rockingham and then Grafton led him to believe that a pardon would be granted to him and his services rewarded by some honourable place. He only slowly realized that none of the Whigs were prepared to risk the King's displeasure for his sake and that the various offers privately made to him were only intended to keep him amused. When he discovered the truth he was extremely bitter against Chatham and Grafton, those chiefly responsible, and pilloried them in a *Letter to the Duke of Grafton,* one of his ablest performances.

In 1768 he decided to risk all by a bold stroke, crossed to London, and announced his candidature, first for London (where he was not elected) and then for Middlesex, where he was chosen M.P. by a heavy majority (Mar. 28). He then surrendered to his outlawry and was sentenced to the comparatively light penalty of £500 fine and a year's imprisonment, each, for the *Essay on Woman* and "No. 45." His popularity was immense, and crowds regularly assembled outside the prison gates (St. George's Fields). On May 10 a riotous crowd was dispersed with bloodshed and loss of life by Scottish soldiery, who were congratulated by the Government. Wilkes published the government instructions which had led to this, with some bitter comments, in the *St. James' Chronicle;* he also presented to the Commons a petition raising the whole question of the illegality of the proceedings against him. (Subsequent investigations show that in the case of the *Essay* these included actual forgery.) He had ignored private promises that he would be left undisturbed if he remained quiet; he reaped the reward of his temerity (Feb. 4, 1769) by being expelled again from the House of Commons, this time with hardly a shred of excuse. He now, by his resentment of a patronizing defence by George Grenville, lost his last wealthy patron (Temple) and was nearly £20,000 in debt. But the arbitrary proceedings of the ministry (instigated by the King) brought him power and, through the subscriptions of wealthy admirers to a "Society of the Supporters of the Bill of Rights," even solvency. He was immediately (Feb. 16) re-elected by the Middlesex electors and once more expelled. Again he was elected (Mar. 16) and again expelled. The Court then secured a bravo named Colonel H. L. Luttrell to stand against Wilkes at the next election (April 13); the figures were Wilkes 1,143, Luttrell 296; but the enraged Commons declared that Luttrell ought to have been elected and actually seated him for Middlesex.

These audacious proceedings had stirred up tremendous excitement in which for the first time for years the artisans and lower middle class felt acutely their disfranchisement. "One of your supporters has turned his coat," Wilkes was told. "Impossible, not one has a coat to turn," he answered. They avenged themselves by rioting and strikes, by scrawling "45" on every door and forcing the court followers to cheer for "Wilkes and Liberty." More effectively, Serjeant Glynn, his colleague for Middlesex, and after his release Wilkes himself, organized, by the medium of public meetings, support from the electors as far distant as Truro, for a "Wilkite" programme which till about 1780 was the standard of a political party. Its chief points were the radical reform of Parliament (to include enfranchisement of the "lower orders" and the suppression of rotten boroughs) and the protection of individual liberty against Ministerial or Parliamentary attack. Wilkes also entered into relations, not fully explored yet, with the American malcontents and seems to have acted as an inspirer of their subsequent action and as English representative of the Boston "Sons of Liberty." His greatest successes, however, were won in the City of London where he triumphantly fought his way through to the Lord Mayoralty in 1774. As Sheriff and Alderman he had welded the powerful City interests with a single block of opposition to the Court and Ministry, achieving his most remarkable victory in the Wheble case, when the City's judicial powers were successfully used to prevent the arrest of printers who reported the House of Commons debates. After the election of 1774, when the Court no longer found it wise to prevent him taking his seat in Parliament, he had a "tail" of about a dozen M.P.'s. He presented (1776) a bill for the radical reform of Parliament. During the American Revolution Wilkes championed the colonial cause. He delivered, in the House of Commons, ten set speeches in which he advocated the immediate cessation of hostilities with America. Lord Shelburne, in concert with John Horne (*see* TOOKE, JOHN HORNE) was able to shake his influence for a short while in the City, but Wilkes more than recovered his position, and in 1779 he was elected Chamberlain of the City, a lucrative office which he filled with absolute scrupulousness till his death. But the violence of his popularity was necessarily waning when in 1780 the Gordon riots broke out (*see* GORDON, LORD GEORGE). Wilkes, despite his turbulence, had never encouraged mob violence, and religious persecution he had always fought. Though all the "lower orders" and even such old allies as Alderman Frederick Bull were deeply implicated in the burning and looting, Wilkes hesitated only a day or two before he practically took matters out of the hands of the complaisant city authorities, secured a draft of troops, and took a prominent part in crushing the disturbance. His own supporters he had to jail—in one case committing his printer Moore for an attack on the house of the judge, Mansfield, who had condemned him.

From this moment, honourable though his motives were, his political career was made impossible. He could no longer drive the rich London merchants and the lower orders in harness together. He had broken violently with the latter and with his own principles (for six years before he had replied to Horne, not necessarily insincerely, that he really believed the voice of the people, when he could ascertain it, to be "the voice of God") and the former had therefore less need for his services. Moreover, they and all well-to-do reformers were attracted by the more respectable reform movement started in the previous year by the Yorkshire M.P.'s. This, based on Rockingham's "Oeconomical reform," substituted triennial for annual Parliaments and the addition of 100 M.P.'s to London and the counties for universal suffrage and redistribution of seats; it was rapidly adopted by a dozen or more counties at general meetings of electors.

Wilkes' energies declined as did his popularity. After he had secured (May 3, 1782) the expunging from the Commons of all record of his expulsions he took little part in politics. In 1790 he did not seek re-election, but retired into private life, dying in 1797. Characteristically enough, he was found to be insolvent, but quite unaware of the fact. An obelisk in Ludgate Circus commemorates him.

Wilkes was above the middle height, exceedingly ugly, with a startling squint that is given all its value in Hogarth's celebrated cartoon, but with a charm of manner and wit which few could resist. Some of his jests have passed into history—as for example his rejoinder to an elector who answered his canvass by saying he would sooner vote for the Devil than Wilkes: "And if your friend is not standing?" To an offer of snuff he answered, "No thank you, I have no *small* vices." To Sandwich, who told him he would either die on the gallows or of venereal disease, "That depends, my lord, on whether I embrace your principles or your mistress." His character, largely through his own fault, has been subject to exaggerated attacks which may be generally traced to Lord Brougham (*see* BROUGHAM AND VAUX, LORD) or to Horace Walpole, whom he was unwise enough to offend. His conversation was indecent, he was entirely incapable of continence in regard to women, though temperate in other ways, and like almost every other public man of his century, he was extravagant. His cynical tongue ruined his reputation with the Victorians: he never did a good thing without giving a bad reason. But dishonesty, cruelty, cowardice or hypocrisy were unknown to him; public money passed untouched through his hands when he was "in want of a guinea"; his political principles were honestly and to all appearances firmly held up till the deadlock of the Gordon riots, de-

scribed above. He secured the great reforms of the abolition of general warrants, the freeing of the press and freedom of choice for the electors; his non-success in securing Parliamentary reform or justice for America can hardly be counted against him.

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WILKES-BARRE (pronounced *Wilkes-Barré*), a city of Pennsylvania, U.S.A.; county seat of Luzerne county, on federal highway 11 and the Susquehanna river, 94 mi. N.N.W. of Philadelphia and 111 mi. N.W. of New York city. It is served by the Central of New Jersey, the Delaware and Hudson, the Lehigh Valley, the Pennsylvania and two electric railways, and by several motorbus and truck lines. Pop. (1920) 73,833 (20% foreign-born white); 1940 federal census 86,236. Within reach of the city by one carfare is a population of 175,000. The city lies in the Wyoming valley and is in the heart of the anthracite region. It is a manufacturing and commercial centre of importance. The assessed valuation for 1940 was $77,804,595. Wilkes-Barre is a compact, substantially built city, with 500 ac. in public parks, large business blocks, wide shaded residential streets, modern school buildings and a large athletic field. The output of Luzerne county in 1940 was 16,982,497 tons (34% of all the anthracite mined) and its value was more than three times as great as the value of all the gold, tin, lead and aluminium mined in the U.S. that year. The city has a large trade in coal mine and railroad supplies. Its manufactures (which include iron and steel, silk goods and other textiles, copper wire, locomotives, electrical goods and many kinds of machinery) were valued in 1938 at $36,591,100. Bank debits in 1940 were $287,141,000.

Wilkes-Barre was settled in 1769 by colonists from New England under the leadership of Maj. John Durkee, on a grant from the Susquehanna Land Company of Connecticut. Maj. Durkee gave the town its name, in honour of John Wilkes and Col. Isaac Barré, stout defenders of the American Colonies in parliament. Ft. Wilkes-Barre was built in 1776 as a defence against Indian invasion. On July 4, 1778, the day after the Battle of Wyoming, Wilkes-Barre was burned by the Indians and British Rangers; and again in July 1784, during the "Second Pennamite-Yankee War," 23 of its 26 buildings were burned. The conflicting claims of Pennsylvania and Connecticut were finally adjusted (*see* WYOMING VALLEY) and the titles of the settlers were confirmed by Pennsylvania in a series of statutes passed in 1799, 1802 and 1807. Wilkes-Barre was incorporated as a borough in 1818 and was chartered as a city in 1871.

WILKIE, SIR DAVID (1785–1841) knighted 1836, Scottish painter, was born on Nov. 18, 1785, the son of the parish minister of Cults, Fifeshire. In 1799 he began to study painting at the Trustees' Academy, Edinburgh. He was much influenced at that time by the work of Carse and David Allan, who painted scenes from humble life, and he haunted fairs and markets with his sketch-book to collect material for similar subjects. In 1805 he went to London, where he entered the Royal Academy schools. His "Village Politicians" and "Blind Fiddler" (commissioned by Sir George Beaumont), were exhibited at the Royal Academy in 1806 and 1807. In 1809 Wilkie was elected A.R.A. and two years later R.A.

In 1830 he succeeded Lawrence as painter in ordinary to the king and from this time onward received many commissions to paint the portraits of royal and other distinguished personages. These were not flattering to their subjects, however, and the female portraits in particular rarely gave satisfaction. His great popularity was due to his genre painting the technique of which he had acquired by a careful study of Teniers, Ostade, and the Dutch masters. Most of his pictures in this category belong to his earlier period, and are distinguished by detailed handling, precision of touch and somewhat subdued colouring, while the pathos of their homely subjects makes a purely sentimental appeal. He died and was buried at sea, off Gibraltar, on June 1, 1841.

His genre pictures include: "Card-Players," "Rent Day" (1807), "The Penny Wedding," the "Village Festival" and "Blind Man's Buff" (National Gallery), "Distraining for Rent," the "Chelsea Pensioners," the "Highland Whisky Still," the "Rabbit on the Wall" and "Reading a Will" (New Pinakothek, Munich). His best portraits are those of "Sir Walter Scott and his family" and "Sir Robert Liston" (cabinet size) and the gallery portrait of Lord Kellie (town hall, Cupar).

A *Life of Sir David Wilkie,* by Allan Cunningham, containing the painter's journals and his "Critical Remarks on Works of Art," was published in 1843.

WILKINS, SIR GEORGE HUBERT (1888–), British explorer, was born at Mt. Bryan East, South Australia, on Oct. 31, 1888. He studied engineering at the Adelaide School of Mines, learned flying in 1910 and became an aeronautical photographer. As photographer he joined the Arctic expedition, 1913–18, of Vilhjalmar Stefansson (*q.v.*), and though he lost his equipment with the sinking of the "Karluk," he stayed on until 1917 and became second in command. In 1917 he enlisted in the Australian Flying Corps, was promoted to captain and decorated for bravery. Later he commanded the photographic section of the Australian forces in France. He was second in command of the British Imperial Antarctic Expedition, 1920–21, and naturalist on the last Antarctic expedition, 1921–22, of Sir Ernest Shackleton (*q.v.*). He led a scientific expedition of the British Museum in tropical Australia, 1923–25, which he records in *Undiscovered Australia* (1928). In 1926 he made his first trip to Point Barrow, Alaska, intending to fly across the Arctic regions, but he could not lift his heavy three-motored plane off the ground. In 1927 he was again at Point Barrow and made a flight 520 m. northwest across a portion of the Arctic ocean previously unexplored, landing and taking off from the ocean ice twice, and making soundings which proved the ocean in this region to be about 3 m. deep. In 1928 Wilkins was back at Point Barrow for a third time and on April 21, with Lieutenant Carl Ben Eielson as pilot, he flew 2,100 m. to Spitsbergen in 20½ hours, covering a route just north of the Canadian Arctic Archipelago and Greenland. With good visibility the flight greatly reduced the unexplored area, but no land was found. The experience is told in *Flying the Arctic* (1928). For this feat, an example of remarkable navigation because of difficult magnetic variations and the constantly changing angles at which longitudinal lines were crossed, Wilkins was knighted. In Dec. 1928 he and Eielson flew from Deception island 600 m. south across Graham Land, discovering several new islands, and that Graham Land consisted of two large islands, the southernmost separated from the Antarctic continent by an ice-filled strait 40 to 50 m. wide. In 1931 he led the Nautilus Arctic submarine expedition, recorded in *Under the North Pole* (1931), and was manager of the Ellsworth Antarctic expeditions of 1933–36.

WILKINS, MARY ELEANOR: *see* FREEMAN, MARY ELEANOR WILKINS.

WILKINSBURG, a borough of Allegheny county, Pennsylvania, U.S.A., on the Pennsylvania railroad, adjoining Pittsburgh on the east. Pop. (1920) 24,403 (89% native white); 1940 federal census 29,853. It is a residential suburb, with little manufacturing. Wilkinsburg was settled in 1798; was first called McNairville and later Rippeyville; and about 1840 was renamed in honour of William Wilkins, then a representative in Congress. It was incorporated as a borough in 1887.

WILKINSON, JAMES (1757–1825), American soldier and adventurer, was born in Calvert county (Md.), in 1757. At the outbreak of the War of Independence he entered the American Army. He served with General Benedict Arnold in the Quebec campaign and was later under General Horatio Gates from May 1777 to March 1778 as adjutant general.

In 1784 Wilkinson settled near the Falls of the Ohio, Louisville, where he became a merchant, farmer and man of influence. He took an active part in the movement for separate statehood for Kentucky, and in 1787 took an oath of allegiance to Spain and began to intrigue with his fellow Kentuckians to detach the western settlements from the Union and bring them under the influence of the Louisiana authorities. His commercial connections at New Orleans enabled him to hold out the lure of a ready market there for Kentucky products. He neutralized the intrigues of British agents then working in Kentucky. For these various services he received until 1800 a substantial pension from the Spanish authorities, being officially known as "Number Thir-

teen." At the same time he worked actively against the Spanish authorities, especially through Philip Nolan. Wilkinson's ventures were not so lucrative as he hoped for, and in Oct. 1791 he was given a lieut. colonel's commission in the regular army, possibly to keep him out of mischief. In 1803 Wilkinson was one of the commissioners to receive Louisiana from France, and in 1805 became governor of that portion of the Purchase above the 33rd parallel, with headquarters at St. Louis. In his double capacity as governor of the territory and commanding officer of the army, reasonably certain of his hold on Jefferson, and favourably situated upon the frontier remote from the centre of government, he attempted to realize his ambition to conquer the Mexican provinces of Spain. For this purpose in 1805 he entered into an agreement with Aaron Burr, and in 1806 sent Z. M. Pike to explore the most favourable route for the conquest of the south-west. Before his agent returned, however, he had betrayed his colleague's plans to Jefferson, formed the Neutral Ground Agreement with the Spanish commander of the Texas frontier, placed New Orleans under martial law, and apprehended Burr and some of his alleged accomplices. In the ensuing trial at Richmond, the prisoners were released for lack of sufficient evidence, and Wilkinson himself emerged with a much damaged reputation. He was then subjected to a series of courts-martial and congressional investigations, but succeeded so well in hiding traces of his duplicity that in 1812 he resumed his military command at New Orleans, and in 1813 was promoted to the rank of major general and took possession of Mobile. Later in this year, by making a miserable fiasco of the campaign against Montreal, he finally brought his military career to a dishonourable end. He died at Mexico City on Dec. 28, 1825.

See Wilkinson's *Memoirs of My Own Time* (1816), untrustworthy and to be used with caution; W. R. Shepherd, "Wilkinson and the Beginning of the Spanish Conspiracy" in *American Historical Review*, vol. ix. (1904); Bemis, *Pinckney's Treaty* (1926). (I. J. C.)

WILKINSON, JOHN (1728–1808), "the great Staffordshire iron-master," was born at Clifton, Cumberland, where his father was overlooker in an iron furnace. A box-iron, patented by his father, but said to have been invented by the son, which helped laundresses to gratify the frilled taste of the dandies of the day, was the beginning of their fortunes. This they made at Blackbarrow, near Furness. When he was about twenty, John moved to Staffordshire, and built, at Bilston, the first furnace there, and, after many experiments, succeeded in utilizing coal instead of wood-charcoal in the puddling and smelting of iron. The father, who now had works at Bersham, near Chester, was again joined by his son, who constructed a new boring machine, of an accuracy heretofore unequalled. James Watt found that the work of this machine exactly filled his requirements for his "fire-engine" for cylinders bored with greater precision. Wilkinson, who by this time owned the Bersham works, now started the manufacture of wrought iron on a large scale at Broseley, and used the first steam-engine made by Boulton and Watt to blow the bellows there. His neighbours in the business, who were contemplating installing Newcomen engines, waited to see how the Wilkinson steam-engine would work. Great care was taken in its manufacture, and Watt himself set it up early in 1776. Its success made the reputation of Boulton and Watt in the Midland counties. Wilkinson now found he had the power alike for the nicest and for the most stupendous operations. The steam cylinder suggested to him the plan of producing blast now in use. He was near coal; he surrounded himself with capable men, whom he fully trusted; he made a good article, and soon obtained large orders. In 1786 he was making 32-pounders, howitzers, swivels, mortars and shells for the government. The difficulty of getting barges to carry his war material down the Severn led him, in 1787, to construct the first iron barge—creating a wonderful sensation among owners and builders. Wilkinson taught the French the art of boring cannon from the solid, and cast all the tubes, cylinders and iron work required for the Paris water-works, the most formidable undertaking of the day. He also erected, in connection with these works, the first steam-engine in France.

Wilkinson also designed and cast the first iron bridge, which connected Broseley and Madeley, across the Severn. He died on July 14, 1808.

WILKINSON (WYLKYNSON), ROBERT, English composer of church music of the 15th and early 16th centuries. Great interest attaches to the four works by him found in an early 16th century ms. in Eton College library. These are: two Salve Reginas for 9 and 5 voices respectively; an imperfect *O Virgo prudentissima,* and a marvellous 13-part canon, which is a setting of the Apostle's Creed preceded by the words *Jesu autem transiens,* which serve as a title. Each of the 13 parts is assigned to an apostle (by name) and the key to the canon is supplied by a Latin note. This impersonation of individual parts would seem to have been a favourite device with him, for in the 9-part *Salve* the voices represent the various angelic hierarchies.

See Grove, *Dictionary of Music and Musicians,* ed. iii.

WILL, in psychology, is sometimes used as synonymous with conation (*q.v.*), but more usually in the restricted sense of deliberate decision, as contrasted with mere impulse (*q.v.*) or desire. In an act of will there is a deliberate choice of one of several alternatives, and frequently a conscious reference to the interests of the subject's self as a whole. People sometimes speak as though the will were a kind of independent entity or faculty which makes the decisions, etc. But that is only a loose way of talking. As Spinoza and Locke pointed out long ago, there is no will apart from particular acts or processes of willing; and it is not the will that wills but the whole self that does it. Similarly with the related hypostasis of "will-power" or "strength of will." There is no strong "will," but there are strong-willed characters, that is, people who can pursue distant ends (good or bad) with great perseverance; weak-willed people, on the other hand, are easily influenced and carried away by every instinct or impulse or desire that prompts them from time to time, and cannot subordinate them to the pursuit of remote ends. For the problem of the freedom of the will *see* FREE-WILL. *See* also PSYCHOLOGY, and the bibliography given there.

WILL or **TESTAMENT,** the legal documentary instrument by which a person regulates the rights of others over his property or family after his death. In strictness "will" is a general term whilst "testament" applies only to dispositions of personalty; but this distinction is seldom observed. The legal power of disposition of one's property by will is more nearly absolute in England than in any other country. In all systems of law derived from Roman law the power is limited so as to preserve the rights of wives and children to fair shares of a deceased father's estate, and it is not even now quite absolute even in England. This is due partly to custom by which in England property among the wealthier classes is usually settled on the marriage of its owner and all that is reserved to him or her is a power of appointing by will the shares in which the issue of the marriage shall take. But even unsettled property was never absolutely subject to the owner's will. Till the Administration of Estates Act 1925 an owner of an estate in fee-tail had no testamentary power over it. Another full power of testamentary disposition will probably be limited very shortly. At this moment (1929) a bill is before parliament proposing to give the courts power to modify a will which deals unfairly with the testator's family. Legislation to that effect has been passed in most of the British colonies.

The custom which ultimately developed into the will is recognized in many primitive systems. It is closely connected with ancestor worship and the continuance, for that purpose, of the family. When a citizen was without descendants ancient law allowed him to continue his family by adopting another person's child as his own. Later, as ancestor worship became more or less obsolete, the practice grew up of allowing an owner of property to nominate an heir if he had no descendants. There most legal systems stopped. The Roman lawyers developed the idea until it became the modern power of testament, which has become in England as regards the owner's own property, the power of free disposition by will without regard to the claims of the disposer's wife and children when he has any.

The oldest form of will in Roman law was the patrician will. It simply amounted to the nomination by a sonless patrician of a

haeres whose duty it would be on the death of his nominator to carry on the family rites. The ceremony was performed before the *comitia calata* or assembly of the *agnati* (male relatives) of the nominator, who would be entitled to succeed to his property if he died without an heir and whose consent to the nomination was in consequence at first necessary. This form of will was possible only where the nominator as a member of a *gens* was also a member of the *comitia calata*. Plebeians had no *gens;* and when they wished to share the patrician privilege of nominating the successor to their family and property they had to do so by a sale of the family to the nominees. At first this sale seems to have been an out and out conveyance *inter vivos* of the testator's property, but gradually it became really the appointment of a trustee to carry out the testamentary dispositions of the nominator. It is from this, the plebeian or mancipatory will, as modified by the praetors and the emperors, that the modern will is descended.

In English Law.—Whether among the customs of the Teutonic tribes or the Anglo-Saxons, there was anything akin to our law of testamentary disposition of property is very doubtful. Tacitus says definitely that there was not. Maitland says that there was, and that it took the form of disposing of the use of property. There appears undoubtedly to have been a proceeding much on the same lines as the patrician will by which a man without lineal descendants might nominate a male child to continue his family; but this is rather adoption than testation, and adoption was a very wide-spread custom in ancient times.

There are reasons to suppose that that proceeding was the only process approaching an act of testation which the Anglo-Saxons brought to England. But we must remember that England had been a Roman province subject to Roman law for centuries before the Anglo-Saxons arrived. It is, therefore, quite possible that after their arrival the Roman law of wills continued to be observed as a special custom in many highly Romanized districts. That, however, there was any general law of wills in a country which was still in the main a congeries of semi-barbarous tribes each with its own primitive customs is frankly incredible. The Norman Conquest altered all that and rapidly turned the Anglo-Saxon tribes into the English nation. The general law of wills dates from the Plantagenets.

After the Norman Conquest there were two great forces which shaped English law. The first was the barons; the second the priests. The first stood for barbaric custom; the second for Roman law. The first fiercely insisted that barbaric custom should control the ownership of land, which belonged chiefly to them. The second contrived to get Roman law applied to goods and chattels which belonged chiefly to their friends, the farmers and townsmen. Hence arose the artificial distinction between real and personal property. The history of later English law is simply a narrative of the struggles between the law of realty and the law of personalty which seems now to have ended in the definite victory of the law of personalty. Since 1925 the whole feudal conception of land owning may be said to have disappeared, as many of its incidents had done generations ago.

So far as wills are concerned the difference between the law of realty and the law of personalty was this: realty could not be disposed of (technically *devised*) by the will of its owner, while the owner of personalty could dispose of (technically *bequeath*) it subject to limitations somewhat similar to the limitations on the Roman power of testation. Thus, if he left behind him a widow and children the testator could dispose freely only of a third part of it. The common law estates in land which were not devisable were *fees simple, fees conditional* (after the Statute *de Donis Conditionalibus,* 1225, turned into *fees tail*) and *life estates.* Later, other interests in land were recognized by the law such as leases for years; but these were not treated as parts of the common law ownership of land but merely hirings of it and as such personalty and bequeathable by will.

The chancellor who was a priest could not make these common law estates devisable but he invented a system under which the beneficial interests in them could be freely disposed of by the owner's will. All the owner had to do was to convey by livery of seisin (or in the case of fees tail by fine or recovery) the common law estate to a friend to hold in trust for (or as the original phrase was *to the use of*) the owner's will. When this was done then on the death of the owner the trustee (or *feofee to uses* as he was called) was compelled by the chancellor to allow the persons for whom the deceased owner directed the use or benefits of the land to go to receive the rents and profits.

This state of the law continued till Henry VIII. in 1535 forced through parliament the Statute of Uses, so called because it abolished uses. At that time England was as Shakespeare described it, a "many slotted land." In other words, it was the age of small landowners, which intervened between the fall of the ancient landowning aristocracy through the Wars of the Roses and the rise of the modern landowning aristocracy through the confiscation of the lands of the priests and the commons of the people. These small landowners resented furiously the deprivation of their right to provide for their younger children out of the only property they possessed and accordingly Henry found it advisable to have another act passed restoring this privilege. The Statute of Wills 1540 allowed owners in fee-simple holding under tenure of common socage to devise all, and those holding under military tenure to devise two-thirds, of their land. By the Military Tenures Act 1662, military tenures were abolished and so fees simple became fully devisable.

But neither act enabled a tenant in fee-tail and a tenant *pur autre vie—i.e.,* for the life of another person than the tenant himself—to devise his estate. The Statute of Frauds made estates *pur autre vie* devisable. Fees tail did not become devisable till the year 1926 (Law of Property Act 1925).

The restrictions on the right to bequeath personalty gradually had become obsolete except in some places where they survived as local customs. The Wills Act 1837 abolished all such customs.

Form of Wills.—From very early times a will of personalty was valid if it was declared by word of mouth of the testator before witnesses (this was called a *nuncupative* will) or, though unwitnessed, if it was all written by the testator in his own hand (this was called a *holograph* will). Uses of land could be devised in the same way. So far as land was concerned, when the Statute of Wills made the legal fee-simple devisable it enacted that the will devising it must be signed by the testator in the presence of three credible witnesses and the courts held that a witness was not credible if he or his wife took any benefit under the will. Later it was enacted that such a witness was credible but the gift was bad. The Statute of Frauds also introduced certain conditions as to the forms of wills of beneficial interests in land and nuncupatory wills of personalty. Finally the Wills Act 1837 decreed that every will of property, whether such property was realty or personalty and whether it was legal or equitable, must be made in the same way, *i.e.,* it must be in writing signed by the testator in the presence of two witnesses, both being present at the same time, who in the presence of the testator are to sign the will as witnesses. Usually the witnesses also sign in the presence of each other but this is not strictly necessary and is only done for greater safety. (*See* further PROBATE.)

The acts of 1925 and 1926 have affected the law of wills to a very small extent. The most important alteration made by them has been the turning of executors into universal successors. For centuries executors as such had nothing to do with their testator's fees simple. When these were expressly left to them for the payment of the deceased's debts they took not as executors but as devisees; and when fees simple were made liable for the deceased's debts even when not so devised, on the death of the testator, they devolved on the devisee, and to make them liable for debts an action for administration was necessary. That was altered by the Land Transfer Act 1897 which vested in his executors the deceased's legal and equitable estates in freehold, and his equitable fees simple in copyholds. That act, however, did not affect the devolution of fees tail and legal fees simple in copyhold. Now by the Administration of Estates Act 1925 all a testator's estate, whether realty or personalty and whether disposed of by his will or not, including property over which he has by his will exercised a general power of appointment and fees tail which he has dis-

posed of by his will, vests in his executors for the purposes of administration. Accordingly executors may now be taken to occupy the position held by the *haeres* in later Roman law. The whole property, realty and personalty, forms a common fund for the payment of the testator's debts. If the estate is inadequate to pay the deceased's debts in full, then the creditors are to be paid according to the rules prevailing in bankruptcy, whether the estate is administered by the court or by the executors. This provision is accompanied by another which seems inconsistent, namely that the executors have still the right to retain their own debts and prefer the debts of other creditors over debts of equal standing. When the estate is solvent but insufficient to pay all debts and legacies in full, the following is the order in which the assets are liable to be appointed for the payment of debts: (1) Property undisposed of by the will, (2) property left by a residuary gift, (3) property left expressly for the payment of debts, (4) property charged with the payment of debts, (5) property liable to pay pecuniary legacies, (6) property specifically devised or bequeathed, and (7) property appointed under a general power of appointment or estates in fee tail disposed of by the will.

It may just be noted that neither the Land Transfer Act of 1897 nor the Administration of Estates Act of 1925 applies to Ireland. (J. A. St.)

Scotland.—Up to 1868 wills of immovables were not allowed in Scotland. The usual means of obtaining disposition of heritage after death was a trust disposition and settlement by deed *de praesenti,* under which the truster disponed the property to trustees according to the trusts of the settlement, reserving a life interest. Thus something very similar to a testamentary disposition was secured by means resembling those employed in England before the Wills Act of Henry VIII. The main disadvantage of the trust disposition was that it was liable to be overthrown by the heir, who could reduce *ex capite lecti* all voluntary deeds made to his prejudice within 60 days of the death of his ancestor. In 1868 the Titles to Land Consolidation Act made it competent to any owner of lands to settle the succession to the same in the event of death by testamentary or *mortis causa* deeds or writings. In 1871 reduction *ex capite lecti* was abolished. A will of immovables must be executed with the formalities of a deed and registered to give title. The disability of a woman as a witness was removed by the Titles to Land Consolidation Act. As to wills of movables, there are several important points in which they differ from corresponding wills in England, the influence of Roman law being more marked. Males may make a will at 14, females at 12. A nuncupative legacy is good to the amount of £100 Scots (£8 6s. 8d.), and a holograph testament is good without witnesses, but it must be signed by the testator, differing in this from the old English holograph. By the Conveyancing Act 1874 such a will is presumed to have been executed on the date which it bears. Not all movables can be left, as in England. The movable property of the deceased is subject to *jus relictae* and *legitim. See* McLaren, *Wills and Succession,* for the law, and *Judicial Styles* for styles.

France.—The law is mainly contained in ss. 967–1074 of the *Code Civil.* Wills in France may be of three kinds: (1) *holograph,* which must be wholly written, dated and signed by the testator; (2) made as a *public instrument, i.e.,* received by two notaries before two witnesses or by one notary before four witnesses; this form of will must be dictated by the testator and written by the notary, must be read over to the testator in the presence of the witnesses and must be signed by testator and witnesses; (3) *mystic,* which are signed by the testator, then closed and sealed and delivered by him to a notary before six witnesses; the notary then draws up an account of the proceedings on the instrument which is signed by the testator, notary and witnesses. Legatees and their blood relations to the fourth degree may not be witnesses. Nuncupative wills are not recognized. Soldiers' and sailors' wills are subject to special rules as in most other countries. Full liberty of disposition only exists where the testator has no ascendants or descendants, in other cases his *quantité disponible* is subject to *réserve;* if the testator has one child he may only dispose of half his estate, if two only one-third, if three or more only one-fourth; if he has no descendants but ascendants in both lines he may dispose of half, if ascendants in one line only he may dispose of three-fourths. The full age of testamentary capacity is 21 years, but minors over the age of 16 may dispose by will of half of the estate of which they could dispose had they been of full age. There is no restriction against married women making wills. A contract to dispose of the succession is invalid, s. 791.

The codes of the Latin races in Europe are in general accordance with the French law. (J. Wil.)

United States.—The American colonists brought with them the English common law of wills as modified by the Statute of Wills. Inasmuch as the feudal system was never a part of American institutions many of the feudalistic limitations upon the devolution of real property by will never became part of American law. Statutes have quite generally modified the older law of wills and deal systematically with the whole subject of testation. In Louisiana the right of testation is governed by principles of the French law which have been adopted by the Louisiana code. In other Southern and Western States where the original settlers were of French or Spanish origin, marked traces of the civil law are to be found in their law of wills. By far the greater part of American law, however, is of English origin.

The American statutes governing the making of wills were modelled closely either upon the English Statute of Frauds of 1677 or the English Wills Act of 1837. As the legislation of any particular State falls within the compass of one or the other of these statutes, the formal requisites governing the making of the will vary. The provisions of the Statute of Frauds, validating nuncupative wills of soldiers or sailors or those made in the last illness of the testator, are quite generally in force. In those States where the civil law once obtained, the holographic will or will without witnesses but written in the handwriting of the testator, is recognized. Its validity has also been recognized by statute in about one third of the American States. Besides the foregoing the State of Louisiana recognizes still another form of will, which has been designated as the mystic will. This is a documentary will which, when signed by the testator, is enclosed in a sealed envelope and presented to and subscribed by a notary together with seven witnesses.

Full liberty of disposition is generally accorded a testator. In some States limitations are placed by statute upon the testator's right to dispose of all his property away from his wife and children. Limitations also exist as to the character of the property which may be disposed of by will. Dower rights, homestead property, the wife's distributive share of the personalty, the wife's interest in the community property where the State has created such an institution, are generally excluded. The rule of the Statute of Wills limiting devises of realty to real estate owned at the time of the making of the will and excluding after-acquired realty, has been abrogated. Testamentary capacity has been broadened in accordance with modern conceptions, the incapacity of the married woman being removed. The inability of certain classes of persons to take by will, notably aliens and corporations, has also been generally removed. (*See* Executors and Administrators; Legacy.)

See Page, *Wills* (2d. ed. 1926); Schouler, *Wills* (6th ed. 1923); Rood, *Wills* (2d ed. 1926). (J. M. La.)

WILLARD, EMMA (1787–1876), American educator, born at Berlin, Conn., Feb. 23, 1787. She began teaching at 16 years of age. In 1807 she became principal of a girls' academy at Middlebury, Vt., and in 1814 she opened a boarding school of her own. Her *Plan for Improving Female Education* (1819), first addressed to the New York State Legislature, found favour with Governor Clinton who invited her to move her school to Waterford, N.Y. Two years later (1821) it was moved to Troy as the Troy Female Seminary. In 1830 she travelled abroad for her health and aided in founding a girls' school in Athens, Greece. The proceeds from her *Journal and Letters from France and Great Britain* (1833) were given to this school. After 1838 she spent most of her time lecturing and revising her text-books. In 1845–47 she travelled 8,000 miles throughout the south and west urg-

ing and counseling in educational matters. In 1854, with Henry Barnard, she represented the United States at the World's Educational Convention in London. Her *Ancient Geography* (2nd. ed., 1827); *History of the United States* (1828); *Astronomy* (1853); and *Morals for the Young* (1857) passed through many editions and were widely used as text-books up to the time of her death. She published also a volume of poems, of which the best known is "Rocked in the Cradle of the Deep." Her death occurred at Troy, N.Y., on April 15, 1876. *See* A. Lutz, *Emma Willard* (1929).

WILLARD, FRANCES ELIZABETH (1839–1898), American reformer, was born at Churchville, Monroe county (N.Y.), on Sept. 28, 1839. In 1859 she graduated at the Northwestern Female college at Evanston (Ill.). She then became a teacher, and in 1871–74 she was president and professor of aesthetics of the Woman's college at Evanston, which became part of the Northwestern university in 1873. In 1874 she became corresponding secretary and from 1879 until her death was president of the National Woman's Christian Temperance Union, and from 1883 until her death was president of the World's Woman's Christian Temperance Union. In 1890 she was elected president of the Woman's National Council, which represented nearly all of the women's societies in America. She was one of the founders of *Our Union,* a New York publication in the interests of the National Woman's Christian Temperance Union. She died in New York city on Feb. 18, 1898.

With Mary A. Livermore she edited *A Woman of the Century* (Buffalo [N.Y.], 1893), which includes a sketch of her life; and she pub. *Nineteen Beautiful Years* (1864), a life of her sister; *How to Win: A Book for Girls* (1886); *Glimpses of Fifty Years* (1889); and, in collab. with H. M. Winslow, Mrs. S. J. White and others, *Occupations for Women* (1897). *See* A. A. Gordon, *The Beautiful Life of Frances E. Willard* (Chicago, 1898), with an intro. by Lady Henry Somerset, and W. M. Thayer, *Women Who Win* (1896).

WILLCOCKS, SIR WILLIAM (1852–1932), British engineer, was born in India and educated at Roorkee college, India. From 1872 to 1897 he was engaged successively in the Indian and Egyptian public works departments. He designed and carried through the Aswan dam in 1898. His most important undertaking, however, was the irrigation of 3,500,000 ac. in Mesopotamia, begun in 1911 at an estimated cost of £26,195,000.

His works include: *Egyptian Irrigation* (1889); *The Irrigation of Mesopotamia* (1905); *From the Garden of Eden to the Crossing of Jordan* (1918).

WILLEMITE, a mineral consisting of zinc orthosilicate, Zn_2SiO_4, crystallizing in the parallel-faced hemihedral class of the rhombohedral system. Crystals have the form of hexagonal prisms terminated by rhombohedral planes: there are distinct cleavages parallel to the prism-faces and to the base. Granular and cleavage masses are of more common occurrence. It varies considerably in colour, being colourless, white, greenish-yellow, apple-green, flesh-red, etc. The hardness is $5\frac{1}{2}$, and the specific gravity 3·9–4·2. A variety containing much manganese replacing zinc is called "troostite." Willemite occurs at Sterling Hill, Sussex county, and Franklin Furnace in New Jersey, where it is associated with other zinc ores (franklinite and zincite) in crystalline limestone. It has been found at only a few other localities, one of which is near Liége, and for this reason the mineral was named after William I. of the Netherlands. Under the influence of radium radiations, willemite fluoresces with a brilliant green colour.

WILLEMS, FLORENT JOSEPH MARIE (1823–1905), Belgian painter, was born at Liége on the 8th of January 1823. He made his debut at the Brussels Salon in 1842 with a "Music Party." Among his most famous works are "The Wedding Dress," "La Fête des grands-parents," "Le Baise-main" (Mme. Cardon's collection, Brussels), "Farewell," "The Arches of the Peace" and "The Widow." He died at Neuilly-sur-Seine Oct. 23, 1905.

WILLESDEN, a municipal and parliamentary borough of Middlesex, England, and suburb of London, lying immediately outside the boundary of the county of London (boroughs of Hammersmith and Kensington). Pop. (est. 1938) 187,600. Area 7.2 sq.mi. At Domesday the manor of Willesden and Harlesden was held by the canons of St. Paul's. In the 12th century it was formed into eight manors. A shrine or image of St. Mary (Our Lady of Willesden) was in the 15th century an object of pilgrimage, but by the middle of the following century the ceremonies had fallen into abuse, and the shrine was suppressed. There are Norman remains in the church of St. Mary. Considerable railway works are attached to Willesden Junction (L.M.S.R.). Willesden, which was incorporated in 1933, is one of the largest non-county boroughs in the United Kingdom, both as regards rateable value and population. It returns two members to parliament.

WILLET, a conspicuous North American wading bird (*Catoptrophorus semipalmatus*), about 15 in. long, and to be recognized by its black primaries with a broad white band and white upper tail coverts. The willet breeds as far north as New Jersey and Manitoba, wintering from southern United States south. The western willet (*C. s. inornatus*) is paler and slightly larger.

WILLETT, WILLIAM (1856–1915), British builder, was born at Farnham, Surrey, in Sept. 1856. He was known in London as a designer of beautiful houses; but his chief claim to fame was his conception and promotion of "daylight saving" (*q.v.*). Though scoffed at in his lifetime, his idea was put into practice in 1916. He died at Chislehurst, Kent, March 4, 1915.

WILLETTE, LEON ADOLPHE (1857–1926), French painter, illustrator, caricaturist, and lithographer, was born in Chalons-sur-Marne. He studied for four years at the École des Beaux-Arts under Cabanel. Whether comedy or tragedy, dainty triviality or political satire, his work is instinct with the profound sincerity of the artist. He set Pierrot upon a lofty pedestal among the imaginary heroes of France, and established Mimi Pinson, frail, lovable, and essentially good-hearted, in the affections of the nation. Willette was at once the modern Watteau of the pencil and the exponent of sentiments that move the emotional section of the public. There is charm even in his thrilling apotheosis of the guillotine, and in the introduction into his caricatures of the figure of Death.

The artist was a prolific contributor to the French illustrated press under the pseudonyms "Cémoi," "Pierrot," "Louison," "Bébé," and "Nox," but more often under his own name. He illustrated Mélandri's *Les Pierrots* and *Les Giboullés d'avril,* and published his own *Pauvre Pierrot* and other works, in which he tells his stories in scenes in the manner of Busch.

WILLIAM (*c.* 1130–*c.* 1190), archbishop of Tyre and chronicler, belonged to a noble French family and was probably born in Palestine about 1130. This, however, is only an inference; unfortunately the chapter (xix. 12) which relates to his early life has been excised or omitted from every extant manuscript of his *Historia.* William was still pursuing his studies in Europe when Amalric I. became king of Jerusalem in 1162, but he returned to Palestine towards the close of 1166, or early in 1167, and was appointed archdeacon of Tyre at the request of Amalric in August 1167. In 1168 he was sent on an embassy, the forerunner of several others, to the emperor Manuel I. at Constantinople, and in 1169, at the time of the disastrous campaign against Damietta, he was obliged to take refuge in Rome from the "unmerited anger" of his archbishop. But he was soon in Palestine again, and about 1170 he was appointed tutor to Amalric's son, Baldwin, afterwards King Baldwin IV. Towards the end of 1174, soon after Baldwin's accession to the throne, he was made chancellor of the kingdom of Jerusalem, an office which he held until 1183, and less than a year later (May 1175) he was consecrated archbishop of Tyre. He was one of those who went to negotiate with Philip I., count of Flanders, in 1177, and in 1179 he was one of the bishops who represented the Latin Church of the East at the Lateran council in Rome. On his return to Palestine he stayed seven months at Constantinople with Manuel. This is William's last appearance in history, but he was writing his history in 1181, and this breaks off abruptly at the end of 1183 or early in 1184. He died probably between 1187 and 1190.

William of Tyre is among the greatest of mediaeval historians. His *Historia rerum in partibus transmarinis gestarum,* or *Historia Hierosolymitana* or *Belli sacri historia* covers the period between 1095 and 1184, and is the main authority for the history of the Latin kingdom of Jerusalem between 1127, where Fulcher of Chartres leaves off, and 1183 or 1184, where Ernoul takes up the narrative. It was translated into French in the 13th century, or

possibly before the end of the 12th, and this translation, known as the *Chronique d'outremer*, or *Livre d'Eracles* or *Livre du conquest*, is quoted by Jean de Joinville, and increased by various continuations, in the standard account of the exploits of the French warriors in the East. William's work consists of twenty-two books and a fragment of another book; it extends from the preaching of the first crusade by Peter the Hermit and Pope Urban II. to the end of 1183 or the beginning of 1184.

As *Belli sacri historia* the *Historia rerum* was first published in 1549 at Basel. More recent editions are in J. P. Migne's *Patrologia Latina*, tome cci., and in the "Recueil des historiens des croisades," *Hist. occid.* i. (Paris, 1844). Manuscripts are in the British Museum, London, and in Corpus Christi College, Cambridge. It has been translated into German by E. and R. Kausler (Stuttgart, 1848); into French in Guizot's *Collection des mémoires*, tomes xvi., xviii. (Paris, 1824); into Italian and into Spanish. An English translation has been made for the Early English Text Society by M. N. Colvin (London, 1893). *See* the *Histoire littéraire de la France*, tome xiv. (1869); B. Kugler, *Studien zur Geschichte des zweiten Kreuzzuges* (Stuttgart, 1866); H. Prutz, *Studien über Wilhelm von Tyrus* (Hanover, 1883); and H. von Sybel, *Geschichte des ersten Kreuzzuges* (Leipzig, 1881).

WILLIAM I. (1027 or 1028–1087), king of England, surnamed the Conquerer, was born in 1027 or 1028. He was the bastard son of Robert the Devil, duke of Normandy, by Arletta, the daughter of a tanner at Falaise. In 1034 Robert resolved on a pilgrimage to Jerusalem. Having no legitimate son he induced the Norman barons to acknowledge William as his successor. They kept their engagement when Robert died on his journey (1035), though the young duke-elect was a mere boy. But the next twelve years was a period of the wildest anarchy. Three of William's guardians were murdered; and for some time he was kept in strict concealment by his relatives, who feared that he might experience the same fate. Trained in a hard school, he showed a precocious aptitude for war and government. He was but twenty years old when he stamped out, with the help of his overlord, Henry I. of France, a serious rising in the districts of the Bessin and Cotentin, the object of which was to put in his place his kinsman, Guy of Brionne. Accompanied by King Henry, he met and overthrew the rebels at Val-des-Dunes near Caen (1047). It was by no means his last encounter with Norman traitors, but for the moment the victory gave him an assured position. Next year he joined Henry in attacking their common enemy, Geoffrey Martel, count of Anjou. Geoffrey occupied the border fortress of Alençon with the good will of the inhabitants. But the duke recovered the place after a severe siege, and inflicted a terrible vengeance on the defenders, who had taunted him with his base birth; he also captured the castle of Domfront from the Angevins (1049).

In 1051 the duke visited England, and probably received from his kinsman, Edward the Confessor, a promise of the English succession. Two years later he strengthened the claims which he had thus established by marrying Matilda, a daughter of Baldwin V. of Flanders, who traced her descent in the female line from Alfred the Great. This union took place in defiance of a prohibition which had been promulgated, in 1049, by the papal council of Reims. Pope Nicholas II. at length granted the needful dispensation (1059). By way of penance William and his wife founded the abbeys of St. Stephen and the Holy Trinity at Caen. The political difficulties caused by the marriage were more serious. Alarmed at the close connection of Normandy with Flanders, Henry I. joined forces with Geoffrey Martel in order to crush the duke, and Normandy was twice invaded by the allies. In each case William decided the campaign by a signal victory. The invasion of 1054 was checked by the battle of Mortemer; in 1058 the French rearguard was cut to pieces at Varaville on the Dive, in the act of crossing the stream. Between these two wars William aggrandized his power at the expense of Anjou by annexing Mayenne. Soon after the campaign of Varaville both Henry I. and Geoffrey Martel died. He at once recovered Maine from the Angevins, nominally in the interest of Count Herbert II., on whose death (1062) Maine was formally annexed to Normandy.

Conquest of England.—About 1064 the accidental visit of Harold (*q.v.*) to the Norman court added another link to William's connection. It seems clear that the earl made a promise to support the claims of William upon the English succession. This promise he was invited to fulfil in 1066, after the Confessor's death and his own coronation. William had some difficulty in securing the help of his barons for his proposed invasion of England; it was necessary to convince them individually by threats and persuasions. Otherwise conditions were favourable. William secured the benevolent neutrality of the emperor Henry IV.; and the expedition had the solemn approval of Pope Alexander II. With Tostig, the banished brother of Harold, William formed a useful alliance; the duke and his Normans were enabled, by Tostig's invasion of northern England, to land unmolested at Pevensey on Sept. 28, 1066. On the 14th of October a crushing defeat was inflicted on Harold at the battle of Senlac or Hastings; and on Christmas Day William was crowned at Westminster.

Five years more were to elapse before he became master of the west and north. Early in 1067 he made a progress through parts of the south, receiving submissions, disposing of the lands of those who had fought against him, and ordering castles to be built; he then crossed the Channel to celebrate his triumph in Normandy. Disturbances at once occurred in Northumbria, on the Welsh marches and in Kent; and he was compelled to return in December. The year 1068 was spent in military expeditions against Exeter and York, in both of which the adherents of Harold had found a welcome. In 1069 Robert of Comines, a Norman to whom William had given the earldom of Northumberland, was murdered by the English at Durham; the north declared for Edgar Atheling, the last male representative of the West-Saxon dynasty; and Sweyn Estrithson of Denmark sent a fleet to aid the rebels. Joining forces, the Danes and English captured York, although it was defended by two Norman castles. Marching rapidly on York William drove the Danes to their ships; and the city was then reduced by a blockade. The king ravaged the country as far north as Durham with such completeness that traces of devastation were still to be seen sixty years later. But the English leaders were treated with politic clemency, and the Danish leader, Jarl Osbiorn, was bribed to withdraw his fleet. Early in 1070 the reduction of the north was completed by a march over the moors to Chester, which was now placed under an earl of William's choice. From this point we hear no more of general rebellions against the foreign rule.

Administration.—Of the measures which William took to consolidate his authority we have many details; but the chronological order of his proceedings is obscure. The redistribution of land appears to have proceeded pari passu with the reduction of the country; and at every stage of the conquest each important follower received a new reward. Thus were formed the vast but straggling fiefs which are recorded in Domesday. The great earldoms of the West-Saxon period were allowed to lapse; the new earls, for the most part closely connected with William by the ties of blood or friendship, were lords of single shires; and only on the marches of the kingdom was the whole of the royal jurisdiction delegated to such feudatories. William's writs show that he kept intact the old system of governing through the sheriffs and the courts of shire and hundred. Those whom he enfeoffed with land held it according to the law of Norman feudalism, and were thus brought into close personal relations with the king. But he forced the most powerful of them to acknowledge the jurisdiction of the ancient local courts; and the old fyrd-system was maintained in order that the crown might not be wholly dependent on feudal levies. Though his forest-laws and his heavy taxation caused bitter complaints, William won the respect of his English subjects. They appear to have accepted him as the lawful heir of the Confessor; and they regarded him as their natural protector against feudal oppression. This is to be explained by his regard for legal forms, by his confirmation of the "laws of Edward" and by the support which he received from the church. Domesday Book shows that in his confiscations he can have paid little attention to abstract justice. Almost every English landholder of importance was dispossessed, though only those who had actually borne arms against William

should have been so treated. As far as possible Englishmen were excluded from all responsible positions both in church and state. After 1071 our accounts of William's doings become jejune and disconnected. Much of his attention must have been engrossed by the work of administration, carried on without the help of those elaborate institutions, judicial and financial, which were perfected by Henry I. and Henry II. William had few ministers of note. William Fitz Osbern, earl of Hereford, who had been his right-hand man in Normandy, fell in the civil wars of Flanders (1071). Odo, bishop of Bayeux, William's half-brother, lost favour and was finally thrown into prison on a charge of disloyalty (1082). Another half-brother, Robert of Mortain, earl of Cornwall, showed little capacity. Of the king's sons Robert, though titular count of Maine, was kept in leading strings; and even William Rufus, who was in constant attendance on his father, never held a public office. The Conqueror reposed much confidence in two prelates, Lanfranc of Canterbury and Geoffrey of Coutances. They took an active part in the civil no less than the ecclesiastical government. But the king himself worked hard in hearing lawsuits, in holding councils and ceremonious courts, and finally in conducting military operations.

In 1072 he undertook a campaign against Malcolm, king of Scots, who had married Margaret, the sister of Edgar Atheling, and was inclined to promote English rebellions. When William reached the Forth his adversary submitted, did homage as a vassal, and consented to expel Edgar Atheling, who was subsequently endowed with an English estate and admitted to William's favour. From Scotland the king turned to Maine, which had profited by the troubles of 1069 to expel the Norman garrisons. William had no difficulty in reducing the country, even though Le Mans was assisted by Fulk of Anjou (1073). A conspiracy of the earls of Hereford and Norfolk, in which the Englishman Waltheof, earl of Northampton, was to some extent implicated, was defeated by Lanfranc in the king's absence; but William returned to settle the difficult question of their punishment, and to stamp out the last sparks of disaffection. The execution of Waltheof, though strictly in accordance with the English law of treason, he only sanctioned after long hesitation, and this severity to a man who was generally thought innocent, is one of the dark stains on his career. In 1076 he invaded Brittany to get possession of the fugitive earl of Norfolk; but Philip of France came to the aid of the Bretons, and William gave way before his suzerain. The next few years were troubled by a quarrel between the king and his eldest son, Robert (*q.v.*). In the years 1083–1085 there was a second rising in Maine. In 1085 news arrived that Cnut the Saint, king of Denmark, was preparing to assert the claims of his house in England. The project fell through, but gave occasion for the famous moot at Salisbury in which William took an oath of direct allegiance from "all the land-sitting men that were in England" (1086).

While the danger was still impending he took in hand (1085) the compilation of Domesday Book (*q.v.*). In 1087 he invaded the French Vexin to retaliate on the garrison of Mantes for raids committed on his territory. He sacked and burned the town. But as he rode out to view the ruins his horse plunged on the burning cinders and inflicted on him an internal injury. He was carried in great suffering to Rouen and there died on Sept. 9, 1087. He was buried in St. Stephen's at Caen. A plain slab still marks the place of his tomb, before the high altar; but his bones were scattered by the Huguenots in 1562.

Character.—In a profligate age William was distinguished by the purity of his married life, by temperate habits and by a sincere piety. His most severe measures were taken in cold blood, as part of his general policy; but his natural disposition was averse to unnecessary bloodshed or cruelty. His one act of wanton devastation, the clearing of the New Forest, has been grossly exaggerated. He was avaricious, but his church policy (*see* article ENGLISH HISTORY) shows a disinterestedness as rare as it was honourable. In personal appearance he was tall and corpulent, of a dignified presence and extremely powerful physique, with a bald forehead, close-cropped hair and short moustaches.

By Matilda (d. 1083), William had four sons, Robert, duke of Normandy, Richard (killed whilst hunting), and the future kings, William II. and Henry I., and five or six daughters, including Adela, who married Stephen, count of Blois.

Of the original authorities the most important are the *Gesta Willelmi,* by William of Poitiers (ed. A. Duchesne in *Historiae Normannorum scriptores,* Paris, 1619); the Winchester, Worcester and Peterborough texts of the *Anglo-Saxon Chronicle* (ed. B. Thorpe, "Rolls" series, 2 vols., 1861, and also C. Plummer, 2 vols., Oxford, 1892–99); William of Malmesbury's *De gestis regum* (ed. W. Stubbs, "Rolls" series, 2 vols., 1887–89); William of Jumièges' *Historia Normannorum* (ed. A. Duchesne, *op. cit.*); Ordericus Vitalis' *Historia ecclesiastica* (ed. A. le Prévost, *Soc. de l'histoire de France,* 5 vols., Paris, 1838–55). Of modern works the most elaborate is E. A. Freeman's *History of the Norman Conquest,* vols. iii.–v. (Oxford, 1870–76). Domesday Book was edited in 1783–1816 by H. Farley and Sir H. Ellis in four volumes. Of commentaries the following are important: *Domesday Studies* (ed. P. E. Dove, 2 vols., 1888–91); J. H. Round, *Feudal England* (1895); F. W. Maitland, *Domesday Book and Beyond* (Cambridge, 1897); P. Vinogradoff, *English Society in the Eleventh Century* (Oxford, 1908). *See* also F. M. Stenton, *William the Conqueror* (1908); R. Francis, *William the Conqueror* (1915); M. de Ranchi, *Apologie pour Guillaume le Conquérant* (1919); S. H. Benton, *From Coronet to Crown* (1926). (H. W. C. D.)

WILLIAM II. (*c.* 1056–1100), king of England, surnamed Rufus, was the third son of William I. by his queen Matilda of Flanders. He seems to have been his father's favourite son, and constantly appears in the Conqueror's company, although like his brothers he was carefully excluded from any share in the government. A squabble with Rufus was the immediate cause of Robert's first rupture with the Conqueror; in the ensuing civil war we find Rufus bearing arms on the royal side (1077–80). On his death-bed the Conqueror was inclined to disinherit his eldest son in favour of Rufus, who by the early death of Prince Richard was now left second in the order of succession. But Normandy was bequeathed to Robert, while Rufus was designated as king of England. Rufus was crowned at Westminster on Sept. 26, 1087, fifteen days after the death of his father.

Domestic Administration.—In his domestic administration we can trace a certain continuity of purpose, and in his dealings with the Welsh and Scots he proceeded, though intermittently, along the broad lines of policy which his father had marked out. Beyond the Channel he busied himself with schemes, first for the reunion of England and Normandy, then for the aggrandisement of Normandy at the expense of France. But the violence, the irregularity, the shamelessness of his private life are faithfully reflected in his public career. Even in cases where his general purpose could be justified, his methods of execution were crudely conceived, brutal and short-sighted. Rufus was not without valour or glimmerings of chivalry, but perfidious to his equals, oppressive to his subjects, contemptuous of religion; with no sense of his responsibilities, and determined to exact the last farthing of his rights. The baronage took up arms for Robert in the name of the hereditary principle, but with the secret design of substituting a weak and indolent for a ruthless and energetic sovereign. Local risings in Norfolk, Somerset and the Welsh marches were easily repressed. The castles of Kent and Sussex offered a more formidable resistance, since their lords were in direct communication with Robert of Normandy, and were led by the able Odo of Bayeux (*q.v.*), the king's uncle, who had been released from prison at the opening of the reign. Rufus secured the help of the native English, by promises (never fulfilled), of good laws, the abolition of unjust taxes and redress for those who had suffered by the afforestments of the late king. Aided by large contingents of the national militia he subdued the rebels. Odo of Bayeux left England under a safe-conduct to sow fresh seeds of discord in Normandy. But Rufus resolved to take vengeance on his brother, and in 1089 he invaded eastern Normandy. In 1091 a treaty was hastily patched up. Rufus retained the eastern marches of the duchy, and also received certain seaports. In return he undertook to aid Robert in reducing the rebellious county of Maine, and in recovering the Cotentin from their younger brother, Henry Beauclerk, to whom it had been pledged by the impecunious duke. The last part of the agreement was duly executed. Rufus then recrossed the Channel to chastise the Scots, who in his absence had raided the north country. Malcolm III.

of Scotland prudently purchased his withdrawal, by doing homage (Aug. 1091) on the same terms which William I. had imposed in 1072. Next year Rufus broke the treaty by seizing the stronghold of Carlisle and the other lands held or claimed by Malcolm in Cumberland and Westmorland. Malcolm in vain demanded satisfaction; while attempting reprisals on Northumberland he was slain in an obscure skirmish (1093). Rufus immediately put forward a candidate for the vacant throne; and this policy, though at first unsuccessful, finally resulted in the accession of Edgar (1097), a son of Malcolm, who had acknowledged the English overlordship. Carlisle remained an English possession; in the next reign Cumberland and Westmorland appear as shires in the accounts of the Exchequer.

Norman Policy.—Rufus resumed his designs on Normandy at the first opportunity. Robert reproached his brother with non-fulfilment of the terms arranged in 1091; and Rufus seized the excuse for a second invasion of the duchy (1094). But Robert resolved to go upon a crusade and, to obtain the necessary funds, gave Normandy in pledge to his brother (1096). The interests of Normandy at once became the first consideration of Rufus's policy. In 1098–99 he recovered Maine, and commenced operations for the recovery of the Vexin. Early in 1100 he accepted a proposal, made by William IX. of Aquitaine, that he should take over that duchy on terms similar to those arranged in the case of Normandy. Contemporaries were startled at the rapid progress of the king's ambitions, and saw the direct interposition of heaven in the fate which cut them short. On Aug. 2, 1100, Rufus fell, in the New Forest, the victim of an arrow from an unknown hand. The common story names Walter Tirel, who was certainly close at hand and fled the country without venturing to abide the issue of a trial. But a certain Ralph of Aix was also accused; and Tirel, from a safe distance, solemnly protested his innocence.

It remains to notice the main features of the domestic administration which made the names of William and his minister, Ralph Flambard, infamous. We are told that the "moots" all over England were "driven" in the interests of the king; which perhaps means that aids were extorted from the shire-courts. We also learn that the forest-laws were rigorously administered; that the king revived, for certain offences, the death-penalty which his father had abolished; that all men were vexed by unjust gelds and the feudal classes by unscrupulous misinterpretations of the customs relating to the incidents of wardship, marriage and relief. On one occasion the militia were summoned in considerable numbers for a Norman expedition, which was no part of their duty; but when they arrived at the sea-coast they were bidden to hand over their journey money and go home. The incident is not uninstructive as a side-light on the king's finance. As to the oppression of the church we are more fully informed; after allowing for exaggeration there still remains evidence enough to prove that the ecclesiastical policy of Rufus was unscrupulously venal.

In appearance William II. was unattractive; bull-necked, with sloping shoulders, extremely corpulent and awkward in his gait. His long locks and clean-shaven face marked his predilection for the new-fangled fashions which contemporary ecclesiastics were never weary of denouncing. His features were strongly marked and coarse, his eyes grey and deeply set; he owed his nickname to the fiery hue of his complexion. He stuttered violently and in moments of passion was almost inarticulate. His familiar conversation was witty and blasphemous. He was surrounded by a circle of vicious parasites, and no semblance of decorum was maintained in his household. His character was assailed by the darkest rumours which he never attempted to confute. He died unmarried and without issue.

The main authorities for the reign are the *Peterborough Chronicle* (ed. C. Plummer, 2 vols., Oxford, 1892–99); Eadmer's *Vita Anselmi* and *Historia Novorum* (ed. M. Rule, "Rolls" series, 1884); William of Malmesbury's *De gestis regum* (ed. W. Stubbs, "Rolls" series, 2 vols., 1887–89); Orderic Vitalis' *Historia ecclesiastica* (ed. A. le Prévost, 5 vols., Paris, 1838–55). Of modern works the most exhaustive is E. A. Freeman's *Reign of William Rufus* (2 vols., Oxford, 1882). *See* also J. H. Round's *Feudal England* (1895).

WILLIAM III. (1650–1702), king of England and prince of Orange, was the only son of William II., prince of Orange, stadtholder of the Dutch republic, and Mary, daughter of Charles I. of England, and was born at The Hague on Nov. 4, 1650, eight days after his father's death. His father had attempted a *coup d'état*, which had failed, with the result that on his death the office of stadtholder was abolished. Power passed into the hands of John de Witt, who represented the oligarchic element and the special interests of one province, Holland, and was taken from the Orange party which represented the more democratic element and the more general interests of the Seven Provinces. William grew up among enemies, and learned to conceal his feeling behind the mask of an immobile, almost repulsive, coldness. Like Charles XII. of Sweden and the younger Pitt, he was a wonderful example of premature mental development.

Stadtholdership.—In 1672 Louis XIV. suddenly invaded Dutch territory. The Dutch people turned for help to the prince of Orange. On July 8, 1672 the states general revived the stadtholderate, and declared William stadtholder, captain-general and admiral for life. This revolution was followed by a riot, in which John de Witt and his brother Cornelius were murdered by the mob at The Hague. Evidence may be sought in vain to connect William with the outrage, but he lavishly rewarded its leaders and promoters. The cold cynicism with which he acted towards de Witt is only matched by the heroic obstinacy with which he confronted Louis. He rejected all thought of surrender and appealed to the last resource of Dutch patriotism by opening the sluices and laying vast tracts under water. The French army could not advance, while the French and English fleets were defeated by the Dutch admiral, De Ruyter. William summoned Brandenburg to his aid (1672) and made treaties with Austria and Spain (1673). In August 1674 he fought his first great battle at Seneffe, where the honours lay with Condé. The French evacuated Dutch territory early in 1674, but continued to hold places on the Rhine and in Flanders. In April 1677 William was badly beaten at St. Omer, but he secured a diplomatic victory by his marriage, in November 1677, with Mary, eldest daughter of James, duke of York, afterwards King James II. He undertook negotiations with England in the following year which forced Louis to make terms and sign the treaty of Nijmwegen in August 1678, which gave Franche Comté and other places in Spanish Flanders to France.

William started a new coalition against Louis in October 1681 by making a treaty with Sweden, and subsequently with the empire, Spain and several German princes. After absorbing Strasbourg (1681), Louis invaded Spanish Flanders and took Luxembourg (1684). Even then the new league would not fight and allowed Louis to retain his conquests by the truce of Regensburg (1685), but none the less these humiliations gave rise to a more closely-knit and aggressive coalition, which was organized in 1686 and known as the League of Augsburg.

The English Crown.—From 1677 onwards William had carefully watched the politics of England. On the accession of James II. in 1685 he forced the duke of Monmouth to leave Holland, and sought to dissuade him from his ill-starred expedition to England. He apparently tried to conciliate his father-in-law in the hope of bringing him into the League of Augsburg. By November 1687 he saw that James would not join the league against Louis, and he turned for support to the English opposition. He caused his chief minister Fagel to write a letter expressing his disapprobation of the religious policy of James, which was published in November 1687. But he made it clear that he would not interfere unless he received a definite invitation. On June 30, 1688 Admiral Herbert, disguised as a blue-jacket, set out from England with a letter from seven influential Englishmen, asking William to "bring over an army and secure the infringed liberties" of England.

William landed at Torbay (Nov. 5, 1688). After a few days of hesitation, many influential noblemen declared for him in different parts of the country. James, who had at first joined his army at Salisbury, fell back to London and tried to negotiate. (For his flight connived at by William, *see* JAMES II.) William, on the advice of an assembly of notables, summoned a convention parliament on Jan. 22, 1689. He was proclaimed joint-sovereign of England in conjunction with his wife, Mary (Feb. 13, 1689).

Internal Administration.—A constitutional settlement was effected by the end of 1689, almost all the disputed points between king and parliament being settled in favour of the latter. Though William by no means appreciated this confinement of his prerogative, he was too wise to oppose it. His own initiative is more clearly traceable in the Toleration Act, extending liberty of private worship to Dissenters. He also secured an Act of Grace and Indemnity in 1690, by which he calmed the violence of party passion. But in general his domestic policy was not very fortunate, and he can hardly claim any personal credit for the reassessment of the land-tax (1692), the creation of the national debt or the recoinage act (1693–1695). Further, he threatened the existence of the Bank of England, by lending his support to a counter-institution, the Land Bank, which ignominiously collapsed. Though he was not blind to the commercial interests of England, he was neglectful of the administration and affairs of her oversea colonies. But though he was unable to extract the best results from parliament he was always able to avert its worst excesses. In spite of strong personal opinions to the contrary, he accepted the Triennial Act (1694), the vote reducing the army to 10,000 men (1697), the vote disbanding his favourite Dutch Guards (1699) and even (November 1699) a bill rescinding the grants of forfeited Irish estates, which he had made to his favourites. The main cause of the humiliations William suffered from parliament lay in his incapacity to understand the party or cabinet system. In his view the best way to govern was to have both parties represented in the ministry, so that, as Whig and Tory fell out, the king came by his own. This method was unsuccessful, and affairs went most smoothly when the parliamentary majority held the same views as the ministry. William possessed an experience of the workings of representative government in Holland, and his mistakes are by no means so pardonable as were, for example, those of the Georges, who had been absolute monarchs in their own country. William's unpopularity with his new people was, on the whole, unjustified, but his memory is rightly darkened by the stain of the "Massacre of Glencoe." In 1692 he signed an order for the "extirpation" of the Macdonalds, a small clan in the vale of Glencoe. It is improbable that he meant his order to be literally executed, it is not certain that he knew they had taken the oath of allegiance to him. None the less, when the massacre was carried out with circumstances of revolting barbarity, William behaved as he had done after the murder of De Witt. Popular pressure forced him to bring the murderers to justice, to punish and dismiss them from his service. But shortly afterwards they were all received into favour; "one became a colonel, another a knight, a third a peer."

These and other actions indicate that William could show on occasion a cold and cynical ruthlessness. The master aim of his life was the restoration of the "Balance of Power," by the overthrow of the predominance of France. This was the real aim of William in going to England in 1688. He had set off to secure an ally against Louis, and he came back from his expedition with a crown on his head and a new nation at his back, united in its detestation of popery and of France.

Foreign Policy.—As king of England he concluded treaties of alliance with the members of the League of Augsburg and sent a large army to oppose the French in Flanders. (For the course of the war on sea and on land, both in Ireland and in Flanders *see* GRAND ALLIANCE, WAR OF.) William had assumed the duties of commander-in-chief too young to learn the full duties of a professional soldier himself, and his imperious will did not suffer others to direct him. Hence though often fertile in resource and ingenious in plan, he was always a brilliant amateur.

In diplomacy William was as uniformly successful as in war he was the reverse. His unity of aim and constancy of purpose make him one of the greatest of modern diplomatists. He held together his ill-assorted coalition, and finally concluded peace at Ryswick in September 1697. Louis restored all his acquisitions since 1678, except Strasbourg, and recognized William as king of England. During the subsequent years William tried to arrange a partition treaty with France, by which the domains of the childless Charles II. of Spain were to be divided at his death. But on the death of Charles in 1700 the whole heritage was left to France. William endeavoured to oppose this, and used Louis's recognition of James Edward the "Old Pretender" as king of England (Sept. 1701) to set the English people in a flame. War was already declared in 1702, but William, who had long been ailing, died from the combined effects of a fall from his horse and a chill on March 8, 1702.

In viewing William's character as a whole one is struck by its entire absence of ostentation, a circumstance which reveals his mind and policy more clearly than would otherwise be the case. He had many faults, both in his public and private life, and both in England and in Holland his domestic administration was criticised. His essential greatness lay in his European policy. The best proof of his real powers of statesmanship is that the peace of Utrecht was subsequently made on the broad lines which he had laid down as the only security for European peace nearly a dozen years before its conclusion. While he lacked in diplomacy the arts of a Louis XIV. or the graces of a Marlborough, he grasped the central problems of his time with more clearness, or advanced solutions with more ultimate success, than any other statesman of his age. Often baffled, but never despairing, William fought on to the end, and the ideas and the spirit of his policy continued to triumph long after the death of their author.

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WILLIAM IV. (1765–1837), king of England, third son of George III., was born at Buckingham Palace on Aug. 21, 1765. In 1779 he was sent to sea and became a midshipman under Admiral Digby. Next year he sailed under Rodney and took part in the action off Cape St. Vincent (Jan. 16, 1780). During the rest of the war the young prince saw plenty of service, for which he had a strong liking, and so laid the foundation of his popularity. On the conclusion of the war he travelled in Germany, visiting Hanover and Berlin, where he was entertained by Frederick the Great. In 1785 he passed for lieutenant; next year he was made captain and stationed in the West Indies.

In 1789 he was made duke of Clarence. When war was declared against the French republic in 1793, he could obtain no command. He amused or revenged himself by joining the prince of Wales and the duke of York in their opposition to the king. He took his seat in the House of Lords, where he defended the extravagances of the prince of Wales, spoke on the Divorce Bill, and vehemently opposed the emancipation of slaves. Meanwhile he formed a connection with Mrs. Jordan, the actress, with whom he lived on terms of mutual affection and fidelity for nearly twenty years. The death of Princess Charlotte in 1817 compelled him to break with Mrs. Jordan, and to marry (1818) Adelaide of Saxe-Meiningen, who obtained great influence over her husband. On the death of the duke of York in 1827 the duke of Clarence became heir to the throne, and in the same year he was appointed lord high admiral. He endeavoured to assume independent control of naval affairs, although his patent precluded him from acting without the advice of two members of his council. This involved him in a quarrel with Sir George Cockburn, in which he had to give way. As he still continued to act in defiance of rules, the king was at length obliged to call upon him to resign.

On June 26, 1830 the death of George IV. placed him on the

throne. During the first two years of his reign England underwent an agitation more violent than any from which it had suffered since 1688. William IV. was well-meaning and conscientious; but his timidity and irresolution drove ministers to despair, while his anxiety to avoid extremes and his want of insight into affairs prolonged a dangerous crisis and brought the country to the verge of revolution. The July revolution in France gave a great impulse to the reform movement in England. Within a fortnight of the opening of parliament the Tory ministry were beaten on a motion for the reform of the civil list, and resigned. Lord Grey undertook to form a ministry, with the avowed intention of bringing in a large measure of reform. This was not in itself displeasing to the king, who had liberal tendencies, and a few years before had supported Catholic emancipation. But when the government were beaten in committee, and offered to resign, the king declined to accept their resignation, but at the same time was unwilling to dissolve. He was only forced to it (April 1831) by the action of the opposition. After a protracted political crisis (*see* GREY, CHARLES GREY, 2nd earl) the king was compelled to consent to create a sufficient number of new peers to carry the Second Reform bill, and the threat was successful in bringing about the passing of the act in 1832.

During the rest of his reign William IV. had not much opportunity of active political interference, but on one other occasion he made an unjustifiable use of his prerogative. This was in Nov. 1834 when he suddenly dismissed the Melbourne ministry on a mere pretext, but in reality because he disapproved of their Irish Church policy, and summoned Sir Robert Peel. The formation of the Peel ministry was immediately followed by a dissolution, and, beaten on Lord John Russell's motion respecting the Irish Church (3rd of April, 1835), Peel resigned and Melbourne again came into power. Under him the Whigs retained the lead during the remainder of the reign. This *coup d'état* of Nov. 1834 was the last occasion on which an English sovereign attempted to impose an unpopular ministry on the majority in parliament.

In May 1837 the king began to show signs of debility, and died from an affection of the heart on June 20, leaving behind him the memory of a genial, frank, warm-hearted man, but a blundering, though well-intentioned prince. He was succeeded by his niece Queen Victoria.

AUTHORITIES.—*Correspondence of Earl Grey with William IV. and Sir Herbert Taylor* (London, 1867); Fitzgerald's *Life and Times of William IV.* (1884); Greville's *Memoirs* (6 vols., 1888); *Memoirs* of Sir Robert Peel (1856–57); the *Creevey Papers* (3rd ed., 1905); *Civil Correspondence of the Duke of Wellington;* Walpole's *History of England* (6 vols., 1890); Martineau's *History of the Thirty Years' Peace, 1816–46* (4 vols., 1877–78).

WILLIAM I. (1797–1888), king of Prussia and German emperor, second son of Frederick William III. of Prussia and Louise, a princess of Mecklenburg-Strelitz, was born at Berlin on March 22, 1797, and received the names of Wilhelm Friedrich Ludwig. After the battle of Jena he spent three years at Königsberg and Memel. On Jan. 1, 1807 he received an officer's patent, and on Oct. 30, 1813 was appointed a captain. William accompanied his father in the campaign of 1814, and early in 1815, received the iron cross for personal bravery shown at Bar-sur-Aube. He took part in the entry into Paris on March 31, 1814, and afterwards visited London. He joined the Prussian army in the final campaign of the Napoleonic wars, and again entered Paris. He was made a colonel and member of the permanent military commission at 20, a major-general at 21, and commander of a division in 1820. During the following nine years he mastered the Prussian military system and studied closely those of the other European States. In 1825 he was promoted lieutenant-general, and commander of the corps of guards. On June 11, 1829 he married Augusta (d. Jan. 1, 1890), daughter of Charles Frederick, grand duke of Saxe-Weimar, a lady of liberal tendencies and Catholic sympathies, whose considerable influence at court was generally exerted against that of Bismarck. By this lady William had two children: the crown prince Frederick William (b. 1831) who succeeded him as Frederick III. (*q.v.*) and the Princess Louise (b. 1838) who in 1850 married the grand duke of Baden.

On the death of his father in 1840—the new king, Frederick William IV., being childless—Prince William, as heir presumptive to the throne, received the title of prince of Prussia. He was also made lieutenant-governor of Pomerania and appointed a general of infantry. In politics he was decidedly conservative. On the outbreak of the revolution of 1848 he saw that some concessions were necessary, but urged that order should first be restored. Generally held responsible for the bloodshed in Berlin on March 18 (and hence nicknamed the "Cartridge Prince," although actually no longer in command of the guards), William was so hated for his supposed reactionary views that the king entreated him to leave the country for some time. He went to London, where he formed intimate personal relations with the leading English statesmen. Returning to Berlin, on June 8 he took his seat in the Prussian national assembly, and spoke expressing belief in constitutional principles. In 1849 he conducted the army which crushed the revolutionary movement in Baden. At the beginning of the campaign an unsuccessful attempt was made on his life. In Oct. 1849 he was appointed military governor of the Rhineland and Westphalia. In 1854 he was promoted field-marshal and made governor of the fortress of Mainz. On Oct. 7, 1858 he became regent for his brother, succeeding him on Jan. 2, 1861.

The political events of William's regency and reign are told elsewhere. (*See* GERMANY: *History.*) William was not a ruler of the intellectual type of Frederick the Great; but he believed intensely in the "God of battles" and in his own divine right as the viceregent of God so conceived. He believed also in the ultimate union of Germany and in the destiny of Prussia as its instrument; and held that whoever aspired to rule Germany must seize it for himself. But an attitude so alien to the Liberal temper of contemporary Germany was tempered by shrewd common sense, and wisdom in his choice of advisers. Thus as regent he called the Liberals into office on Bismarck's advice, though later he did not hesitate to override the Constitution when parliament refused supplies for the new armaments. From Sept. 1862, when Bismarck took office as minister president, William's personality tends to be obscured by that of his masterful servant. Yet he was no cipher. His prejudices, indeed, were apt to run athwart the minister's plans; as in the Schleswig-Holstein question, when the king's conscience regarding the claims of the Augustenburg prince threatened to wreck Bismarck's combinations. But, as Bismarck put it, the annexation of the duchies gave him "a taste for conquest," and in the campaign of 1866 the difficulty was to restrain the king, who wished to enter Vienna in triumph.

In 1870–71 again it was Bismarck and not the king that gave the determining impulse. King William's attitude was strictly correct; and the excitement which it aroused in France was due to Bismarck's editing of the Ems telegram. On the French declaration of war all Germany rallied round the king of Prussia, and when, on July 31, he quitted Berlin to join his army, he knew that he had the support of a united nation. It was during the siege of Paris, at his headquarters in Versailles, that he was proclaimed German emperor (Jan. 18, 1871). On March 21, he opened the first imperial parliament of Germany; on June 16, he entered Berlin at the head of his troops.

After that period the emperor left the destinies of Germany almost entirely in the hands of Bismarck. In his personal history the most notable events were two attempts upon his life in 1878, on the second of which he was seriously wounded. Until within a few days of his death the emperor's health was remarkably robust; he died at Berlin, March 9, 1888.

William I.'s military writings were published in 2 vols. at Berlin in 1897. Of his letters and speeches several collections have appeared: *Politische Korrespondenz Kaiser Wilhelms I.* (1890); *Kaiser Wilhelms des Grossen Briefe, Reden und Schriften* (2 vols., 1905), and his correspondence with Bismarck (ed. Penzler, Leipzig, 1900). A large number of biographies have appeared in German, of which may be mentioned L. Schneider's *Aus dem Leben Kaiser Wilhelms* (3 vols., 1888; Fr. trans., 1888); Oncken, *Das Zeitalter Kaiser Wilhelms* (2 vols., 1890–92); F. Delbrück, *Die Jugend des Königs Friedrich Wilhelm IV. von Preussen und des Kaisers u. Königs Wilhelm I., Tagebuchblätter* (1907); E. Marcks, *Kaiser Wilhelm I.* (Leipzig, 1897; 5th ed. 1905). In English have appeared *William of Germany,* by Archibald Forbes (1888), a translation of Edouard Simon's *The Emperor William and his Reign* (2 vols., 1886). *See* also GERMANY.

WILLIAM II. (1859–1941), German emperor, was born on Jan. 27, 1859, eldest son of Prince Frederick William of Prussia and Princess Victoria of England. Even as a young prince he had to feel the conflict of opinions then swaying Germany. His mother always remained at heart a foreigner there; deeply convinced of the excellence of English institutions, she regarded her new home as a backward country; in particular, she always looked on her father-in-law's minister, Bismarck, as a personal antagonist—a view which he returned with interest. Clever, but imperious and essentially cold, Princess Victoria was never able to win the heart of her son. The Crown Prince Frederick William had grown up in an age when the ideas of liberalism had become general among the educated classes of Germany, and was himself deeply influenced by them. He was often accused of lacking initiative, and despite occasional revolts, of being too much influenced by his wife's stronger will. As a soldier he did his duty in the great wars of 1866 and 1870, and, with the assistance of expert advisers, won great successes on the battle-field; but he was never primarily a soldier. His diaries show a wide range of interests, but little serious occupation with any one definite subject. His whole nature and views seemed un-Prussian to the old Emperor William I. and his circle. He was kept wholly outside official business, and thus up to the 60th year of his life he was obliged to stand beside the throne in the part of a critic without influence.

Education and Character.—His eldest son grew up in a different spiritual atmosphere. The great victories over Austria and France, the foundation of a new German empire and the winning of the German Crown by the Hohenzollerns were the dominating impressions of his boyhood years. He shared the enthusiasm felt by his generation for Bismarck and for the glorious German army. Thus from an early age he was really at variance with the spirit reigning in his parents' house. His father and mother wished to train him in other ways by giving him a middle-class education, quite contrary to the traditions of the Hohenzollern dynasty. They sent him to the gymnasium in Kassel. But although nominally a student like all the rest, yet for teachers and comrades alike he still remained always the prince and future emperor. None the less, these school years had an important effect on his intellectual development; all the solid knowledge he ever had was acquired in this period. He always retained a great devotion and respect for Professor Hinzpeter, the head of the Kassel gymnasium. In Jan. 1877 the young prince passed his final examination in Kassel. He was then sent for six months to serve in the first regiment of Guards, and afterwards to the University of Bonn, where he studied constitutional law and political economy. He passed two years at Bonn, but here again failed to come into really close contact either with his teachers or with the students.

After the autumn of 1879 military training definitely took the first place; the prince spent the next years chiefly in Potsdam, and although he was introduced by the chief president of the Province of Brandenburg into the secrets of civil administration, this was only a secondary occupation. His years with the corps in Potsdam again brought him into touch almost exclusively with the views predominant among Prussian nobles and corps of officers. The veneration paid him here suited his wilful and imperious nature better than the spirit of the middle class school or of his parents' house. Sustained work was never demanded of him, and consequently he never learnt to perform it. In Feb. 1881 he married Princess Augusta Victoria of Schleswig Holstein-Augustenburg, daughter of the Prince Frederick who in 1864 had crossed Bismarck's plans by aspiring to the throne of Schleswig-Holstein. The prince had been for long a personal friend of the Crown Prince Frederick William. The old emperor and Bismarck approved of this marriage, as tending to bring about a reconciliation with those elements in Schleswig-Holstein which still maintained the rights of the Augustenburgs. The young princess had been brought up very simply and piously; she had no great intellectual powers. Six sons and a daughter were born of the marriage. Prince William had come little before the eyes of the public, when his father's sudden death on June 15, 1888, brought him to the throne.

The new emperor was certainly a man of intellectual gifts above the average. He had a quick apprehension which enabled him to form in a short time a general view of matters which interested him, but which also seduced him into satisfying himself with these quick, superficial impressions and thinking it unnecessary to penetrate more deeply into the heart of a problem. He also possessed an extraordinarily happy turn of speech, equally effective in intimate conversation and in dealing with large audiences. His oratorical gifts, often, indeed, led him, particularly when he was speaking in public, into saying more than he really meant. He often found himself carried away, by his own inner excitement and by the admiring astonishment of his listeners, into ill-considered remarks afterwards turned against him on the battle-ground of politics. He was most profoundly persuaded of the importance of his imperial office, and of his duty to maintain his authority as monarch. Never doubting that the monarchy was a divine institution, he believed firmly that God, who had set him in this place, would also show him the right way in the exercise of his sovereign duties.

In a letter to Bismarck written two years before his death, William's father had complained of his eldest son's immaturity and inexperience, which was coupled with an inclination to overestimate his own powers. This was, indeed, a just criticism of very important traits in William's character. He was unready and unripe in mind when he ascended the throne at the age of twenty-nine. He never attained that spiritual maturity which comes only through heartfelt co-operation in great tasks and earnest consideration of the problems of the world and of life. His personality lacked the solid background of a definite philosophy of life; thus he always remained dependent on the impressions of his immediate surroundings and on the influences of those persons who knew how to win his ear and flatter his vanity. Nor had he any definite religious convictions which might have given him this inner firmness; for although he believed in the basic dogmas of Christianity, yet he was as strongly affected by the confusing influence of the modern technical and intellectual culture and really never knew at heart how far he could give way to it without violating the traditional religious beliefs so essential for his monarchic sentiments.

He has often been compared with Frederick William IV., and there were certainly many points of resemblance between him and his great-uncle; but the deep difference between them lay in the fact that Frederick William's whole nature was rooted in a definite philosophy of the world which always turned the scale at the critical moments of his life, despite all wavering in points of detail, while this firm basis was lacking in William II. Consequently he was never free from a feeling of inner uncertainty, which he tried to hide from the outward world under a pompous manner and by big words. As soon as he showed himself in public he put on the mask of the emperor. When he laid it aside there remained a man of fine talents, but of moderate education and weak character, vain and wilful through excess of self-consciousness, who felt himself most at home in amusements of a very common sort, and liked to surround himself with subservient people who suffered his not always tactful jokes with becoming respect. A great and increasing part of his time was taken up with journeys, with official appearances, with parades and shows, while real work receded more and more into the background.

When he became emperor he knew very little of the details of foreign policy. He had only a few definite principles, to which he always remained true. First among these came the maintenance of his own monarchic status at home and of Germany's international position. This in his opinion required not only a strong army, which Germany already possessed, but also a strong fleet, which he set about forming. The big increase of military forces was intended not only to enable Germany to defend herself against possible attack, but also to increase her prestige and to ensure her her share in the partition of the world's territories which was proceeding rapidly. He believed that the likelihood of ever having to make serious use of these armaments would decrease in inverse proportion to the strength of them. He never had any warlike intentions or ambitions; he certainly always felt at heart that he was lacking in the military gifts requisite for command in a great modern war. On the other hand, he felt that his duty

to himself as monarch forbade him to leave the control to others.

William's Relations with his Ministers.—When the new emperor mounted the throne, Bismarck was still in charge. While still a prince, William had often assured him of his admiration, although there had, indeed, already been several small disagreements, the story of which Bismarck has told in the third volume of his *Gedanken und Erinnerungen.* But it was in any case hardly likely that a young man of so lively a temperament and so keen an ambition to bring affairs under his personal control could agree for long with a minister who had conducted the Government according to his own principles for a generation, and who was not inclined to subordinate himself to the wishes of a young and inexperienced monarch. Bismarck felt from the first that in the personality of the emperor were inherent grave dangers for Germany's peaceful development and for the settlement of her international relations, and thought himself bound to confine the emperor's influence on policy within the narrowest limits possible. In these circumstances a collision was inevitable, and the occasion which finally led to the split was of comparatively minor importance. The repeated great strikes in the Rhenish Westphalian coal fields had inclined the emperor to listen to the counsels of his former teacher, Hinzpeter, who urged that his duty was to meet the wishes of the workmen half way and to remove their discontent by a wide measure of social reform. He demanded suddenly an announcement of such measures on the occasion of his coming birthday.

The friction began when Bismarck, in view of the great importance of such a proclamation, demanded close scrutiny and preparation in detail. It was increased by differences of opinion with regard to the prolongation of the state of emergency against the Social Democrats, and led to personal conflicts of increasing violence. Bismarck had undoubtedly determined to remain in office even against the emperor's will, and attempted to persuade the other ministers to declare themselves one with him. At last, on the strength of a cabinet order of 1850, he forbade the individual ministers to report to the emperor except in his presence; the emperor saw in this an attempt to eliminate his influence and demanded that this cabinet order be revoked. Bismarck refused to give the order, and the emperor then sent word that he expected the chancellor to tender his resignation. This Bismarck did on March 18, 1890, and it was immediately accepted by the emperor.

After Bismarck's dismissal the emperor announced that the course of the ship of State was to remain the same, even though the steersman had been changed. He proposed to take over command of the ship himself, and called to the leading posts men wholly unacquainted with the duties which they were to assume, in order to secure himself from supervision by experts. General von Caprivi became imperial chancellor and Freiherr von Marschall, a former lawyer, secretary of State for foreign affairs. Such men were meant only to be channels for executing William's will. Indeed, the emperor believed up to the end of his reign that he himself was the real guiding force of all German policy. If, however, we consider more closely the system of government which developed after Bismarck's dismissal, we find that the emperor's influence was not nearly so great as most of his contemporaries assumed. The right which he enjoyed of nominating at his personal discretion the imperial chancellor, the secretaries of State and the Prussian ministers naturally gave him great influence.

Yet the emperor could not lay down a consistent line of policy, if only for the reason that he himself possessed no solid views, based on definite convictions, in the main questions, and that he had neither the will nor the perseverance to help with hard, sustained work on the big issues. This was apparent even in foreign affairs, which attracted his chief interest. The emperor read a great part of the despatches from the ministers abroad and added notes to them, mostly expressing his views at the moment, but seldom containing real political directions. Reports were rendered to him verbally or in writing on important questions and his decisions were put away in the files. He also often had political conversations with the representatives of foreign powers and made a rule of reporting all these in detail to the Foreign Office. When he was travelling, which was often the case, he was accompanied by a member of the diplomatic service who saw to communications between him and the Foreign Office.

Very often, and particularly in important questions, he let himself be persuaded by his ministers into decisions altogether contrary to his own views. For example, immediately after Bismarck's dismissal, he allowed Caprivi and Holstein to dissuade him from renewing the re-insurance treaty with Russia, although he personally wished, and had, indeed, already consented to renew it. Later he always disapproved at heart of Holstein's and Bülow's policy in Morocco, but allowed himself time and again to be persuaded into approving of the measures proposed by his advisers. On the whole, William II. did not so much exercise a real, lasting control, as produce confusion by sudden and impulsive interference.

In foreign policy, after Bismarck's dismissal, as the new chancellor and the new secretary of State had absolutely no experience in this field, the actual control fell into the hands of Baron von Holstein, chief of the political department in the Foreign Office, a mistrustful and misanthropic eccentric who shrank from any sort of public appearance, never reported to the emperor or appeared in parliament, but provided the ministers with his information from the seclusion of his office. He always regarded the emperor's personality and inclination to personal interference with the greatest mistrust. When the chancellor and secretary of State, out of loyalty to their sovereign—a feeling very little developed in Holstein—put up too weak an opposition to the emperor, he tried by every kind of intrigue to egg them on or else to turn them out, and had them attacked in the press with which he was connected. Consequently during the decade after Bismarck's dismissal there was a continual feeling of crisis which might at any moment have led to grave conflicts.

The events of William II.'s reign will be found elsewhere. (*See* GERMANY.) Here we can only attempt to indicate the emperor's personal share in the most important decisions of this time, beginning with foreign policy.

Foreign Policy.—Although the non-renewal of the re-insurance treaty was contrary to the emperor's wish, the *rapprochement* with England which began with the conclusion of the Heligoland treaty, undoubtedly accorded at the time with his personal wishes. He was anxious to create a counterpoise to the pressure of the incipient Franco-Russian *rapprochement* by strengthening relations between the Triple Alliance and England. But he very soon experienced bitter disappointments; the interests of Germany and England clashed violently in Africa, and England, after the outbreak of the Chinese-Japanese War (1894) followed the opposite policy to Germany in the Far East. Germany's intervention in this struggle against Japan and on the side of France and Russia was essentially the work of Baron von Holstein. The emperor had at first shown great personal sympathies for the military efficiency of Japan, but skilful working on his Christian sentiments and his fear of the "yellow peril," persuaded him to fall in with Holstein's advice; especially as this coincided with his personal ambition to seize the occasion to secure for Germany a naval base in the Far East. He then promised the tsar of Russia support if the latter's Far Eastern policy led him into difficulties, the tsar, in return, consenting on Russia's behalf to Germany's occupying a Chinese port.

After these events had brought about a coldness between Germany and England, the emperor devoted his chief attention to strengthening the German war fleet, in which he had always felt a strong personal interest. He used every opportunity, public and private, to advocate this move, because he was convinced that Germany would only be able to follow a policy independent from England if she was covered against attack from the sea by a strong navy of her own. Throughout his entire reign, the expansion of German sea power remained one of the unaltered principles of his policy; from 1897 on he found in Admiral von Tirpitz, the secretary of State for naval affairs, an enthusiastic assistant in these plans, who was capable of giving them practical form and of defending them against statesmen and parliament.

If the emperor's naval policy already showed a deep mistrust of England, this was intensified by British policy towards the Boers. When Jameson made his raid into the Transvaal in 1896,

the emperor seriously thought of breaking off diplomatic relations with the British Government if it countenanced Jameson's conduct. He even planned a military intervention in favour of the Boers; his advisers only restrained him from doing so, with difficulty, by proposing instead the despatch of the notorious telegram to President Kruger. The growing tension of relations with England made the emperor increasingly ready to adopt the idea, originally put forward by Holstein and afterwards also repeatedly advocated by Bülow, of seeking *rapprochement* with France via St. Petersburg (Leningrad) in order to create a counterpoise to the threatening increase of British power through an alliance of all the great European continental States, the so-called Continental Alliance. It may, however, be doubted whether all these efforts were not only meant to serve to bring England to change her policy and enter into closer relations with Germany. For the emperor always retained a lively sympathy for England, which was expressed in particularly vivid fashion in the reports which he sent to the German Foreign Office on his frequent visits to that country. On the other hand, he also felt himself attracted to Russia by old family traditions and by the consciousness of common monarchic interests, and probably never really made up his own mind which of these two countries would prove the more valuable ally for Germany. Holstein and Bülow, who thought Germany would do best to bind herself to neither of these two Powers, but to sell her support to the one or the other, as the case arose, for concrete concessions, took advantage of the emperor's uncertainty to restrain him from entering into any binding engagements on one side or the other. Bülow flattered his vanity by representing to him that he would then become the arbiter of the world. Nevertheless, when England began in the spring of 1898, at Chamberlain's instigation, to sound Germany regarding a German-English alliance, William II. showed a real inclination to accept this offer, and all his advisers' cunning and precautions were needed to keep him in the path which they considered desirable.

After the failure of these negotiations, when England first drew closer to France and Russia and the path was cleared for the Entente, Berlin began to grow apprehensive. Holstein and Bülow thought it their duty to show the world, in the Morocco question, that France and England were not to be allowed to dictate the partition of the world's remaining colonial territories without reference to Germany, especially as Russia was at the time completely immobilized by her severe struggle with Japan. The emperor, whose personal view it was that German interests in Morocco were not large enough to justify such an attitude, and who only a short while previously had told the king of Spain that Germany demanded nothing for herself in Morocco, was utterly opposed to such interference. Bülow needed all his art of persuasion to persuade him to land in Tangier on his Mediterranean voyage in March 1905. Up to the last moment he hesitated whether to do this. Here he certainly showed more political wisdom than his advisers, but once again he was too weak to carry his point against them. The result of Germany's action here was not only to make her relations with France more strained, but also to confirm the Franco-British entente. It is well-known that the agreements between these two Powers for military and naval co-operation in case of war were a result of the Morocco crisis.

Another reason why the emperor viewed the increasing tension of Franco-German relations with alarm was because, after the failure of the negotiations for an alliance with England, he had resumed with new zest the idea of a Continental Alliance. Bülow prevented him from intervening during the delicate negotiations with Paris on the preparations for the Algeciras conference, but only by concealing from him altogether the offer made by Rouvier, the French minister-president, for a general understanding with Germany. He consented, however, that the emperor should take advantage of his meeting with the tsar in Finland to conclude with him a treaty, to which France should afterwards be asked to adhere. The emperor in fact succeeded at the meeting in Björkö (July 23, 1905) in persuading the tsar Nicholas to sign an offensive and defensive alliance. He believed that he had won a great success, and wrote to Bülow that the meeting had been a turning point in the history of the world. This, however, soon proved to be a complete error; when the tsar returned to St. Petersburg his ministers persuaded him to demand a revision of the treaty, as in its existing form it was irreconcilable with the provisions of the Franco-Russian treaty. As the alterations proposed by Russia would have deprived the treaty of its whole value for Germany, it was thought best to drop the whole affair and the Björkö treaty was buried for good and all.

Germany's situation now grew increasingly dangerous; Russia's adhesion to the Franco-British entente (1907) was followed by growing tension between Germany and England, due principally to the fears aroused in England by the German naval programme. Various early attempts by England to reach an understanding with Germany on the naval armaments of the two Powers broke down because the emperor, in agreement with Admiral von Tirpitz, maintained that any engagement of this sort was dishonourable to Germany. On this point Bülow disagreed with the emperor. He would willingly have negotiated with England on a limitation of armaments; but when King Edward visited Friedrichshof in Aug. 1908, the emperor told the British official, Hardinge, most abruptly, that he would not agree to any negotiations of the sort, and Bülow thought it better not to press his own view any further at present, hoping to be able to convert the emperor gradually. In the autumn of 1907 the emperor visited England, and made remarks which, in his opinion, were calculated to remove the apprehension aroused in England by the German naval programme. Soon after, these remarks were published as an interview with the *Daily Telegraph,* but produced exactly the opposite effect to that which had been intended. They were looked on in England as an attempt by a foreign monarch to interfere in England's private affairs. In Germany also the publication evoked lively disapproval and led to a question in the Reichstag and to an excited debate on the emperor's personal conduct of affairs. The emperor was obliged to make a declaration (Oct. 31, 1908), that he would in the future undertake no political step of importance without the chancellor's advice.

The first conflict between the Triple Alliance and the Entente arose over Austria's annexation of Bosnia in the autumn of 1908, in consequence of the Young Turk revolution. Serbia protested against the annexation, and as Russia supported her, a severe crisis broke out. Here again the emperor and Bülow differed. The emperor was shocked by Austria's action, which she had taken without previously informing Germany. He accused Vienna of duplicity and said that he personally felt himself most deeply wounded in his sentiments as an ally. Bülow, however, fearing that Germany would lose her last reliable ally, thought it right to support Austria at all costs.

Soon afterwards, Bülow, having been defeated in the Reichstag on the question of financial reform, again offered his resignation, which was this time immediately accepted by the emperor. The chancellor had long enjoyed his particular favour; but their relations had become increasingly unhappy for some time past. This was due partly to differences on points of policy, but even more to the emperor's feeling that Bülow had deceived him and left him in the lurch over the *Daily Telegraph* affair. Bethmann-Hollweg was now appointed imperial chancellor; but the emperor never really trusted him. Bethmann-Hollweg's earlier career had been passed in the internal administrative service and he himself realized his own lack of experience in foreign affairs; he therefore insisted on the appointment of Kiderlen-Wächter, formerly minister in Bucharest, as secretary of State. Kiderlen-Wächter enjoyed a reputation for unusual skill and energy, but more than ten years previously he had incurred the emperor's personal dislike in a private matter. He was primarily responsible for the new collision with France which arose in 1911 when the French began to bring Morocco under their rule altogether. Here again the emperor was against letting a fresh quarrel between Germany and France arise over Morocco. At his instigation, a treaty with France had been concluded in Feb. 1909, while Bülow was still in office, allowing France an exceptional position in Morocco. Kiderlen, however, believed that France would be prepared to cede the French Congo wholly or in part to Germany in return for a free hand in Morocco; he succeeded in making the emperor be-

lieve that this could be reached at the cost of a little pressure. Here again William yielded against his own better judgment to pressure from his advisers and agreed to the despatch of the "Panther," a small ship of war, to the Moroccan coast. Kiderlen did, indeed, obtain some of his demands, but the resentment in France now grew increasingly serious, and Germany's relations with England, who felt herself particularly pledged to support France over Morocco, deteriorated correspondingly.

Nevertheless one more opportunity for a German-English *rapprochement* seemed to offer itself, when the peace of Europe was dangerously threatened by the outbreak of the Balkan Wars. Relations seemed to have become really happy when Lord Haldane, the British War Minister, visited Berlin in Feb. 1912 on an official mission, and held personal conversations with the emperor, Tirpitz and Bethmann-Hollweg. The emperor in his sanguine fashion believed that his interview with Haldane had resulted in a complete understanding, but failed to see that the limitation of Germany's naval armament was still the British *sine qua non*; whereas he himself and Tirpitz were just engaged in drafting a new bill for increasing the rate of naval construction. This attempted *rapprochement* thus led to renewed coolness.

When the murder of the heir to the Austrian throne precipitated a crisis which led to the World War, the emperor was determined from the start to help Austria to get satisfaction from Serbia. Real difficulties could only arise if Russia took Serbia's part. The emperor, however, reckoned firmly on the community of monarchical interests, which he believed would prevent the tsar from coming forward as protector to the murderers of a prince. He failed to see that the final decision in Russia did not really lie with the weak tsar at all. The emperor himself did not at first imagine that any danger of war could arise. He started off on his Baltic cruise, without making any preparations; the alleged "Crown council" in Potsdam never took place. He did not return till after the Austrian Note to Belgrade had already been delivered; and he personally thought the Serbian answer quite fitting to form a basis for future negotiations. He disapproved when, despite this answer, Austria mobilized and declared war on Serbia, and he undoubtedly approved of Bethmann-Hollweg's eleventh-hour attempt to persuade the Austrians to hold their hand and to negotiate directly with Russia. He also sent a number of personal telegrams to the tsar Nicholas to try to restrain him from the mobilization which finally led to the outbreak of the war, and to offer him his mediation. All these endeavours to maintain peace proved, however, unsuccessful. The idea that the emperor wished for a war in order to found a German world empire, or to make any conquests at all, though widely current during the war, is, in the opinion of the writer, incorrect.

Interference in Internal Policy.—The emperor's interventions in German internal policy were also irregular. The first occasion was when he called on Bismarck to proclaim a far-reaching social and political reform. Only a small fraction of this was carried out during the first years of his reign. As these measures had not the desired effect of winning the mass of the workers from Social Democracy, a feeling of disappointment overcame the emperor. He always looked upon Social Democracy, which was republican on principle, as the irreconcilable enemy of the whole existing order, and particularly of the monarchy, and held it to be his duty to fight against it with all the means in his power. The murder of the French president, Carnot, seemed to him to be a sign of the increasing effect of international social propaganda, and after the autumn of 1894 he pleaded repeatedly in his speeches that the revolutionary movement must be fought, and called on his ministers to bring in fresh emergency legislation penalizing all attempts to overthrow the social order and any agitation in favour of class hatred with penal servitude. It was the differences which this bill evoked among the emperor's advisers that led to the dismissal of Caprivi in Oct. 1894 and the appointment of Prince Hohenlohe as imperial chancellor. Hohenlohe brought in a bill, which was rejected by the Reichstag in May 1895. The emperor, however, returned again and again to the idea but was never able to carry it through.

Another matter which caused him anxiety was the increasing influence of the Centre Party in the Reichstag and in the Prussian diet. Himself a Protestant, he resented the growing power of the Catholic elements. He intervened personally when the Centre allied itself with the Conservatives and attempted to pass a primary education act for Prussia, which would have increased the influence of the Church in the schools to an extraordinary degree. Being hostile both to Social Democracy and to the Centre party, the emperor naturally looked with sympathy on the idea of forming a working majority in parliament by a coalition between the Conservative and Liberal parties. Prince Bülow, who had become Imperial Chancellor in 1899, attempted to put this idea into practice, his own feelings agreeing here with the emperor's. The elections of Jan. 1907, which brought the so-called "Bloc Parties" a considerable majority, seemed to the emperor to be a personal victory for himself. Bülow's inability to form a permanent coalition between the Bloc Parties, and to carry through the urgent financial reform by their help, seemed to the emperor a proof that the chancellor was incapable of carrying through his principles in domestic policy and strengthened him in his decision to accept his resignation.

The emperor did not openly rebel against the constitutional form of government which he found on his accession, since he saw the impossibility of altering it, but at heart he always disliked it, and his dislike increased in proportion to the numerical growth of Social Democracy and of the Centre in the parliaments. He looked on parliament as a necessary evil, and always considered the monarch to be the true vessel of sovereign power, appointed thereto by God. The opposition raised by the Reichstag to the emergency legislation which he desired, and the difficulties which had to be overcome over every increase of the army or the fleet led him on many occasions into bitter remarks about the people's representative. The emperor never had any new and constructive ideas on matters of domestic policy.

The World War.—On the outbreak of the World War, the emperor himself felt his own inability to take over the supreme command of the military operations. During the first years of the war an appearance was kept up of referring the last decisions to the imperial headquarters; but William was increasingly reduced to the position of a mere onlooker. The choice of leaders lay, indeed, in his hand, and here he did not always show the best judgment. He only agreed with reluctance, and under the pressure of emergency, to make Hindenburg commander-in-chief and to leave the real decisions to him and Ludendorff. The inaction of the German fleet during the first years of the war is also to be attributed to the emperor's personal wish, and involved him in a sharp difference with Admiral von Tirpitz.

After Aug. 1918 it became ever clearer that the existing situation was growing untenable; and now the emperor proved himself once again incapable of a firm decision. He was driven forward step by step by events and by individual advisers who managed to win his ear. A Crown Council under his presidency resolved to initiate peace negotiations; yet he allowed so much time to be wasted before this decision was executed, that in the meantime the military situation took a turn fatal for Germany. At the same time the signs of discontent in the population and in parliament increased, and he let himself be persuaded to appoint Prince Max of Baden imperial chancellor in Oct. 1918, although the prince was looked on as an advocate of the parliamentary methods which the emperor hated in his heart. After this, when President Wilson in his proclamations showed clearly that he considered the person of the emperor to be a real obstacle to the conclusion of peace, Prince Max, in agreement with the majority of the Reichstag, called upon the emperor to abdicate, a step which was not at first thought to involve the removal of the Hohenzollern dynasty. The outbreak of the revolution at the beginning of Nov. 1918 and its rapid growth made an immediate decision urgently necessary. As the emperor hesitated, Prince Max acted on his own authority, and on Nov. 9, proclaimed that the emperor would renounce the throne and the crown prince the succession, and that a regency was to be formed. The victorious Socialist party, however, was no longer satisfied with these concessions but proclaimed a republic.

The emperor, who was at that time on the western front, was now confronted with a very difficult decision. He might have ventured an attempt to overthrow the revolution by force by detaching a portion of the army on the western front, whose loyalty to the sovereign was not yet shaken. It was, however, doubtful whether the remainder of this army would be able, meanwhile, to defend Germany's western frontiers against the increasingly violent attacks of the enemy. Or again, he might have placed himself at the head of his army and sought death on the field of battle. Both these were courses which only a strong and confident personality could have taken. William II. preferred to abandon the army, steal quietly away from the territory of his former empire, and escape to Holland on Nov. 10. His action dealt a fatal blow to the monarchist cause in Germany. The minor princes now saw no issue but to capitulate and to abdicate before the revolution.

On arrival in neutral Holland, William was interned. The castle of Doorn was given him as a residence and he lived henceforth in complete retirement from the world. During the peace negotiations the idea arose from time to time among Germany's enemies of demanding his extradition and punishing him for initiating the war, of which he was unjustly accused. Finally, however, this idea was abandoned. The most important change in William's circumstances during these last years was his second marriage, after the death of the Empress Augusta Victoria, with the widowed Princess Hermine of Schonaich-Carolath. He died at Doorn June 4, 1941 and was buried there. A military funeral was ordered by Adolf Hitler. (E. BRA.)

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See *Kaiserreden; Reden und Erlässe, Briefe und Telegramme Kaiser Wilhelms II.* (ed. A. O. Klaussmann, 1902): Eng. trans., selection, *The German Emperor's Speeches* (ed. L. Elkind, 1904); *Briefe Wilhelm II. an den Zaren 1894–1914* (ed. W. Goetz, 1920; Eng. trans. I. D. Levine, 1921); F. Rachfahl, *Kaiser und Reich, 1888–1913* (1913); W. von Massow, *Die deutsche innere Politik unter Kaiser Wilhelm II.* (1913); J. L. de Lanessan, *L'empire germanique sous la direction de Bismarck et de Guillaume II.* (1915); H. Oncken, *Die Friedenspolitik Kaiser Wilhelms II.* (1918); W. Rathenau, *Der Kaiser* (1919); *Die Grosse Politik der Europäischen Kabinette, 1871–1914* (German Foreign Office, 1922, etc.); E. Ludwig, *Wilhelm II.* (1926; Eng. trans. 1926); *Letters of the Empress Frederick* (ed. F. Ponsonby, 1928).

WILLIAM I. (1772–1844), king of the Netherlands, born at The Hague on Aug. 24, 1772, was the son of William V., prince of Orange and hereditary stadtholder of the United Netherlands by Sophia Wilhelmina, princess of Prussia. In 1791 he married Frederica Wilhelmina, daughter of Frederick William II., king of Prussia, thus cementing very closely the relations between the houses of Orange-Nassau and Hohenzollern. After the outbreak of war with the French republic in 1793, he distinguished himself in the struggle against the revolutionary army under Dumouriez by the capture of Landrecies and the relief of Charleroi. By the victories of Pichegru the stadtholder and all his family were, however, compelled to leave Holland and seek refuge in England, where the palace of Hampton Court was set apart for their use. He afterwards made Berlin his residence, and took an active part in the unfortunate campaign under the duke of York for the reconquest of the Netherlands. After the peace of Amiens he had an interview with Napoleon at Paris, and received some territory adjoining the hereditary domains of the house of Nassau in Westphalia as a compensation for the abandonment of the stadtholderate and the domains of his house. William refused, however, in 1806, in which year by the death of his father he became prince of Orange, to separate his interests from those of his Prussian relatives, and fought bravely at Jena. He was therefore despoiled by Napoleon of all his possessions. In 1809 he accepted a command in the Austrian army under the archduke Charles and was wounded at the battle of Wagram. When Holland rose in revolt against French domination in 1813, after eighteen years of exile he landed at Scheveningen (on Nov. 19) and was on Dec. 3, proclaimed prince sovereign of the Netherlands. His assumption in 1814 of the title of king of the Netherlands was recognized by the Powers, and by the Treaty of Paris his sovereignty was extended over the southern as well as the northern Netherlands, Belgium being added to Holland "as an increase of territory." After the battle of Waterloo, in which Dutch and Belgian troops fought side by side under his command, the congress of Vienna further aggrandized him by making him sovereign of the territory of Luxembourg with the title of grand duke.

William failed to realise that religious, racial and other differences made the union of the Netherlands and Belgium difficult. He drew up a constitution, which was accepted unanimously by the Dutch, but was rejected by the Belgians, because it contained provisions for liberty of worship. The king, however, by a subterfuge declared that the fundamental law had been approved. The new constitution, therefore, started badly, and it was soon evident that William intended to make his will prevail, and to carry out his projects for what he conceived the social, industrial and educational welfare of the kingdom regardless of the opposition of Belgian public opinion. For the discontent which culminated in the revolt of 1830 *see* BELGIUM: *History*. The Dutch were almost without striking a blow expelled from the country, the strongly fortified seaport of Antwerp alone remaining in their hands. Had the king consented at once to the administrative autonomy of Belgium, and appointed the prince of Orange governor of the southern Netherlands, the revolt might perhaps have been appeased. William, however, was too proud and too obstinate to lend himself to such a course. He appealed to the Powers, who had, in 1815, created and guaranteed the independence of the kingdom of the Netherlands. By the treaty of the eighteen articles, however, concluded at London on June 29, 1831, the kingdom of Belgium was recognized, and Leopold of Saxe-Coburg was elected king. William refused his assent, and in August suddenly invaded Belgium. The Belgian forces were dispersed, and the Dutch would have entered Brussels in triumph but for the intervention of the French. Still, however, William declined to recognize the new throne, and he had behind him the unanimous support of Dutch public opinion. For nine years he maintained this attitude, and resolutely refused to append his signature to the treaty of 1831. His subjects at length grew weary of the heavy expense of maintaining a large military force on the Belgian frontier and in 1839 the king gave way. He did so, however, on favourable terms and was able to insist on the Belgians yielding up their possession of portions of Limburg and Luxembourg which they had occupied since 1830.

A cry now arose in Holland for a revision of the fundamental law and for more liberal institutions; ministerial responsibility was introduced, and the royal control over finance diminished. William, however, disliked these changes, and finding further that his proposed marriage with the countess d'Oultremont, a Belgian and a Roman Catholic, was very unpopular, he suddenly abdicated on Oct. 7, 1840. After his abdication he married the countess and spent the rest of his life in quiet retirement upon his private estate in Silesia. He died in 1844.

See L. Jottsand, *Guillaume d'Orange avant son avénement au trône des Pays-Bas;* E. C. de Gerlache, *Histoire du royaume des Pays-Bas depuis 1814 jusqu'en 1830* (3 vols., Brussels, 1842); W. H. de Beaufort, *De eerste regeeringsjaren van Koning Willem I.* (Amsterdam, 1886); H. C. Colenbrander, *De Belgische Omwenteling* (The Hague, 1905); T. Juste, *Le Soulèvement de la Hollande en 1813 et la fondation du royaume des Pays-Bas* (Brussels, 1870); P. Blok, *Geschiedenis der Nederlandsche Volk*, vols. vii. and viii. (Leiden, 1907–08); H. T. Colenbrander, *Gedenksbukken d. algem. gesch. v. Netherland, d8–10, Regeering v. William I.* (1915–20).

WILLIAM II. (1792–1849), king of the Netherlands, son of William I., was born at The Hague on Dec. 6, 1792. When he was three years old his family was driven out of Holland by the French republican armies, and lived in exile until 1813. He was educated at the military school at Berlin and afterwards at the University of Oxford. He entered the English army, and in 1811, as *aide-de-camp* to the duke of Wellington, took part in several campaigns of the Peninsular War. In 1815 he commanded the Dutch and Belgian contingents, and won high commendations for his courage and conduct at the battles of Quatre Bras and Waterloo, at the latter of which he was wounded. The prince of Orange married in 1816 the grand duchess Anna Pavlovna, sister of the tsar Alexander I. In 1830, on the outbreak of the Belgian revolution, he went to Brussels, and tried to bring about a peaceable settlement on the basis of the administrative auton-

omy of the southern provinces under the house of Orange. His father had given him powers to treat, but afterwards threw him over and rejected the terms of accommodation that he had proposed. He withdrew on this to England and resided there for several months. In April 1831 William took the command of a Dutch army for the invasion of Belgium, and in a ten-days' campaign defeated and dispersed the Belgian forces under Leopold I. after a sharp fight near Louvain. His victorious advance was stayed by the intervention of the French. In 1840, on the abdication of his father, he ascended the throne as William II. The peace of 1839 had settled all differences between Holland and Belgium, and the new king found himself confronted with the task of the reorganization of the finances, and the necessity of meeting the popular demand for a revision of the fundamental law, and the establishment of the electoral franchise on a wider basis. He acted with good sense and moderation, and, although by no means a believer in democratic ideas, he saw the necessity of satisfying public opinion and frankly gave his support to larger measures of reform. The fundamental law was altered in 1848 and the Dutch monarchy, from being autocratic, became henceforth constitutional. The king's attitude secured for him the good will and affection of a people, loyal by tradition to the house of Orange, and the revolutionary disturbances of 1848 found no echo in Holland. William died suddenly on March 17, 1849.

See J. J. Abbink, *Leven van Koning Willem II.* (Amsterdam, 1849); J. Bosscha, *Het Leven van Willem den Tweede, Koning der Nederlanden, 1793–1849* (Amsterdam, 1852); P. Blok, *Geschiedenis der Nederlandsche Volk* (Leyden, 1908).

WILLIAM III. (1817–1890), king of the Netherlands, son of William II., was born at Brussels on Feb. 19, 1817. He married in 1839 Sophia, daughter of William I., king of Württemberg. The marriage was an unhappy one, and ended in complete estrangement. William had no sympathy with political liberalism, but throughout his long reign of forty-two years, with a constant interchange of ministries and many ministerial crises, he never had a serious conflict with the states-general. He was economical, and gave up a third of his civil list in order to help forward the task of establishing an equilibrium in the annual budget, and he used his large private fortune to forward schemes of social and industrial progress.

William's two sons by his marriage with Sophia of Württemberg, William (1841–1879) and Alexander (1843–1884), died unmarried. By his second marriage in 1879, with the princess Emma of Waldeck-Pyrmont, he had a daughter, Wilhelmina (*q.v.*), who succeeded him. William died at the Loo, on Nov. 23, 1890.

See J. A. Bruijne, *Geschiedenis van Nederland in onzen tijd.* (5 vols., Schiedam, 1889–1906); P. Blok, *Geschiedenis der Nederlandsche Volk* (Leiden, 1908), vol. viii.; and G. L. Keppers, *De regeering van Koning Willem III.* (Groningen, 1887).

WILLIAM (1227–1256), king of the Romans and count of Holland, was the son of Count Floris IV. and his wife Matilda, daughter of Henry, duke of Brabant. He was about six years of age at his father's death, but his long minority, under the guardianship of his two paternal uncles, was peaceful. In 1247 William allowed Pope Innocent IV. to proclaim him king of the Romans in opposition to the excommunicated Frederick II., and having taken Aix-la-Chapelle, was crowned there on All Saints' Day, 1248. He thus became the recognized head of the Guelph party, but even after Frederick's death he had gained few adherents, when he was killed on Jan. 28, 1256. He was more successful in asserting the rights of John of Avennes, who had married his sister Aleidis, to the county of Hainaut against John's mother, Margaret, whom he defeated decisively at West Kappel in 1253.

See A. Ulrich, *Geschichte des römischen Königs, Wilhelm von Holland* (Hanover, 1882).

WILLIAM (1143–1214), king of Scotland, surnamed "the Lion," was the second son of Henry, earl of Huntingdon (d. 1152), a son of King David I., and became king of Scotland on the death of his brother, Malcolm IV., in Dec. 1165, being crowned at Scone during the same month. After his accession to the throne William spent some time at the court of the English king, Henry II.; then, quarrelling with Henry, he arranged in 1168 the first definite treaty of alliance between France and Scotland, and with Louis VII. of France assisted Henry's sons in their revolt against their father in 1173. In return for this aid the younger Henry granted to William the earldom of Northumberland, a possession which the latter had vainly sought from the English king, and which was possibly the cause of their first estrangement. However, when ravaging the country near Alnwick, William was taken prisoner in July 1174, and after a short captivity at Richmond was carried to Normandy, where he purchased his release by assenting in Dec. 1174 to the Treaty of Falaise. By this arrangement the king and his nobles, clerical and lay, undertook to do homage to Henry and his son; this and other provisions placing both the church and state of Scotland thoroughly under the suzerainty of England. William's next quarrel was with Pope Alexander III., and arose out of a double choice for the vacant bishopric of St. Andrews. But in 1188 William secured a papal bull which declared that the Church of Scotland was directly subject only to the see of Rome, thus rejecting the claims to supremacy put forward by the English archbishop. This step was followed by the temporal independence of Scotland, which was one result of the continual poverty of Richard I. In Dec. 1189, by the Treaty of Canterbury, Richard gave up all claim to suzerainty over Scotland in return for 10,000 marks, the Treaty of Falaise being thus definitely annulled.

In 1186 at Woodstock William married Ermengarde de Beaumont, a cousin of Henry II., and peace with England being assured three years later, he turned his arms with success against the turbulent chiefs in the north and west. Soon after John's accession in 1199 the Scottish king asked for the earldom of Northumberland, which John, like his predecessors, refused; but the threatened war did not take place, and in 1200 William did homage to the English king at Lincoln with the ambiguous phrase "saving his own rights." War again became imminent in 1209; but a peace was made at Norham, and about three years later another amicable arrangement was reached. William died at Stirling on Dec. 4, 1214, and was buried at Arbroath. He left one son, his successor Alexander II., and two daughters, Margaret and Isabella, who were sent to England after the treaty of 1209, and who both married English nobles, Margaret becoming the wife of Hubert de Burgh. He also left some illegitimate children.

See E. W. Robertson, *Scotland under her Early Kings* (Edinburgh, 1862); Lord Hailes, *Annals of Scotland* (Edinburgh, 1819); A. Lang, *History of Scotland,* vol. i. (1900); also SCOTLAND: *History.*

WILLIAM I. (d. 1166), king of Sicily, son of King Roger II. by Elvira of Castile, succeeded in 1154. His title "the Bad" probably expresses the bias of the historian Falcandus and the baronial class against the king and the official class by whom he was guided. William was far inferior in character and energy to his father, however, and the real power in the kingdom was at first exercised by Maio of Bari, whose title *ammiratus ammiratorum* was the highest in the realm. Maio continued Roger's policy of excluding the nobles from the administration, and sought also to curtail the liberties of the towns. The barons were encouraged to revolt by Pope Adrian IV., whose recognition William had not yet sought, by the emperor Manuel and the emperor Frederick II. At the end of 1155 Greek troops recovered Bari and began to besiege Brindisi.

William, however, destroyed the Greek fleet and army at Brindisi (May 28, 1156) and recovered Bari. Adrian came to terms at Benevento (June 18, 1156), abandoned the rebels and confirmed William as king, and in 1158 peace was made with the Greeks. These diplomatic successes were probably due to Maio; on the other hand, the African dominions were lost to the Almohads (1156–1160). The policy of the minister led to a general conspiracy, and in November 1160 he was murdered in Palermo by Matthew Bonello, leader of the Sicilian nobles. For a while the king was in the hands of the conspirators, but the people and the army rallied round him; he recovered power, crushed the Sicilian rebels, and in a short campaign reduced the rest of the Regno. Thus freed from feudal revolts, William confided the government to men trained in Maio's school, such as the grand notary, Matthew d'Agello. He was the champion of the

true pope against the emperor, and Alexander III. was installed in the Lateran in November 1165 by a guard of Normans. William died on May 7, 1166.

WILLIAM II. (d. 1189), king of Sicily, was only thirteen years old at the death of his father William I. when he was placed under the regency of his mother, Marguerite of Navarre. Until 1171 the government was controlled first by the chancellor Stephen of Perche (1166–1168), and then by Walter Ophamil, archbishop of Palermo, and Matthew d'Ajello, the vice-chancellor. William's character is indistinct; yet his reign is marked by an ambitious foreign policy and a vigorous diplomacy. Champion of the papacy and in secret league with the Lombard cities he defied the common enemy, Frederick II. In 1174 and 1175 he made treaties with Genoa and Venice and in February 1177 he married Joan, daughter of Henry II. of England. To secure peace with the emperor he sanctioned the marriage of his aunt Constance, daughter of Roger II., with Frederick's son Henry, afterwards the emperor Henry VI., causing a general oath to be taken to her as his successor in case of his death without heirs. This step, fatal to the Norman kingdom, was possibly taken that William might devote himself to foreign conquests. He now attacked Egypt, but Saladin's arrival before Alexandria, forced the Sicilians to re-embark in disorder. On the death of Manuel Comnenus (1180), William took up the old design and feud against Constantinople. Durazzo was captured (June 11, 1185), Thessalonica surrendered in August, and the troops then marched upon the capital; but were overthrown on the banks of the Strymon (Sept. 7, 1185). Thessalonica was abandoned and in 1189 William made peace with Isaac, abandoning all the conquests. He now planned to induce the crusading armies of the West to pass through his territories, and seemed about to play a leading part in the third Crusade. His admiral Margarito kept the eastern Mediterranean open for the Franks, and forced Saladin to retire from before Tripoli in the spring of 1188. In November 1189 William died, childless.

WILLIAM I. [Friedrich Karl] (1781–1864), king of Württemberg, son of Frederick, afterwards King Frederick I. of Württemberg, was born at Lüben, Silesia, on Sept. 27, 1781. In early years he took no part in public life owing to a quarrel with his father whose deference to Napoleon displeased him; but in 1814–15 commanded an army corps in the Wars of Liberation with distinction. On his accession in 1816 he realized the expectations formed of him as a liberal-minded ruler by promulgating a constitution (1819), under which serfdom and obsolete class privileges were swept away, and by issuing ordinances which greatly assisted the financial and industrial development and the educational progress of his country. In 1848 he issued further liberal decrees; but his relations with the legislature having become hopelessly strained over questions of Germanic policy, William repudiated the enactments of 1848–49 and summoned a packed parliament (1851), which re-enforced the code of 1819.

William encountered similar difficulties as a champion of Germanic union and of the rights of the Middle Germanic States against encroachments by Austria and Prussia. In 1820–23 he protested against Metternich's treatment of the minor German States and in 1848–49 opposed the proposals for a Germanic union made by the Frankfort Diet, for fear of granting Prussia excessive preponderance. Thus he gradually became the ally of Austria against Prussia. Nevertheless his devotion to the cause of Germanic union is proved by the eagerness with which he helped the formation of the Zollverein (1828–1830), and in spite of his conflicts with his chambers he achieved unusual popularity with his subjects. He died on June 25, 1864.

See Nick, *Wilhelm I., König von Württemberg, und seine Regierung* (Stuttgart, 1864).

WILLIAM (1882–), late Crown Prince of Germany, eldest child of William II. of Germany, was born at the Marble Palace, Potsdam, on May 6, 1882. He began his military career by serving in the 1st Foot Guards, and accompanied the Kaiser to England (Jan. 19–Feb. 5, 1901) on the occasion of the funeral of Queen Victoria. On June 6, 1903 he married the Duchess Cecilia, sister of the Grand Duke of Mecklenburg-Schwerin. There were five children, four sons and one daughter, of the marriage. His political and personal interventions in public affairs gave some trouble in the years preceding the War.

On the outbreak of World War I the Crown Prince was appointed to the command of the V. Army in the west. In Sept. 1915 he received the command of an army group, and he was nominally in charge of the German operations against Verdun. His flight to Holland speedily followed that of the Emperor in Nov. 1918, and he went to Wieringen, an island in the Zuider Zee. He formally renounced on Dec. 1, 1918 his rights of succession to the crowns of Prussia and the German Empire. The ex-Crown Princess and her children, however, continued to reside at Potsdam. On Nov. 10, 1923 he suddenly returned to his estate at Oels in Silesia. There was strong feeling in France that the German Government should be compelled to surrender him, but the matter was settled by a German note which stated the act of renunciation of the ex-Crown Prince and declared that the return of the Kaiser would not be permitted. The Allied Powers declared that they would hold Germany responsible for any consequences which might arise, but the ex-Crown Prince himself declared that he would take no part in politics. His memoirs, *Ich suche die Wahrheit* were published in 1922 (English translation by R. Butler, *I seek the truth,* 1926).

WILLIAM (1533–1584), surnamed the Silent, count of Nassau and prince of Orange, was born at the castle of Dillenburg in Nassau on April 25, 1533, eldest of the five sons of William count of Nassau and Juliana of Stolberg (*see* Nassau). The boy's father had decided leanings towards Lutheranism, his mother was a convinced adherent of the new faith. So it was not without hesitation that the emperor sanctioned an arrangement by which the great heritage of the Nassau family in his Netherlands dominions and the princedom of Orange would fall to their son, and when he did sanction it, it was on condition that the old count should surrender all claims to the guardianship and that the boy should be educated in the Netherlands, with a household of Netherlanders, and as a Catholic. To this arrangement the father consented.

William of Orange thus grew up, at Brussels and at Breda, a great Netherlands nobleman, marked out for a career in the service of the ruler. In 1551 he married Anna van Buren, an heiress of the Egmont family, adding estates in Holland to his already extensive possessions. Charles V. distinguished him with his favour. Philip II., too, began by creating Orange a member of the Brussels Council of State, and before he left the Netherlands for Spain, 1559, he made him his governor (Stadtholder) in the provinces of Holland, Zeeland and Utrecht.

If William of Orange's career was soon so startlingly to deviate from the lines of tradition laid down for him by his predecessors, it was due in the first place to the different relationships in which, in his time, the monarchy had come to stand with respect to the Netherlands. The creation of a united Netherlands state had been the historical task of the Burgundian dynasty. By successive marriages of Mary, daughter of Charles the Bold, with Maximilian of Habsburg, and of their son, Philip the Fair, with Johanna of Spain, that state had become connected with an empire with which it had few interests in common. Under Charles V. already this had created many difficulties, while his son Philip II. looked upon the Netherlands merely as an outpost of the Spanish imperialist policy.

The high nobility of the Netherlands were quick to resent the anti-national tendencies of Philip's government at Brussels. After the king's departure it was carried on by his half-sister, Margaret of Parma, as his regent, but the real force behind her was the bishop of Arras, later archbishop of Mechlin and cardinal, the Franc-Comtois Granvelle, who was made president of the Council of State. Between that zealous and docile minister and the proud, unruly nobles a bitter struggle was soon in progress, in which Orange, with the counts of Egmont and Horn and others, played a conspicuous part. When Orange and Egmont stayed away from the Council of State as a protest against Granvelle's presence there the public realized that grave issues had been raised. In 1564 Philip gave way and ordered Granvelle to depart, whereupon the Regent tried to govern with the noblemen of the Council of

State. It was a victory for the national cause, but at the same time it was a victory for class interests.

One question, which aggravated the difficulties between the ruler and the Netherlands people considerably, had suddenly become of paramount importance when the dismissal of the cardinal seemed to indicate a slackening of purpose on the part of the distant king. All through Charles V.'s reign Lutheranism had been severely kept under. To the Lutheran heresy Calvinism, spreading northward from France, was now added. Public opinion in the Netherlands was generally averse from the savage methods of suppression imposed on the government by Philip. William of Orange never was a very devout Catholic. He had maintained close relations with his Lutheran kinsmen in Germany. His brother Louis, particularly, who spent much of his time at Orange's court at Brussels or Breda, had great influence over him. In 1561, Anna van Buren having died in 1558, the prince had contracted a matrimonial alliance with German Protestantism in the person of Anna of Saxony, daughter of the late Elector Maurice, the betrayer and victor of Charles V. In order to gain the present elector's consent, as well as to quiet the objections and suspicions of Philip II.'s Government, Orange had secretly given to both sides flatly contradictory assurances. The episode shows his character on its least attractive side. But at any rate his position helped him to realize how impossible it was, in the Netherlands, surrounded by countries where Protestantism had in some form or other achieved some sort of recognition, and always open to influences from outside, to enforce a rigid Catholic supremacy. He said so boldly in the Council of State, but it was in vain that he and his friends urged the king to concede some degree of toleration. When Philip, after long delay, by the famous letters from Legovia, ordered more relentless persecution than ever, Orange, realizing the impotence of the Council of State, countenanced the action of his brother Louis, and Hendrik van Brederode, who organized the lower nobility to petition the governess for liberty of conscience. The question was thus brought before the public and excitement raised to fever pitch.

Most of the petitioners were undoubtedly good Catholics, but suddenly there now occurred the outbreak by extreme Calvinists, known as the Breaking of the Images, which brought about a violent reaction. While the nobles lately in opposition ranged themselves behind Margaret of Parma to restore order, Philip prepared to send to the Netherlands an army under the duke of Alva to chastise them and to introduce absolutism. In the interval before the arrival of the terrible duke there was much talk of organizing resistance. The prince of Orange was in doubt as to the régime to be expected, yet he shrank from co-operating with the only party ready to throw themselves into the fight, the Calvinists. As viscount of Antwerp he prevented the Antwerp Calvinists from going to the assistance of a little army of their co-religionists that was cut to pieces by Margaret of Parma's troops under the walls of the town (March 1567).

The first period of Orange's career ended in failure. After the encouragement he had given to the national opposition movement his conduct at the moment of crisis is disconcerting. To understand it one has to remember that the Calvinists still were a tiny minority, suspected and hated as a menace to society no less than to the Church. A movement in which they took the lead had, at that moment, little chance of becoming truly national; and William of Orange, who was not yet personally in sympathy with Calvinism, was then and always concerned before everything else with preserving national unity.

From Germany, where he had retired, the prince kept in touch with adherents in the Netherlands, and with money collected from them and raised in his Nassau lands, he brought together an army with which he attempted to deliver the Netherlands from Alva's tyranny (1568). The attempt failed miserably. The Netherlands, cowed, did not rise, and the army had, for lack of money, soon to be disbanded. Help, as Orange realized, could only come from outside, and nothing was to be expected from German Lutheranism. He now entered into close relations with the French Huguenot leaders, for some years taking part in their campaigns against the French Government. At La Rochelle Louis of Nassau organized the forces of the Sea Beggars, whose booty went to swell the prince's war chest. New hope was born when after the peace of St. Germain (Aug. 1570) they seemed to win influence at the court of France. Louis of Nassau and Coligny inspired Charles IX. with plans of war and conquest against Spain, and it was in the expectation of French help that Orange in 1572 repeated the attempt of 1568 and invaded the Netherlands with an army collected in Germany. The St. Bartholomew's massacre, which overthrew Huguenot influence at court dashed his hopes. Again he had to disband his army and to leave Alva in possession.

But this time there had been a response to his invasion. Not the central province of Brabant, kept quiet by the presence of Alva's army, but a number of towns in the outlying northern provinces had risen against the Spaniards. The surprise capture of the Brill by a fleet of Sea Beggars had started the movement. Now that his great plans in conjunction with France had come to nothing, the prince decided to join the Holland and Zeeland rebels, who had proclaimed him as their Stadtholder again. It seemed a forlorn hope. Compared with Flanders and Brabant, Holland and Zeeland at that time seemed poor and distant regions.

The decision was one of the great moments of his career. For four heroic years he shared the anxieties and distress of the two maritime provinces, stubbornly holding out against the Spanish army sent to subdue them. The States assemblies of Holland and Zeeland, which were almost entirely composed of burghers and of Calvinists, placed complete confidence in the great nobleman who had lost his fortune and his position for the national cause. In 1573 the prince himself joined the Reformed Church. Meanwhile he led the desperate resistance against the Spaniards. The relief of Leyden in 1574 was to a large extent due to his untiring efforts. Yet in 1576, with the Spaniards at Haarlem and Amsterdam as well as at Middelburg and Zieriksee, the two provinces were near succumbing, when the situation underwent a dramatic change.

The Spanish governor, who had succeeded Alva in 1574, Requesens, unexpectedly died. The Spanish soldiery, long unpaid, mutinied. They evacuated their hard-won posts in Holland and Zeeland and came south to live on the riches of Brabant. The Spanish Government in the Netherlands practically broke down. The States of Brabant summoned a meeting of the States-General to Brussels, and negotiations between this nominally loyal body and the two rebel provinces were started at Ghent for the purpose of combining against the Spanish soldiers. The conclusion of the Pacification of Ghent (Nov. 8, 1576) seemed to restore the unity of the Netherlands, threatened since the separate rebellion of Holland and Zeeland.

But an ominous rift threatened that unity. The Pacification, while suspending the edicts against heresy, had safeguarded the supremacy of Catholicism in all the provinces save Holland and Zeeland. Calvinist refugees were now flocking back to the towns of Flanders and Brabant, and they were not content with toleration, they wanted the same position of supremacy which their co-religionists in the two rebel provinces, in the stress of revolution and under the immediate menace of foreign attack, had managed to secure. This irritated the nobility, who in the south had greater power and were everywhere slow to embrace Calvinism, while the French-speaking provinces, like Hainaut, or Lille, Orchies and Douai, were now almost solidly Catholic. Orange was fully alive to the danger of these elements gravitating back to the king.

But in many respects his position was a thoroughly false one. Circumstances had ever since 1567 conspired to drive him into closer association with Calvinism. The Calvinists who had obtained control in the provinces of Holland and Zeeland did not dream of sacrificing any of their local supremacy to the national compromises elaborated at Brussels. Yet those two provinces continued to afford to the prince his firmest *point d'appui* in the shifting conditions of Netherlands polities. Early in 1579, the Walloon provinces, incensed at the aggressiveness of the Flemish Calvinists, had deserted the national cause and at Arras had made their peace with the king's new governor, the duke of Parma, who could now from that foothold in the south set about re-conquering the rest of the Netherlands. Did not the event, which was followed by the loss of the north-eastern province of Groningen, go

to prove that the Calvinists were the only party who could be counted on to hold out against all the blandishments of Parma? When Orange tried once more to enlist the help of France, and the Catholic duke of Anjou was clothed with the sovereignty of the Netherlands from which in 1581 the States-General solemnly deposed Philip II., the prince's particular connection with the two maritime provinces was expressly safeguarded. And however earnestly he deplored and tried to restrain the intolerant fanaticism of the Calvinists in Flanders and Brabant, all the time he saw himself forced underhand to work with them, thereby adding to the grievances of the Catholics, although at the same time Calvinist ministers denounced him as a godless timeserver.

The last years of William the Silent's life were a tragic struggle against overpowering circumstances. The unity of the Netherlands was broken beyond repair, and the area supporting the national cause kept crumbling away. The States-General had to leave Brussels in 1578, they stayed at Antwerp for a short while, then moved behind the waters to Middelburg, and finally to Delft, where William the Silent resided from 1583 onwards. His main efforts throughout those years were directed towards preserving the southern provinces, until then the principal provinces of the Netherlands, and of which Brabant had such close associations with him personally, and towards obtaining foreign help. The conclusion of the Union of Utrecht in 1579 met with his disapproval, as it seemed to be, on the part of the more easily defensible regions north of the rivers, an abandonment of the wider union of the Pacification. He had soon, nevertheless, to fall back upon it, and then did his best to make it comprehensive, nor were his efforts without success, for in the course of that year and the next all the towns of Flanders and several of those of Brabant entered it.

In 1581 Philip II. had promulgated a ban against William of Orange, by which a high reward was promised to anyone who would deliver the world of this traitor. A year later a serious attempt was made on his life, but it was only in 1584 that the ban achieved its purpose. On July 9, Balthazar Gérard, a Burgundian, shot the prince at Delft. William was 51 years of age.

Some years after the prince's death, owing to the assistance given by England and to Philip's injudicious interference in the French civil war, the turn came in the tide of Netherlands affairs, and although of the country south of the rivers little was recovered, at least the country north of them was secured and blossomed out into the republic of the Seven United Provinces. Of that state William the Silent is truly called the father. Yet it should not be forgotten that this was not the object which he had in view and that the split of the Netherlands means that his life's work was not accomplished. Apart from his success and failure in Netherlands politics, William the Silent will always be honoured as a man who nobly struggled and suffered for the cause of liberty of conscience. His personality, genial and humane, was fully worthy of the great part he played. There is something exceptionally attractive in his evolution from a frivolous courtier into the frugal and hard-working leader of a seemingly hopeless revolt, harassed but patient, courageous in the face of accumulating disaster, while the steadfastness with which at a time of furious religious fanaticism he preached moderation and forbearance has a heroic quality that is not disposed of by observing that his outlook was secular. His correspondence proves that in his later years religion was a real thing to him, and his attachment to the Reformed Church was sincere.

See Groen van Prinsterer, *Archives ou correspondance inédite de la Maison d'Orange-Nassau;* Gachard, *Correspondance de Guillaume le Taciturne; Apologie du Prince d'Orange;* Motley, *Rise of the Dutch Republic;* Putnam, *William the Silent;* Fruin, *Het Voorspel van den tachtigjarigen oorlog,* and other essays; Rachfahl, *Wilhelm van Oranien* (3 vols. to 1572, no more appeared); P. J. Blok, *Willem de Eerste* (2 vols., Amsterdam, 1919–20). (P. GE.)

WILLIAM II. (1626–1650), prince of Orange, born at The Hague on May 27, 1626, was the son of Frederick Henry, prince of Orange, and his wife Amalia von Solms, and grandson of William the Silent. By the act of survivance passed in 1631 the offices and dignities held by Frederick Henry were made hereditary in his family. On May 12, 1641 William married, in the royal chapel at Whitehall, Mary, princess royal of England, eldest daughter of King Charles I. At the time of the wedding the bridegroom was not yet fifteen years old, the bride was five years younger. William from his early youth accompanied his father in his campaigns, and already in 1643 highly distinguished himself in a brilliant cavalry fight at Burgerhout (Sept. 5). On the death of Frederick Henry William succeeded him. At the moment of his accession to power the negotiations for a separate treaty of peace with Spain were almost concluded, and peace was actually signed at Münster on Jan. 30, 1648. By this treaty Spain recognized the independence of the United Netherlands and made large concessions to the Dutch. William did his utmost to prevent the ratification, but failed. He opened secret negotiations with France in the hope of securing the armed assistance for a war of aggrandisement against the Spanish Netherlands and of a restoration of his brother-in-law, Charles II., to the throne of England. The states of Holland, on the other hand, were determined to thwart any attempts for a renewal of war, and insisted, in defiance of the authority of the captain-general supported by the states-general, in virtue of their claim to be a sovereign province, in disbanding a large part of the regiments in their pay.

A prolonged controversy arose, which ended in the states-general in June 1650 commissioning the prince of Orange to visit the towns of Holland and secure a recognition of their authority. The mission was unsuccessful. Amsterdam refused any hearing at all. William resolved therefore to use force and crush resistance. On July 30 six leading members of the states of Holland were seized and imprisoned in the castle of Loevestein. On the same day an attempt was made to occupy Amsterdam with troops. The citizens were, however, warned in time, and the gates closed. William's triumph was nevertheless complete. The states of Holland submitted. The prince entered into fresh negotiations with the French government, and a draft treaty was drawn up. But William died of small-pox on Nov. 6, 1650. A week after his death his widow gave birth to a son, who was one day to become William III., king of England.

WILLIAM IV., landgrave of Hesse (1532–1592), was the son and successor of the landgrave Philip the Magnanimous. He took a leading part in safeguarding the results of the Reformation, endeavouring to unite all sections of Protestantism against the Catholic reaction. As ruler he displayed common-sense and tolerance; patronized art and science; placed the finances of his country on a sound basis and secured it against subdivision by a law of primogeniture. He was chiefly famous, however, as a pioneer in astronomical research.

See R. Wolf, "Astronomische Mittheilungen," No. 45 (*Vierteljahrsschrift der naturforschenden Gesellschaft in Zürich,* 1878).

WILLIAM [Frederick Henry], Prince of Wied (1876–), born at Neuwied on March 26, 1876, was 3rd son of William Prince of Wied and Mary Princess of Holland, grand-nephew of the emperor William I. and nephew of Queen Elizabeth of Rumania. An able soldier, he became a captain of the general staff in 1911, and in 1913 commanded a squadron of the 3rd Uhlans of the Guards. He married in 1906 Sophie, Princess of Schoenburg-Waldenburg, and had two children, Princess Marie Eleonor (1909) and Prince Charles Victor (1913). In Feb. 1914, inspired by idealism rather than ambition, he accepted the Albanian throne against the Kaiser's advice, and landed on March 7. Italy, France, Russia, Greece, Montenegro, Serbia, Turkey and Essad Pasha intrigued against him. Essad possessed troops, and the Mbreti (King), who had none, felt obliged to conciliate him with the Ministries of War and Interior. While the Greeks ravaged southern Albania an insurrection confined the Mbreti to Durazzo Essad was exiled in May; but foreign agents, protected by the Capitulations, paralysed the royalists. In Aug. 1914 Austria abandoned him because he determined to preserve neutrality. Besieged, and without resources, he reluctantly left Albania on Sept. 3. He did not abdicate. Early in 1915 the insurgents, finding they had been victims of intrigue, asked him to return, but this Austria prevented. He was attached as an Albanian and foreigner to a German divisional staff in Poland during the World War. On the accession of Ahmed Zogu in 1928 Prince William declared that he would not return unless unanimously invited. (J. Sw.)

WILLIAM OF MALMESBURY (*c.* 1080–*c.* 1143), English historian of the 12th century, was born about the year 1080, in the south country. He was a monk of Malmesbury, and assisted Abbot Godfrey (1081–1105) in collecting a library for the use of the community. The education which he received at Malmesbury included a smattering of logic and physics; but his principal studies were on moral philosophy and history. He made a collection of the histories of foreign countries, and decided to write a popular account of English history, modelled on the great work of Bede. William produced about 1120 the first edition of his *Gesta regum,* followed by the first edition of the *Gesta pontificum* (1125). A second edition of the *Gesta regum* (1127) was dedicated to Earl Robert of Gloucester; another patron was Bishop Roger of Salisbury. He was offered the abbacy of Malmesbury in 1140, but he preferred to remain a simple *bibliothecarius.* His one public appearance was made at the council of Winchester (1141), in which the clergy declared for the empress Matilda. About this date he undertook to write the *Historia novella,* giving an account of events since 1125. This work breaks off abruptly at the end of 1142.

William is the best English historian of his time. His contempt for the annalistic form makes him at times careless in his chronology and arbitrary in his method of arranging his material; but he is, however, an authority from 1066 onwards; many telling anecdotes, many shrewd judgments on persons and events, are found in his pages.

The standard edition of the *Gesta regum* and the *Historia novella* is that of W. Stubbs in the "Rolls" series (1 vol., in 2, 1887–89); the second part contains a valuable introduction on the sources and value of the chronicler. The *Gesta pontificum* was edited for the "Rolls" series by N. G. S. A. Hamilton (London, 1870) from a manuscript which he was the first to identify as the archetype. Another work, *De antiquitate Glastoniensis ecclesiae* (A.D. 63–1126), is printed in Gale's *Scriptores XV.* (Oxford, 1691). Wharton in the second volume of his *Anglia sacra* (London, 1691) gives considerable portions of a life of Wulfstan which is an amplified translation of an Anglo-Saxon biography. Finally Stubbs in his *Memorials of St. Dunstan* ("Rolls" series, London, 1874) prints a *Vita S. Dunstani* which was written about 1126.

WILLIAM OF NEWBURGH (d. *c.* 1198), or, as he is sometimes styled, Guilielmus Parvus, English ecclesiastic and chronicler, was a canon of the Augustinian priory of Newburgh in the North Riding of Yorkshire. He was born about 1136, and lived at Newburgh from his boyhood. Shortly before 1196 he began his *Historia rerum Anglicarum.* This work, divided into five books, covers the period 1066–1198. A great part of it is derived from known sources, especially from Henry of Huntingdon, Jordan Fantosme, the *Itinerarium regis Ricardi,* or its French original, and a lost account, by Anselm the chaplain, of the captivity of Richard I. The value of Newburgh's work lies in his estimates of men and situations. His political insight and his impartiality entitle him to a high place among the historians of the 12th century.

See the editions of the *Historia* by H. C. Hamilton (2 vols., 1856) and by R. Howlett in *Chronicles of the Reigns of Stephen, etc.* ("Rolls" series, 1884–85), vols. i. and ii. In the latter edition a continuation, the *Annales Furnesienses* (1190–1298), composed by a monk of Furness Abbey, Lancashire, is also given. *See* also Sir T. D. Hardy's *Descriptive Catalogue* ("Rolls" series, 1865), ii. p. 512; and H. E. Salter in the *English Historical Review,* vol. xxii. (1907).

(H. W. C. D.)

WILLIAM OF POITIERS (*c.* 1020–*c.* 1090), Norman chronicler, was born at Préaux, near Pont Audemer, and became chaplain to Duke William (William the Conqueror) and archdeacon of Lisieux. He wrote an eulogistic life of the duke, the earlier and concluding parts of which are lost; and Ordericus Vitalis, who gives a short biography of him in his *Historia ecclesiastica,* says that he also wrote verses. William's *Gesta Guilelmi II. ducis Normannorum,* the extant part of which covers the period between 1047 and 1068, is valuable for details of the Conqueror's life, although untrustworthy with regard to affairs in England.

The *Gesta* was first published by A. Duchesne in the *Historiae Normannorum scriptores* (1619); and it is also found in the *Scriptores rerum gestarum Willelmi Conquestoris* of J. A. Giles (London, 1845). There is a French translation in tome xxix. of Guizot's *Collection des mémoires relatifs à l'histoire de France* (1826). *See* G. Körting, *Wilhelms von Poitiers Gesta Guilelmi ducis* (Dresden, 1875); and A. Molinier, *Les Sources de l'histoire de France,* tome iii. (1903).

WILLIAM OF ST. CALAIS (CARILEF) (d. 1096), bishop of Durham and chief counsellor of William Rufus, a Norman monk and prior of St. Calais in Maine, received the see of Durham from the Conqueror (1081). He is remembered as the prelate who designed the existing cathedral, and for his reform of ecclesiastical discipline. His political career is less creditable. He died in Jan. 1096.

See E. A. Freeman, *William Rufus* (1882), and *Symeon of Durham,* vol. i., pp. 170–195 (Rolls ed.).

WILLIAM OF VALENCE (d. 1296), brother of Henry III. of England, was a son of John's widow, Isabelle of Angoulême, by her second marriage. William came to England with his brothers in 1247, and at once became a court favourite. He married Joan de Munchensi, the heiress to the Pembroke estates, whence he is sometimes styled earl of Pembroke. In 1258 he was attacked by the baronial opposition and forced to leave England. He returned in 1261, after Henry III. had repudiated the Provisions of Oxford, and fought on the royal side at Lewes (1264). Escaping from the pursuit of the victorious Montfortians, he later appeared at the head of a small army in Pembrokeshire. This gave the signal for the outbreak of a new civil war which ended with the defeat of Montfort at Evesham (1265). Valence accompanied Prince Edward to the Holy Land and, in later years, became a trusted agent of the crown, especially in the Welsh wars. The position of his estates made him the natural leader of all expeditions undertaken against Llewelyn from South Wales. He was also employed in Aquitaine. He died at Bayonne in 1296.

See R. Pauli's *Geschichte von England,* vol. iii. (Hamburg, 1853); W. H. Blaauw, *Barons' War* (1871).

WILLIAM OF WYKEHAM (1323?–1404), English lord chancellor and bishop of Winchester. William Wykeham was born at Wickham, Hants, in 1323 or 1324, son of John, whose name was probably Wykeham, but nicknamed Long. He was educated at Winchester, probably at the grammar school there, and became undernotary to the constable of Winchester castle, probably Robert of Popham, who was appointed in 1340. He was transferred to the king's court in 1343. In 1350 he appears to have been keeper of the manor of Rochford, Hants. His name appears in various other transactions in the county during the next few years; in 1356 he is first recorded as being directly employed by the king as clerk of the works to the manors of Henley and Easthampstead. In October he was appointed to the same office at Windsor, which he held until 1361.

Wykeham was already receiving wages as king's clerk in 1357, and he was richly rewarded for his various services by a series of benefices. He received the rectory of Pulham, Norfolk, in 1357, a canonry and prebend at Lichfield in 1359, though he did not obtain actual possession in either case without a struggle. In 1359 also, after the French raid on Winchelsea, he was placed in charge of the repair of the castles on the Kent coast and of many manors.

Meanwhile he had been appointed a clerk of the exchequer (Oct. 1361) and keeper of the forests south of the Trent. In 1364 he became privy seal. On Oct. 13, 1366, Wykeham was named bishop of Winchester. He was consecrated in Oct. 1367, and enthroned in 1368. Meanwhile he had been made (Sept. 17, 1367), chancellor of the kingdom. Parliament was inclined to lay the blame of the disasters of the French war on the clerical advisers of the Crown, and in 1372 Wykeham resigned the chancellorship.

Wykeham must have amassed a large fortune by his various employments and benefices; his application of that fortune has made him revered by successive generations of "Wykehamists." He began buying lands for the endowment of his great foundations of Winchester college, Winchester, and of New college, Oxford, in 1367. In 1373 he entered into an agreement with the master, Richard of Herton, "Grammaticus," for ten years faithfully to teach and instruct the poor scholars whom the bishop maintained at his own cost, in the art of grammar, and to provide an usher to help him. He was diverted from his foundations by public affairs, being named by the Commons one of the eight peers to discuss with them the state of the realm.

Lord Latimer and Alice Perrers, the king's mistress, were impeached (1376), and Wykeham took a leading part against Latimer. At the dissolution of parliament a council of nine, of whom Wykeham was one, was appointed to assist the king. But on June 8, the Black Prince died. Alice Perrers returned. John of Gaunt called a council (Oct. 16) to impeach Wykeham on articles which alleged misapplication of the revenues, oppressive fines on the leaders of the free companies, taking bribes for the release of the royal French prisoners, especially of the duke of Bourbon, who helped to make him bishop, failing to send relief to Ponthieu and making illegal profits by buying up Crown debts cheap. He was condemned on one only, that of halving a fine of £80 paid by Sir John Grey of Rotherfield for licence to alienate lands, and tampering with the rolls of chancery to conceal the transaction. Wykeham's answer was that he had reduced the fine because it was too large, and that he had received nothing for doing so. Skipworth, a judge of the common pleas, cited a statute under which for any erasure in the rolls to the deceit of the king 100 marks fine was imposed for every penny, and so Wykeham owed 960,000 marks. Wykeham was convicted, his revenues were seized and bestowed (1377) on the young prince Richard.

On June 21, 1377, Edward III. died. Wykeham received full pardon, and at once took an active part in the financial affairs of the new king, giving security for his debts and himself lending 500 marks, afterwards secured on the customs (Pat. 4 Rich. II. pt. i. m. 4). He then set to work to buy endowments for Winchester and New colleges. On Nov. 26 he issued his charter of foundation of "Seynt Marie College of Wynchestre in Oxenford" for a warden and 70 scholars to study theology, canon and civil law and arts, who were temporarily housed in various old halls. On March 5, 1380, the first stone was laid of the present buildings, which were entered on by the college on April 14, 1386. The foundation of Winchester was begun with a bull of Pope Urban VI. on June 1, 1378, enabling Wykeham to found "a certain college he proposed to establish for 70 poor scholars, clerks, who should live college-wise and study in grammaticals near the city of Winchester," and appropriate to it Downton rectory, one of the richest livings belonging to his bishopric. The bull says that the bishop "had, as he asserts, for several years administered the necessaries of life to scholars studying grammar in the same city." On Oct. 20, 1382, "Seinte Marie College of Wynchestre by Wynchestre" was founded for a warden and "70 pore and needy scholars studying and becoming proficient in grammaticals or the art and science of grammar." The first stone of the buildings was laid on March 26, 1388, and they were entered by the scholars on March 28, 1394, not, as supposed at the quincentenary celebration in 1893, in 1393. While the new buildings were being erected, the college remained in the parish of "St. John the Baptist on the Hill" of St. Giles, supplying scholars to New college then as since. The foundation was on the model of Merton and Queen's colleges at Oxford, to which grammar schools were attached by their founders, while fellows of Merton were the first wardens of both of Wykeham's colleges. The severance of the school which was to feed the college exclusively, placing it not at Oxford, but at Winchester, and constituting it a separate college, was a new departure of great importance in the history of English education. Ten fellows and 16 choristers were added in 1394 to the 70 scholars, the choristers attending the school like the scholars, and being generally, during the first three centuries of the foundation, promoted to be scholars. The original statutes have not come down to us. Those which governed the colleges until 1857 were made in 1400. They state that the colleges were provided to repair the ravages caused by the Black Death in the ranks of the clergy, and for the benefit of those whose parents could not without help maintain them at the universities.

The time which elapsed between the foundation and completion of the colleges may be attributed to Wykeham's preoccupation with politics in the disturbed state of affairs, due to the papal schism begun in 1379, in which England adhered to Urban VI. and France to Clement VII., to the rising of the Commons in 1381, and the wars with France, Scotland and Spain during John of Gaunt's ascendancy. Then followed the constitutional revolution of the lords appellant in 1388. When Richard II. took power on himself on May 3, 1389, he at once made Wykeham chancellor, with Brantingham of Exeter again as treasurer.

On Sept. 27, 1391, Wykeham finally resigned the chancellorship. For three years after there are no minutes of the council. On Nov. 24, 1394, Wykeham lent the king the sum of £1,000 (equivalent to £30,000 now), which same sum or another £1,000 he promised on Feb. 21, 1395, to repay by midsummer, and did so (Pat. 18, Rich. II. pt. ii. m. 23, 41). Wykeham was clearly against the assumption by Richard of absolute power. He excused himself from convocation in 1397, and from the subservient parliament at Shrewsbury in 1398. Possibly he took part in the revolution of Henry IV. He appeared in the privy council four times at the beginning of Henry's reign (*Proc. P.C.* i. 100). There are records of loans by him to Henry IV. in the first years of his reign. Meanwhile, on Sept. 29, 1394, he had begun the recasting of the nave of the cathedral with William Wynford, the architect of the college, as chief mason, and Simon Membury, an old Wykehamist, as clerk of the works. He died on Sept. 27, 1404, aged 80.

His effigy in the cathedral chantry and a bust on the groining of the muniment tower at Winchester college are no doubt authentic portraits. The pictures at Winchester and New college are late 16th-century productions. Three autograph letters of his, all in French, and of the years 1364–66, are preserved, one at the British Museum, one at the Record Office, a third at New college, Oxford.

See Thomas Martin, *Wilhelmi Wicami* (1597); R. Lowth, *Life of Wykeham* (1736); Mackenzie E. C. Walcott, *William of Wykeham and his Colleges* (1852); T. F. Kirby, *Annals of Winchester College* (1892); G. H. Moberly, *Life of Wykeham* (1887); A. F. Leach, *History of Winchester College* (1899); and the *Calendars of Patent and Close Rolls, Edward III. and Richard II.*

WILLIAMS, JOHN (1582–1650), English archbishop and lord keeper, son of Edmund Williams of Conway, was born in March 1582 and educated at St. John's College, Cambridge. He received rapid promotion in the Church, and, on the fall of Bacon (1621), was appointed lord keeper, and was at the same time made bishop of Lincoln, retaining also the deanery of Westminster. Williams took the popular side in condemning arbitrary imprisonment by the sovereign. A case was preferred against him in the Star Chamber of revealing state secrets, to which was added in 1635 a charge of subornation of perjury, of which he had undoubtedly been guilty and for which he was condemned in 1637 to pay a fine of £10,000, to be deprived of the temporalities of all his benefices, and to be imprisoned during the king's pleasure. He was sent to the Tower. In 1639 he was again condemned by the Star Chamber for libelling Laud, a further heavy fine being imposed for this offence. In 1641 he recovered his liberty on the demand of the House of Lords, who maintained that as a peer he was entitled to be summoned to parliament. In December 1641 the king, anxious to conciliate public opinion, appointed Williams archbishop of York. In the same month he was one of the twelve bishops impeached by the Commons for high treason and committed to the Tower. Released on an undertaking not to go to Yorkshire, a promise which he did not observe, the archbishop was enthroned in York Minster in June 1642. On the outbreak of the Civil War, after visiting Conway in the Royalist interest, he joined the king at Oxford; he then returned to Wales, and finding that Sir John Owen, acting on Charles's orders, had seized certain property in Conway Castle that had been deposited with the archbishop for safe-keeping, he went over to the Parliamentary side and assisted in the recapture of Conway Castle in November 1646. Williams, who was a generous benefactor of St. John's College, Cambridge, died on March 25, 1650.

WILLIAMS, JOHN (1796–1839), English Nonconformist missionary, was born at Tottenham near London on June 29, 1796. He was sent by the London Missionary Society in 1816 to Eimeo, in the Society Islands, where he rapidly acquired a knowledge of the native language. After staying there for a short time, he finally settled at Raiatea, which became his permanent headquarters. His success was remarkable. The people rapidly became Christianized and adopted many of the habits of civilization. Williams

travelled unceasingly among the various island groups, planting stations and settling native missionaries whom he himself had trained. From the Society Islands he visited the Hervey group, where he discovered, and stayed for a considerable time on, the island of Rarotonga. Besides establishing Christianity and civilization among the people, he also, at their own request, helped them to draw up a code of laws for civil administration upon the basis of the new religion. While at Rarotonga he, with the help of the natives, built himself a 60-ft. ship, "The Messenger of Peace," within about four months; with this he returned to Raiatea, and made voyages among other island groups, including Samoa and the neighbouring islands. Williams returned to England in 1834 (having previously visited New South Wales in 1821); and during his four years' stay at home he had the New Testament, which he had translated into Rarotongan, printed. Returning in 1838 to the Pacific, he visited the stations already established by him, as well as several fresh groups. He went as far west as the New Hebrides, and, while visiting Eromanga, one of the group, was murdered by cannibal natives Nov. 20, 1839.

His *Narrative of Missionary Enterprises in the South Sea Islands* was published in 1837, and formed an important contribution to our knowledge of the islands with which the author was acquainted. See *Memoir of John Williams*, by Ebenezer Prout (London, 1843); C. S. Horne, *The Story of the L.M.S.* (1908), pp. 41–54.

WILLIAMS, ROGER (*c.* 1604–1684), founder of the Colony of Rhode Island in America and pioneer of religious liberty, son of a merchant tailor, was born about 1604 in London. It seems reasonably certain that he was educated, under the patronage of Sir Edward Coke, at the Charter House and at Pembroke college, Cambridge, where he received his degree in 1627. He devoted himself to theology, and in 1629 was chaplain to Sir William Masham of Otes, High Laver, Essex, but from conscientious scruples, in view of the condition of ecclesiastical affairs in England at the time, refused preferment. He soon decided to emigrate to New England, and, with his wife Mary, arrived at Boston early in Feb. 1631. In April he became teacher of the church at Salem, Mass.

Owing to the opposition of the ecclesiastical authorities at Boston, with whose views his own were not in accord, he removed to Plymouth in the summer, and there remained for two years as assistant pastor. In Aug. 1633, he again became teacher at Salem. Here he incurred the hostility of the authorities of the Massachusetts Bay Colony by asserting, among other things, that the civil power of a State could properly have no jurisdiction over the consciences of men, that the King's patent conveyed no just title to the land of the colonists, which should be bought from its rightful owners, the Indians, and that a magistrate should not tender an oath to an unregenerate man, an oath being, in reality, a form of worship. For the expression of these opinions he was formally tried in July 1635 by the Massachusetts general court, and at the next meeting of the general court in October, he not having taken advantage of the opportunity given to him to recant, a sentence of banishment was passed upon him, and he was ordered to leave the jurisdiction of Massachusetts within six weeks. The time was subsequently extended, conditionally, but in Jan. 1636, an attempt was made to seize him and transport him to England. Forewarned, he escaped and proceeded alone to Manton's Neck.

At the instance of the authorities at Plymouth, within whose jurisdiction Manton's Neck was included, Williams, with four companions, who had joined him, founded in June 1636 the first settlement in Rhode Island, to which, in remembrance of "God's merciful providence to him in his distress," he gave the name *Providence*. He immediately established friendly relations with the Indians in the vicinity, whose language he had learned, and, in accordance with his principles, bought the land upon which he had settled from the sachems Canonicus (*c.* 1565–1647) and Miantonomo. His influence with the Indians, and their implicit confidence in him, enabled him in 1636, soon after arriving at Providence, to induce the Narragansetts to ally themselves with the Massachusetts colonists at the time of the Pequot War, and thus to render a most effective service to those who had driven him from their community. Williams and his companions founded their new settlement upon the basis of complete religious toleration, with a view to its becoming "a shelter for persons distressed for conscience." (*See* RHODE ISLAND.) Many settlers came from Massachusetts and elsewhere, among others some Anabaptists, by one of whom in 1639 Williams was baptized, he baptizing others in turn and thus establishing what has been considered the first Baptist Church in America. Williams, however, maintained his connection with this church for only three or four months, and then became what was known as a "Seeker," or Independent.

In 1643 he went to England, and there in 1644 obtained a charter for Providence, Newport and Portsmouth, under the title "The Providence Plantations in the Narragansett Bay." He returned to Providence in the autumn of 1644 and in 1646 removed from Providence to a place now known as Wickford, R.I. He was president, or governor, in 1654–57, and an assistant in 1664, 1667 and 1670. In 1651, with John Clarke (1609–66), he went to England to secure the issue of a new and more explicit charter. He returned in the summer of 1654, having enjoyed the friendship of Cromwell, Milton and other prominent Puritans. Williams died at Providence in March 1684; the exact date is unknown.

Williams was a vigorous controversialist, and published, chiefly during his two visits to England, *A Key into the Language of the Indians of America,* written at sea on his first voyage to England (1643); reprinted in vol. i. of the *Collections of the Rhode Island Historical Society* (1827), and in series i. vol. iii. of the *Massachusetts Historical Society Collections; Mr. Cotton's Letter Examined and Answered* (1644); *The Bloudy Tenent of Persecution for the Cause of Conscience* (1644); *Christenings make not Christians* (1645); *Queries of Highest Consideration* (1644); *The Bloudy Tenent yet more Bloudy* (1652); *Experiments of Spiritual Life and Health and Their Preservatives* (1652); *The Hireling Ministry none of Christ's* (1652); and *George Fox Digged out of his Burrowes* (1676); *Something in answer to a Letter . . . of John Leverat Governor of Boston . . .* (1678).

His writings were republished in the *Publications of the Narragansett Club* (Providence 1866–74). *Letters and Papers of Roger Williams, 1629–82* (limited to 18 copies, photostatic reproductions, Boston, 1924) contained manuscripts discovered since. The best biographies are those by Oscar Straus (1899) and E. J. Carpenter (1910). *See* also J. D. Knowles, *Memoir of Roger Williams* (Boston 1834); Elton, *Life of Roger Williams* (London 1852; Providence 1853); A. B. Strickland, *Roger Williams, Prophet and Pioneer of Soul Liberty* (1919); *New England Hist. and Gen. Register,* July and Oct. 1889, and Jan. 1899; M. C. Tyler, *History of American Literature, 1607–1765* (1878). "Letters, concerning Colonial History of Rhode Island," written by Benedict Arnold, Roger Williams and others, *Newport Hist. Soc. Bull.* (1926). For the best apology for his expulsion from Massachusetts, *see* H. M. Dexter's, *As to Roger Williams and his "Banishment" from the Massachusetts Plantation* (Boston, 1876).

WILLIAMSBURG, a city of southeastern Virginia, U.S.A., the county seat of James City county, on the peninsula between the James and York rivers, 50 mi. S.E. of Richmond. It is on federal highway 60 and the Chesapeake and Ohio railway. Population, 3,942 in 1940. It is the seat of the College of William and Mary, which was founded in 1693 and ranks next to Harvard in seniority among American colleges. The main building of the college is the oldest (1695) academic building in English America and was designed by Sir Christopher Wren. One of the oldest state supported institutions for the insane, the Eastern State hospital was established here in 1769. Starting in 1633 as the scattered settlement of Middle Plantation it became the capital of the colony and was renamed Williamsburg in 1699. It was incorporated in 1722 and was one of the most important cities of the colonial era. Because of its historic associations, the number of its early buildings still surviving and the preservation of its historic sites, Williamsburg has become the centre of a unique restoration project which involves the restoration and reconstruction of the most significant portions of the city to its colonial aspect. Through the support of John D. Rockefeller, Jr., a restoration visualized by the late Dr. W. A. R. Goodwin, rector of Bruton parish church, has been virtually accomplished. To achieve this vision of a restored city 77 colonial buildings have been restored, 189 buildings reconstructed upon their foundations, and 572 modern buildings have been razed.

Among the buildings restored or reconstructed as part of this program, now open for public inspection are: The Capitol, reconstructed upon the foundations of the first capitol building, 1699–1747; the Governor's palace and gardens, originally con-

structed in 1705–1720 and esteemed by contemporaries as "the best in all English America"; the Raleigh tavern, one of the most historic taverns of colonial America, dating from about 1742 and reconstructed on original foundations; the Public Gaol, the restored prison and yards include a portion of the building erected in 1701; the restored Wythe house, Washington's headquarters prior to the siege of Yorktown; the Ludwell-Paradise house, a restored town mansion built *c.* 1717 and containing the collection of American Folk Art presented by Mrs. John D. Rockefeller, Jr., to the restoration; the old courthouse, erected 1770 and restored; the Public Magazine, an octagonal arsenal erected 1714 for the safekeeping of the Virginia colony arms and ammunition; and the Wren building of the College of William and Mary. Two other ancient buildings of the college—Brafferton hall and the President's house—have been restored and are used by the college. Other colonial places of note are Bruton parish church, 1710–15; Travis house and garden; site of the first theatre in America, and St. George Tucker house. The main street of the town, named after the duke of Gloucester, now simulates a colonial road and the squares, greens and gardens have been restored to eighteenth century aspect. The battle of Williamsburg in the Civil War was an attack (May 5, 1862) by a Union division on a part of the Confederate army in retreat, resulting in heavy losses on both sides.

WILLIAMSON, a city of West Virginia, U.S.A., the county seat of Mingo county; on the Tug Fork of Big Sandy river (the southwestern boundary of the state), the Norfolk and Western railway and federal highways 52 and 119. The population was 6,819 in 1920 (17% being Negroes) and was 8,366 in 1940 by the federal census. It is a coal mining centre and the trading and supply point for the entire Thacker-Kenova districts which in 1937 mined 11,259,052 tons of bituminous coal. The city was founded in 1895 and incorporated in 1896, being named for its founder, Wallace J. Williamson.

WILLIAMSPORT, a city of central Pennsylvania, U.S.A., the county seat of Lycoming county; on the west branch of the Susquehanna river, 85 mi. N. of Harrisburg. It is on federal highways 15 and 220, and is served by the New York Central, the Pennsylvania, and the Reading railways. The pop. by the federal census of 1940 was 44,355 (94.8% native-born). Williamsport has 106 industries of a widely diversified nature consisting of aircraft motors, boilers, wire rope, sole leather, venetian blinds, furniture, prefinished oak flooring, fire hydrants and valves, glue, steel posts, rails, bars, broad silks, braids, crepe paper, concrete blocks, uniforms, ladies' and children's clothing, radio tubes, pajamas, hosiery, shoes, shirts and other products. These plants employed more than 14,000 people in 1942, 70% men and 30% women. Founded in 1795, the year in which Lycoming county was erected, it became the county seat after a bitter contest with Jaysburg, a village of half a dozen houses (subsequently abandoned). It was incorporated as a borough in 1806 and as a city in 1866. Until the surrounding timber was exhausted it was a one-industry town.

WILLIAMSTOWN, a town of Berkshire county, Massachusetts, U.S.A., on the Hoosac and the Green rivers, in the northwestern corner of the state; served by the Boston and Maine railroad. Pop. 4,294 federal census, 1940. Williamstown village, on the Green river, surrounded by the Berkshire hills, its streets shaded with fine old trees, is a charming residential centre. It is the seat of Williams college. Ephraim Williams, who was killed in the battle of Lake George on Sept. 8, 1755, left a small bequest for a free school, on condition that the town when incorporated should be named Williamstown. It was incorporated under that name in 1765. Williams college sponsors a spring conference on U.S. problems—a conference which succeeded the Institute of Politics held each summer, 1921–32.

WILLIAMSTOWN (VICTORIA): *see* under MELBOURNE.

WILLIBRORD (or WILBRORD), **ST.** (d. 738), English missionary, "the apostle of the Frisians," was born about 657. His father, Wilgils, an Angle or, as Alcuin styles him, a Saxon, of Northumbria, withdrew from the world and constructed for himself a little oratory dedicated to St. Andrew. The king and nobles of the district endowed him with estates till he was at last able to build a church, over which Alcuin afterwards ruled. Willibrord, almost as soon as he was weaned, was sent to be brought up at Ripon, where he must doubtless have come under the influence of Wilfrid. About the age of 20 the desire of increasing his stock of knowledge (*c.* 679) drew him to Ireland, which had so long been the headquarters of learning in western Europe. Here he stayed for 12 years, enjoying the society of Ecgberht and Wihtberht. Ecgberht commissioned him as a missionary to the North-German tribes.

In his 33rd year (*c.* 690) he started with 12 companions for the mouth of the Rhine. These districts were then occupied by the Frisians under their king, Rathbod, who gave allegiance to Pippin of Herstal. Pippin befriended Willibrord and sent him to Rome, where he was consecrated archbishop (with the name Clemens) by Pope Sergius on St. Cecilia's Day 696. Bede says that when he returned to Frisia his see was fixed in Ultrajectum (Utrecht). He spent several years in founding churches and evangelizing, till his success tempted him to pass into other districts. From Denmark he carried away 30 boys to be brought up among the Franks. When Pippin died, Willibrord found a supporter in his son Charles Martel. He was assisted for three years in his missionary work by St. Boniface (719–722).

He was still living when Bede wrote in 731. A passage in one of Boniface's letters to Stephen III speaks of his preaching to the Frisians for 50 years, apparently reckoning from the time of his consecration. This would fix the date of his death in 738; and, as Alcuin tells us he was 81 years old when he died, it may be inferred that he was born in 657—a theory on which all the dates given above are based, though it must be added that they are substantially confirmed by the incidental notices of Bede. The day of his death was Nov. 6, and his body was buried in the monastery of Echternach, near Trier, which he had himself founded. Even in Alcuin's time miracles were reported to be still wrought at his tomb.

The chief authorities for Willibrord's life are Alcuin's *Vita Willibrordi,* both in prose and in verse, and Bede's *Hist. Eccl.* v. cc. 9–11. *See* also Eddius's *Vita Wilfridii* (1879; text trans. and notes by Colgrave, Cambridge, 1927); J. Mabillon, *Annales ordinis sancti Benedicti, lib.* xviii; and *The Calendar of St. Willibrord,* edited by H. A. Nelson (1918).

WILLIMANTIC, a city of Windham Co., Connecticut, U.S.A., 25 mi. E.S.E. of Hartford, at confluence of the Willimantic and Natchaug rivers to form the Shetucket. It is served by the Central Vermont and the New York, New Haven and Hartford railways. Pop. (1940) 12,101. There is abundant waterpower, and the city has extensive manufactures of spool-cotton, silk twist, silk and cotton fabrics, velvet and other commodities, with an output in 1937 valued at $5,905,932. The town of Windham, in which Willimantic is situated, was incorporated in 1692. Willimantic was settled in 1822, incorporated as a borough in 1833 and chartered as a city in 1893. The name is of Indian derivation.

WILLIS, THOMAS (1621–1675), English anatomist and physician, was born at Great Bedwin, Wiltshire, on Jan. 27, 1621. In 1660 he became Sedleian professor of natural philosophy. He was one of the first members of the Royal society. He died in London, on Nov. 11, 1675.

Willis' most important work is *Cerebri anatome nervorumque descriptio et usus* (1664), in which he described what is still known, in the anatomy of the brain, as the circle of Willis.

See Munk, *Roll of the Royal College of Physicians,* London (2nd ed., vol. i, 1878).

WILLISTON, SAMUEL WENDELL (1852–1918), U.S. palaeontologist and entomologist, was born in Boston, Mass., on July 10, 1852. He graduated from Kansas Agricultural college in 1872 and afterward became an ardent collector of vertebrate fossils in the chalk beds of western Kansas. In 1876 he entered the department of palaeontology at Yale university. He was professor of anatomy at Yale, 1886–90; professor of geology at the University of Kansas, 1890–1902; and professor of vertebrate palaeontology at the University of Chicago from 1902 until his death at Chicago on Aug. 18, 1918. While Williston's contributions to entomology were of a high order, especially his work on the

Diptera, his pre-eminence in science rests upon his monumental researches in vertebrate palaeontology, notably on Cretaceous and Permian reptiles and amphibians. His published writings, comprising about 300 titles, include *Manual of North American Diptera* (3rd ed., 1908); *American Permian Vertebrates* (1911); *Water Reptiles of the Past and Present* (1914); and *The Osteology of Reptiles* (ed. by W. K. Gregory, 1925).

See H. F. Osborn, *Jour. of Geol.*, vol. xxvi, pp. 673–689 (1918); R. S. Lull, *Mem. Nat. Acad. Sci.*, vol. xvii (1924).

WILLISTON, a city of North Dakota, U.S.A., on the north bank of the Missouri river and the main line of the Great Northern railway, 20 mi. from the western boundary of the state; the county seat of Williams county. Pop. (1940) 5,790.

WILLKIE, WENDELL LEWIS (1892–1944), Republican candidate for the presidency of the United States in 1940, was born Feb. 18, 1892, in Elwood, Ind. He was graduated from the University of Indiana in 1913 and in 1916 obtained his law degree there. He served as a captain during World War I and subsequently became associated with a law firm in Akron, O., where he remained until 1929, when he joined the legal staff of Commonwealth and Southern, a utilities holding company with operating units in 11 states. In 1933, when the president of the company retired, Willkie succeeded to the office. He first came into widespread notice because of his controversy with the Tennessee Valley authority, which set up an extensive power distributing system running parallel in many areas to the lines of the Commonwealth and Southern companies. Commonwealth and Southern, after considerable negotiation, sold its operating subsidiary, the Tennessee Electric Power company, to the TVA in July 1939, and it was about this time that a small "Willkie for President" movement began to spring up. During the Republican National convention in June 1940 Willkie, who was generally considered to have little chance to win the nomination, was chosen Republican nominee for president on the sixth ballot. He resigned as president of Commonwealth and Southern immediately in order to conduct his campaign. In the 1940 election he was defeated by 449 electoral votes to 82, but he received 22,327,226 votes to President Roosevelt's 27,241,939.

After his defeat Willkie returned to the practice of law. Even before the United States entrance into World War II he was a strong proponent of all possible aid to the Allies. He visited England at the request of President Roosevelt in 1941 and in 1942 was Roosevelt's special representative on a tour to the middle east, the U.S.S.R. and China. His book *One World* (1943), the story of the trip, contained a plea for postwar co-operation among all nations. Willkie died Oct. 8, 1944.

WILLMAR, a city of Minnesota, U.S.A., 92 mi. W. of Minneapolis; the county seat of Kandiyohi county, where the lakes of Minnesota begin. It is on federal highways 12 and 71 and is served by the Great Northern railway. Pop. (1940) 7,623. It is a division point on the Great Northern which has yards and a roundhouse there. The city was founded in 1869 and incorporated in 1874. It has a 200-ac. municipal airport.

WILLMORE, JAMES TIBBITTS (1800–1863), English line engraver, was born at Bristnall's End, Handsworth, near Birmingham, on Sept. 15, 1800. In 1814 he was apprenticed to a Birmingham engraver, and in 1823 he went to London. He engraved after Chalon, Leitch, Stanfield, Landseer, Eastlake, Creswick and Ansdell, and especially after Turner. He died on March 12, 1863.

WILLOBIE (or WILLOUGHBY), **HENRY** (1575?–1596?), the supposed author of a poem called *Willobie his Avisa,* which derives interest from its possible connection with Shakespeare's personal history. Henry Willoughby matriculated from St. John's college, Oxford, in Dec. 1591, at the age of 16. He is probably identical with the Henry Willoughby who graduated B.A. from Exeter college early in 1595, and he died before June 30, 1596, when to a new edition of the poem Hadrian Dorrell (probably a pseudonym) added an "Apologie" in defense of his friend the author "now of late gone to God." *Willobie his Avisa* was licensed for the press on Sept. 3, 1594, four months after the entry of Shakespeare's *Rape of Lucrece.*

It is preceded by two commendatory poems, the second of which, signed "Contraria Contrariis; Vigilantius; Dormitanus," contains the earliest known printed allusion to Shakespeare by name:—

Yet Tarquyne pluckt his glistering grape,
And Shake-speare paints poore Lucrece rape.

See *Shakspere Allusion-Books,* part i, ed. C. M. Ingleby (New Shakspere society, 1874); A. B. Grosart's "Introduction" to his reprint of *Willobie his Avisa* (1880).

WILL-O'-THE-WISP: *see* IGNIS FATUUS.

WILLOW (*Salix*), a well-marked genus of plants constituting, with the poplar (*Populus*), the family Salicaceae. Willows are trees or shrubs, varying in height from a few inches, like the small British *S. herbacea* and Arctic species generally, to 120 ft., and occurring most abundantly in cold or temperate climates in both hemispheres, and generally in moist situations. Their leaves are deciduous, alternate, simple, and generally much longer than broad, whence the term willow-leaved has become proverbial. At their base they are provided with stipules, which are also modified to form the scales investing the winter buds.

The flowers are borne in catkins, which are on one tree male (staminate) only, on another female (pistillate). Each staminate flower is borne in the axil of a small scale or bract, and consists usually of two but sometimes of more stamens. In addition there are one or two small glandular organs, the nectaries. The pistillate flowers are equally simple and also arise in the axil of a bract; they show a very short stalk, surmounted by two carpels adherent one to the other for their whole length, except that the upper ends of the styles are separated into two stigmas; nectaries are present in these flowers also. When ripe the two carpels separate in the form of two valves and liberate a large number of seeds, each provided at the base with a tuft of silky hairs. The flowers appear generally before the leaves and are thus rendered more conspicuous, while transport of pollen by the wind is facilitated. Fertilization is effected by insects, especially by bees; but some pollen must also be transported by the wind to the pistillate flowers, especially in arctic species which, in spite of the poverty of insect life, set abundant fruit. The tuft of hairs at the base facilitates rapid dispersion of the seed.

Although the limitations of the genus are well marked, and its recognition in consequence easy, it is otherwise with regard to the species. The greatest difference of opinion exists among botanists as to their number and the bounds to be assigned to each; and the extensive cross-fertilization that takes place between the species, resulting in numerous hybrid forms, intensifies the difficulty.

N. J. Andersson, a Swede, who spent nearly 25 years in their investigation, published a monograph on the genus. He admits about 100 species. C. S. Sargent (*Silva of North America*) suggested 160 to 170 as the number of distinguishable species. Some botanists have enumerated 80 species from Great Britain alone, while others count only 12 or 15.

Buchanan White, who made a special study of the British willows, grouped them under 17 species with numerous varieties and hybrids.

As timber trees many of the species are valuable from their rapidity of growth and for the production of light durable wood, serviceable for many purposes. Among the best trees of this kind are *S. fragilis,* the crack willow, and *S. alba,* the white or Huntingdon willow. These trees are usually found growing by river banks or in other moist situations, and are generally pollarded for the purpose of securing a crop of straight poles. The wood of *S. alba* var. *caerulea* is used for cricket bats; there is a great difference in the value for this purpose of timber from different soils; and wood of the pistillate tree is said to be preferable to that of the staminate. *S. caprea,* a hedgerow tree, generally grows in drier situations. It is a useful timber tree, and its wood, like that of *S. alba,* is prized in the manufacture of charcoal. Its catkins are collected in England in celebration of Palm Sunday, the bright-coloured flowers being available in early spring. Certain sorts of willow are largely used for basketmaking and wickerwork. The species employed for this purpose are known under the col-

lective name of osiers. (*See* OSIER.) *S. acuminata* and other species do well by the seaside, and are serviceable as windscreens, nurse-trees and hedges. *S. daphnoides, S. repens* and other dwarf kinds are useful for binding heathy or sandy soil. In addition to their use for timber or basketmaking, willows contain a large quantity of tannin in their bark. A medicinal glucoside named salicin (*q.v.*) is also extracted from the bark. The wood, especially of *S. alba,* is used for paper pulp. As ornamental trees some willows also take a high rank. The white willow is a great favourite, while the drooping habit of the weeping willow renders it very attractive. Though named *S. babylonica,* it is really a native of China, from which it has been widely spread by man; the willow of the Euphrates (Ps. cxxxvii) is in all probability *Populus euphratica. S. repens* var. *rosmarinifolia* is remarkable for its very narrow leaves—purplish above, silvery beneath.

In North America upwards of 70 native species occur, together with numerous varieties and natural hybrid forms. Of these about 25 species attain the stature of trees. The black willow (*S. nigra*), the largest and most conspicuous willow of eastern North America, reaches a height of 120 ft., with a trunk 3 ft. in diameter. Other well-known willow trees found east of the Rocky mountains are the peach-leaved willow (*S. amygdaloides*), sometimes 70 ft. high; the pussy willow (*S. discolor*), 10 ft. to 25 ft. high; the shining willow (*S. lucida*), occasionally 20 ft. high; the beaked willow (*S. bebbiana*), rarely 25 ft. high; and the sandbar willow (*S. interior*). Some of the foregoing range northward and westward to British Columbia, Alaska and the Arctic circle. Interesting shrubby species found chiefly east of the Rocky mountains are the autumn willow (*S. serissima*), with fruit maturing in the autumn; the broad-leaved willow (*S. glaucophylla*), found on sand dunes; the furry willow (*S. adenophylla*), of lake and river shores; the silky willow (*S. sericea*), with silky leaves; the hoary willow (*S. candida*), with sage-like foliage; and the prairie willow (*S. humilis*) and the dwarf pussy willow (*S. tristis*), both low slender shrubs.

Among noteworthy willows found in the Pacific states and northward are the western black willow (*S. lasiandra*), sometimes 45 ft. high; the red willow (*S. laevigata*), 20 ft. to 50 ft. high; the California white willow or arroyo willow (*S. lasiolepis*), 8 ft. to 20 ft. high; and the Sitka or velvet willow (*S. sitchensis*), sometimes 30 ft. high, which grows from California to Alaska.

Several old world willows, widely planted for ornament and other purposes in eastern North America, have become extensively naturalized, especially the white willow (*S. alba*), the yellow willow (*S. vitellina*), the weeping willow (*S. babylonica*), the brittle or crack willow (*S. fragilis*), and the purple willow (*S. purpurea*). The basket willow (*S. viminalis*), the bay willow (*S. pentandra*) and the goat willow or sallow (*S. caprea*) have become sparingly naturalized.

WILLOW-HERB, the popular name for the species of *Epilobium,* a genus (family Onagraceae) of often tall herbaceous plants. The genus embraces upwards of 160 species, nine of which are natives of Great Britain. The slender stems bear narrow leaves and pink or purple flowers, which in the rose-bay (*E. angustifolium*), found by moist riversides and in copses, are 1 in. in diameter and form showy spikes. The great hairy willow-herb, *E. hirsutum,* found by sides of ditches and rivers, a tall plant with many large rose-purple flowers, is known popularly as codlins-and-cream. In North America some 40 species of willow-herb are found, including *E. angustifolium,* which is native across the continent and called usually great willow-herb or fire-weed, and *E. hirsutum,* extensively naturalized in the eastern states and Canada.

WILLS, WILLIAM GORMAN (1828–1891), Irish dramatist, was born at Kilmurry, Ireland, on Jan. 28, 1828, the son of James Wills (1790–1868), author of *Lives of Illustrious and Distinguished Irishmen* (1839–47). The son was educated at Waterford grammar school and Trinity college, Dublin. Wills was a Dublin journalist, then a portrait painter, and finally "dramatist to the Lyceum." He had written several plays under this agreement when he made a great success with *Charles I* (1872) and with *Olivia* (1873), an adaptation of the *Vicar of Wakefield.* Wills also wrote ballads, the best known of which is "I'll sing thee songs of Araby." He died on Dec. 13, 1891.

See F. Wills, *William Gorman Wills* (1898).

WILLSTÄTTER, RICHARD (1872–1942), German organic chemist. Willstätter was the foremost investigator of the constitution of natural products during the first quarter of the 20th century. His studies of the structure of chlorophyll, demonstrating the central magnesium atom, the pyrrolerings and the presence of phytol won him the Nobel prize in 1915.

Moreover, these and similar researches on the pigments of the blood, formed the basis for the later work of Hans Fischer in the same fields, leading to another Nobel prize in 1930 for Fischer's complete synthesis of hemin.

Willstätter began his career with an investigation of plant alkaloids, determining at the age of 26 the structures of tropine, atropine and cocaine. Three years later he had synthesized tropine, tropilidine and tropane. There followed a penetrating study of the quinones, culminating in the determination of the structure of aniline black. Next came the work on blood pigments and chlorophyll, leading to further investigations which revealed the structures of many of the pigments of flowers and fruits.

In his later years, Willstätter took up the study of enzymes and of catalytic hydrogenation, particularly in the presence of oxygen. His work on the degradation of cellulose has been used as the basis for the process for obtaining glucose from wood. He also investigated the phenomenon of fermentation, and was a pioneer in the use of hydrogels for absorption.

It was characteristic of Willstätter that he attempted only difficult problems, remarking that the greatest joy in research came from overcoming obstacles. He also stated that the highest goal of science is the improvement of the lot of humanity, and he was particularly proud of his syntheses of hypnotics and narcotics, which included cocaine and avertin.

Willstätter was born at Karlsruhe, Aug. 13, 1872. He studied at Munich under Adolph von Baeyer, (*q.v.*) and in 1905 became professor at Zürich. He was director of the Kaiser Wilhelm Institute in Berlin from 1912 to 1916, and then succeeded his old teacher Baeyer at the University of Munich. He resigned because of anti-Jewish pressure in 1925, but continued his work privately, first in Munich, and later in Switzerland.

He died in forced exile on August 3, 1942.

For additional biographical details see R. Adams, *Journal American Chemical Society, 65,* 127 (1943); R. Willstätter, *Industrial and Chemical Engineering,* News Edition, *11,* 275 (1933); F. Haber *et al., Naturwissenschaften, 20,* 601 (1932).

WILLUGHBY, FRANCIS (1635–1672), English ornithologist and ichthyologist, son of Sir Francis Willughby, born at Middleton, Warwickshire, was the pupil, friend and patron as well as the active and original co-worker of John Ray (*q.v.*), and hence to be reckoned as one of the most important precursors of Linnaeus. His connection with Ray dated from his studies at Trinity college, Cambridge (1653–1659); and he made an extensive continental tour in his company. The specimens, figures and notes thus accumulated were in great part elaborated on his return into his *Ornithologia,* posthumously published in 1676, and translated by Ray as the *Ornithology of Fr. Willughby* (London, 1678, fol.); the same friend published his *Historia Piscium* (1686, fol.). In Ray's preface to the former work he gives Willughby much of the credit usually assigned to himself, both as critic and systematist.

Willughby died at Middleton Hall on July 3, 1672.

WILLY, the pen name adopted by the French novelist HENRI GAUTHIER-VILLARS (1859–1931), born at Villars-sur-Orge, on Aug. 10, 1859. He was educated at the Lycée Condorcet and the Collège Stanislas. He is best known for his novels, many of which were written in collaboration with the actress and authoress Colette. The most famous of these is *Claudine à l'ecole* (1900), with its sequels *Claudine à Paris* (1901, dramatized 1902), *Claudine en Ménage* (1902) and *Claudine s'en va* (1903). Included in this series is *La Maison de Claudine.*

WILMERDING, a borough of Allegheny county, Pennsylvania, U.S.A., 14 mi. S.S.E. of Pittsburgh, on the Pennsylvania railroad, between the boroughs of Turtle Creek and Pitcairn, in a

valley surrounded by three hills. Pop. (1920) 6,441 (28% foreign-born white); 1940 federal census 5,662. The borough was incorporated in 1890.

WILMETTE, a beautiful residential village of Cook county, Illinois, U.S.A., on Lake Michigan, 14 mi. N. of Chicago. It is served by the Chicago and North Western and the Chicago, North Shore and Milwaukee railways. Pop. 7,814 in 1920 (88% native white); 15,233 in 1930, and 17,226 in 1940 by the federal census. The village was founded in 1869 and incorporated in 1872.

WILMINGTON, the chief city of Delaware, U.S.A., a port of entry and the county seat of New Castle county; 26 mi. S.W. of Philadelphia, on the Delaware river, at the mouth of the Christina, which is joined by the Brandywine within the city limits. It is on federal highways 13 and 40, and is served by the Baltimore and Ohio, the Pennsylvania, and the Reading railways, interurban trolley, motorbus and truck lines and several steamship companies. Pop. 110,168 in 1920 (16,279 foreign-born white and 10,746 Negroes); 106,597 in 1930 federal census, with an additional 40,000 in the immediate suburbs, and 112,504 in 1940.

Half the population of the state lives in Wilmington; its plants make nearly $\frac{2}{3}$ (by value) of the products manufactured in the state; and its banks hold more than $\frac{2}{3}$ of the deposits in the state's banking institutions. The city occupies 11·26 sq.mi. of gently rolling land, the altitude ranging from tidewater to 260 feet. The harbour includes 4 mi. of the Christina river (a tidal stream, 750 ft. wide at its mouth) and the navigable part (about a mile) of the Brandywine, and has a controlling depth in the lower stretches of about 20 ft., which will be increased to 35 ft. by projects now under way. There is a continuous line of piers and wharves along both sides of the Christina river for two miles. At its mouth is a municipal marine terminal, with ample berthing accommodations and storage space and modern equipment for handling cargoes (constructed by the city in 1920–23).

The public parks cover 786·4 ac. There are 22 supervised playgrounds, 30 baseball fields and provision for various other sports, 28 public and 23 private and parochial schools, 3 private business schools, 2 daily newspapers, 115 churches, 4 public hospitals (710 beds) and 10 hotels. Wilmington is the headquarters of both a Roman Catholic and a Protestant Episcopal bishop. It operates under a mayor-and-council form of government. A zoning ordinance was adopted in 1924. Among the interesting old buildings are Holy Trinity (Old Swedes) church (1698); the building occupied by the Historical Society of Delaware, which was the First Presbyterian meeting house (1740); and the old city hall (1798), now a museum. The Wilmington Institute free library (1788) is housed in a fine new building, completed in 1923. A joint city hall and county building was completed in 1914; and a civic centre (Rodney square) in 1915. The University of Delaware is at Newark, 12 mi. southwest.

The total traffic of the port amounted in 1936 to 8,709,311 tons of which 8,152,004 tons represented commercial shipments and receipts (entirely domestic) and the rest vehicular ferry traffic. There are 159 diversified manufacturing plants within the city, with an output in 1939 valued at $57,678,025, and products ranging alphabetically from acids to zaponite. Its assessed valuation for 1940–41 was $159,795,973.

The site of Wilmington was occupied in 1638 by Swedish and Dutch colonists under the leadership of Peter Minuit, and the settlement was called Christinaham in honour of the queen of Sweden. In 1655 the fort (Christina) was captured without bloodshed by Peter Stuyvesant, but very few of the Swedes left the colony. In 1731 a large part of the present territory of the city was owned by Thomas Willing, and was called Willingtown. In 1739 a borough charter was granted by William Penn, and the name with two slight changes was altered to honour the earl of Wilmington. The Battle of Brandywine (Sept. 11, 1777) was fought 10 mi. N.W. of Wilmington. In the first half of the 19th century Wilmington was a centre of strong antislavery sentiment, and it was a station on the "underground railroad." It was chartered as a city in 1832. Shipbuilding was established as early as 1739, and in 1836 the first iron steamship built in the United States was constructed there. In 1802 the French refugee Eleuthère Irénée du Pont de Nemours (1771–1834), who had learned from Lavoisier the modern methods of powder making, established the company which still bears the family name and is carried on by his descendants, and built on the Brandywine the first powder mill in America.

WILMINGTON, the chief seaport of North Carolina, U.S.A., a port of entry and the county seat of New Hanover county; in the southeastern part of the state, on the Cape Fear river, 30 mi. from the ocean bar at its mouth. It is on federal highways 17, 76 and 421; has a municipal airport; and is served by the Atlantic Coast Line and the Seaboard Air Line railways and steamship lines. Pop. 32,270 in 1930 (33⅓% Negroes); and 33,407 in 1940 by the federal census. The city lies on an elevated sand ridge, extending along the river for 2·5 miles. Causeway and buses connect it with Wrightsville beach (8 mi. E.), and 14 mi. S. are three other resorts on the mainland (Carolina, Wilmington and Fort Fisher beaches). The ample fresh-water harbour accommodates vessels drawing 30 ft., and the channel down the river and over the bar has a depth of 30 ft. at mean low water. The commerce of the port in 1940 amounted to 2,758,861 tons, valued at $70,500,000, of which 182,114 tons represented foreign trade (imports of molasses and chemicals for fertilizer and exports of cotton). Wholesale and jobbing business amounts to $65,000,000 annually. It is the headquarters of the Atlantic Coast Line railroad, which employs about 2,000 persons in its offices and shops there. Wilmington operates under a city-manager form of government. Its assessed valuation for 1940 was $36,856,533.

A settlement was established there in 1730. It was called New Liverpool at first, New Town after 1732 and in 1739 was incorporated and renamed in honour of Spencer Compton, Earl of Wilmington (*c.* 1673–1743). In 1760 it was incorporated as a borough and in 1866 as a city. It was the first place to make armed resistance to the Stamp act. Cornwallis made it his headquarters through most of the spring of 1781. During the Civil War, although blockaded by the Union fleet, it was the centre of a lively foreign trade, and was the last port kept open by the Confederacy. It was defended by Ft. Fisher, a heavy earthwork on the peninsula between the river and the ocean, which was finally taken, after several terrific bombardments, by a combined naval and land attack, on Jan. 15, 1865.

WILMOT, DAVID (1814–1868), American political leader, born at Bethany, Penn., Jan. 20, 1814. He was admitted to the bar in 1834 and practised law in Towanda. He entered politics as a Democrat, served in the national house of representatives (1845–51), and, although he favoured the Walker tariff, the Mexican War, and other party measures, he opposed the extension of slavery. On Aug. 8, 1846, on behalf of advocates of the restriction of slavery he offered an amendment to a bill appropriating $2,000,000 to settle the U.S. boundary with Mexico by purchase of land if necessary, to the effect that "neither slavery nor involuntary servitude shall ever exist in any part of the said territory" acquired from Mexico. The bill including the Wilmot proviso, as the amendment was called, passed the house, but was defeated by the senate's adjournment. In the next session a similar bill was introduced in the house and again Wilmot moved to attach his proviso. A second time it passed the house, but the senate refused to consider it and on the last day of the session secured the consent of the house to the unamended bill. Although the Wilmot proviso failed in 1847, it was revived in the house again and again in the two years following; it was a formulation of the essential issue of the Civil War; out of the efforts of the Democrats and Whigs to subordinate this issue, grew the Republican party that definitely accepted the principle of the proviso. Wilmot supported Van Buren in 1848 and entered the Republican party at the time of its formation.

Wilmot was president judge of the 13th judicial district of Pennsylvania in 1853–61, U.S. senator in 1861–63, and judge of the U.S. court of claims in 1863–68. He died at Towanda, Penn., March 16, 1868.

See G. P. Garrison, *Westward Extension* (1906); Charles B. Going, *David Wilmot, Free-Soiler* (1924).

WILNO: *see* VILNIUS.

WILSON, ALEXANDER (1766–1813), American ornithologist and poet, was born in Paisley, Scotland, July 6, 1766. At 13 he was apprenticed to a weaver that he might follow his father's trade, but after a few years rebelled and became a pedlar. Tramping up and down Scotland, he composed numerous dialect poems treating his lot or depicting with broad humour and the pathos born of poverty the life of the folk. The most famous of these productions, *Watty and Meg,* published as a penny chapbook, is said to have sold to the number of 100,000 copies within a few weeks and to have been praised by Burns. In the labour troubles which arose at this time Wilson's sympathies were naturally with the oppressed weavers. He published a number of lampoons in verse, for which he was convicted of libel and compelled to burn his satires at the town cross, and later, for lack of money for a fine, he was imprisoned. It is small wonder then that with his nephew, William Duncan, he emigrated to America as a deck passenger, landing with only a gun and the clothes on his back. His years of poverty and hardship were not over, but a turning point came when as a village schoolmaster in Philadelphia he met William Bartram, the naturalist, who encouraged him in his drawing and collecting "of all the birds in this part of North America." In 1806 he obtained the assistant-editorship of the American edition of *Ree's Encyclopaedia,* and thus acquired more means and leisure for his great work, *American Ornithology,* the first volume of which appeared in the autumn of 1808, after which he spent the winter in a journey "in search of birds and subscribers." By the spring of 1813 seven volumes had appeared. He succumbed to dysentery at Philadelphia Aug. 23, 1813.

Wilson's *Poems and Literary Prose* were edited with a memoir by the Rev. A. B. Grosart in 1876, a statue being erected to Wilson in Paisley the same year. The eighth and ninth volumes of the *American Ornithology* were edited after his decease by his friend George Ord, who published an early *Sketch of the Life of Alexander Wilson,* and the work was continued by Lucien Bonaparte. The complete *Ornithology* has been several times republished.

WILSON, SIR ARTHUR KNYVET, G. C. B. (1842–1921), English admiral, was born at Swaffham, Norfolk, on March 3, 1842. He entered the navy in 1855, and served in the Crimean War and the Chinese campaign of 1857–58. In 1876 he was appointed to H.M.S. "Vernon," the torpedo school-ship at Portsmouth. With the rank of captain (1880), he took part in the operations against Alexandria, and in 1884 won the V.C. at El Teb for great gallantry in single combat with the Arab enemy. He became rear-admiral in 1895, third sea lord and controller of the navy in 1897, and vice-admiral in 1901, receiving the K.C.B. in 1902. From 1901–03 he commanded the Channel squadron, and from 1903–07 was commander-in-chief of the Home and Channel fleets. On leaving that command in 1907 he was specially promoted to the rank of admiral of the fleet. In 1909 he succeeded Lord Fisher as first sea lord. On retirement from that office he received, in 1912, the Order of Merit. During the World War he acted in an advisory capacity to the Board of Admiralty and on the sudden resignation of Lord Fisher in May 1915, he was offered by Winston Churchill, and with much diffidence accepted, the appointment of first sea lord for a second time. But Churchill was himself superseded and the appointment never materialized. He died at Swaffham on May 25, 1921.

See Admiral Sir Edward Bradford, *Admiral of the Fleet Sir A. K. Wilson* (1923). (E. A.)

WILSON, SIR ERASMUS (1809–1884), British surgeon and philanthropist, was born in London on Nov. 25, 1809, studied at St. Bartholomew's Hospital in London, and at Aberdeen, and early in life became known as a skilful operator and dissector. He took up skin diseases as a special study. In the opinion of one of his biographers, we owe to Wilson in great measure the habit of the daily bath, and he helped very much to bring the Turkish bath into use in Great Britain. His books, *A Healthy Skin* and *Student's Book of Diseases of the Skin,* have long remained text-books of their subject. Wilson founded in 1869 the chair and museum of dermatology in the Royal College of Surgeons, of which he was chosen president in 1881. He also founded a professorship of pathology at Aberdeen university. After the death of his wife the bulk of his property, some £200,000, went to the Royal College of Surgeons. In 1878 he defrayed the expense of bringing the Egyptian obelisk called Cleopatra's Needle from Alexandria to London, where it was erected on the Thames Embankment. He was knighted in 1881 and died at Westgate-on-Sea on Aug. 7, 1884.

WILSON, HENRY (1812–1875), vice-president of the United States from 1873 to 1875, was born at Farmington, N.H., on Feb. 16, 1812. His name was Jeremiah Jones Colbath. At the age of 21, for some unstated reason, he had his name changed by act of the legislature to Henry Wilson. At Natick, Mass., he learned the trade of shoemaker, and during his leisure hours studied much. After successfully establishing himself as a shoe manufacturer, he attracted attention as a public speaker in support of William Henry Harrison during the campaign of 1840. In 1855 he was elected to the United States Senate and remained there by re-elections until 1873. His uncompromising opposition to the institution of slavery furnished the keynote of his earlier senatorial career, and he soon took rank as one of the ablest and most effective anti-slavery orators in the United States. Upon the outbreak of the Civil War he was made chairman of the military committee of the Senate, and in this position performed most laborious and important work for the four years of the war. The Republicans nominated Wilson for the vice-presidency in 1872, and he was elected. He died on Nov. 22, 1875.

He published, besides many orations, a *History of the Anti-Slavery Measures of the Thirty-Seventh and Thirty-Eighth United States Congresses* (1865); *Military Measures of the United States Congress* (1868); *History of the Reconstruction Measures of the Thirty-Ninth and Fortieth Congresses* (1868) and *History of the Rise and Fall of the Slave Power in America* (1872–75), his most important work.

The best biography is that by Elias Nason and Thomas Russell, *The Life and Public Services of Henry Wilson* (Boston, 1876).

WILSON, SIR HENRY HUGHES (1864–1922), British soldier, was born at Edgeworthstown, County Longford, Ireland, on March 5, 1864, and educated at Marlborough and Sandhurst. He joined the Rifle Brigade in 1884 and in 1894 he married a daughter of G. C. Wray. From the outset he was a serious and an ambitious soldier, and while his natural gaiety of disposition made him a welcome companion everywhere, his industry soon attracted the attention of his superiors. He was indeed, almost from the first, one of those men who could not be overlooked. His earliest experience of active service was in Burma betwen 1886 and 1888, and when the Boer War broke out in 1899 he had passed through the Staff College and become a brigade major at Aldershot.

Before that war ended Wilson was brought back to the war office, where in the newly formed staff-duties directorate it was his especial task to study and to apply the lessons which were learned in South Africa—of which the chief perhaps was the necessity of organising the British Army on something approaching continental lines and establishing a general staff for the study and application of the principles of war. In the work of reform Henry Wilson played a great, if still subordinate, part and it was no surprise when, in 1906, he was appointed to succeed Rawlinson as commandant of the Staff College at Camberley. Himself an inspiring teacher with the Irishman's birthright of eloquence, he gathered around him a group of young officers upon whom he impressed his own views and his own system. More than all he became himself impressed with an almost overpowering sense of the imminence of war between France and Germany. The Entente was already in existence, and if it were to mean anything at all, must carry with it grave military responsibilities. Wilson, therefore, established close relations with the French Staff College, and particularly a close personal friendship with its commandant, Ferdinand Foch, whose great work *Les Principes de la Guerre* (*The Principles of War*) became a text-book in Great Britain. Under his influence Wilson became more and more convinced of the danger which was threatening Europe and made himself acquainted with the Franco-German frontier.

In 1910 he left the Staff College to succeed Sir W. Robertson as director of military operations, while Robertson took Wilson's place at Camberley. In Whitehall, Wilson concentrated

the labours of his directorate upon what he believed to be the vital field of operations. Incidentally he was one of Lord Roberts' most ardent supporters in his campaign for national training. Thus, while British statesmen were striving for peace, the director of military operations, acting under the chief of the Imperial General Staff, was step by step perfecting the nation's preparations for war. At each step he had the cordial support of the other directors, with the result that in August 1914 the British war office was in a position to bring off the greatest strategical surprise of the whole war. Mobilisation was rapid and the Expeditionary Force was landed in France without the loss of a man or a horse, complete in every detail.

In France Wilson was deputy chief of the general staff. Of all those who crossed with the British Expeditionary Force he was without doubt the best known in France, so much so that when the number of British troops increased the British Army Corps came to be referred to in French confidential documents as *C. d'A.W.* or *Corps d'Armée Wilson.* It was therefore natural that he should be appointed principal liaison officer with the French field headquarters, a post which he held until he took command of the IV. Army Corps towards the end of 1915.

Although deeply interested in the life and welfare of the private soldier, he never really made his mark as a commander. To some extent, no doubt, this was due to lack of opportunity, but still more to temperament and to mental development along other lines. Thus it was that early in 1917 he left the field armies for good and accompanied Lord Milner's mission to Russia. In Nov. 1917 he went to Versailles as British military representative on the newly-established Supreme War Council. Three months later, less than a month before the great German attack of March 1918, he once more succeeded Robertson and this time as chief of the Imperial General Staff in London. He was one of those who supported Lloyd George in his efforts to secure unity of command on the Western front and strongly pressed the claims of his old friend Foch to be appointed commander-in-chief of the Allied forces in France and Flanders.

Wilson had always belonged to what became known as the Eastern school of thought rather than to the Western, and when the German advance had been checked he worked hard to re-establish that Eastern front which had been shaken by the Russian revolution and shattered by "General Hofmann's jack-boot," at Brest Litovsk. When the Armistice was declared on Nov. 11, 1918, he had attained the rank of general, and in the final honours for the War he was promoted field marshal, was given a baronetcy and a grant of £10,000. As chief of the General Staff he was military adviser of the government during the prolonged negotiations at Versailles, and subsequently at numerous conferences. His mastery of language and effective manner of expressing in non-technical terms his views on technical matters no less than his charm of manner made him *persona grata* to ministers of state, and his intimacy with all the French superior commanders enabled him to make smooth on times of stress many rough places.

Parliamentary Career.—Unfortunately, when the War was over, the troubles in Ireland came to a head and Wilson was a great Irishman. His position as chief of the Imperial General Staff, under a government with whose policy in Ireland he could not agree, became extremely difficult. Cordial relations became strained and old friendships were broken. When, in Feb. 1922, his tenure at the war office came to an end he entered parliament as member for North Down and at the same time he placed his military experience at the disposal of the Government of Northern Ireland. Seldom has a new member gone to Westminster better equipped. Debate, and especially criticism, came easily to him, for he was a ready and effective speaker with sufficient restraint to prevent him from discussing subjects of which he did not possess special knowledge. His maiden speech was delivered on March 15 on the Army estimates and was followed at fairly frequent intervals by others on the Irish question. Here he quickly established himself as the most outspoken critic of those colleagues with whom in his military capacity he had worked so long, and in so doing he drew upon himself the hatred of his fellow countrymen in the 26 counties. On May 31, 1922, when the situation was critical, he concluded a speech with the words:

> I wonder when the moment will come when the Government will have the honesty and truthfulness to say, "We have miscalculated every single element in the Irish problem. We are exceedingly sorry for all the terrible things that have happened owing to our actions. We beg leave to return to private life and never to appear again."

He never spoke again in the House of Commons, for just three weeks later he was shot on his own doorstep in Eaton Place, London, as he returned from Liverpool Street Station after unveiling a memorial to the men of the Great Eastern Railway who had fallen in the War. He was buried with full military honours in St. Paul's Cathedral.

Sir Henry Wilson's character is difficult to sum up. Essentially a critic, he nevertheless did great constructive work for the British Army and was, as much as any man in Great Britain, the builder, though not the architect, of the Entente with France. Nevertheless he cannot be ranked with the greatest soldiers for he never held high command; in parliament he achieved distinction, but died before he could prove himself a statesman. (N. MA.)

His *Life and Letters* were published by Major-General Sir C. E. Callwell, with a preface by Marshal Foch (2 vols., 1927).

WILSON, JAMES (1742–1798), American statesman and jurist, born in or near St. Andrews, Scotland, September 14, 1742. He matriculated at the University of St. Andrews in 1757 and was subsequently a student at the universities of Glasgow and Edinburgh. In 1765 he emigrated to America. Landing at New York in June, he went to Philadelphia in the following year and in 1766–1767 was instructor of Latin in the college of Philadelphia, later the University of Pennsylvania. Meanwhile he studied law in the office of John Dickinson, was admitted to the bar in 1767, removed first to Reading and soon afterward to Carlisle, and rapidly rose to prominence. In August 1774 he published a pamphlet *Considerations on the Nature and Extent of the Legislative Authority of the British Parliament,* in which he argued that parliament had no constitutional power to legislate for the colonies; this pamphlet strongly influenced members of the Continental Congress which met in September. Wilson was a delegate to the Pennsylvania provincial convention in January 1775, and he sustained there the right of Massachusetts to resist the change in its charter, declaring that as the force which the British Government was exercising to compel obedience was "force unwarranted by any act of parliament, unsupported by any principle of the common law, unauthorized by any commission from the crown," resistance was justified by "both the letter and the spirit of the British constitution"; he also, by his speech, led the colonies in shifting the burden of responsibility from parliament or the king's ministers to the king himself. In May 1775 Wilson became a member of the Continental Congress. He was in favour of the Declaration of Independence and a signer of that document. Receiving a commission as colonel in May 1775, Wilson raised a battalion of troops in his county of Cumberland, and for a short time in 1776 he took part in the New Jersey campaign, but his principal labours in 1776 and 1777 were in Congress. In May 1777 he wrote the address *To the Inhabitants of the United States,* urging their firm support of the cause of Independence; he drafted the plan of treaty with France together with instructions for negotiating it; he was a member of the Board of War from its establishment in June 1776 until his retirement from Congress in September 1777; from January to September 1777 he was chairman of the Committee on Appeals to hear and determine appeals from the courts of admiralty in the several states; and he was a member of many other important committees. In September 1777 the political faction in his state which opposed Independence came into power, and Wilson was kept out of Congress until the close of the war; he was back again, however, in 1783, and 1785–1786, and, advocating a sound currency, laboured in co-operation with Robert Morris to direct the financial policy of the Confederation.

In 1779 he was commissioned advocate-general for France, and in this capacity he represented Louis XVI. in all claims arising out of the French alliance until the close of the war. In 1781–1782 he

was the principal counsel for Pennsylvania in the dispute with Connecticut over possession of the Wyoming valley, which was decided in favour of Pennsylvania in December 1782 by an arbitration court appointed by Congress.

As a constructive statesman Wilson had no superior in the Federal Convention of 1787. He favoured the independence of the executive, legislative and judicial departments, the supremacy of the Federal Government over the State Governments, and the election of senators as well as representatives by the people, and was opposed to the election of the President or the judges by Congress. His political philosophy was based upon implicit confidence in the people, and he strove for such provisions as he thought would best guarantee a government by the people. Together with Gouverneur Morris he wrote the final draft of the Constitution and afterwards pronounced it "the best form of government which has ever been offered to the world." In the Pennsylvania ratification convention (November 21 to December 15, 1787) he was the constitution's principal defender.

Wilson was a delegate to the Pennsylvania state constitutional convention of 1789–1790, and a member of the committee which drafted the new constitution. In 1789 Washington appointed him an associate justice of the United States Supreme Court, and in 1793 he wrote the important decision in the case of *Chisholm* v. *Georgia,* the purport of which was that the people of the United States constituted a sovereign nation and that the United States were not a mere confederacy of sovereign states. He continued to serve as associate justice until his death, near Edenton, North Carolina, on August 28, 1798.

Wilson's *Works,* consisting principally of his law lectures and a few speeches, were published under the direction of his son, Bird Wilson (3 vols., 1803–1804; rev. ed., with notes, 1896). *See* also *Documentary History of the Constitution of the United States of America,* vols. i. and iii. (Washington, 1894); J. B. McMaster and F. D. Stone, *Pennsylvania and the Federal Constitution, 1787–1788* (1888); L. H. Alexander (ed.), *James Wilson* (1908); A. C. McLaughlin, "James Wilson and the Constitution," *Political Science Quarterly,* vol. 12 (1897); Justice J. M. Harlan, "James Wilson and the Formation of the Constitution," in the *American Law Review,* vol, 34; B. A. Konkle *et al.,* "The James Wilson Memorial," in the *American Law Register,* vol. 55 (1907); R. C. Adams, "The Legal Theories of James Wilson," *Univ. of Pa. Law Review,* vol. 68 (1920).

WILSON, JOHN (1595–1674), English composer. He was engaged to write the music for a "Maske of Flowers," written for the wedding of the earl of Somerset and the daughter of the earl of Suffolk in 1614. Although the printed copy does not contain Wilson's name, he afterwards printed the songs in an arrangement for three voices in his "Cheerfull Ayres" (1660). Other songs from plays, including some from Shakespeare were printed by him in later collections, and there is reason to suppose that he sang on the stage and is identical with a Jacke Wilson, mentioned in the stage direction of the first folio edition of Shakespeare (1623). Wilson became one of the King's Musicians in 1635 and was evidently a remarkable lutenist, much appreciated by Charles I. on that account and also for his singing. In the Civil War he went with the court to Oxford, and in 1645 was made Mus.D. of the university, as being "now the most noted Musitian of England." After the surrender of Oxford he retired into the country for some years, most of his compositions being published during this period. In 1656 he was appointed professor of music at Oxford, with rooms in Balliol college. His professorship came to an end in 1661. In 1657 he had published what purported to be his last work, the "Psalterium Carolinum" for three voices and organ or theorbo. The "Cheerfull Ayres" which followed contained earlier songs revised. He went back to his post as one of the King's Musicians at the Restoration and in 1662 became a gentleman of the Chapel Royal in place of Henry Lawes. He died at the Horseferry, Westminster, on Feb. 22, 1674. A portrait of him is in the Oxford Music School. His early settings of Shakespeare's songs, including "Take, O take those lips away," and other of his songs show him to have been a master of melody. His manuscript music is in the British Museum, the Bodleian, and elsewhere; songs and catches occur in Playford's "Select Musicall Ayres and Dialogues" (1652, 1653), in his "Catch that catch can" (1667) and other collections.

See the article by G. E. P. Arkwright in Grove's *Dictionary.*

WILSON, JOHN (1785–1854), Scottish writer, the CHRISTOPHER NORTH of *Blackwood's Magazine,* was born at Paisley on May 18, 1785, the son of a wealthy gauze manufacturer who died when John was eleven years old. In 1803 Wilson was entered as a gentleman commoner at Magdalen College, Oxford. He took his degree in 1807, and found himself at twenty-two his own master, with a good income, no father or guardian to control him, and an estate on Windermere called Elleray. In 1812 he published a considerable volume of poems the *Isle of Palms.* In 1815 he lost his fortune. He now read law and was called to the Scottish bar. In 1817 Wilson began his connection with *Blackwood's Magazine.* He became the principal writer for the review, though he was never its nominal editor. In 1822 began the series of *Noctes Ambrosianae,* after 1825 mostly Wilson's work.

Wilson now established himself (1819) in Ann Street, Edinburgh, with his wife and family of five children, and in 1820 he was elected to the chair of moral philosophy in the university of Edinburgh. His duties left him plenty of time for magazine work, and for many years his contributions to *Blackwood* were extraordinarily voluminous, in one year (1834) amounting to over fifty separate articles. In 1851 he resigned his professorship, and a Civil List pension of £300 a year was conferred on him. He died at Edinburgh on April 3, 1854.

See Christopher North, by Mrs. Mary Gordon, his daughter (1862); and Mrs. Oliphant, *Annals of a Publishing House; William Blackwood and his Sons* (1897).

WILSON, RICHARD (1714–1782), English landscape painter, was born at Penegoes, Montgomeryshire, where his father was a clergyman, on Aug. 1, 1714. In 1729 he was sent to London to study under Thomas Wright, a little-known portrait painter of the time. After six years he started on his own account, and was soon in a good practice. In 1749 Wilson visited Italy, where he spent six years. "Niobe," one of his best works, was exhibited at the Society of Artists in 1760. He was an original member of the Royal Academy and was a regular contributor to its exhibitions till 1780. During his lifetime his landscapes were never widely popular; his temper was consequently embittered by neglect, and he was so poor that he had to live in an obscure, half-furnished room in Tottenham Court Road, London. In 1776, however, he obtained the post of librarian to the Academy; and by the death of a brother he acquired a small property near Llanferras, Denbighshire, to which he retired to spend his last days, and where he died suddenly in May 1782. After his death his fame increased, and in 1814 about seventy of his works were exhibited in the British Institution. The National Gallery, London, contains nine of his landscapes.

See *Studies and Designs by Richard Wilson, done at Rome in the year 1752* (Oxford, 1811); T. Wright, *Some Account of the Life of Richard Wilson* (1824); Thomas Hastings, *Etchings from the Works of Richard Wilson, with some Memoirs of his Life* (London, 1825). Many of Wilson's best works were reproduced by Woollett and other engravers of the time. His portraits will be found in Greenwich hospital, the Garrick Club and private collections.

WILSON, ROBERT (d. 1600), English actor and playwright, was a comedian in the earl of Leicester's company in 1572, 1574 and 1581; and from 1583 until about 1588 in the Queen's. He then probably gave up acting for writing. He wrote several morality plays. The *Three Ladies of London* (1584), *Three Lords of London* (1590) and *The Cobbler's Prophecy* (1594) are generally ascribed to him. *Three Ladies of London* (1584) contains the episode of the attempt of the Jew to recover his debt, afterwards adapted by Shakespeare in *The Merchant of Venice.* Robert Wilson (1579–1610), supposed to be his son, was one of Henslowe's dramatic hack-writers.

WILSON, THOMAS WOODROW (1856–1924), 28th President of the United States, was born in Staunton, Va., Dec. 28, 1856. The Scotch strain predominated in his ancestry, for his paternal grandfather came from County Down, in Ulster, and his maternal grandfather, Thomas Woodrow, a graduate of Glasgow,

from Scotland. The stern Presbyterianism of his father, a minister of small means but marked capacity as a theologian, early influenced him and left an indelible mark upon his character. His early years were spent in Georgia and South Carolina, where he was deeply affected by the sufferings of the South during the reconstruction period. In 1875 he entered Princeton, graduating four years later. His record for scholarship in college was not remarkable, but he was prominent in debating and literary circles, and became student director of athletic sport. His most notable achievement was an article written in his senior year, and published in the *International Review,* which analysed unfavourably the procedure of Congress and formed the basis of his more mature political principles. After studying law in the university of Virginia and following a brief attempt to practise in Atlanta, he decided to pursue his studies in government and history at Johns Hopkins University, where he received the degree of Ph.D. in 1886.

Wilson's thesis, entitled *Congressional Government* (1885), was a development of the attack upon Congressional methods, and because of its clear and felicitous expression has been reprinted many times. In that year[1] he began his teaching career at Bryn Mawr college, where he was associate professor of history and political economy until 1888; after two years as professor of the same at Wesleyan, he entered the Princeton faculty in 1890 as professor of jurisprudence and political economy. With slight changes in title he served in this capacity until 1902, when he became president of Princeton. As professor he rapidly achieved distinction. His lectures were remarkable for clarity of presentation and brilliancy of phrasing, and the same qualities characterised both his addresses and his published writings. His gift was for generalisation rather than plodding scholarship, and after the publication of his thesis his happiest literary efforts were in essay form. They display keen critical capacity, but are not remarkable either for erudition or for striking creative power. As president of Princeton, Wilson devoted himself to serious reforms of the educational and social habits of the undergraduates. In the hope of elevating the standards of scholarship and of increasing the efficiency of instruction, he inaugurated in 1905 the "preceptorial system," designed through small classes to bring teachers and students into the most intimate relationship. In his endeavours to democratise the social life of the university he met determined opposition. Further difficulties developed from a disagreement with the dean of the graduate college. Wilson's policies aroused warm controversy among alumni, faculty and undergraduates.

While at Princeton, both as professor and as president, Wilson displayed great interest in political questions of the day, and through his addresses and articles speedily won a national reputation. In Sept. 1910 he was tendered the Democratic nomination for governor of New Jersey. The offer, coming at the moment when the prospects for success of his policy at Princeton seemed most discouraging, secured his ready acceptance. Resigning his academic position he entered upon an active electoral campaign which won him the support of progressive elements throughout the state, despite the fact that his candidacy had been inaugurated largely under the auspices of the conservative Col. George Harvey (afterwards U.S. ambassador to Great Britain) and the Democratic state boss, Senator James Smith.

In Nov. he was elected by a plurality of 49,000 votes. He at once made it plain that he intended, regardless of the protests of machine leaders, to fulfil his liberal pledges and would assume the leadership of the party for this purpose. As governor he successfully carried through a series of reform measures. Of these the most significant were: a Direct Primaries Law, which, supplemented by an effective Corrupt Practices Act, did much to purify the political atmosphere of New Jersey; an Employers' Liability Act; the creation of a Public Utilities Commission; reform in municipal administration, making possible the adoption of the commission form of government. Elections to the state Senate and Assembly in 1911 gave the Republicans a majority in both Houses and the legislative output was curtailed. Nevertheless his final activities as governor were characterised by the impetus which he gave to the passage of a series of bills, known as the Seven Sisters, directed to the protection of the public from exploitation by trusts.

When in June 1912 the Democratic National Convention met at Baltimore to choose a candidate for President, Wilson's reputation as an effective reformer had brought his name prominently before the delegates. The convention was apparently controlled by conservative elements and there seemed little chance of the nomination of an anti-machine progressive. But as the struggle to secure the necessary two-thirds vote proceeded, with the conservative forces divided between Champ Clark, Harmon and Underwood, W. J. Bryan, leader of the progressive elements, threw his dominating influence in favour of Wilson. It proved decisive, and on the 46th ballot he was nominated, July 2, 1912. In the campaign that followed he voiced popular discontent with the conservatism of the Republican administration, which he believed to have been too closely allied with the interests of "privileged big business." His campaign speeches, characterised by a striking phraseology, won much applause, but were remarkable for their high moral tone rather than for originality of thought or policy. Like Roosevelt he demanded a national renaissance of ideals. In matters of immediate concern, such as the tariff, trust regulation, currency, the interests of labour, he insisted that the "rule of justice and right" must be set up. As regarded the future, in matters of conservation and trade, he asserted that great opportunities had been lost through the interlacing of privilege and private advantage with the framework of existing laws: "we must effect a great readjustment and get the forces of the whole people once more into play." His radicalism was of a mild sort, and he insisted that "we need no revolution, we need no excited change; we need only a new point of view and a new method and spirit of counsel." The popular temper was responsive to such a tone, but success in large measure could hardly have come to him except for the division of Republican forces through the campaign of Theodore Roosevelt as Progressive candidate. In the Nov. election Wilson received 435 electoral votes as against 88 for Roosevelt and 8 for Taft; but his popular vote was 1,000,000 less than that of his two chief opponents, and in only 14 states (all in the South) did he receive a clear majority.

Despite the fact that he was the choice of a minority of the whole people, Wilson's political position when he assumed office on March 4, 1913 was one of remarkable strength. He was supported by a Democratic majority in both Houses of Congress, the Republicans were at loggerheads and he might expect support from the Progressives for much of his reforming legislative programme. His cabinet was not distinguished, but it contained certain elements of political and administrative strength, which proved advantageous for the moment, although later it was to become the mark for bitter criticism. The President soon made it plain that he was determined, as in his governorship of New Jersey, to exercise his personal influence and his position as head of the party to initiate and carry through the legislation he had advocated in his campaign. His ascendancy in Congress was soon established. After convoking both Houses in special session on April 7, 1913 he delivered his first message in person, reviving the custom that had lapsed since the administration (1797) of the elder Adams. He intervened constantly during this and later sessions, to further the legislation in which he was especially interested.

The first important piece of legislation that resulted from the special session was the Underwood Tariff Act, which was passed in Sept. and signed by the President Oct. 3, 1913. It provided for a notable downward revision, and naturally met strong opposition from varied industrial interests. Such opposition was overcome largely through the personal efforts of Wilson, who appealed constantly to public sentiment, notably in an attack upon the activities of hostile lobbyists. The Tariff Act, in addition to lower duties and important administrative changes, intro-

[1] In 1885 he married Ellen Louise Axson, of Savannah, Ga., who died in 1914, leaving three daughters. On Dec. 18, 1915, he married Edith Bolling Galt, of Washington, D.C.

duced an income tax—long advocated by Democrats—which was destined in later developments to counterbalance the loss of revenue resulting from the lowering of the tariff; it weighed heavily upon the industrial interests of the North and increased the growing unpopularity of the President in that region. The Tariff Act was followed by a broad measure of currency reform, the Federal Reserve Act, signed Dec. 23, 1913; it is generally regarded as the administration's second great legislative triumph. Wilson's purpose was to supplant the dictatorship of private banking institutions by a reorganisation that should provide funds available to meet extraordinary demands and a currency that would expand and contract automatically. Early in 1914 the President called upon Congress to continue its labours of reform by the regulation of the trusts. After long debate and warm opposition, his appeal was answered by the passing of the Federal Trade Commission Act and the Clayton Anti-trust Act. The latter, besides perfecting anti-trust legislation in several ways, met the demands of labour by declaring that labour was not a commodity, by prohibiting injunctions in labour disputes unless necessary to prevent irreparable injury, and by proclaiming that strikes and boycotts were not violations of Federal law. It further exempted labour associations from the anti-trust laws.

Wilson's policy of domestic social reform had thus been developed with surprising legislative success during the first year of his administration. His foreign policy was not so clear-cut and aroused little enthusiasm. It was characterised by an evident desire to concede the rights of other nations to the limit and to avoid any stressing of the power of the United States for the material advantage of its citizens. Definite steps were taken to prepare the Filipinos for self-government. Pressure was brought to bear upon the California State Government to mitigate the severity of its anti-Japanese legislation. The "dollar diplomacy" of the preceding administration was repudiated and American bankers effectively discouraged from participating in the international Chinese loans. As a result of the President's personal demand, Congress repealed the law exempting American coastwise shipping from Panama Canal tolls. Wilson, however, failed to secure the Senate's ratification of a treaty with Colombia, which contained a virtual apology on the part of the United States and an offer to pay $25,000,000 as reparation for the alleged grievances of Colombia in connection with the establishment of Panama as an independent country. In the Caribbean, Wilson's policy differed in principle rather than practice from that of his predecessors; in Nicaragua and Haiti the customs were taken over by U.S. officials. By a treaty signed Sept. 16, 1915, a virtual protectorate of Haiti was assumed; in Santo Domingo the precautionary visits of American cruisers were followed in the summer of 1916 by the landing of marines, and in Nov. of that year by the proclamation of a military government under American auspices.

Wilson's Mexican policy aroused heated criticism. Following the accession of Gen. Victoriano Huerta to power and the President's failure to arrange a settlement providing for his elimination as dictator, Wilson resigned himself to what he called a policy of "watchful waiting." Conditions in Mexico were anarchical, and intervention was strongly urged by both American and European commercial interests. To formal intervention the President was definitely opposed, but in April 1914 he was compelled to authorise the occupation of Vera Cruz in retaliation for affronts to American bluejackets. The proffered mediation of Argentina, Brazil and Chile he gladly accepted, but the resulting protocol of Niagara Falls (June 24, 1914) did not provide a basis for peace. Although Huerta fled from Mexico in July, the country continued to be torn by rival factions. American troops were withdrawn from Vera Cruz in Nov. 1914, but it was not until Oct. 1915 that the Government of Carranza was recognised by Wilson, in company with eight South and Central American Governments. Further complications ensued. The raid into American territory of Gen. Villa, March 9, 1916, led Wilson to authorise a punitive expedition, which soon aroused the protests of Carranza. In May and June the President mobilised the National Guard and sent a force of about 100,000 to patrol the Mexican border. The crisis was tided over by a joint Mexican-American commission sitting at New London, Conn., which brought no definite settlement, but at least postponed hasty action on either side. In Jan. 1917 the last American troops were withdrawn from Mexican soil. The President's policy had not led to stable conditions in Mexico, and the sole advantage secured seemed to be the emphasis laid by the U.S. Government on the principle that it would not take advantage of the misfortunes of a weak neighbour for its own selfish profit.

Foreign affairs after July 1914 were naturally dominated by the World War. President Wilson insisted upon a policy of strict neutrality. This he emphasised not merely by formal proclamation on Aug. 4, but by an address to the American people on Aug. 18, in which he adjured them, in view of the mixture of nationalities in the United States, to be impartial in thought as well as action. His offer of mediation, made on Aug. 5, remained without response, and further attempts at mediation in early autumn proved fruitless. His determination to remain absolutely aloof from European quarrels was underlined in several addresses, in which he insisted that the United States was in no way concerned, and was further emphasised by his opposition to any change in its military policy. America's vital interest in the struggle, however, soon became plain and resulted in diplomatic controversies with the belligerents. Great Britain's attempt to control indirect importation of goods into Germany, by an enlargement of contraband schedules and an extension of the doctrine of "continuous voyage" to conditional contraband, was vigorously opposed by President Wilson, who authorised William Jennings Bryan, his Secretary of State, to protest in strong terms. A lengthy interchange of notes followed, which led to no settlement.

The diplomatic controversy with Germany proved more serious. The proclamation of a "war zone" about the British Isles, in which German submarines threatened to destroy enemy merchant vessels with consequent danger to the lives and property of neutrals, was met by a note of Feb. 10, 1915, which warned Germany that she would be held to "strict accountability" for the lawless acts of submarine commanders. Wilson further attempted to find a compromise, based upon a relaxation of the British food blockade and an abandonment of the German submarine campaign. The effort failed and was followed by a series of submarine attacks, which culminated in the sinking of the "Lusitania," May 7, 1915, with the loss of over 100 American lives. The President, while he disappointed opinion in the Eastern States by a speech in which he reaffirmed his pacific determination, stating that a man might be "too proud to fight," at once set out to win from Germany a disavowal and a promise that merchant ships should not be torpedoed without warning and the saving of the lives of passengers.

A lengthy exchange of notes ensued: the pacific Bryan, Secretary of State, regarding the President's language as too strong, resigned; on the other hand Wilson's patience with the evasions of the German Government and the continued sinking by submarines led to bitter attacks upon the President's policy of conciliation, which was stigmatised as anaemic or even cowardly. Wilson succeeded, however, in securing from Germany a promise not to sink liners without warning (Sept. 1, 1915), and continued his efforts to induce Germany to abandon the submarine campaign completely. He was hampered by an attempted revolt of Congressional leaders, who blurred the issue with Germany by introducing resolutions designed to prevent Americans from travelling upon belligerent ships. The President, through his personal influence, secured the defeat of these resolutions in Feb. 1916, insisting that he would not consent "to any abridgment of the rights of American citizens in any respect." Shortly afterwards the issue with Germany was brought to a head by the sinking of the "Sussex," March 24, 1916. Wilson waited three weeks before sending a formal note of protest to Germany (April 19, 1916), but couched it in the form of an ultimatum, stating that unless Germany should immediately declare and effect an abandonment of its present methods of submarine warfare, the United States would be compelled to sever diplomatic relations.

The German answer, while attempting to make acceptance conditional upon Great Britain's relaxation of the blockade, was in effect a promise not to sink merchant ships without warning and without saving human lives. The submarine issue now seemed less critical.

The diplomatic victory thus apparently secured by Wilson was utilised in his behalf during the electoral campaign of 1916, in which he was inevitably the Democratic candidate. It enabled his supporters to declare that he had vindicated the rights of the United States successfully, and at the same time had "kept us out of war." The slogan made a strong appeal, especially in the districts of the Middle West. The Republicans, on the other hand, who had nominated Charles E. Hughes, criticised the whole foreign policy of the President. They insisted that he had failed to take prompt action for the protection of American lives and honour, alike in his dealings with Germany and in his handling of the Mexican crisis. They characterised his domestic policy as demagogic, instancing the Clayton Act and the Adamson Act; the latter had been urged on Congress by Wilson to avert a railroad strike in Sept. 1916, and many citizens regarded it as an untimely surrender to labour threats. They also criticised his attitude on "preparedness," to which the President had been opposed until the close of 1915, and ridiculed the cautious expansion of military forces provided for in the National Defence Act of 1916. In the East and in most industrial centres of the Middle West Wilson was unpopular, but the election showed his strength in the farming districts west of the Mississippi and on the Pacific coast; in spite of Roosevelt's return to the Republican fold the President drew largely from the Progressives, and on election day received a slight electoral majority over Hughes (277 to 254) and a popular plurality of 9,129,606 to 8,538,221.

His re-election enabled Wilson to proceed with plans for peace proposals to the European belligerents. These he had been preparing since the early spring of 1916. He had authorized Col. House to propose to the British that the President "on hearing from France and Britain that the moment was opportune" should propose a conference to end the war. "Should the Allies accept this proposal and should Germany refuse it, the United States would probably enter the war against Germany." The Allies made no move to take advantage of American help in this plan to enforce peace. Wilson decided to act independently and on Dec. 18 sent identical notes to the belligerents, asking them to state the terms upon which they would consider peace. Informed of the undercurrents of German military circles, he evidently feared that if the war continued the United States would necessarily become involved; he also hoped that a clear definition of war aims would strengthen pacific elements in both belligerent camps. The German reply was evasive; that of the Allies refused to consider peace until Germany should offer "complete restitution, full reparation and effectual guarantees." The replies gave the President opportunity to expound what he had come to believe was the only sure basis of an enduring peace. This he did in a speech of Jan. 22, 1917, in which he insisted that the peace must be organised by the major force of mankind, thus emphasising the need of a League of Nations; that no nation should extend its policy over another nation; that no one Power should dominate the land or the sea. There must be a limitation of armaments. As a guarantee of future peace and justice, the ending of the existing war must not be the violation of the rights of one side or the other; it must be "a peace without victory."

Further efforts to secure a peaceful arrangement were frustrated by the determination of the German militarist clique to renew the submarine warfare, regardless of the effect on the United States. On Jan. 31, the German ambassador, Von Bernstorff, who strongly but vainly opposed the intensive submarine campaign, delivered a note to this effect, and four days later the President handed him his papers. He still, however, avoided formal war with Germany, and on Feb. 26 asked for a resolution of armed neutrality, which would permit the arming of American merchant ships for entrance into the barred sea zone. The resolution was blocked by a filibuster. Finally, in view of continued sinking of American ships, the President came to Congress on April 2, 1917 and asked for a declaration that a state of warfare existed with Germany. The resolution was passed by the Senate on April 4, by the House on April 6.

President Wilson had always abhorred the exercise of force in international relations, and the war which he at last regarded as necessary was, in his mind, a war to ensure peace. Nevertheless he was determined that it should be waged efficiently and that the mistakes of previous wars should not be repeated. Those mistakes, he believed, had resulted chiefly from the inter-mixture of politics in military affairs, and from the decentralisation of the American military machine. He opposed a coalition war cabinet, as leading to divided responsibility. Military policy was handed over to the military experts. He approved the immediate development of the general staff as the centralising military organ, and it was upon the recommendation of that body that he urged, against the wish of Congressional leaders, the Selective Service Act. On the advice of the general staff he appointed Gen. John J. Pershing commander of the expeditionary force to France, and, also following that advice, he refused to authorise a volunteer force under Roosevelt. Similarly the plans for the development of a large army in France were inaugurated and translated into fact by the military experts.

As regards conduct of operations the President gave to Gen. Pershing complete authority, and permitted no interference by politicians. In the building of the new army the President took no direct part, but he used his authority consistently to favour centralisation under the general staff. He followed a similar policy in the mobilisation of the industrial resources of the nation. He encouraged the centralising efforts of the Council of National Defence and its committees, and sought always to secure for them executive rather than the merely advisory powers which they at first possessed. He urged the Lever Act, which in Aug. 1917 created a Food and a Fuel Administration, and advocated the taking over of the railroads by the Government in December. His policy of economic centralisation was ultimately assisted by the many protests against his war policies which were made in the winter, and which centred round the demand for a non-partisan war cabinet or ministry of munitions; for his supporters were able to insist that the more effective handling of war problems demanded not new machinery but greater efficiency of the existing mechanism. The President asked for powers to cut through red tape and rearrange bureaux without reference to Congress. His demands were embodied in the Overman Act, which was passed in May 1918, and which enabled him to grant executive powers to the various boards that had been created. The War Industries Board, released from its dependence upon the Council of National Defence, at once became the centralising organ of the economic activities of the country. In his war appointments Wilson disregarded party lines, a notable fact since in political appointments he always showed himself strictly a party man. Republicans, such as Hoover, Stettinius, Goethals, Schwab, Vanderlip, were chosen because of their administrative qualities and regardless of political affiliations.

During the War President Wilson consistently developed his ideals of a new international system which should perpetuate peace and assure justice and security to every nation regardless of its material strength. He hoped thus not merely to construct a basis for just peace when the war should end, but to hasten the end of the war by appealing to the peoples of the enemy states against their Governments. The most notable of his speeches was that of Jan. 8, 1918, in which he stated 14 points necessary to a just and lasting peace. This, with his later addresses, was ultimately accepted as the basis of the final settlement. Their effect in Germany and Austria-Hungary was not apparent until the military defeat of those empires, but his words acted continually as a corroding factor, weakening the enemy's determination to fight. When in the autumn of 1918 they faced military defeat, they turned to Wilson, offering to accept his Fourteen Points as the basis of peace.

The President's insistence upon justice as essential to a settlement brought him great prestige in Allied countries, but the chiefs of the Allied Governments hesitated to accept the Fourteen

Points in the fear that the advantages of the victory might be thrown away. They yielded, however, to the persuasive diplomacy of Col. House, who represented the President on the Supreme War Council during the Armistice proceedings, and it was on the understanding that the Fourteen Points (reservations made of "Freedom of the Seas" and inclusion of Germany's promise to make full reparation) should be the basis of the peace that the Armistice was granted to Germany.[1] The President realised, however, that it would be difficult to translate his principles into the actual treaty. Aside from the opposition he might expect from selfish nationalistic interests among the Allies, he lacked unified support at home, where his political opponents called for a "strong peace" that would annihilate Germany; there was little enthusiasm for a League of Nations, which the President regarded as essential to a just and lasting settlement. Furthermore he had weakened his political position at home by a series of tactical mistakes. Of these, the most important was an appeal issued immediately before the Congressional election of Nov. 1918, in which Wilson asked the voters to cast their ballots for Democratic candidates, on the ground that a Republican Congress would divide the leadership at the moment of international crisis. Such an appeal would have been comprehensible if it had been made by a prime minister in a parliamentary country, but Wilson had proclaimed himself the leader of the nation and could not logically also play the rôle of party leader. The Republicans seemed to have some ground for complaining that although they had submerged partisan quarrels during the war, President Wilson was now attempting to capitalise the war and foreign affairs in order to win a partisan advantage. Many voters were antagonised by the appeal, and the elections went in favour of the Republicans. The President, in consequence of the substantial reverses sustained in the November elections, lost command of the Senate in the next Congress and its Foreign Relations Committee was to be controlled by his political and personal opponents.

Believing that his presence at the Peace Conference was necessary, if it was not to be dominated by old-style diplomatic practices, Wilson decided himself to go to Paris, and on Dec. 4, 1918 sailed with the other members of the American Commission on the "George Washington." He arrived at Brest on Dec. 13, and was received at Paris, in England and at Rome with tremendous enthusiasm. For the moment he was the popular hero, both in Allied and enemy countries. But his prestige rested on a precarious footing, and must inevitably diminish when he came to oppose the national aspirations of any people. Col. House urged him to strike off a quick general peace, leaving details for later settlement; but this proved impossible, and formal conversations at Paris began only in Jan. 1919. The President succeeded in winning an early victory when he persuaded the conference to accept the principle of the League of Nations as the basis of the peace, and when the Commission on the League succeeded in completing by Feb. 14 the preliminary draft of the covenant. On returning to the United States, however, he found Republican opposition to the league strongly manifested in the Senate, although he had the support of Taft's influence in that party and in the country. Public opinion seemed to be uninstructed and apathetic as to the President's policies. Going back to Paris in March, he was able to secure the insertion in the covenant of certain amendments required by American sentiment. On Apr. 28 he won unanimous approval by the conference of the final draft of the covenant.

But he was confronted by the demands of the French, Italians and Japanese for territorial and economic concessions from the enemy, which he regarded as excessive. Long discussions followed, culminating in Wilson's acceptance of a portion of the Allied demands, notably the granting of Shantung to the Japanese, of much of the frontier line promised by the Treaty of London to Italy, the separation of the Saar from Germany and the exaction from Germany of what amounted to a blank cheque in the matter of reparations. Such concessions aroused the opposition of liberals in England and America, who insisted that the President had surrendered his principles. Wilson, on the other hand, acknowledging that certain aspects of the settlement were not ideal, believed that he had won his main contention in securing the League of Nations, which provided the mechanism for eradicating the vices contained in the treaties. In this belief he was supported by another liberal protagonist, Gen. Smuts. On June 29, 1919, the day following the signing of the Versailles Treaty, the President sailed for America. His international prestige had suffered from his opposition to national claims, especially that of the Italians to Fiume and of the French to the left bank of the Rhine. His prestige as a liberal leader had also suffered from his failure to achieve the peace of conciliation which he had promised. This failure was due to the lack of any spirit of conciliation in Europe which might inspire a new sort of peace settlement. As Col. House wrote in his diary, the day after the signing of peace, "I should have preferred a different peace, I doubt whether it could have been made, for the ingredients for such a peace as I would have had were lacking at Paris." The single great creative accomplishment of the Peace Conference, the League of Nations, resulted primarily from Wilson's leadership.

The strain of the conference had told upon Wilson's physical and nervous strength. He was thus not well equipped to wage the struggle with his Republican opponents in the Senate which developed upon his presentation of the treaty. Had the President been willing to compromise and accept reservations to the covenant of the league, it is likely that the two-thirds necessary to ratification would have been secured. This course he refused to follow, and it soon became clear that the Foreign Relations Committee would not recommend ratification without serious reservations or amendments. In the hope of winning popular support, the President set forth upon a tour of the country, and along the Pacific coast aroused enthusiasm in marked contrast to the coldness of the East. The effort, however, overtaxed his strength, and on Sept. 26 at Wichita, Kan., the President was compelled to give over his tour and return to Washington, where he suffered a complete nervous collapse. The exact nature of his illness was not made public and few realised how serious it would prove to be. Many, however, felt that in view of his inevitable abstention from active work it would have been wiser for him to retire at least temporarily. As it was, his system had provided for no understudy and the administration was left without a leader.

Entirely apart from the confusion thus caused in the conduct of public business, Wilson's illness led directly to the defeat of the treaty. There was no one else available either for leading the fight for ratification without reservations, or with sufficient authority to arrange a compromise. On Nov. 13 the Senate adopted reservations which Wilson declared would "nullify" (etc., etc.) the treaty; for this reason he urged the Democrats to refuse to vote for the ratifying resolution, which was accordingly defeated on Nov. 19, 1919. During the succeeding weeks efforts were made to arrange a compromise. The Republican leaders agreed to soften the language of certain reservations, and the President intimated that he would accept a mild reservation on Article X. of the covenant, which had aroused the chief opposition. Neither side would yield enough, and when on March 19, 1920, the final vote was taken on the ratifying resolution, which contained a strong reservation on Article X., Wilson again urged Democratic senators not to accept. The resolution thus failed of the necessary two-thirds by a margin of six votes, 57–37. The President appealed to the autumn presidential election in 1920 as the decisive plebiscite. Although he had lost his former control of the party, and the Democratic presidential nominee at San Francisco was not his choice, the Wilsonian policies, including approval of the League of Nations, were inevitably the issue of the elections. In the electioneering campaign, however, the President himself could take no active part, for his physical collapse proved so serious as to confine him to the White House. For the overwhelming victory won by the Republicans, *see* UNITED STATES: *History*. After his defeat Wilson kept close silence on public matters, and his annual message of Dec. 1920,

[1]The Fourteen Points are set forth in full in an article on that subject.

while it sounded the note of national duty, made no reference to that which lay nearest his heart—the League of Nations. This silence, indeed, he preserved until the close of his administration, March 4, 1921. In Dec. 1920 he had been awarded the Nobel Peace prize.

After his retirement from office Wilson lived quietly in Washington, refraining from all political comment. He appeared to greet his admirers on Armistice Day, 1923, with a short speech from the porch of his house. For months he had been growing weaker, and on Feb. 3, 1924, he died in his sleep.

The failure of President Wilson to win the approval of the United States for his peace policies presents one of the most interesting problems of American history. He had led the country through the difficult period of a war unsurpassed in magnitude and culminating in complete victory; in the face of serious obstacles he had forced European statesmen to accept the major item in his programme; he returned home only to be repudiated by his own people. Personal and partisan factors unquestionably contributed to his defeat. In private intercourse Wilson displayed a personal magnetism, a breadth of culture and a genial cordiality that are amply attested by his intimates. But in public life he proved unable to capitalise such advantages, possibly because of natural shyness, possibly because physical delicacy restricted his social activities. Roosevelt's capacity for "mixing" with all political and human types he totally lacked. In the formation of his policies he isolated himself and was unable to establish close relations with Congressional leaders. This gave rise to the impression that the President disliked advice, was an egocentric autocrat and immediately dispensed with anyone who disagreed with him. Such criticism, by no means a novelty in the case of strong-willed presidents, was utilised by his political opponents and intensified his unpopularity in the industrial centres, especially of the East, an unpopularity which, except for a brief period during the opening months of the war, was an outstanding factor in the political situation. Broadly speaking, the criticism does not seem to be fully justified. In matters of what he regarded as principle he was adamant, and he distrusted the judgment of those whose basic point of view was different from his own; but the evidence of those who worked with him, including that of Republican advisers at Paris, is almost unanimously agreed that he was anxious to secure advice, was tolerant of opinions, and glad to delegate responsibility. The contrary belief was doubtless fostered by Wilson's inability to build up an efficient secretarial organisation, and his incapacity, rather than unwillingness, to apportion effectively the details of administrative labour. His handling of war problems shows clearly his desire to delegate responsibility; once an appointment was made he refused to interfere and consistently protected his appointee from the importunities of politicians.

Political responsibility in general, he believed, should rest with the President. From conviction, rather than from egotism, he sought to emancipate the presidential office from the control of Congressional committees, a control which he earnestly deplored in his earliest writings. The President, he felt, should be the real leader of the nation, and not a mere executive superintendent. The cabinet he looked on as an executive and not as a political council, and it was always strictly subordinated to his policies. So long as the Democrats held the majority in Congress he was able to translate such ideas into fact, and effectively disposed of all attempted Congressional revolts. This attitude naturally did not allay the political resentments which were inevitably aroused and which were intensified by Wilson's tendency to regard political opposition as tantamount to personal hostility; when the Democratic majority disappeared he faced uncompromising hostility. He was intensely impatient of partisan obstruction of his idealistic plans, and there is much of the Calvinist in his refusal to temporise or deviate from the path which he believed himself appointed to tread. While in matters of detail he showed at times some capacity for compromise, in matters of principle he displayed the unswerving determination characteristic of the prophet, a trait that is not always conducive to success in the exigencies of modern party warfare. Indeed it is as a prophet rather than as a statesman that Wilson should be regarded. No one has preached more impressively and effectively the necessity of introducing a moral standard into international politics.

The following are the most important writings of President Wilson: *Congressional Government, a Study in American Politics* (1885); *The State—Elements of Historical and Practical Politics* (1889); *Division and Reunion, 1829–89* (1893); *An Old Master and Other Political Essays* (1893); *Mere Literature and Other Essays* (1893); *George Washington* (1897); *A History of the American People* (1902); *Constitutional Government in the United States* (1908); *The New Freedom* (1913); *On Being Human* (1916); *International Ideals* (1919). The authorized biography is by Ray S. Baker, *Woodrow Wilson, Life and Letters* (1927–). Biographies based upon personal contact with Mr. Wilson have been written by W. E. Dodd, *Woodrow Wilson and His Work* (1921); by his private secretary, Joseph P. Tumulty, *Woodrow Wilson as I Know Him* (1922); by Josephus Daniels, *Life of Woodrow Wilson* (1924); and by David F. Houston, *Eight Years with Wilson's Cabinet* (2 vols., 1926). Critically appreciative biographies are: David Lawrence, *The True Story of Woodrow Wilson* (1924), and William Allen White, *Woodrow Wilson, the Man, his Times, and his Task* (1924). A less friendly interpretation, valuable for Wilson's Princeton career, is Robert E. Annin, *Woodrow Wilson; a Character Study* (1924). Wilson's work at the Peace Conference is favorably presented by Ray S. Baker, *Woodrow Wilson and World Settlement* (1923). A documented exposition of Wilson's character and policies is found in *The Intimate Papers of Colonel House,* arranged as a narrative by Charles Seymour (4 vols., 1926–28). General surveys of Wilson's foreign policy are to be found in E. E. Robinson and V. J. West's *The Foreign Policy of President Wilson, 1913–17* (1918), and in Charles Seymour's *Woodrow Wilson and the World War* (1920). In *Beacon Lights of History* (1924), P. W. Wilson gives a close analysis of Wilson's character and career. The authorized edition of President Wilson's state papers and addresses is *The Public Papers of Woodrow Wilson,* edited by Ray S. Baker and William E. Dodd (1925). (C. SEY.)

WILSON, a town of North Carolina, U.S.A., the county seat of Wilson county; 46 mi. E.S.E. of Raleigh, on federal highways 301 and 264 and state 42 and 58; served by the Atlantic Coast Line and the Norfolk Southern railways. Pop. (1940) 19,234, an increase of 52·5% over 1930. Wilson is the largest bright-leaf tobacco market in the world. It was incorporated in 1849. Its first sale of leaf tobacco took place in 1890.

WILSON AND CO., INC., a Delaware Corporation, is the third largest meat packer in the U.S.A., and is one of the so-called Big Four American meat packers. The company was founded in 1853 as a local abattoir in New York City. The business has been gradually expanded to one of national and international scope. The company is engaged primarily in the business of processing meat animals and the distribution and sale of fresh, cured, and canned meat products. The company is also an important processor and distributor of poultry, butter, fresh eggs, frozen eggs, powdered eggs, cheese, oleomargarine, salad oils, cooking oils, salad dressing, lard. Important by-products are hair insulation, animal feeds, fertilizer, gelatine, wool, pharmaceuticals, acids, soaps and tallows.

Plants are maintained in Chicago; New York; Los Angeles; Oklahoma City; Cedar Rapids; Kansas City, Kans.; Albert Lea, Minn.; Omaha, Neb.; Columbus, Ga.; Buenos Aires, Argentina; and Sao Paulo, Brazil. All meat produced in the United States is under the inspection of the U.S. Dept. of Agriculture. In addition, research laboratories are attached to each plant carrying on constant bacteriological tests, controlling quality, and developing new uses for products and by-products. Sales branches are located in one hundred key cities in the United States, Europe, Central and South America. Wilson & Co., through its subsidiary, Wilson Sporting Goods Company, is one of the world's largest manufacturers of sporting goods and game equipment. Home offices are located in Chicago. (E. F. WN.)

WILSON CLOUD CHAMBER, a method, due to C. T. R. Wilson, for rendering visible the tracks of swift electrified particles, which has proved of the greatest importance for recent researches in atomic physics. By a special device minute drops of water are made to condense on the ions produced by a particle in its rapid passage: the trail of droplets is dense enough to be visible to the eye as a white line, and is usually recorded by photography, for subsequent study. The particles whose behaviour is studied by the method are the α-particles (*see* RADIOACTIVITY), and swift electrons, which may be either β-particles

(*see* RADIOACTIVITY) or electrons released by the photoelectric action of X-rays. (*See* PHOTOELECTRICITY; X-RAYS, NATURE OF.) Many properties of the X-rays themselves are revealed by the tracks of these secondary electrons.

The Condensation of Supersaturated Vapours.—Air saturated with moisture can be cooled until a very high degree of supersaturation is reached—that is, until the amount of water which it contains in the form of vapour is much greater than suffices to saturate it, once condensation has been started—if there are no particles in it to act as nuclei round which droplets can form. (The term nucleus used with regard to condensation merely means a centre or core round which vapour molecules collect to form a liquid layer, and has nothing to do with the exceedingly minute structure which is called the nucleus of the atom.) Aitken, in his investigations from 1880 onwards, had showed that dust particles could act as such nuclei, and had utilised this fact to count dust particles. Early workers, such as Lenard and Wolff, who found that ultra-violet light falling on a zinc plate could produce condensation in a steam jet attributed the effect, actually due to the electrons thus liberated, to dust. In 1890 R. von Helmholtz and F. Richarz attributed the condensation of a steam jet by a point discharge to the formation of ions, and in 1896 Richarz found that X-rays could produce condensation in the steam jet, without, however, pursuing the subject. Serious study of the condensation on ions was begun in 1896 by C. T. R. Wilson, when he found that the ions formed in gases by X-rays could act as centres of condensation in moist air in a state of supersaturation. A little later he showed that the rays from radioactive substances, ultra-violet light, and other agents which produce ions lead to the same effect. That the condensation was actually due to the ions, and not to some other action of the rays, was proved by applying an electric field before the conditions necessary for condensation were produced: this removed the ions, and at the same time stopped the formation of a cloud of moisture.

Wilson produced his cooling of the air, kept saturated at the initial temperature by the presence of liquid water, by a rapid, approximately adiabatic, expansion: this was effected by the sudden withdrawal, through a controlled distance, of a glass plunger fitting the closed tube in which the condensation was produced. He found that, once dust particles had been removed by repeatedly expanding, and allowing the drops to settle, no condensation could be produced unless the ratio of expansion v_2/v_1 (where v_2 is the final, v_1 the initial volume) exceeded a certain threshold value, namely 1·25. This corresponds to a supersaturation of about 4·2, the supersaturation S, defined as the ratio of the amount of water vapour present to that required to produce saturation at the prevailing temperature, being given by the formula

$$S = \frac{\pi_1 v_1 T_2}{\pi_2 v_2 T_1}$$

where T_1 and T_2 are the temperatures before and just after expansion, and π_1 and π_2 are the vapour pressure of water at those temperatures; by a familiar expression $T_1/T_2 = (v_2/v_1)\gamma^{-1}$ where γ is the ratio of the specific heat at constant pressure to the specific heat at constant volume, for air. With an expansion ratio exceeding 1·25 a few drops are produced in dust-free air; with an expansion ratio exceeding 1·38 a dense cloudy condensation is produced, but in this case the supersaturation is about 8. The essential observation made by Wilson was that when ions were produced in the air by the action of X-rays or any other agent, a fog was formed with an expansion ratio 1·25, in place of the few drops, due to residual ions, formed when there was no radiation. The density of the cloud depends upon the strength of the radiation, but no cloud at all is formed unless the expansion equals or exceeds 1·25. Wilson showed that positive and negative ions are not equally effective as nuclei of condensation; whereas the negative ions begin to act as nuclei at the ratio just specified, namely 1·25, positive ions do not become effective until the expansion ratio is 1·31, which corresponds to 6-fold saturation.

The efficacy of charged ions as nuclei of condensation is bound up with the question of the evaporation of drops of different sizes in a saturated atmosphere, for a droplet can only form if there is a tendency for liquid to deposit on it from the vapour state rather than for its liquid to pass into vapour. It was shown by Lord Kelvin that the vapour pressure p at a surface of radius of curvature r differs from the vapour pressure P at a plane surface in a way given by the equation

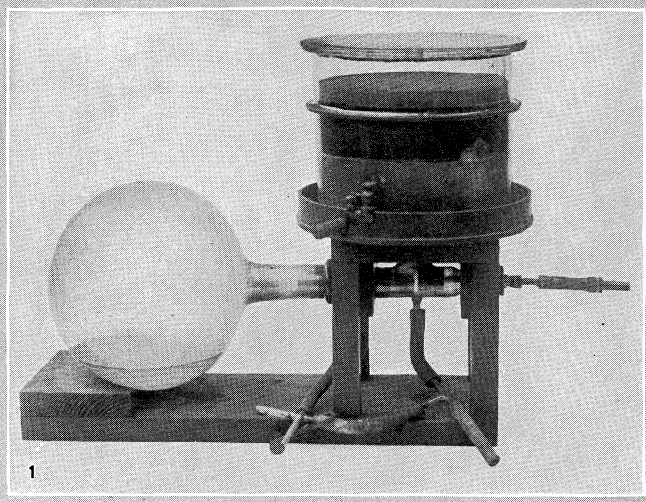
$$\sigma RT \log \frac{p}{P} = \frac{2\alpha}{r}$$

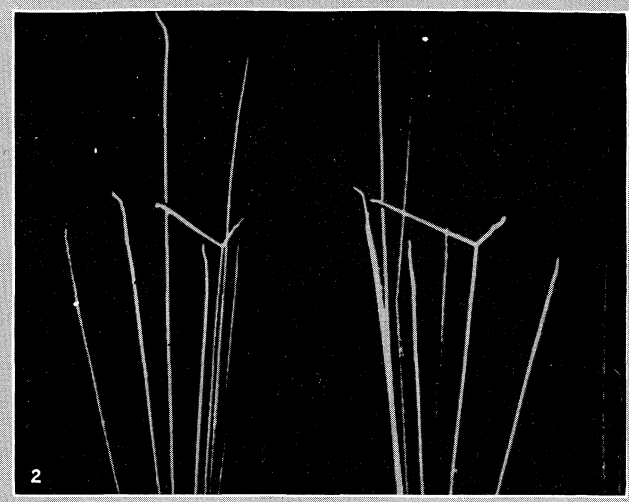
where σ is the density of the liquid, R the gas constant for unit mass of vapour, and α the surface tension. The vapour pressure at the surface of a spherical drop being greater than that at a plane surface the drop will tend to evaporate, in an atmosphere of saturated vapour, which is in equilibrium with a plane surface, and it will only be stable, or tend to grow, if there is a supersaturation equal to or greater than p/P as given by the above formula, showing a dependence on r. The effect of charging the droplet electrically is to diminish the tendency to evaporate, as can be seen by considering that the electrical capacity of a sphere is proportional to the radius, and hence the electrical energy, with a given charge, inversely as the radius, so that the diminution in size of a charged drop requires, in respect of the electric forces, a supply of energy, and will not take place under conditions in which an uncharged drop of the same size may evaporate. J. J. Thomson worked out the theory in detail, and showed, by thermodynamic reasoning, that the above formula becomes, for a drop carrying a charge e,

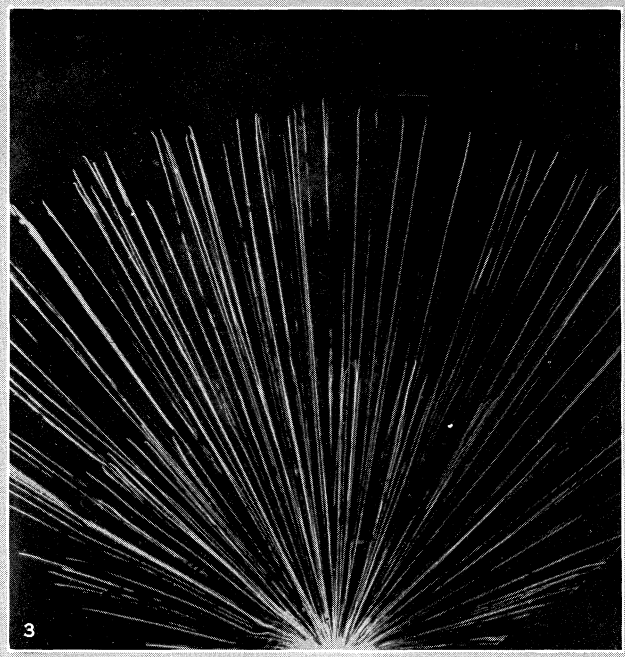
$$\sigma RT \log \frac{p}{P} = \frac{2\alpha}{r} - \frac{e^2}{8\pi r^4}.$$

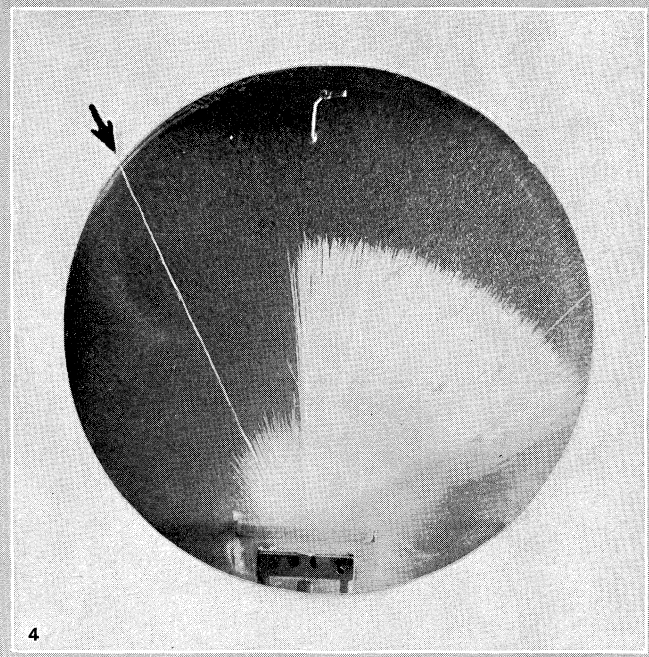
While for uncharged drops the supersaturation required to produce condensation on a droplet increases steadily as r is diminished, for a charged drop, as shown by this formula, S = p/P has a maximum at a radius approximately 6×10^{-8} cm., and then decreases. A droplet of radius 4×10^{-8} cm. is in equilibrium with saturated vapour above a plane surface, and so droplets of any smaller size grow automatically to this size without supersaturation. The maximum value of S, at $r = 6\times10^{-8}$ cm., works out to be about 4·2, so that for this supersaturation, or any greater value, a droplet once begun will grow large. This agrees excellently with the value found by C. T. R Wilson for condensation on negative ions: the different value found for positive ions requires subsidiary hypotheses, which are not altogether satisfactory, to explain it. The above numerical values are all for the case of water vapour. Experiments have been carried out with other vapours, and the values obtained for the limiting expansion agree well, on the whole, with J. J. Thomson's theory. It may be noted, as indicating the difficulties of a complete explanation, that the relative efficiency of positive and negative ions is reversed, as compared to water vapour, for the vapours of the organic liquids tested.

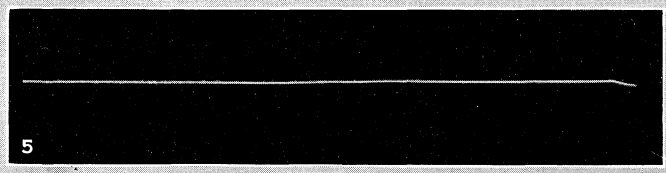
The Apparatus for Obtaining Cloud Tracks.—For the successful application of the method it is necessary, firstly, to produce the expansion in such a way as not to stir up the gas, and so distort the trails of water drops which record the paths of the particles, and, secondly, to ensure that before the passage of the particle no ions or other condensation nuclei are present. To ensure the fulfilment of the first condition the body of the apparatus is made in the form of a circular cylinder, with the axis vertical, and the expansion effected by the movement of a close-fitting cylindrical piston. The upper part of the cylinder, which constitutes the walls of the chamber itself, is of glass, and it is closed at the top by a glass plate, so that observation can be made vertically or horizontally. The movement of the piston, the extent of which is controlled by contact with the floor of the chamber, is produced by a sudden lowering of pressure of the air under the piston, brought about by connecting the space beneath the cylinder with an evacuated vessel. Plate I., fig. 1, represents the actual chamber used by C. T. R. Wilson from 1911 until the present day (1929); the evacuated vessel is seen on the right, communication being established by the opening of a valve, which leaves a wide passage free. The diameter of this particular cham-

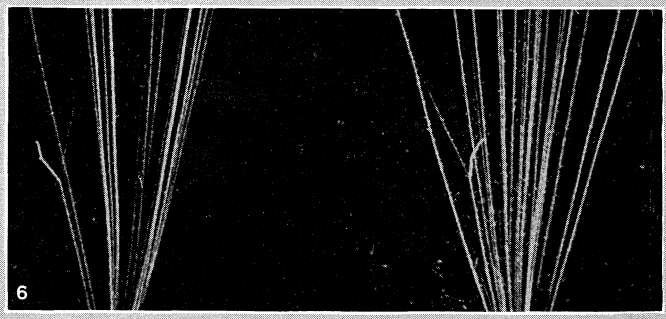


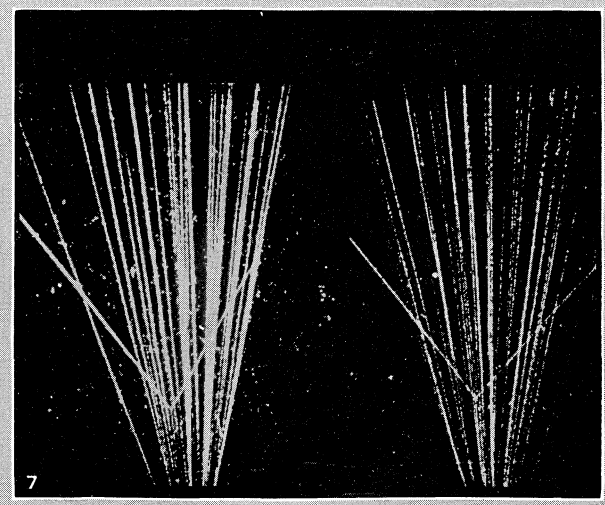










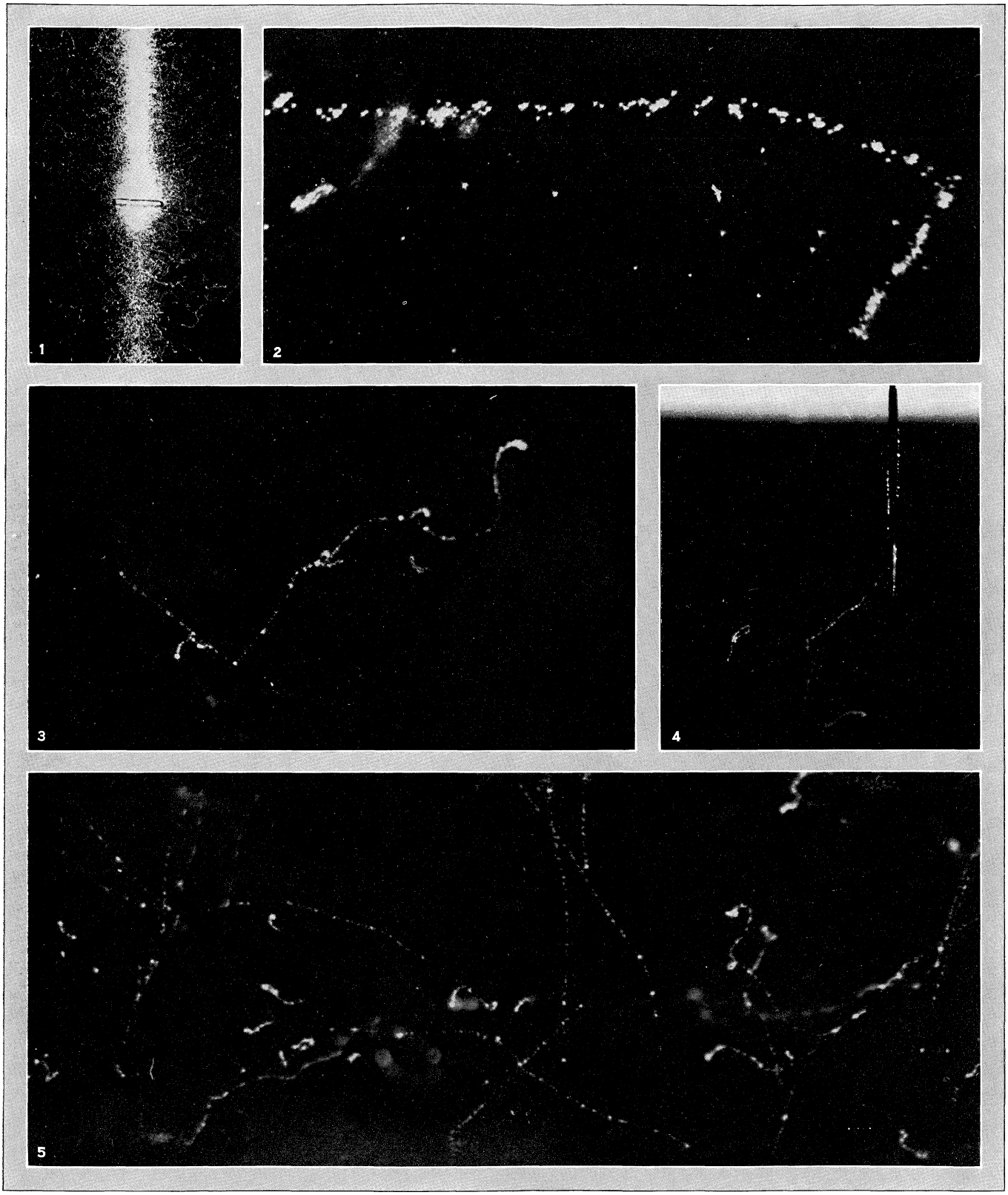


BY COURTESY OF (1, 5, 6, 7) THE ROYAL SOCIETY

RENDERING VISIBLE THE PATHS OF SWIFT ELECTRIFIED PARTICLES BY MEANS OF CLOUD TRACKS

1. The apparatus of C. T. R. Wilson for obtaining cloud tracks. 2. Pair of photographs of α-particle tracks in oxygen showing nuclear collision. (Blackett). 3. Tracks of α-particles from thorium C+C′ showing two distinct ranges, the shorter due to thorium C, the longer to thorium C′. (Chadwick and Emeleus). 4. Track of α-particles, half of which have passed through a film of paraffin wax, showing expulsion of proton (Meitner). 5. Track of single α-particle (C. T. R. Wilson). 6. Pair of photographs of α-ray tracks in nitrogen, showing expulsion of proton. The path of the proton appears as a fine line at extreme left in left-hand picture and next to extreme left in right-hand picture (Blackett). 7. Pair of photographs of α-particle tracks in helium, showing nuclear collision (Blackett)

WILSON CLOUD CHAMBER



BY COURTESY OF C.T.R. WILSON AND THE ROYAL SOCIETY

MAKING VISIBLE THE PATHS OF β PARTICLES, AND OF ELECTRONS RELEASED BY THE ACTION OF X-RAYS

1. Passage of a beam of X-rays through a silver plate, showing absorption of primary beam and characteristic radiation from plate
2. Track of a slower electron, magnified to show individual droplets
3. β-ray track, starting on left, showing initial straight portion, nuclear deflection, branches and curvature in later portion of track
4. Weak X-ray radiation, falling on a copper plate showing one electron ejected from the copper and one electron ejected from a gaseous atom by the X-radiation from the copper
5. Passage of hard X-rays through air, showing different types of electron tracks produced

ber is 16·5 cm. with the depth about 3 cm. In his earlier experiments Wilson coated the inner surfaces of the roof and sides with a thin layer of gelatine, to prevent the formation of droplets on these surfaces, but he now prefers to keep the base of the chamber slightly colder than the rest by sending a slow stream of tap water through the shallow receptacle in which the expansion cylinder rests; this is perfectly effective in keeping walls and roof clear, even when no gelatine is used. The base of the chamber, that is, the upper surface of the piston, is coated with a layer of blackened gelatine, the gelatine keeping the air saturated with water vapour, while the black shows up the cloud tracks. The apparatus has been variously modified by other workers since: for instance, Shimizu, who used a chamber only 6 cm. in diameter, found that perfect tracks could be obtained when the piston was given a reciprocating motion by a simple mechanical device. The frequency of the motion may be as high as 3 oscillations a second, which permits a large number of photographs to be rapidly taken. This form of apparatus was used by Blackett to obtain the pictures to be mentioned later, specimens of which are given in Plate I., figs. 2, 6, and 7.

Any dust particles which would act as condensation nuclei are removed by a run of preliminary expansions. To remove the stray ions a vertical electrical field is maintained between a marginal ring of tin-foil, cemented between roof or walls and the top of the piston: this field is about 3 volts per cm., which, while it suffices to remove ions, does not produce sufficient movement of the heavy drops to disturb the tracks.

To obtain satisfactory pictures, it is necessary to control carefully the sequence of the three events:—admission of ionising particles or radiation; expansion; and the flash of light by which the photographs are taken. The rays should traverse the chamber immediately after the sudden expansion of the gas, and the illumination, from the side, should occur after a very short interval. Wilson's method is to produce the illuminating flash by the discharge of a Leyden jar through mercury vapour at atmospheric pressure, the flash of X-rays by the discharge of a Leyden jar through the X-ray tube, and to effect the timing by three pendulums, of adjustable period, all released simultaneously. The first produces the expansion by opening the passage between the space beneath the piston and the evacuated vessel: the second discharges the jar through the X-ray tube and the third the jar through the mercury spark gap. When the tracks of α or β-particles are to be recorded the particles are admitted into the chamber at the right time by a little mechanical shutter, controlled by the second pendulum.

When it is desired, for purposes of measurement, to know the direction of the tracks in space, one photograph, which merely gives the projection of the track on a single plane, is not sufficient. Two photographs of the same tracks must be obtained, either stereoscopically or from two directions at right angles: the latter arrangement is easily obtained with a single camera lens and plate by a suitable arrangement of mirrors. Examples of such double photographs are given in Plate I., figs. 2, 6, and 7. From these it is a matter of simple geometry to obtain the true angles between the different branches in the case of a forked track, or any other directional property of the track.

Applications of the Method.—In Wilson's first photographs, published in 1912, certain of the α-ray tracks showed a sharp change of direction towards the end of the path, an example being given in Plate I., fig. 5. This change of direction was a brilliant confirmation of Rutherford's theory of single scattering. (*See* NUCLEUS.) At the point where the change of direction takes place, the track shows a little spur, pointing away from the direction in which the track is bent. This spur, which is barely visible in Plate I., fig. 5, but much more distinct with tracks showing a bigger deflection of the α-particle, is due to ionisation produced by the nucleus which is struck by the α-particle. This method of recording the single scattering of α-particles has been developed by Blackett, who, in the course of a large number of photographs, has obtained some striking examples of forked tracks, showing the path of both α-particle and struck nucleus after collision. Double photographs, from directions at right angles were taken, to enable the angles to be calculated. Plate I., fig. 2, is a pair of photographs of α-particle tracks in oxygen, showing a fork due to nuclear collision: the shorter branch of the fork is made by the struck oxygen nucleus. Plate I., fig. 7, shows a magnificent example of a forked track in helium, where the masses of striking and struck particle are equal. For a discussion of these photographs *see* NUCLEUS.

The method has been used to study many other phenomena attending the passage of α-rays. Rutherford, by the method of scintillations, found that swift α-particles can dislodge a proton from certain types of nucleus, notably the nitrogen nucleus. Plate I., fig. 6, shows a pair of photographs of α-ray tracks in nitrogen, taken by Blackett, actually recording the expulsion of the proton. The path of the expelled proton is shown by the very fine track which appears as a continuation of the γ-ray track which is on the extreme left in the left-hand photograph, and on the extreme left but one in the right-hand photograph. These experiments are discussed in NUCLEUS. The ejection of a proton at high speed from a film of paraffin wax is shown in Plate I., fig. 4, due to Meitner: this proton comes, of course, not from a complex nucleus, but from a hydrogen atom of the wax. Half of the bundle of α-particles passes through the film of wax, and consequently appears with diminished range: the single long fine track is due to the proton expelled.

The method can clearly be applied to the study of the ranges of individual α-particles, and has been used for this purpose by Mme. Curie and by Meitner. A pretty example of a general record of ranges is offered by Plate I., fig. 3, due to Chadwick and Emeléus: it is a photograph of the tracks of α-particles from thorium C+C′, and shows very clearly the two distinct ranges, the shorter attributed to Thorium C itself, the longer to Thorium C′. (*See* RADIOACTIVITY.) Many effects associated with the α-particles, which were established by less direct evidence, can be made evident by the use of the cloud chamber: for instance, the recoil of the radioactive atom when it discharges an α-particle is clearly shown in some of Wilson's pictures taken with a trace of Thorium emanation in the chamber, for at the beginning of the track of the α-particle is a short clearly defined spur, pointing in the opposite direction, due to the ionisation produced by the atom itself. The same photographs show further the short life of the atom of Thorium A (half-value period ·14 sec.), for the ray tracks occur in pairs, one due to an atom of Thorium emanation ejecting an α-particle and becoming an atom of Thorium A, and the other due to the ejection, within a fraction of a second, of an α-particle by the atom of Thorium A. The slow electrons (sometimes called δ-particles) ejected by the α-particle from atoms of the gas through which it passes (*see* RADIOACTIVITY) appear on enlarged photographs of tracks taken at reduced pressure as short projections, like tiny hairs, on the early part of the tracks.

The properties of the β-rays have also been elucidated by the cloud chamber. Plate II., fig. 2, is the track of a slower β-particle, magnified to show the individual droplets. It will be seen that these occur partly in pairs of single droplets, corresponding to positive and negative ions produced, and partly in groups, the groups being due to the ionisation produced by secondary electrons, that is, by electrons released from atoms by the electrons of the primary beams. The track of a swift β-particle is quite straight as long as it retains something like its initial velocity, but becomes curved in random directions as the particle loses speed. Plate II., fig. 3, shows a typical track: the initial portion is quite straight, but suffers a sudden large change of direction, which is due to close approach to a nucleus—Rutherford's "single scattering." (*See* NUCLEUS.) The track continues straight for a short distance after the deflection, but then takes on gradually increasing curvatures, due to accumulated small deflections—"multiple scattering." It also exhibits branches, due to the ionisation produced by comparatively swift secondary electrons. Photographs have also been obtained showing forked β-ray tracks, due to the collision of the β-particle with an atomic electron, both electrons producing ionisation after the impact.

The photographs of the tracks produced by the electrons lib-

erated by X-rays have yielded very valuable results. A good general idea of the appearance produced by a beam of X-rays is afforded by Plate II., fig. 1, which is a little less than natural size. The X-rays come from the right, and traverse a plate of silver in the middle of the ionisation chamber. Before passing through the plate the tracks of the electron released form so dense a mass that the individual tracks cannot be seen: passage through the silver weakens the beam sufficiently for the separate tracks to be distinguished. The intense patch of tracks round the silver plate is due to radiations emitted by the copper under the influence of the primary beam. The picture serves to emphasize that the ionisation produced by X-rays is a secondary effect due to the electrons which they eject from the atoms of the gases in their path. Careful measurement of the tracks of electrons ejected by the characteristic K radiations from selected metals (*see* X-RAYS) have enabled close estimates to be made of the range in air of electrons corresponding to a given voltage.

The quantum theory has been strikingly illustrated by cloud tracks. Plate II., fig. 4, shows the result of a very weak X-radiation falling on a copper plate. A single electron track will be seen coming from the plate, and another single electron track starting from a gaseous atom; such pairs have been frequently photographed. They are simply explained by attributing the first track to an electron ejected, by the action of the primary beam, from the K level of a copper atom, which must then adjust its electron levels with emission of a quantum of copper K-radiations. (*See* X-RAYS; QUANTUM THEORY.) The other electron track must be due to an electron ejected from an oxygen or nitrogen atom by this quantum of radiation. The method has thus rendered visible the tracks of two electrons, associated respectively with the emission and absorption of a single quantum of X-radiation.

The passage of hard X-rays through a gas produces different types of electron tracks. Wilson distinguishes, besides the long tracks due to secondary electrons which have practically the full energy $h\nu$, and have already been discussed, "sphere," "comma," and "fish" tracks. Examples of all of these can be found in Plate II., fig. 5: the sphere tracks are simply white dots, the term comma is self-explanatory, and the fish tracks are the short curved tracks with one end thicker than the other—fish swimming in the direction in which the X-rays are travelling. These short tracks are due to comparatively slow electrons, and the different forms are easily explained if it is remembered that the intensity of ionisation increases as the speed of the electron diminishes. A very slow electron will be deviated through very large angles in a very short path, and will produce large ionisations, making a little patch of droplets, or sphere track; a somewhat faster electron will have a more clearly defined line as its initial portion, and will form a "comma"; while an electron with slightly greater speed will present the form of an elongated comma, or "fish." These short tracks appear in appreciable numbers only when the primary X-radiation is very hard, and all their peculiarities are easily explained in terms of the Compton effect, of whose validity they offer strong confirmation. In the Compton effect a quantum of X-radiation interacts with an atom on which it falls in such a way that a quantum of softer radiation is scattered, the balance of energy appearing as kinetic energy of an electron. The energy of this so-called recoil electron depends upon its direction, which is bound up with the direction of scattering of the quantum of radiation, and is greatest when the electron proceeds in the direction of the incident rays. This accounts at once for the fact that the fish tracks all have their heads away from the source of radiation, as if swimming with the stream. The sphere tracks are due to recoil electrons of low initial velocities, thrown off at right angles, say, and the commas constitute an intermediate class. For further details, *see* the article COMPTON EFFECT. Many measurements on long and short tracks, by A. H. Compton and A. W. Simon, J. M. Nuttall and Williams and others, have confirmed the theory put forward by Compton. Further references to the use of the Wilson Cloud Chamber will be found in the articles COMPTON EFFECT; PHOTOELECTRICITY; NUCLEUS; RADIOACTIVITY, ARTIFICIAL; RADIOACTIVITY, NATURAL; TRANSMUTATION OF THE ELEMENTS.

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(E. N. DA C. A.)

WILTON, a market town and municipal borough in the Salisbury parliamentary division of Wiltshire, England, 86 mi. S.W. of London, on the S. and G.W. railways. Area 4.2 sq.mi. Pop. (1938) 2,288. It lies among the pastures beside the rivers Nadder and Wylye. Wilton house, a little to the south, was founded by William Herbert, first earl of Pembroke by the second creation, on the estates of the dissolved convent which were granted him by Henry VIII, and rebuilt later, part of it being designed by Inigo Jones. Tradition has it that Shakespeare and his company played here before James I in 1603, and the house is rich in memories of Sir Philip Sidney, Holbein and Van Dyck, Jonson and Massinger.

Carpet-making forms the main industry of Wilton; the most famous fabrics being those known as Wilton carpets; Brussels carpets; Saxony carpets made of short-staple wool; and the rich and durable Axminsters, long woven by hand at Axminster in Devon. It is also an important centre for the sale of sheep.

A chantry was founded here about A.D. 800, afterwards changed into a priory of Benedictine sisters. It was refounded by Alfred and lasted until the dissolution of the monasteries. Antiquaries have seen in Wilton the capital of a British kingdom. It was certainly the chief town of the Wilsaetas, or men of Wilts, whom Cynric the Saxon leader crushed in 556. It afterwards became a residence of the Wessex kings; and here, in 871, Alfred was severely defeated by the Danes. Wilton was burned in 1003 by Sweyn, the Danish king. In 1141 Queen Matilda celebrated Easter here with great pomp, and two years later Stephen, who came to found a castle, was driven off by her adherents. The prosperity of Wilton began to fail when Icknield Street, the great highway of commerce, was diverted to pass through Salisbury in 1224; and its decline was hastened by the plague, by which a third of the townsfolk were swept away in 1349.

Two members were returned to parliament from 1293 to 1832 and one from 1832 to 1885, at which date Wilton lost its separate representation. The September sheep fair is one of the largest in England.

WILTSHIRE, a county of England, bounded north-west and north by Gloucestershire, north-east and east by Berkshire, south-east by Hampshire, south-west and south by Dorsetshire, and west by Somersetshire. Area 1,345 sq.mi. About two-thirds is chalk upland, and the remainder is a series of clay plains and scarps bordering it on the north-west. The uplands consist of the broad western end of the Kennet syncline with drainage eastward of the Marlborough downs (400 ft.–900 ft. Inkpen beacon, on the borders of Berks, Wilts and Hants, 1,011 ft.); the narrow anticlines of Ham and of the Vale of Pewsey (200 ft.–400 ft.)

with drainage eastward to the head streams of the Salisbury Avon, and westward to tributaries of the Bristol Avon; the wide-rolling Salisbury plain (400 ft.-800 ft.), dipping to the southeast, though rising in Cranborne Chase on the south to 911 ft., and drained by the Salisbury Avon (rising near Bishops Cannings), the Wylye, the Nadder, the Ebble (draining the Vale of Chalk), and the Bourne (rising near Ludgershall), all of which unite at or near Salisbury.

The Tertiary rocks of the Hampshire basin rest upon the chalk uplands in the extreme southeast corner of the county, Reading beds and London clay east of Downton and on the Clarendon hills; these are covered by Bagshot sands at Alderbury, Grimstead and Hampworth common; Tertiaries of the London basin appear as outliers southeast of Marlborough, Reading beds and London clay occurring round Great Bedwyn. The edge of the chalk uplands forms a scarp to the northwest, from beneath which outcrops a fringe of the Selbornian—Upper Greensand and Gault—the former is well exposed in the Vale of Pewsey, west of Devizes and marginally in the Vale of Wardour; it forms an elevated tract from Mere through Stourton to Warminster. Lower Greensand appears from beneath the Gault at Poulshot and follows the same line of outcrop northward; a small outlier at Seend is worked for iron. At Dinton in the Vale of Wardour the Wealden formation appears. The rest of the northwest area is occupied by Jurassic rocks, the following appearing in small outcrops: Purbeck limestones and clays at Teffont Evias, and Portland stone at Tisbury, south of Potterne and south of Swindon. Beyond the Lower Greensand lies a narrow belt of Kimmeridge clay from Semley to Mere (where it is faulted against the Cretaceous); Westbury to Seend; Calne to Swindon (where it is used for bricks).

Beyond the plain rises the irregular scarp of the Corallian oolitic limestones and marks, and again beyond this, the Oxford clay and Kellaways beds of the Middle Oolite, forming a broad, low plain (known at its northeast end as the Vale of White Horse, draining northeastward to the Thames) on which stand Trowbridge, Melksham, Chippenham and Cricklade, and which is drained by the Upper Bristol Avon flowing southwest. Bounding the plain is the rubbly Cornbrash, which outcrops at Westwood, Trowbridge and Malmesbury. This is succeeded further west by the Great Oolite series which includes the building-stones of Bath, quarried at Winsley down, near Bradford and at Box, Corsham down and elsewhere. Above the freestones near Bradford comes the Bradford clay (with fossil *Apiocrinus*) followed by the Forest Marble limestones and clays. Still further west follows a rim of Inferior Oolite and Fuller's earth giving place to upper lias in the valley of a tributary of the Avon near Box. Here and there, gravels and brick earths rest upon the older rocks.

Agriculture.—The downs of the uplands are mostly covered with coarse grass; the valleys are fertile and well wooded. Three ancient forests remain: Savernake, south of Marlborough; Cranborne Chase (partly in Dorset) and No Man's Land and Hampworth common, which are outlying parts of the New Forest (Hants). There are also some fine parks. The lowlands and clay plains are mostly under grass for dairying purposes. Sheep are the basis of upland farming, but the milk demand of London and the local co-operative dairies are gradually converting more farms to dairying. In 1939, 50.6% of the total area of 857,796 ac. was under grass. The principal crops are wheat (39,614 ac.), oats (24,455 ac.) and barley (12,732 ac.); a considerable area, 4,062 ac., was under vetches or tares. Clover and rotation grasses for hay are important—29,384 ac. in 1939. Of the root crops, turnips and swedes are the principal, with an acreage of 7,391 ac. The National Trust owned 1,643 ac. in the county in 1942.

History and Early Settlement.—Wiltshire was densely peopled at a very early period; and it is rich in pre-historic remains. Its most famous monument is Stonehenge (*q.v.*), 2 mi. N.N.W. of Salisbury (which had a supposed wooden prototype "Woodhenge" about 2 mi. to the northeast). At Avebury there are avenues of monoliths leading to what was once a stone circle, surrounded by an earthwork, and enclosing two lesser circles. A valley near Avebury is filled with immense Sarsen blocks, perhaps of prehistoric origin; there are also many menhirs and dolmens. Circles, formed by a ditch within a bank, are common, as also grave mounds or barrows. Plentiful traces of primitive agriculture are found in rectangular-shaped fields and lynchets or cultivation terraces on the hill sides.

Of ancient strongholds there are Vespasian's Camp, near Amesbury; Silbury hill, the largest artificial mound in Europe, near Avebury; the mounds of Marlborough and Old Sarum (an important road centre in Roman times and a mediaeval town of importance); the camps of Battlesbury and Scratchbury, near Warminster; Yarnbury, to the north of Wylye, in perfect preservation; Casterley, on a ridgeway about 7 mi. E.S.E. of Davizes; Whitesheet and Winkelbury, overlooking the Vale of Chalk; Chisbury, near Savernake; Sidbury, near Ludgershall; and Figbury Ring, 3 mi. N.E. of Salisbury. Ogbury, 6 mi. N. of Salisbury is a British enclosure. Durrington walls, north of Amesbury, may be remains of a British village, and there are similar ones on Salisbury plain and Marlborough downs. Of Roman work, Wans dyke or Woden's dyke, one of the largest extant entrenchments, runs west for about 60 mi. from a point east of Savernake nearly to the Bristol channel. Its date has often been discussed and it has been described as Romano-British and as post-Roman; it consists of a bank, with a trench on the north side and was clearly for defense; forts strengthened it at intervals. Bokerly dyke (part of the boundary between Wilts and Dorset) is the largest among several similar entrenchments, with a ditch north of the rampart.

Settlements on the Greensand consist of small scattered homesteads; on the Chalk there are compact villages along spring lines, and parishes lie in long narrow strips across the scarp so as to include hill pasture, and valley arable or meadow. Parishes originally in forest clearings seem to be characterized by churches placed centrally with roads radiating from them. The valleys also suggest downward migration of settlement from Chalk ridgeway to hillside road and, later, to lowland routes. Cynric's victory at Old Sarum (552) began the conquest of the present Wiltshire; his victory at Barbury hill in 556, extended the West Saxon kingdom to the Marlborough downs. At this period the district south of the Avon and the Nadder was dense woodland, of which Cranborne Chase survives and at first West Saxon colonization was chiefly confined to the valleys of the Avon and the Wylye. There was a definite administrative and territorial organization in the 9th century. Walstan, ealdorman of the Wilsaetan, being mentioned as repelling a Mercian invasion (800). "Wiltunscire" is mentioned by Asser (878) and in that year the Danes established their headquarters at Chippenham. In the time of Aethelstan mints existed at Old Sarum, Malmesbury, Wilton, Cricklade and Marlborough. Wilton and Salisbury were destroyed by the Danish invaders under Sweyn in 1003, and in 1015 the district was harried by Canute. After the Conquest more than two-fifths of the county fell to the church; one-fifth to the crown.

In 1086, after the completion of Domesday, Salisbury was the scene of a great council, in which all the landholders took oaths of allegiance to the king, and a similar council assembled at Salisbury in 1116. At Clarendon in 1166 was drawn up the assize which remodelled the provincial administration of justice. Parliaments were held at Marlborough in 1267 and at Salisbury in 1328 and 1384. During the wars of Stephen, Salisbury, Devizes and Malmesbury were garrisoned by Roger, bishop of Salisbury, for the empress, but in 1138 Stephen seized the bishop and captured Devizes castle. In 1216 Marlborough castle was surrendered to Louis by Hugh de Neville. Hubert de Burgh escaped in 1233 from Devizes castle. In the Civil War, Wiltshire supported the Parliamentary cause, displaying a spirit of violent anti-Catholicism; nevertheless, in the early stages of the struggle the Royalists had some success. In 1645 the "Clubmen" of Dorset and Wiltshire were organized to punish any member of either party discovered plundering. Devizes, the last stronghold of the Royalists, was captured by Cromwell in 1645. In 1655 a rising organized on behalf of the king at Salisbury was dispersed.

At the time of Domesday Wiltshire was almost exclusively agricultural; 390 mills are mentioned, and vineyards at Tollard and Lacock. Under the Cistercians, sheep-farming developed, and in the 13th and 14th centuries the monasteries of Kingswood and

Stanlegh exported wool to the Florentine and Flemish markets. Wiltshire was among the chief of the clothing counties, the principal centres being Bradford, Malmesbury, Trowbridge, Devizes and Chippenham. In the 16th century Devizes was noted for its blankets, Warminster had a famous corn market, and cheese was extensively made in north Wiltshire. Amesbury was famous for its tobacco pipes in the 16th century. The clothing trade went through a period of depression in the 17th century, partly owing to the constant outbreaks of plague.

Architecture.—Among the monastic buildings are the ruined abbeys of Malmesbury and of Lacock near Melksham. There are traces of the hospital for leprous women (afterwards an Austin priory) at Maiden Bradley. Monkton Farleigh had its Cluniac priory, founded as a cell of Lewes in the 13th century. A college for a dean and 12 prebendaries, afterwards a monastery of Bonhommes, was founded in 1347 at Edington. The church, Decorated and Perpendicular, resembles a cathedral in size and beauty. The 14th century buildings of Bradenstoke priory or Cleck abbey, founded near Chippenham for Austin canons, are incorporated in a farmhouse. The finest churches of Wiltshire, generally Perpendicular, were built in districts of good stone, while the architecture is more simple in the Chalk region, where flint was used. Small wooden steeples and pyramidal bell-turrets are not uncommon; and the churches of Purton, 3½ mi. N.W. of Swindon, and Wanborough, 3 mi. S.E., have each two steeples, one in the centre, one at the west end. St. Lawrence's at Bradford-on-Avon is one of the most perfect Saxon churches in England. Three arches in the nave of Britford church, within a mile of Salisbury; the east end of the chancel at Burcombe, near Wilton; and parts of the churches at Bremhill, and at Manningford Bruce or Braose in the Vale of Pewsey are all Saxon work. Norman work is found in the churches of St. John and St. Mary, Devizes, the churches of Preshute, near Marlborough, Ditteridge or Ditcheridge, near Box, and Nether Avon, near Amesbury. Early English is illustrated by Salisbury cathedral, its purest and most beautiful example; and, on a smaller scale, at Amesbury, Bishops Cannings, Boyton in the Vale of the Wylye, Collingbourne Kingston, east of Salisbury plain, Downton and Potterne, near Devizes. Bishopstone, in the Vale of Chalk, has the finest Decorated church in the county. Mere has a Perpendicular church, with a mediaeval chantry, used as a schoolhouse by Barnes, the Dorsetshire poet, as well as 14th century dwelling-houses.

The castles of Wiltshire have almost disappeared. At Old Sarum, Marlborough and Devizes only a few vestiges are left. The ruins of Wardour castle (14th century) consist of a high hexagonal outer wall, enclosing an open court. The 18th century castle, one mile distant, is noteworthy for its collection of paintings, and for the "Glastonbury Cup," said to be made of wood from the celebrated thorn. Place house, in Tisbury, and Barton farm, at Bradford, date from the 14th century. Fifteenth century work is best exemplified in the manor-houses of Norrington (Vale of Chalk); Teffont Evias (Vale of Nadder); Potterne; and Great Chaldfield, near Monkton Farleigh.

Manufactures and Communications.—Many hands are employed in the G. W. railway locomotive works at Swindon. There are also large engineering works at Devizes. Cloth is still woven, especially at Trowbridge; there is some boot and shoe making at Salisbury and sacking and coco-nut fibre are made at Melksham, where, and at Bradford-on-Avon, there is a rubber industry. Silk weaving is carried on at Warminster and Malmesbury. Wilton is a famous carpet centre. Portland and Bath stone are quarried, while iron ore near Westbury is smelted in that town.

Three great railways traverse Wiltshire from east to west. In the north one main line of the G.W. railway passes through Swindon from London to Bath; a second runs from Hungerford to Bath via Devizes. South of Salisbury plain the Southern main line goes through Salisbury into Somerset. Important branch lines of the G.W. railway link up Salisbury and Westbury as also Cricklade, Swindon and Marlborough with the Southern railway. Swindon, Salisbury and Westbury are the three centres of railway traffic. The Avon is navigable as far as Salisbury, and goods are carried on the Thames and Severn canal in the northeast and on the Kennet and Avon canal across Salisbury plain.

The area of the administrative county is 1,344.7 sq.mi., with a population estimated in 1938 at 305,900, though between Sept. 1939 and Feb. 1941 wartime movements increased it by 20%. The municipal boroughs are: Calne, Chippenham, Devizes, Malmesbury, Marlborough, Salisbury, a city and the county town, Swindon, Wilton. The county is in the western circuit, and assizes are held at Salisbury and Devizes. It has one court of quarter sessions, and is divided into 16 petty sessional divisions. The boroughs of Devizes and Salisbury have separate courts of quarter sessions and commissions of the peace, Salisbury also has its own police force and Marlborough and Swindon have separate commissions of the peace. There are five urban districts and 12 rural districts. Wiltshire is mainly in the diocese of Salisbury, but a considerable part is in that of Bristol, and small parts in those of Gloucester, Oxford and Winchester.

The county is divided into five parliamentary divisions—Chippenham, Devizes, Salisbury, Swindon and Westbury, each returning one member.

See Sir R. C. Hoare, *The Ancient History of Wiltshire,* (2 vols., London, 1812–21), *The History of Modern Wiltshire* (14 pts. London, 1822–44); Aubrey's *Collections for Wiltshire,* edited by Sir T. Phillipps, pts. 1, 2 (London, 1821); Leland's *Journey through Wiltshire, A.D. 1540-1542,* with notes by J. E. Jackson (Devizes, 1875); W. H. Jones, *Domesday for Wiltshire* (Bath, 1865); John Britton, *The Beauties of Wiltshire* (3 vols., London, 1801–25); J. E. Jackson, *The Sheriff's Tourn, Co. Wilts. A.D. 1439* (Devizes, 1872); *see* also *Proceedings* of the Wiltshire Archaeological and Natural History Society; *Highways and Byways in Wiltshire,* ed. Hutton (1919); *The Land of Britain,* Report of Land Utilisation Survey, pt. 87 (London, 1940).

WILUNA, a mining district and settlement in Western Australia, situated in the Central division about an equal distance (*c.* 120 miles) east of Meekatharra and north by east of Sandstone.

Wiluna has been linked with Meekatharra by railway (Meekatharra–Perth: 600 miles; Sandstone–Perth: 575; Meekatharra–Geraldton: 334; Sandstone–Geraldton: 309 miles, by rail.) Auriferous deposits of large extent have been discovered there and the area is under vigorous development. It is the chief town of the East Murchison gold field, which, however, ranks behind Kalgoorlie, Meekatharra, Laverton and Menzies as a gold producer. Population (1933), 1,181 for the locality.

WIMBLEDON, a municipal borough of Surrey, England, and a residential suburb of London. It adjoins the metropolitan borough of Wandsworth and is 8 mi. S.W. of Charing Cross. Pop. (1938) 58,680. Area 5.02 sq.mi.

Wimbledon has noted sports grounds, especially for tennis and cricket. Wimbledon (Wibbandune) is supposed to have been the scene of a battle in 568 between Ceawlin, king of Wessex, and Aethelbert, king of Kent, in which Aethelbert was defeated.

At Coombe's hill British relics have been found. Wimbledon was incorporated in 1905, and including the urban district of Merton and Morden is a parliamentary division.

WIMBORNE (WIMBORNE MINSTER), a market town and urban district in the eastern parliamentary division of Dorsetshire, 111½ mi. W.S.W. of London by the S.R., but also has connection with the L.M.S.R. Pop. (est. 1938) 4,054. Area 1 sq.mi. It is situated on a gentle slope above the river Allen near its confluence with the Stour. The town depends chiefly on agriculture; but the manufacture of hose is carried on to a small extent, and there are also coachbuilding works.

Although Wimborne (*Wimburn*) has been identified with the *Vindogladia* of the Antonine Itinerary, the first undoubted evidence of settlement is the entry of the Anglo-Saxon Chronicle, under the date 718, that Cuthburh, sister of King Ine, founded the abbey here; to this the old church of St. Cuthburga belonged. The importance of the foundation made it the burial-place of King Aethelred in 871, and of King Sifferth in 962. Aethelwald seized and fortified Wimborne in his revolt in 901 against Edward the Elder. The early abbey was probably destroyed by the Danes in the reign of Aethelred the Unready (*c.* 968–1016), for in 1043 Edward the Confessor founded here a college of secular canons. The college remained unaltered until 1496, when Margaret, countess of Richmond, obtained letters patent from her son,

Henry VII., to found a chantry, in connection with which she established a school. The continuance of this was recommended by the commissioners of 1547, and in 1562 Elizabeth vested a great part of the property of the former college in a school corporation of twelve governors, who had charge of the church.

See John Hutchins, *The History and Antiquities of the County of Dorset* (3rd edition, Westminster, 1861); Anon., *History of Wimborne Minster* (London, 1860); Victoria County History of Dorset.

WINBURG, a town in the Orange Free State, 90 m. N.E. by rail of Bloemfontein. Pop. (1936) 3,723 (1,484 white). It is by the banks of a tributary of the Vet affluent of the Vaal, and is a trading centre for a large grain and pastoral district. It is joined to the trunk railway from Port Elizabeth to the Transvaal by a branch line from Smaldeel, 28 m. N.W. The town was founded in 1837 by Commandant H. Potgieter, one of the voortrekers, and was named by him in commemoration of a victory gained over the Matabele chief Mosilikatze. It became the capital of a quasi-independent Boer state. In 1848 the town and district were annexed to Great Britain and thereafter followed the fortune of the Orange river sovereignty. (*See* ORANGE FREE STATE.)

WINCHCOMB, a town in Gloucestershire, England, 7 mi. N.E. of Cheltenham, among the Cotswold Hills, in the valley of the Isbourne stream. Pop. (1931) 2,409.

Excavations indicate both British and Roman settlements at Winchcomb. There were founded religious houses by Offa and Coenwulf of Mercia (8th century). It became a borough in Saxon times and remained so until 1883. It was the chief town of a shire of Winchcomb and the seat of government of the Mercian kings. Paper and silk factories were introduced about 1830.

The church of St. Peter, cruciform, with central tower, is a good example of the Perpendicular. Sudeley castle (14th century) was given by Edward VI to Sir Thomas Seymour, fourth husband of Catherine Parr; this queen died and was buried there.

WINCHELSEA, ANNE FINCH, COUNTESS OF (1661–1720), English author, daughter of Sir William Kingsmill of Sidmonton, near Southampton, was born in April 1661. In 1683, Anne was one of the maids of honour of Mary of Modena, duchess of York. She married in 1684 Col. Heneage Finch, who in 1712, on the death of his nephew Charles, became the 5th earl of Winchelsea. The countess of Winchelsea died in London on Aug. 5, 1720. Anne Finch's poems contain many copies of verse addressed to her friends and contemporaries. She was to some extent a follower of the "matchless Orinda" in the fervour of her friendships. During her lifetime she published her poem "The Spleen" in *Gildon's Miscellany* (1701) and a volume of *Poems* in 1713 which included a tragedy called *Aristomenes.*

Edmund Gosse wrote a notice of her poems for T. H. Ward's *English Poets* (vol. iii., 1880), and in 1884 came into possession of a ms. volume of her poems. A complete edition of her verse, *The Poems of Anne, Countess of Winchilsea,* was edited by Myra Reynolds (Chicago, 1903) with an exhaustive essay, and a new edition by John Middleton Murry (1928). *See* also E. Gosse, *Gossip in a Library* (1891), and E. Dowden, *Essays, Modern and Elizabethan,* Wordsworth's anthology for Lady Mary Lowther was first printed in 1905 (Oxford). Some of her work remains in ms. in the possession of Professor Dowden.

WINCHELSEA, ROBERT (d. 1313), archbishop of Canterbury, was probably born at Old Winchelsea. He studied in Paris, and was rector of the university at some period before 1267; he then taught at Oxford, where he became chancellor of the university in 1288. He held prebendal stalls in the cathedrals of Lincoln and St. Paul's, and was made archdeacon of Essex about 1283. In 1293, he succeeded Peckham as archbishop of Canterbury. His consecration, which took place at Aquila in Sept. 1294, was delayed owing to the vacancy in the papacy, but he found no difficulty in obtaining the temporalities of the see from King Edward I. Winchelsea is chiefly renowned as a strenuous upholder of the privileges of the clergy and the authority of the pope, and as a fearless opponent of Edward I. He assisted the barons in their struggle with Edward II. by a frequent use of spiritual weapons, and took part in the proceedings against the Templars. He died at Otford on May 11, 1313. Miracles were said to have been worked at his tomb in Canterbury cathedral, but extensive efforts to procure his canonization all proved unavailing.

See *Chronicles of the Reigns of Edward I. and Edward II.,* edited with introduction by W. Stubbs (London, 1882–83); S. Birchington, in the *Anglia sacra,* edited by H. Wharton (London, 1691); and W. Stubbs, *Constitutional History,* vol. ii. (Oxford, 1896).

WINCHELSEA, an unreformed prescriptive borough in the Rye parliamentary division of Sussex, England, 9 mi. E.N.E. from Hastings by a section of the S. railway. Pop. (1931) 130. Area, 1.26 sq.mi. It stands on an abrupt hill-spur rising above flat lowlands which form a southward continuation of Romney marsh. This was within historic times a great inlet of the English channel, and Winchelsea was a famous seaport until the 15th century. Two gates, the one of the time of Edward I, the other early 15th century, overlook the marshes; a third stands some way to the west, its position pointing the contrast between the extent of the ancient town and that of the shrunken village of today. The town was laid out by Edward I with regular streets intersecting at right angles; in the centre stands the church of St. Thomas Becket. This comprises only the chancel and aisles of a building which, if entire, would rank as one of the finest parish churches in England. As it stands it is of the highest interest, showing remarkable Decorated work, with windows of beautiful and unusual design, and a magnificent series of canopied tombs.

Winchelsea had become a member of the Cinque Port of Hastings by the time of Henry II. It is governed by 12 jurats, including the mayor. It returned two members to parliament from 1366 till 1832, when it was disfranchised. Winchelsea was once a great resort for smugglers, and the vaults originally constructed for the Gascon wine trade were used for storing contraband goods.

WINCHENDON, a town of Worcester county, Massachusetts, U.S.A.; served by the Boston and Albany and the Boston and Maine railways. Pop. 6,575 in 1940 federal census. It has a variety of manufacturing industries, and is known as "Toy Town" from one of the principal ones. Woodenware and machine industries are prominent. In 1764 the plantation called Ipswich-Canada was incorporated as the town of Winchendon.

WINCHESTER, a city and municipal borough in the Winchester parliamentary division of Southampton, England, 66½ mi. W.S.W. from London by the S. railway; served also by the Southampton branch of the G.W.R., with a separate station. Pop. (1938) 24,460. Area 6 sq.mi. It occupies a hilly and picturesque site in and above the well wooded valley of the Itchen, lying principally on the left bank. The surrounding hills are chalk down.

The Cathedral.—The erection of Winchester into an episcopal see may be placed early in the second half of the 7th century, though it cannot be dated exactly. The West Saxon see was removed hither from Dorchester on the Thame, and the first bishop of Winchester was Hedda (d. 705). The modern diocese including nearly the whole of Southampton, part of Surrey and small portions of Wiltshire, Dorsetshire and Sussex, was found to be too unwieldy and in 1927 was divided into the dioceses of Winchester, Guildford and Portsmouth, the first including the greater part of Southampton together with the Channel Isles. St. Swithin (852–862), known through the connection of his feast day (15th July) with the superstition that weather conditions thereon determine those of the next 40 days, is considered to have enlarged the cathedral, as are Aethelwold (963–984) and Alphege (984–1005). The history of the Saxon building, however, is very slight, and as usual, its place was taken by a Norman one, erected by Bishop Walkelin (1070–1098). The cathedral church of St. Swithin lies in the lower part of the city in a wide and beautiful walled close. It is not very conspicuous from a distance, a low central tower alone rising above the general level of the roof. It consists of a nave, transepts, choir and retrochoir, all with aisles, and a lady-chapel forms the eastward termination. The work of the exterior, of whatever date, is severely plain.

The cathedral, however, is the longest in England, and indeed exceeds any other church of its character in length, which is close upon 556 ft. Within, the effect of this feature is very fine. The magnificent Perpendicular nave is the work of Bishop Edington (1346–1366) and the famous William of Wykeham (1367–

1404), by whom only the skeleton of Walkelin's work was retained. The massive Norman work of the original building, however, remains comparatively intact in both transepts. The central tower is Norman, but later than Walkelin's structure. The choir is largely Edington's work, though the clerestory is later, and the eastern part of the cathedral shows construction of several dates. Here appears the fine Early English construction of Bishop de Lucy (1189–1204), in the retrochoir and the lady-chapel, though this was considerably altered later.

The square font of black marble is a fine example of Norman art, its sides sculptured with scenes from the life of St. Nicholas of Myra. The magnificent reredos behind the high altar must have been erected late in the 15th century. A second stone screen, placed at the interval of one bay behind the great reredos, served to enclose the small chapel in which stood the gold shrine, studded with jewels, the gift of King Edgar, which contained the body of St. Swithin. Under many of the arches of the nave and choir are a number of very elaborate chantry chapels, each containing the tomb of its founder. The most notable are the monuments of Bishops Edington, Wykeham, Waynflete, Cardinal Beaufort, Langton and Fox. The door of iron grilles, of beautiful design, now in the north nave aisle, is considered to be the oldest work of its character in England; its date is placed in the 11th or 12th century. The mortuary chests in the presbytery contain the bones of Saxon kings who were buried here. The remains were collected in this manner by Bishop Henry de Blois (1129–1171), and again after they had been scattered by the soldiers of Cromwell. The choir stalls furnish a magnificent example of Decorated woodwork, and much stained glass of the Decorated and Perpendicular periods remains in fragmentary form. The library contains a Vulgate of the 12th century, a finely ornamented ms. on vellum.

In 1905 the cathedral fabric showed serious signs of weakness, and it was found that a large part of the foundation was insecure, being laid on piles, or tree trunks set flat, in soft and watery soil. Extensive works of restoration, including the underpinning of the foundations with cement concrete (which necessitated the employment of divers), were carried out between 1906 and 1912.

The Minster and Hyde Abbey.—King Alfred founded a minster immediately north of the present site of the cathedral, and here he and other Saxon kings were buried. The house, known as Hyde Abbey, was removed (as was Alfred's body) to a point outside the walls considerably north of the cathedral, during the reign of Henry I. Here foundations may be traced, and a gateway remains. To the east of the cathedral are ruins of Wolvesey Castle, a foundation of Henry de Blois, where the bishops resided. On the southern outskirts of the city, in the pleasant water meadows by the Itchen, is the Hospital of St. Cross. This also was founded by Henry de Blois, in 1136, whose wish was to provide board and lodging for 13 poor men and a daily dinner for 100 others. It was reformed by William of Wykeham, and enlarged and mostly rebuilt by Cardinal Beaufort (1405–1447). The buildings form three sides of a quadrangle, with a lawn and sun-dial in its midst; while the fourth side is partly open, and partly formed by the magnificent cruciform church. The earliest parts of this building are late or transitional Norman, but other parts are Early English or Decorated. The work throughout is very rich and massive. St. Cross is a unique example of a mediaeval almshouse, and its picturesqueness is enhanced by the curious costume of its inmates. It is still customary to provide a dole of bread and beer to all who desire it. King's gate and West gate alone remain of the gates in the walls which formerly surrounded the city. The West gate is a fine structure of the 13th century. In the High street stands the graceful Perpendicular city cross. The county hall embodies remains of the Norman castle, and in it is preserved the so-called King Arthur's round table. This is now considered to be about 400 years old, though possibly more, and it shows signs of having been repainted shortly before the visit of the emperor Charles V in 1522. New county council offices on Castle hill were opened in 1911. The Stanmore housing estate is a good modern development and a district planning scheme covering 80 sq.mi., including the city, is in operation.

Winchester is famous as an educational centre, and in addition to Winchester College there are several modern preparatory schools. The College of St. Mary, lying to the south of the cathedral close, is one of the greatest of English public schools. While a monastic school was in existence here from very early times, the college was originated in 1387 by William of Wykeham, whose famous scheme of education embraced this foundation and that of New College, Oxford. The buildings were completed about 1395. The quadrangles, with the fine chapel, tower, hall and cloister are noteworthy.

HISTORY

The history of the earliest Winchester (*Winton, Wynton*) is lost in legend; tradition ascribes its foundation to Ludor Rous Hudibras and dates it ninety-nine years before the first building of Rome; earthworks and relics show that the Itchen valley was occupied by Celts, and it is certain from its position at the centre of six Roman roads and from the Roman relics found there that the Caer Gwent (White City) of the Celts was, under the name of *Venta Belgarum,* an important Romano-British country town. Hardly any traces of this survive, but mosaic pavements, coins, etc., have been discovered on the south side of High Street. The name of Winchester is indissolubly linked with that of King Arthur and his knights, but its historical greatness begins when after the conquest of the present Hampshire by the Gewissas, it became the capital of Wessex.

When the kings of Wessex became kings of all England, Winchester became, in a sense, the capital of England, though it always had a formidable rival in London, which was more central in position and possessed greater commercial advantages. The parallel position of the two cities in Anglo-Saxon times is illustrated by the law of Edgar, ordaining that the standard of weights and measures for the whole kingdom should be "such as is observed at London and at Winchester." Under Alfred it became a centre of learning and education, to which distinguished strangers, such as St. Grimbald and Asser the Welshman, resorted. It was the seat of Canute's government; many of the kings, including Ecgberht, Alfred, Edward the Elder and Canute, were buried there.

Winchester was very prosperous in the years succeeding the Conquest, and its omission, together with London, from Domesday Book is probably an indication of its peculiar position and importance; its proximity to the New Forest commended it to the Norman kings, and Southampton, only 12 m. distant, was one of the chief ports for the continent. The Conqueror wore his crown in state at Winchester every Easter, as he wore it at Westminster at Whitsuntide and at Gloucester at Christmas. The royal treasure continued to be stored there as it had been in Anglo-Saxon times, and was there seized by William Rufus, who, after his father's death, "rode to Winchester and opened the Treasure House." In the reign of Stephen and again in the reign of Henry II. the Court of Exchequer was held at Winchester, and the charter of John promises that the exchequer and the mint shall ever remain in the city.

Under the Norman kings Winchester was of great commercial importance; it was one of the earliest seats of the woollen trade, which in its different branches was the chief industry of the town, although the evidence furnished by the *Liber Winton* (*temp.* Henry I. and Stephen) indicates also a varied industrial life.

The gild merchant of Winchester claims an Anglo-Saxon origin, but the first authentic reference to it is in one of the charters granted to the city by Henry II. The *Liber Winton* speaks of a "cnihts' gild," which certainly existed in the time of the Confessor. The prosperity of Winchester was increased by the St. Giles's Fair, originally granted by Rufus to Bishop Walkelin. It was held on St. Giles's Hill up to the 19th century, and in the middle ages was one of the chief commercial events of the year.

From the time of the Conqueror until their expulsion by Edward I., Winchester was the home of a large colony of Jews, whose quarter in the city is marked to the present day by Jewry Street; Winchester is called by Richard of Devizes "the Jerusalem of England" on account of its kind treatment of its Jews, and there alone no anti-Jewish riots broke out after the

coronation of Richard I. The corporation of Winchester claims to be one of the oldest in England, but the earliest existing charters are two given by Henry II., one merely granting to "my citizens of Winchester, who are of the gild merchant with their goods, freedom from toll, passage and custom," the other confirming to them all liberties and customs which they enjoyed in the time of Henry I.; further charters, amplified and confirmed by succeeding sovereigns, were granted by Richard I. and John. The governing charter till 1835 was that of 1587, incorporating the city under the title of the "Mayor, Bailiffs and Commonalty of the City of Winchester"; this is the first charter which mentions a mayor.

Winchester seems to have reached its zenith of prosperity at the beginning of the 12th century; the first check was given during the civil wars of Stephen's reign, when the city was burned. However, the last entry concerning it in the Anglo-Saxon Chronicle says that Henry Plantagenet, after the treaty of Wallingford, was received with "great worship" in Winchester and London, thus recognizing the equality of the two cities; but the latter was rising at Winchester's expense, and at the second coronation of Richard I. (1294) the citizens of Winchester had the significant mortification of seeing in their own city the citizens of London take their place as cupbearers to the king. The loss of Normandy further favoured the rise of London by depriving Winchester of the advantages it had enjoyed from its convenient position with regard to the continent.

During the Civil War the city suffered much for its loyalty to Charles I. and lost its ancient castle founded by William I. After the Restoration a scheme was started to restore trade by making the Itchen navigable to Southampton, but without success. Charles II., intending to make Winchester again a royal residence, began a palace there, which being unfinished at his death was used eventually as barracks. It was burnt down in 1894 and rebuilt in 1901. Northgate and Southgate were pulled down in 1781, Eastgate ten years later. Westgate still stands at the top of High Street. The guard room was formerly used as a debtors' prison, now as a museum. Two weekly markets, on Wednesday and Saturday, were confirmed by Elizabeth's charter; the latter dates from a grant of Henry VI abolishing the Sunday market, which had existed from early times. The same grant established three fairs—one on October 13 (the day of the translation of St. Edward, king and confessor), one on the Monday and Tuesday of the first week in Lent, and another on St. Swithin's day; the first is still held, but the only market, for corn, is held on Mondays. Winchester sent two members to parliament from 1295 to 1885, when the representation was reduced to one, and since 1918 it has been included in the county division which bears its name.

WINCHESTER, a city of Kentucky, U.S.A., the county seat of Clark county; 18 mi. E. by S. of Lexington, on federal highways 60 and 227, and served by the Chesapeake and Ohio and the Louisville and Nashville railways. Pop. 8,333 in 1920 (29% Negroes); and 8,594 in 1940 by the federal census. Winchester is in the heart of the blue-grass region, where the breeding of horses and cattle and the raising of tobacco are the leading interests. The city was founded in 1792 and chartered in 1793.

WINCHESTER, a town of Middlesex county, Massachusetts, U.S.A., 8 mi. N.W. of Boston, at the head of Upper Mystic lake; served by the Boston and Maine railroad. Pop. (1920) 10,485 (21% foreign-born white); 1940 federal census 15,081. Within the town limits are two beautiful ponds, hills rising 320 ft. above sea level, and parts of the Mystic Valley parkway and the Middlesex Fells reservation. The streets are heavily shaded with fine old trees. In 1850 the town of Winchester was formed and named after Col. W. P. Winchester, of Watertown, who had left it a legacy for municipal works.

WINCHESTER, a city of northern Virginia, U.S.A., 65 mi. N.W. of Washington; the county seat of Frederick county, but administratively independent. It is on federal highways 11, 50, 340 and 522, and state highways 7, 261, 259, and is served by the Baltimore and Ohio, the Pennsylvania and the Winchester and Western railways. Pop. 12,095 (1940) by federal census. Winchester is situated at the northern end of the fertile Shenandoah valley, 725 ft. above sea-level, and is surrounded by apple orchards. It has cold-storage warehouses with a capacity of 500,000 bbl. of apples, and large plants making cider, vinegar, apple sauce, apple butter and by-products. There are many buildings of historic interest in the city: Ft. Loudoun, built by George Washington in 1756; the houses used as headquarters by Stonewall Jackson and Sheridan; the ruins of the old Lutheran church, commenced in 1765; the stone building erected by the First Presbyterian church in 1790; and the county court house (1840), which was used both as a hospital and as a prison during the Civil War. The tomb of Lord Fairfax (d. 1781) is in the Christ Protestant Episcopal church. "Carter Hall," 10 m. S.E., is a typical ante-bellum Virginia home. Stonewall cemetery contains the graves of 3,000 Confederate soldiers, and in the national cemetery adjoining it are buried 4,500 Union soldiers.

A settlement was made in this vicinity as early as 1732, and in 1752 the town was established under its present name. It was incorporated in 1779, chartered as a city in 1852 and in 1916 adopted a council-manager form of government. In 1756, during the Seven Years' War, Washington made it his headquarters. During the Civil War it was the centre of important operations (*see* SHENANDOAH VALLEY).

WINCHESTER FOOTBALL: *see* FOOTBALL: *The Winchester Game.*

WINCKELMANN, JOHANN JOACHIM (1717–1768), German archaeologist, born at Stendal, Prussian Saxony, on Dec. 9, 1717, the son of a poor shoemaker. He attended a gymnasium at Berlin and the school at Salzwedel, and in 1738 was induced to go as a student of theology to Halle. He then held various teaching posts. Winckelmann's study of ancient literature had inspired him with a desire to visit Rome. He became librarian to Cardinal Passionei in 1754, and embraced Catholicism. In 1755, before leaving for Rome, Winckelmann published his *Gedanken über die Nachahnung der griechischen Werke in Malerei und Bildhauerkunst* ("Thoughts on the Imitation of Greek Works in Painting and Sculpture"), followed by a pretended attack on the work, and a defence of its principles, nominally by an impartial critic. Augustus III., elector of Saxony and king of Poland, granted him a pension of 200 thalers to continue his studies in Rome.

He gradually acquired an unrivalled knowledge of ancient art. In 1760 appeared his *Description des pierres gravées du feu Baron de Stosch;* in 1762 his *Anmerkungen über die Baukunst der Alten* ("Observations on the Architecture of the Ancients"), including an account of the temples at Paestum. In 1758 and 1762 he visited Naples, and from his *Sendschreiben von den herculanischen Entdeckungen* (1762) and his *Nachricht von den neuesten herculanischen Entdeckungen* (1764) scholars obtained their first real information about the treasures excavated at Pompeii and Herculaneum.

His masterpiece, the *Geschichte der Kunst des Alterthums* ("History of Ancient Art"), issued in 1764, was soon recognized as a permanent contribution to European literature. In this work Winckelmann sets forth both the history of Greek art and the principles on which it seemed to him to be based. Many of his conclusions based on the inadequate evidence of Roman copies have been modified or reversed by subsequent research, but the fine enthusiasm of the work, its strong and yet graceful style, and its descriptions of works of art give it enduring value. It was read with intense interest by Lessing, who had found in Winckelmann's earliest works the starting-point for his *Laocoon.*

In 1768 Winckelmann went to Vienna, where he was received with honour by Maria Theresa. At Trieste on his way back he was murdered in an hotel by a man named Arcangeli to whom he had shown some coins presented by Maria Theresa (June 8, 1768). He was buried in the churchyard of the cathedral of St. Giusto at Trieste.

An edition of his works was begun by Fernow in 1808 and completed by Meyer and Schulze (1808–20). There are admirable studies of his character and work in Goethe's *Winckelmann und sein Jahrhundert* (1805), to which contributions were made by Meyer and Wolf, and in Walter Pater's *Renaissance* (1902). The best biography of Winckelmann is by Justi, *Winckelmann und seine Zeitgenossen*

(2nd ed., 3 vols., Leipzig, 1898). A collection of letters, *Briefe an seine Züricher Freunde,* was published by Blümner (Freiburg, 1882).

WIND, a current of air coming from any particular direction or with any degree of velocity. For the general account of winds, their causes, etc., *see* METEOROLOGY. Winds may be classified according to the velocity with which they blow, varying from a light breeze (*q.v.*) to a gale, storm or hurricane (*qq.v.*); *i.e.,* according to their place on the BEAUFORT SCALE (*q.v.*); for the measurement of their velocity *see* ANEMOMETRY.

WINDAU: *see* VENTSPILS.

WINDBER, a borough of Somerset county, Pennsylvania, U.S.A., 10 mi. S.E. of Johnstown; served by the Pennsylvania railroad. Pop. (1920) 9,462 (29% foreign-born white); 1940 federal census 9,057. It is the centre of a large coal-mining, farming and lumbering region, and its manufactures include firebrick and various other commodities. It was incorporated in 1900.

WIND BRACES, in architecture, diagonal braces to tie the rafters of a roof together and prevent "racking." In many mediaeval roofs they are arched, and run from the principal rafters to catch the purlins. In modern steel construction, wind bracing is necessary in the wall and floor framing of high buildings to withstand the diagonal stresses set up by the wind pressure on a side wall; the wind braces take the form either of diagonal tension rods, of diagonal angle, channel or I-beam bracing at the corners, or of enlarged web or gusset plates at the intersections of framing members.

WINDERMERE, the largest lake in England, in the south-eastern part of the Lake District (*q.v.*). In the county of Westmorland, the boundary with Lancashire runs along the western shore, round the foot and northward along about one-third of the eastern shore. It is 10½ m. long and never reaches 1 m. in width: area 5·69 sq.m. The shores are generally steep, beautifully wooded and fretted with numerous little sheltered bays. The hills immediately surrounding the lake rarely reach 1,000 ft., but the distant views of the mountains to the north and west contrast finely with the sylvan beauty of the lake itself. Immediately opposite Bowness is a group of islands (Belle Isle, Thompson's Holme, the Lilies and others) which divide the lake into two basins. The greatest depth sounded in the northern basin is 219 ft., and in the southern 134. The lake receives the Rothay and Brathay streams at the head; Trout Beck also flows into the north basin, and Cunsey Beck from Esthwaite into the south. The lake is drained by the Leven. Steamers ply regularly on Windermere, the chief stations being Lakeside, on the L.M.S. railway (south) Ferry (west), Bowness (east) and Waterhead, for Ambleside (north). The lake contains perch, pike, trout and char; there are several large hotels at Bowness and elsewhere on its shores.

The town of WINDERMERE, above the eastern shore adjacent to Bowness (*q.v.*), is an urban district and the terminus of a branch of the L.M.S. railway. Pop. (1938) 5,876.

WINDHAM, WILLIAM (1750–1810), English politician, son of Col. William Windham (1717–1761), was born in Golden square, London, on May 3, 1750. His first political office was as chief secretary for Ireland in the coalition ministry of Fox and North, for a few short months in 1783. Though he was opposed to parliamentary reform, to which most of the Whigs were committed, he remained in alliance with the party until the outbreak of the French Revolution, when, with several of his friends, he joined Pitt. In 1794 he became secretary at war, with a seat in the cabinet, and he held office until 1801. He declined a place in Pitt's new cabinet in 1804, but was again at the War Office in the brief ministry (1806) of "All the Talents." He died on June 4, 1810. Windham was a dignified and commanding figure in parliament, and a keen advocate of army reform.

See his *Speeches* (3 vols., 1806), and his *Diary* (edit. Mrs. Henry Baring, 1866).

WINDING ENGINE: *see* COAL AND COAL MINING.

WIND INSTRUMENTS, a numerous and important section of the orchestra, classified according to the acoustic properties of the instruments and to certain important structural features. The first great natural subdivision is that of (A) mouth blown, and (B) mechanically blown, instruments.

Section A.—This falls into the classes of (1) wood wind; (2) brass wind, with their numerous subdivisions.

1. *Wood Wind.*—(*a*) Pipes without embouchure or mouthpiece, such as the ancient Egyptian nay, a long flute with narrow bore held obliquely, and the *syrinx* (*q.v.*), or pan-pipes, both of which are blown by directing the breath not *into* the pipe but *across* the open end. (*b*) Pipes with embouchure but no mouthpiece, such as the transverse flute, piccolo and fife. (*See* FIFE; FLUTE; PICCOLO.) (*c*) Pipes with whistle mouthpieces, an ancient contrivance, extensively used by primitive races of all ages, which finds application at the present day in the flageolet, the whistle and in organ pipes known as the flue-work, earlier examples having been the recorders, beak or fipple-flutes, *flûtes à bec, flûtes douces,* etc. (*d*) Reed instruments, by which are to be understood, not reed pipes but instruments with reed mouthpieces, which subdivide again into two families owing to the very different acoustic conditions produced by the combination of a reed mouthpiece with (1) a cylindrical pipe and (2) a conical pipe. These combinations influence not only the timbre, but principally the harmonics obtained by over-blowing, and used to supplement the fundamental scale given out as the lateral holes are uncovered one by one. (*d*1) comprises pipes with cylindrical bore with either single or double-reed mouthpiece, such as the clarinet (*q.v.*), the obsolete batyphone (*q.v.*) and the family of cromornes (*q.v.*). To these we may add the aulos (*q.v.*) and tibia (*q.v.*) of ancient Greece and Rome, which at different times had single and double-reed mouthpieces (*d*2) Pipes with conical bore and either single or double-reed mouthpiece. This class comprises the important members of the oboe family (with double reed) derived from the Schalmey and Pommer of the middle ages. (*See* OBOE and REED INSTRUMENTS.) The modern family of saxophones (*q.v.*) with single-reed mouthpiece may be classed with the wood wind, although actually made of brass for durability. The same may be said of the sarrusophones, a family of brass oboes with double reed. To these we may add the Cheng (*q.v.*) or Chinese organ. (*e*) Wooden tubes of conical bore having lateral holes and sometimes from one to three keys played by means of a cup or funnel mouthpiece, such as the obsolete cornet (*q.v.*) or Zinke, which enjoyed such widespread popularity during the 16th and 17th centuries, and their bass the serpent. The bagpipe and its drones and chaunter are mostly indirectly mouthblown.

2. *The Brass Wind* consists of the following classes: (*a*) Tubes of fixed length, such as the natural trumpet and French horn, all mediaeval horns and trumpets, including the busine, the tuba, the oliphant, the hunting horn and the bugle, the classical buccina, lituus, tuba and cornu. The compass of all these was restricted to the few notes of the harmonic series obtained by over-blowing. (*b*) Tubes of which the length is varied by a slide, such as the sackbut family, the slide trombone and slide trumpet. (*c*) Tubes of which the length is varied by lateral holes and keys. To this class belong the keyed bugle and its bass the ophicleide. The saxophones and sarrusophones might also be classed with these (*see* above, 1, *d*2). (*d*) Tubes of which the length is varied by valves or pistons, such as the tubas, cornets, valve trombone, valve trumpet, valve horn and so on. (*See* BUCCINA; BUGLE; CORNET; HORN; LIBUUS; OLIPHANT; ORPHICLEIDE; SACKBUT; TROMBONE; TRUMPET; TUBA.)

Section B: Mechanically Blown Instruments.—This section consists mainly of instruments having the air supply fed by means of bellows; it comprises the two classes (1) with keyboard, (2) without keyboard.

1. This includes all kinds of organs and to this class also belong the accordion and concertina and the numerous instruments of the harmonium type which have free instead of beating reeds.

2. This includes the bagpipes known as musettes and the Union or Irish and the Border bagpipes having a wind supply fed by bellows instead of by the insufflation pipe proper to the bagpipe.

WINDLASS, a large cylinder, conventionally termed the wheel, turning a smaller cylinder or barrel termed the axle, the difference in size giving a gain of power. A rope, partly coiled around the "axle" is attached to the load. In some cases the

wheel is turned by means of a rope coiled around it, *e.g.*, light hand cranes, but in many hoists and cranes the function of the wheel is taken by a winch handle, and in other cases by a toothed wheel driven from a pinion, hand or motor driven. The Chinese windlass gives a great gain of power by the use of axles of two diameters. A ship windlass is a more complicated apparatus, hand, steam or electrically driven, with chain wheels by means of which the anchor chain is hoisted and let out. Powerful brakes, and often coned warping drums for whipping purposes, are fitted.

WINDMILLS AND WIND POWER. A windmill is any machine for directing the wind's energy to perform work. Specifically it is the familiar type persisting through centuries of selection, in which the wind's action on the sails produces a torque and from which, by gearing or otherwise, power is transmitted to perform work.

History of Windmills.—Early windmill history is obscure, and although records state that they existed prior to the 12th century, authentic records indicate that they first became common in Germany, the Netherlands and surrounding countries. Windmills have occupied a prominent part in the efforts of those interested in the mechanical arts, and since the 12th century many ingenious designs were perfected. Detailed information is available on the later mills in records of Smeaton's tests of 1755 and Coulomb's of 1821. During the first half of the 19th century the old types were still prominent, but because of their high cost and uselessness during calm weather, they gave way increasingly to the steam engine.

In the latter half of the 19th century conditions in rural America were suitable for the use of windmills for the pumping of water in moderate quantities and Daniel Halladay brought out the first American type of windmill about 1854. Halladay's mill had a sectional wheel with wood sails, and its lines followed somewhat the European mill (*see* below). Its success promoted rapid windmill development, and solid wheel mills with wood sails soon followed, being the forerunners of the present most common type of steel sail windmill first brought out by Perry in 1883.

Windmills are generally placed in two classes: (1) horizontal, having the axis of sail revolution perpendicular to the wind direction and (2) vertical, having the axis parallel with the wind direction. Although many ingenious horizontal windmills have been made, they are impracticable, as not more than a quarter of sail surface is presented to the wind at any time. Efficient use of sail surface is essential to economy in first cost and compels the adoption of the vertical type, because the wind acts on all of its sail surface continuously.

Early Windmill Construction was of the vertical type and of two kinds; the German or post mill, in which the building on which the windmill was erected revolved on a central post to shift

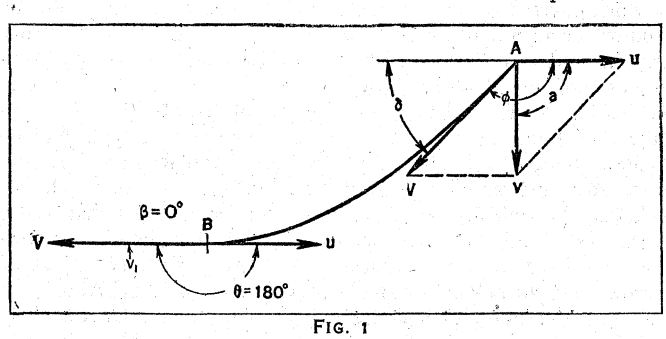

FIG. 1

the mill according to the wind direction; and the Dutch mill, in which the building remained stationary, while the entire top or roof revolved and the mill-shaft with its bearings, being a part of this structure, revolved with it. The design of the wind-wheel and sails was similar in both mills. The axle was usually inclined 15° because the dip of the general wind direction was considered to be that amount, and was so placed that the sail-ends came quite close to the ground in revolving.

The sails consisted of canvas stretched over cross slats on the four, five or six radial arms. The sail (of a 60 ft. wheel), beginning about 4½ ft. from the axle and extending to the arm extremity, might be 4½ ft. wide throughout or wider at the outer end. The sail was plane, concave or warped, the latter being the most common and efficient. According to Smeaton the angle of weather for plane sails varied from 12° to 18° and for warped sails, from 18° at inner end to 7° at outer end. The power was usually transmitted through a large toothed wheel on the inclined axle meshing with a pinion on a vertical shaft extending down in the mill building. The first mills were brought and kept in the wind by hand; later a small wheel back of, and with its plane perpendicular to the large wheel, kept it in the wind through a rack and pinion operated when the wind direction changed so that it could act on the small wheel's surface.

Regulation was accomplished by increasing or decreasing canvas on the sails, necessitating the mill being stopped, usually by applying a brake on the main gear. Later this was done automatically, so that the mills governed as accurately as other prime movers. American mills have tended toward small sizes, with many narrow sails set radially quite close together. This type has been very successful and where conditions are similar to those in the United States, it has been made in many different designs and marketed throughout the world.

Windmills as Prime Movers have been developed by American designers, but with the appearance of small gasolene engines, power windmills have practically disappeared. Windmills are used in the United States almost entirely for pumping water for rural use. The mechanism for transmitting power to the vertical shaft of the power mill, or to the pump-rod of the pumping mill, embodies any common form of transmission device.

Construction of Pumping Windmill.—Aside from the tower which supports it, the American pumping windmill usually has seven units; windwheel, including sails, girts, arms and spider; pivot, including main-shaft, gears and reciprocating mechanism, now commonly made self-oiling; brake, including operating levers; rudder vane, including bar and hinge; governor spring or weight and attachments; pull-out, including swivel, wire and lever or reel; and pump-pole with its swivel.

The main types of modern windmills are the solid and sectional, direct-stroke and back-geared, all made in wood or steel, with the latter fast supplanting the former. Inherent construction makes the wood sail mill direct-stroke, with either sectional or solid wheel, and the steel sail mill back-geared, with solid wheel only. In the sectional wheel, each section is hinged on a chordal axis so that, in governing, centrifugal force swings the section toward a position parallel with the wheel axis. In the solid wheel mill, governing is accomplished by providing a side vane or setting the wheel off-centre with respect to the pivot or tower centre, so that the wind pressure tends to turn the mill on its vertical axis, thus reducing the effective area of the wheel and therefore its speed as the wind increases. In both mills, the governing force is opposed by a spring or weight and levers, the entire device being simple and reliable, and the governing not within close limits, as this is unnecessary.

Recent years have seen considerable progress in development of windmills having aeroplane type sails, such mills of small size also being used in aeroplanes to drive auxiliary apparatus. Practical electric generating units are manufactured on a limited scale, the windwheel being similar to an aeroplane propeller and its drive being through gearing or direct connected to the generator. The low starting torque of the propeller presents a real difficulty in applying this idea economically to the pumping windmill.

Windmills of the aeroplane propeller type, in large size, are used to some extent, but have not found a ready market, indicating they are not economically practicable. Certain principles applying to other prime movers are not applicable to windmills. In a line of windmills, all lineal dimensions are in proportion to the wheel diameter D. The area of the wheel and the power of the mill increase as D^2, but the material, weight and cost increase as D^3 increases. This has the abnormal effect of making the cost of power produced by a large mill greater than for a smaller mill; for example, 100 10′ mills produce as much power as one 100′ mill, but would cost only one-tenth as much. This

explains why the common windmill in large sizes is not economically feasible. American windmills were originally made 25 ft. and larger, but the common steel windmill sizes range from 6 to 16 ft., with more of the 8 ft. size sold than all others combined. (H. C. Sc.)

GENERATION OF ELECTRICITY

In Great Britain.—The development of the windmill for the generation of electricity is mainly—so far as Great Britain is concerned—a post-War movement. During the years 1924–25 the Institute of Agricultural Engineering, University of Oxford, carried out an investigation into the performance of eight sets, ranging in rated output from 0·300 kw. to 10·0 kw. The windwheels were from 8 feet to 29·5 feet in diameter and the structures varied in height from 10 feet to 60 feet.

Wind Power.—In windmill work the "fuel" used is free and unlimited and there arises the possibility of a large "inefficient" wheel being preferable to a smaller "efficient" one, which is more expensive to manufacture.

The cost of the energy obtained is mainly due to capital charges and depreciation; maintenance and repair are relatively small items. The plants tested by the Institute of Agricultural Engineering supplied energy at costs varying from 12·7 pence per kw.h. for a set giving an annual output of 316 kw.h. to 4·1 pence per kw.h. for a set giving an annual output of 7,640 kw.h.

It was established that continuity of supply is assured in average cases by installing a storage battery capable of supplying the heaviest winter demand for three successive days. The battery fulfils a further important function in acting as a "flywheel" between the dynamo and the load. The wind fluctuates in strength from second to second, with corresponding fluctuations in the power supplied by the dynamo: the battery enables the demand to be supplied steadily without momentary reference to the state of the wind.

Design.—The development of windmill generating plants has proceeded along two lines; (*a*) the adaptation of the slow-speed windwheel—typified by the American multibladed wheel—to drive a dynamo, (*b*) the design of a new high-speed type of wheel to suit the particular requirements. The medium speed type—exemplified by the familiar sweep-sail Dutch mill—has not been applied to any extent to generating electricity.

By the term "speed" in connection with a wind-wheel is meant the circumferential speed of the blade tips, and it is usual in windwheel technique to compare this speed with the wind-speed at which it is produced. If the wind-speed is denoted by V and the circumferential speed of the blade tips at this wind-speed is denoted by U, the ratio $\frac{U}{V}$ expresses the speed characteristic of the wheel. Slow-speed wheels—multibladed with concave sheet-metal blades—have a value for $\frac{U}{V}$ varying from 1·0 to 1·5. Medium-speed wheels vary from 1·5 to 3·0: the sweep-sail mills are in this class. High-speed wheels run at values for $\frac{U}{V}$ varying from 3·0 to 6·0: this class contains wheels with the modern stream-lined blades, varying from two to five in number and covered with sheet metal or fabric.

Efficiency.—A useful formula for determining the power exerted by the wind on a windwheel is

$$H.P. = 0{\cdot}00000226AV^3$$

where A is the whole area, in square feet, enclosed by the circumference described by the windwheel and V is the wind-speed in feet per second.

The efficiency of a windwheel is the use which it makes of this power, and the figure by which efficiency is expressed shows what proportion of the energy of the wind acting on the windwheel is transformed into mechanical energy available at the hub of the wheel. It is not possible to use up all the energy in the wind, since some must be left to carry on the flow of air: this consideration results in the theoretical maximum possible efficiency being 0·59. The practical efficiencies are much below this.

M. Sabinin finds the best efficiencies and the speed at which they are obtained to be:

	Best Efficiency	at U/V
Slow-speed wheel	0·33	1·17
Medium-speed wheel	0·22	2·00
4-bladed high-speed wheel	0·42	3·10
2-bladed high-speed wheel	0·36	4·30

Dr. Betz has a design for a high-speed wheel to run with reasonable efficiency at $\frac{U}{V}=6$.

The use of high-speed wheels for driving generators is increasing in favour for four reasons:—

1. They are more efficient.
2. The higher speed of the wheel means that less gearing is required to drive the dynamo at the proper speed.
3. The surface area of the blades is small, thus reducing the risk of damage in gales.
4. They are more easily erected.

Observation of wind conditions over several years show that, when fixing the site for a windmill plant the greatest care should be taken to ensure freedom from interference from trees, etc., on the sides from which the winds mainly come. The wheel should be as high as possible to obtain the utmost use of the winds. At the coast and in exposed hilly districts there should be no hesitation in adopting windpower to supply electricity. Even in ordinary inland parts there are very few districts where a suitable site cannot be found. Thus, for isolated districts wind power may be adopted for generating purposes with every assurance of reliability and economy; for communal groupings and for medium power work there are larger sets providing the same service.

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(C. A. C. B.)

WINDOW, an opening in the wall of a building, for the admission of light and air. Windows are obviously a very ancient invention, probably almost coincident with the development of fixed and enclosed houses, particularly in those parts of the world in which courtyards were of little importance. Representations of windows occur alike in early wall paintings in Egypt, reliefs from Assyria, and terra-cotta plaques from Crete. The Egyptian examples show openings in house walls covered with mattings, like the doors, as in the V. Dynasty tomb of Ti. Well known examples of Egyptian windows also exist in the hypostyle hall of the great temple at Karnak, built by Seti I. and Rameses II., and in the so-called pavilion at Medinet Abu, near by. In the hypostyle hall the central aisles have much higher columns than those at the sides, and the space between is filled by clerestorey windows consisting of huge granite slabs pierced with two tiers of narrow, vertical openings. In the pavilion at Medinet Abu there are several windows consisting of simple rectangular openings with a small, decorative frame. These were probably originally closed by hangings of matting or cloth. Assyrian windows are almost always wider than they are high, and subdivided by little colonnettes. Many such openings are shown in the palace reliefs of the 9th and 8th centuries B.C. They are generally high in the wall. The Cretan plaques show many house fronts; in these there are indications of several tiers of windows, as though the houses were two or three storeys high, and in the windows themselves representations of frames, dividing the large opening into four smaller ones by means of a central mullion and a horizontal transom bar.

Greek and Roman.—The devotion of the Greeks to the house built around a court led to an almost total disappearance of windows, and such remains as those of Delos, although they are principally of Alexandrian and Hellenistic date, show scanty signs of windows, each room being lighted only by a door to the central, colonnaded court. In temples, also, windows are usually lacking, and the interior was lighted only by what light entered through the door or percolated dimly through the marble tiles of the roof. In exceptional cases, however, windows of very marked architectural character occurred. In the Erechtheum (*q.v.*), for instance, although the windows in the western wall date from a Roman reconstruction, the great eastern door was, from the beginning, flanked by window openings, with an architrave band around and a cornice above, and the existence of such highly developed window forms in the 5th century B.C. would seem to indicate that similar forms had long been well known.

In Roman imperial times the glazed window first definitely appears, and fragments of glass in a bronze frame have been found in Pompeii, as well as many other fragments of glass in the remains of Roman villas in England. Moreover, it is obvious that the great windows in the Roman bath halls must have been enclosed in some way, in order to retain the heat. The general hypothesis is that these great segmental-headed clerestorey openings, whose shape is perfectly preserved to the present day in the tepidarium of the baths of Diocletian at Rome, now the church of S. Maria degli Angeli, were filled, originally, with frames of bronze which subdivided the whole into small areas, each of which held a pane of glass. There is much debate as to how common glass was during the early empire, and whether the *speculares* which Pliny refers to, in his letter (no. 217), describing his villa at Laurentum, were glazed windows or not; they, without doubt, refer to transparent or translucent windows. In addition to glass, the Romans are known to have used thin sheets of translucent marble, panes of mica, shells and horn.

Byzantine church windows were glazed from an early period. Thus it is known that from the beginning, the windows of S. Sophia at Constantinople (begun 532) were filled with pierced, marble frames enclosing panes of glass, and it is possible that some of the glass still existing may be the original glazing.

The Mohammedan builders copied this Byzantine technique of inserted, small pieces of glass, in a masonry frame, and by substituting cement for marble, obtained great freedom and richness in pattern design, so that with the use of different colours of glass in the small openings, brilliant effects were produced.

Mediaeval.—It was probably also during the Byzantine period that windows covered by a complete arch superseded the segmental and square heads common in Roman work, and it is the arched window that became the governing form throughout mediaeval Europe, at least for masonry buildings. The history of the window in the domestic architecture of the early middle ages is as difficult to trace as that of ecclesiastical architecture is easy. From existing reliefs, representing early Romanesque houses, it appears that semicircular, arched windows were the rule in masonry town houses, and square-headed windows in timber-built country work. From an early period, however, the tendency appeared to use square-headed openings in masonry houses. Thus in the Hôtel de Ville at S. Antonin, France (12th century), the main hall is lit by 12 little square-headed openings in groups of four, forming practically an open loggia. There are indications that these openings were closed by shutters. The rooms above, however, have semicircular windows in pairs. With the gradual introduction of the glazed sash in secular work, which apparently began during the 12th century, the tendency toward the use of rectangular openings was much increased, due to the ease with which sash could be framed in them. During the late 12th century, transitional forms are found, especially in south France, in which arch-headed openings are divided by a heavy frame member at the spring, so that at least the lower part of the window could have a rectangular sash, as in the 12th century house at Monpazier, illustrated by Viollet-le-Duc, *Dictionnaire raisonné*, art. "Maison." The 12th century Jew's house in Lincoln, England, preserves traces of original arch-headed windows, which were later altered to square heads. From the middle of the 13th century on, the square head becomes almost universal, even in masonry buildings, although traces of the arch tradition remain in the arch forms often carved upon the stone lintels.

The desire for light and air increased continuously with the growing cheapness of glass, but the necessity for small sashes remained; the inevitable result was the development of the mullioned and transomed window, generally rectangular in shape, in which the entire opening is subdivided into convenient sizes by vertical bars known as mullions and horizontal bars known as transom bars. The climax of the development appears in France in such 15th century work as the Cluny museum at Paris, and the house of Jacque Coeur at Bourges; in England, in countless Tudor and Jacobean houses. In some of these, as in Sutton place, Surrey (1525), the small, rectangular sections made by the mullions and transoms are decorated with cusped arches. The glazing of these mediaeval, secular windows was probably originally done by assembling many small pieces of glass in a wooden framework or sash. There was a great use of roundels. Later, leading was introduced, although the whole leaded sash was set in a wooden frame. The leading was usually in panes, either rectangular, with the long dimension vertical, or in diamonds. Toward the end of the period, especially in England, metal sashes began to be introduced.

The development of ecclesiastical windows was quite different, for two reasons: first, the necessity for large size, which rendered the arch head inevitable; and second, the development of stained glass (*q.v.*). The combination of these two elements, together with the general use of stone, vaulted forms, in church architecture, led to, first, the grouping of several small windows in one composition, as in much early English Gothic work, and later, during the early 13th century, the evolution of tracery (*q.v.*). The leaded glass in these windows was inserted in a groove cut in the inside edge of the jamb and held in place by iron bars or an iron framework. A characteristic feature of almost all mediaeval windows is the splaying of the jambs on the interior, so that the opening on the inside face of the wall is much larger than that on the outside. In this manner the illumination was increased and the large openings inside offered great opportunities for decorative richness.

Renaissance.—Early Renaissance palace windows in Italy show many attempts at compromise between the arched and mullioned windows of Gothic tradition and the classic feeling that the rectangular opening was more dignified. Thus most of the 15th century Florentine palaces had twin, arched windows under a single enclosing arch; in many cases the opening itself was square-topped and the arches above mere panels. During the high Renaissance period, the rectangular window was the most popular form. It was frequently decorated with an architrave, and a cornice and pediment. Pilasters and columns were often added at the sides. During the Baroque period these decorative window enclosures were often elaborately scrolled and ornamented with fantastic cartouches, consoles, masks and human figures. Arched windows appeared spasmodically throughout the Renaissance, usually in churches or enclosed loggias. The general system of glazing in Renaissance Italy was the use of wooden-hinged frames, subdivided by small wooden bars known as *muntins;* the tendency was continuous toward the use of larger and larger panes of glass.

In the countries north of Italy, the persistence of mediaeval window forms into the Renaissance was marked. In France, for instance, debased Flamboyant tracery forms occur in churches well into the reign of Henry II. (1547–59), as in the church of Notre Dame at Grand Andely, and mullioned and transomed windows were a distinctive feature of the chateaux of the time of Francis I. Similarly in England, rectangular, mullioned windows, with hinged sashes and leaded glass, and occasionally decorated with cusped arches, are found, particularly in the collegiate buildings at Oxford and Cambridge, well into the 17th century.

The later Renaissance in France produced and developed the type of large casement window that has remained the accepted form on the continent of Europe ever since—popularly known as

the French window. In this type the opening is high and comparatively narrow, frequently extending down to the floor and is glazed with two large, hinged, wooden sashes, arranged to swing in, each subdivided into three or more lights of comparatively large size. An iron railing or stone balustrade is built on the outside for safety. It is largely the use of such windows that has given the stimulus to the extensive use of balconies in modern continental apartment houses. In England the late Renaissance development was determined by the common use of the type of window known as "double hung," which during the late 17th and 18th centuries almost superseded the swinging casement. In this the window is divided into two sashes, horizontally, the lower one on a plane slightly inside the upper one. By lowering the upper sash and raising the lower, any desired amount of ventilation up to half the area of the entire opening can be produced. In the cruder kinds of double hung window, the sashes are supported in position by pegs or spring cams, or elbows. The more developed type, now universal, has the sash hung on ropes or chains, which pass over pulleys and are connected at the other end to counter weights concealed in the window frame or box. In England the custom was to use smaller size panes than on the Continent, and this custom coloured all window design of England and America for 150 years; recent times have seen a new popularity of this use of small panes.

Modern.—Modern mechanical genius has developed many ways of using metals in window design. Not only are metal windows used largely in fire-proof buildings, but due to the economies of large scale manufacture, are more and more coming into use in smaller houses. The most common type of metal window for residence buildings is the steel casement in which all of the members are of rolled steel sections put together in stock units. Rolled steel is also used for certain types of double hung windows, especially in commercial buildings, and somewhat similar bronze frames and sashes are much used in monumental windows, such as those in banks, public buildings, etc. All sorts of operating devices have also been developed for controlling sashes far from the floor. The steel sash and the operating device have rendered possible the enormous increase in window area in industrial buildings, so that the typical modern factory has not only walls almost entirely of glass but frequently, as well, roofs arranged with a saw-tooth profile that permits ranges of almost vertical windows on the steeper slope.

Oriental.—A great difference in window design between the orient and the west is due to the almost total lack of window glass in oriental countries. In addition to the mosque windows which followed Byzantine prototypes, the Mohammedan builders of Egypt and Syria developed an extremely rich type of domestic window which was usually unglazed. This consisted of a projecting, bracketed, framework of wood with its sides entirely filled by intricate grille-work formed by carved, turned, wooden spindles. In China and Japan windows are usually covered with paper, cloth or shell. All of these require a large amount of subdivision of the window area; shell, because of the small size of the elements, the other materials because of their fragility.

Japanese windows are usually arranged to slide horizontally. Ordinarily the whole opening is of great width in relation to its height, and is subdivided into a number of small sashes, each sliding in a different plane, and all arranged so as to slide back into a pocket or case, bracketed out from the outside face of the wall. The patterns of Japanese window subdivisions are more limited than those of China and are universally based on the subtle relationships of rectangular shapes, these rectangles always having their long dimensions horizontal. (*See* BYZANTINE AND ROMANESQUE ARCHITECTURE; GLASS; GOTHIC ARCHITECTURE; TRACERY.) (T. F. H.)

WINDOW TAX, a tax first levied in England in the year 1696 for the purpose of defraying the expenses and making up the deficiency arising from clipped and defaced coin in the recoinage of silver during the reign of William III. All houses inhabited save those not paying Church or Poor rates were assessed two shillings a year. An added tax was laid according to the number of windows—on 10 to 19 windows the additional tax was 4/-.

In its first year the tax raised £1,200,000. It was increased six times between 1747 and 1808, but was reduced in 1823. After a strong agitation in the winter of 1850–51, it was repealed on July 24, 1851, and replaced by a tax on inhabited houses.

WINDPIPE: *see* TRACHEA.

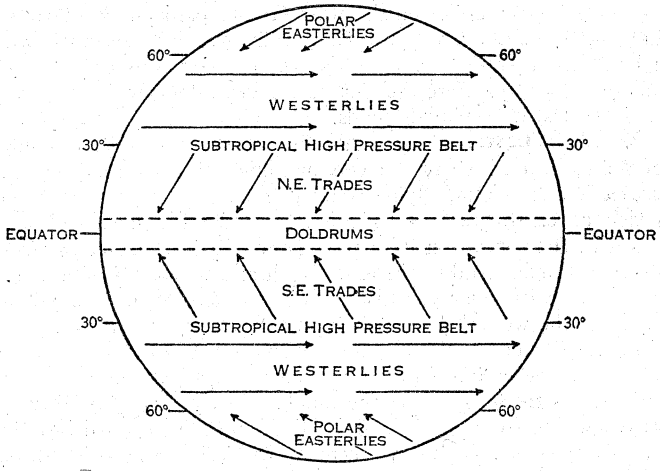
WINDS, GENERAL CIRCULATION OF. The distribution of the winds over the globe shows a great number of semi-permanent features which are referred to as the general circulation of the atmosphere. The pattern of the general circulation is primarily determined by the unequal heating of the atmosphere at different latitudes and altitudes and by the effects of the earth's rotation (*see* METEOROLOGY). The distribution of the winds is closely related to that of atmospheric pressure, and both must be discussed together.

In general, the pressure distribution gives a good indication of the prevailing winds, the latter following on the whole Buys Ballot's law. According to this law the wind in the northern hemisphere blows in such a manner that an observer facing downwind has the lower pressure to his left, the higher pressure to his right. In the southern hemisphere the lower pressure is to the right of the observer, the higher pressure to the left. In both hemispheres the wind near the ground does not flow exactly parallel to the isobars, but has a component toward lower pressure because of surface friction. Near the equator where the change in direction from one hemisphere to the other takes place, this rule does not hold, and the winds are more irregular and more subjected to local influences. Even at higher latitudes the topography of the earth's surface and changing atmospheric conditions often modify the wind direction so that Buys Ballot's law is not always well satisfied.

General Circulation, Schematic.—Schematically, the general circulation near the earth's surface can be described as follows (*see* figure): between roughly 30° N. and S. latitude easterly winds prevail (note that winds are named after the direction from which they are blowing) with components toward the equator, the N.E. trades of the northern hemisphere and the S.E. trades of the southern hemisphere. These winds blow toward an equatorial zone of light winds or calms, the doldrum belt, in which the pressure is low. On the poleward side the trade wind belts are followed by the subtropical high-pressure belts in which calms or light winds prevail and in which precipitation and cloudiness are on the whole light. In the days of sailing ships the doldrums and the subtropical high-pressure belts were often difficult to cross, and the latter zones received the name "horse latitudes." The explanation given for this name is that ships with cargoes of horses were often becalmed in these regions and ran out of water, so that the horses had to be disposed of. Poleward, beyond the horse latitudes are the zones of the westerlies which extend roughly from 35° to 65° latitude. These zones are the regions of interaction between cold and warm air masses and of migrating centres of high and low pressure. In connection with the moving pressure systems, winds from directions other than west are frequently observed in these zones. Poleward from the regions of the westerlies the polar easterlies with components toward lower latitudes are found. However, the predominance of the easterly direction over the others is not pronounced, and other wind directions occur frequently.

Seasonal Variation, Effects of Land and Water.—The actual distribution of pressure and wind over the globe is considerably more complicated than indicated by this schematic description. Seasonal variations of position and intensity of these wind belts are produced by the annual march of the sun, and further complications are caused by the physical differences between water and land. Before entering into a detailed discussion of these modifications, the disturbing effects of the continents will be considered in general. During the summer the land is warmer than the water because the radiant energy from the sun is distributed to a greater depth by turbulence than in the solid ground. Further, as a rule, more heat is used for evaporation over water than over land. In winter the ocean surface is warmer than the land because the cold surface water is mixed with the warmer water from below. The air tends to assume the temperature of the surface, so that in summer the air is warmer over land, in winter over water. Since cold air is in general heavier than warm air, the pressure over the land in winter is higher than over water, and an anticyclonic circulation develops, clockwise in the northern hemisphere, counterclockwise in the southern hemisphere with a component outward from the high pressure because of surface friction. For instance, on the east coast of a continent in the northern hemisphere a N.W. wind will be observed, while in the

southern hemisphere a S.W. wind would result in the same location. During the summer the land is heated more strongly than the water so that a low pressure develops over the land with a cyclonic circulation, counterclockwise in the northern hemisphere, clockwise in the southern hemisphere with a component of inflow toward the centre of low pressure. Hence on the east coast of a continent in the northern hemisphere, for instance, the wind would be S.E., in the southern hemisphere N.E. When the wind direction varies as much as 180° as in the example quoted here, one speaks of a monsoon (from the Arabic word for season). Typical monsoon winds are found along the east coast of Asia where cold and dry N.W. winds from the interior prevail during the winter, warm and moist S.E. winds from the Pacific during the summer. However, in most regions in temperate latitudes the shift of the prevailing wind direction from summer to winter is not so large, and it is only possible to discover a monsoonal tendency in the wind shift. For instance, on the east coast of North America the prevailing wind direction changes from N.W. during winter to S.W. during summer, through 90° only.



THE WIND SYSTEMS OF THE EARTH (VERY SCHEMATIC)

Description of the Wind Belts

In order to consider the wind distribution and its seasonal modifications in detail the various wind and pressure zones will now be discussed separately.

The Zone of Doldrums.—Near the equator the earth is surrounded by the doldrum belt where the pressure is lower than farther north or south. The winds in this zone are, as a rule, light and irregular in direction with calms having a high frequency. The effect of the earth's rotation on the air flow being negligible, the winds at the equator do not obey Buys Ballot's law. Instead, the air can move across the isobars so that any existing large pressure differences would be destroyed quickly. During January which may be taken as a typical month for conditions during the northern winter, the belt of highest temperature is at or slightly south of the equator, with larger displacements south over the continents where the temperature maxima are considerably farther south than over the oceans. Consequently the doldrums during January are everywhere near the equator over the oceans. Only over the warm land masses of South America, Africa, and over the East Indies their position is farther south, at about 15° latitude. The displacement north of the zone of maximum temperature during the northern summer is much larger than that during the southern summer into the southern hemisphere because the large continental masses of the northern hemisphere become now very hot. Consequently, the zone of doldrums too is displaced far northward. In July, for instance, the doldrum belt is considerably north of the equator, especially over Central America, North Africa and Asia. In the latter region, especially over India, the name doldrum belt is, however, hardly appropriate, since this is one of the regions where the monsoon is well developed. The width of the doldrum belt is very variable from day to day and from place to place. This zone represents the region toward which the N.E. trades of the northern hemisphere and the S.E. trades of the southern hemisphere converge. These two wind systems meet often directly without being separated by a zone of calms. The line along which the two trades meet is called the intertropical front, a name which is frequently applied to the zone of doldrums even if a sharp front is absent. The convergence of the two trade-wind systems produces ascent and cooling of the air, and thus precipitation. Because of the seasonal motion of the doldrum zone there are few regions which are under its regime throughout the whole year.

The Trade-Wind Zones.—The trade winds, northeast in the northern hemisphere, southeast in the southern hemisphere, blow between the subtropical high-pressure belts and the zone of doldrums. They are characterized by the steadiness of their direction and speed, especially over the oceans. Variations occur, of course, also in the trade-wind zones, but they are much smaller than the variations in other wind belts. The average speed of the N.E. trades over the Atlantic has been estimated to be about 11 m.p.h., that of the S.E. trades to be about 14 m.p.h. There is an annual period of the wind speed and direction. The direction of the trade winds is not uniform throughout the whole trade-wind region. On the east side of the subtropical highs, that is, near the west coasts of the continents, the component toward the equator is developed best, and the trade-wind zones reach here farthest north and south. Toward the west the easterly component of the trades becomes more pronounced. The average limits of the trade winds and doldrums over the Atlantic and the Pacific are shown in the following table after Hann-Süring (*Lehrbuch der Meteorologie*, 4 ed. Leipzig, 1929) during the months when these zones have their extreme positions:

	March		September	
	Atlantic	Pacific	Atlantic	Pacific
N. E. trade	26°–3° N.	25°–5° N.	35°–11° N.	30°–10° N.
Doldrums	3° N.–0°	5°–3° N.	11°–3° N.	10°–7° N.
S. E. trade	0°–25° S.	3° N.–28° S.	3° N.–25° S.	7° N.–20° S.

In conjunction with the displacement of the doldrum belt into one or the other hemisphere, the trade winds cross the equator in some regions. In this case they change their direction because of the different effects of the earth's rotation on air currents in the two hemispheres. Near the Guinea coast of Africa, for instance, the S.E. trades cross the equator into the northern hemisphere and become S.W. winds blowing into the African low-pressure trough. This deflection is particularly well developed during the northern summer when the pressure is low over the hot Sahara. Another example is found in the Pacific during winter where the N.E. trades become N.W. winds after crossing the equator and blowing toward the Australian low-pressure centre.

Monsoon Circulations.—Over the large continental mass of Asia the changes in pressure distribution from summer to winter are very pronounced. Hence a typical monsoon regime is established as well along the east coast as over India and the adjoining countries to the west where the S.W. monsoon blows during the summer season, the N.E. monsoon during the winter season. During the regime of the S.W. monsoon a continuous flow of air takes place from the subtropical high of the South Indian ocean toward the low pressure over Asia. Thus, the S.E. trades cross the equator and become the S.W. winds of the summer monsoon, demonstrating the change of the deflecting effect of the earth's rotation from one hemisphere to the other, The Indian monsoon is strongly affected by the Himalaya so that the summer monsoon blows from southwest over the Indian peninsula, from south into the Bay of Bengal and from southeast up the Ganges valley. The speed of the S.W. monsoon varies from place to place. Over the Arabian sea between 5°–15° N. and 50°–60° E., its speed during June and July is, on the average, 20 to 25 m.p.h.; over Bombay, 14 m.p.h. The speed of the N.E. monsoon is not much more than half the speed of the S.W. monsoon. The S.W. monsoon blows with great steadiness compared with the winds of other regions but its onset is often delayed for a considerable period, resulting in drought and famine in India. In no other region is the monsoon as strong as in Asia, although the north coast of Australia shows a well-developed monsoon regime. Monsoonal tendencies in the seasonal wind variation are found, for instance, along the east coast of the United States and along the Guinea coast of Africa.

The Subtropical High-Pressure Belts.—During the northern summer the high-pressure belt of the northern hemisphere is not continuous, but interrupted by thermal lows over Africa-Asia and over North America. In the southern hemisphere, on the other hand, which now has winter, the continents are cold, and the high-pressure belt surrounds the earth without interruption. During the northern winter conditions are reversed. The southern hemisphere now has summer, and the pressure is low over the continents, while in the northern hemisphere the pressure is high over the continents. However, the North American high is not a very permanent feature, as the daily weather maps show. In the first place, the continent is not as large as Asia; secondly, there is no barrier like the Himalaya preventing warmer air from invading the continent, and consequently cold anticyclones are often replaced by cyclones which derive their energy from the warm, moist air. The Asiatic high, on the other hand, is very pronounced and has a high persistence during the cold season.

The Westerlies.—On the poleward sides of the subtropical high-pressure belts are the regions of the westerlies which extend approximately from 40° latitude to the polar circles. While the prevailing

winds in the westerlies are from the west or southwest the wind direction is much less steady than that of the trades because in the westerlies the main frontal and cyclonic activity takes place. Hence in these belts a steady succession of migrating cyclones occurs causing frequent changes of the wind direction. Conditions in the westerlies are more complicated in the northern hemisphere because of the disturbances produced by the large land masses of North America and Asia, than in the southern hemisphere where the continental areas are very small. Here the belt of westerlies, the roaring forties, is one of the stormiest regions throughout the year. In the northern hemisphere during the winter, high-pressure centres are found over North America and Asia and centres of low pressure near Iceland and the Aleutians. The Asiatic anticyclone is very strong so that the westerlies and the cyclone paths lie along the northern margin of the continent. Cyclones penetrate occasionally into the region under the regime of the Asiatic anticyclone, but their frequency here is much smaller than over western Europe and especially over the North Atlantic which during the winter often has winds of gale force. Since over North America the high-pressure centre is much less permanent than over Asia the westerlies with their succession of cyclones can cross the western mountains and the whole width of the continent alternating with migrating highs produced by the cold polar continental air. In summer the Icelandic low is much less intense while the Aleutian low has completely disappeared from the mean pressure map. This indicates that the strength of the westerlies and the cyclone frequency are much reduced during the warmer season in the northern hemisphere.

Since the equatorial limit of the westerlies, the subtropical high-pressure belt, shifts with the seasons, there are marginal zones on the equatorial side of the westerlies which are under their regime during the winter while they are dominated by the subtropical highs during the summer. Consequently, these regions experience the effects of cyclonic activity, cloudy skies and precipitation during the winter while the summers are dry with cloudless skies. Notable examples of this type of climate are found in California, the Mediterranean lands and South Africa.

The Polar Easterlies.—The polar easterlies are located poleward beyond the westerlies. In the southern hemisphere the polar region is largely covered by the cold antarctic continent, and the pressure is high. Consequently the winds are easterly or southeasterly but local topographical variations are common. Over the high antarctic plateau the winds conform to the upper-level pressure pattern rather than to the sea-level isobars. Over the north polar zone conditions are complicated by the fact that the largest glaciated land mass in this region, Greenland, is not centred at the pole, and that in winter northern Siberia and northern Canada are colder than the Arctic ocean. Thus, the winds over the Canadian archipelago are predominantly northwest while over Spitsbergen and Fridtjof Nansen Land winds with an easterly component are more frequent although changes in the wind direction occur often. During the summer the pressure gradients in the north-polar region are weak, and the winds are light and variable.

Winds in the Upper Atmosphere.—The dominant feature of the pressure distribution at higher levels is the decrease of the pressure from the equator toward the poles, which is caused by the more rapid decrease of the pressure with altitude in cold air than in warm air. Consequently, the subtropical high-pressure belts are displaced more toward the equator, the higher the elevation, and the lowest pressures are found in the polar regions. Hence on the whole, the belt of easterly winds observed in the tropics near the ground decreases in width with altitude while the westerlies extend from the poles closer and closer to the equator. In the stratosphere where the temperature increases toward higher latitudes, the pressure gradient between the equator and the poles becomes again smaller so that the maximum velocity of the westerlies occurs at the boundary between troposphere and stratosphere. At sufficiently high levels the pressure gradient must even reverse its direction so that easterly winds are found above 11 to 13 miles.

The modifying influence of the continents on the pressure distribution becomes smaller with elevation. At 4 km., for instance, its effect is still appreciable. Thus, at this level the lowest pressure in January is not over the north pole. Instead, two centres of low pressure exist, one over the Canadian archipelago, the other over northeastern Siberia west of the Icelandic and the Aleutian low, respectively. These are among the coldest regions in the northern hemisphere during the winter season, and the westward displacement of the two upper-level lows as compared with the surface lows represents the effect of the rapid decrease of the pressure in vertical direction. Conversely, during summer the pressure is high over the Sahara, central Asia and North America where the Atlantic subtropical high extends over the southwestern United States and Mexico.

The seasonal shift of the zone of highest temperature makes itself felt inasmuch as the zone of highest pressure aloft is farther north in summer than in winter.

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WINDSOR, DUKE OF: *see* EDWARD VIII.

WINDSOR, HOUSE OF: *see* GEORGE V.

WINDSOR, a city and port of entry of Essex county, Ontario, Canada, on the left bank of the Detroit river, opposite the city of Detroit. Pop. (1941) 105,311. It is on the Canadian National, Canadian Pacific, Pere Marquette and Michigan Central railways, which connect at this point with the railways of the United States by means of a tunnel and large car-ferries. It is the centre of an important agricultural and fruit-growing district, in which tobacco is also produced. In 1935 the former city of East Windsor and the towns of Walkerville and Sandwich were amalgamated with Windsor to make one city under that name. Even outside this area, outlying suburbs make up a total Greater Windsor of 121,112. Windsor is one of the great automobile manufacturing centres of Canada and has in addition large pharmaceutical concerns, together with salt and chemical works. It is a main terminus of Trans-Canada air lines. Settlement dates back to the Jesuit missionaries of 1640 and the farms of Cadillac's Detroit trading post of 1740. The settlement was called the Ferry till 1800, then Richmond and Windsor after Queen Victoria's accession.

WINDSOR (properly NEW WINDSOR), a municipal borough in the Windsor parliamentary division of Berkshire, England. Pop. (1938) 19,430. Area 7.2 sq.mi. The town, which is famous for its royal castle, lies on the west (right) bank of the Thames, $21\frac{1}{4}$ mi. W. of London by the G.W. railway, which serves it with a branch line from Slough. It is also the terminus of a branch of the S. railway. Here the Thames makes a loop which partially encircles the Eton playing fields.

Windsor Castle.—The castle lies at the north-eastern edge of the town, on a slight but commanding eminence made by the projection of the underlying chalk through the clays and gravels which cover the rest of the district, while the massive round tower in the centre, on its artificial mound, is conspicuous from far over the flat land to the east, north and west. The site of the castle is an irregular parallelogram measuring about 630 yd. by 180. On the west the walls enclosing the "lower ward," with the Clewer, Garter, Salisbury and Henry III towers, overlook Thames Street and High Street, from which the "hundred steps" give access to the ward on the north, and the Henry VIII gateway, opening from Castle Hill, on the south. This ward contains St. George's Chapel in the centre, with the Albert Memorial Chapel on the east and the Horseshoe Cloisters on the west. To the north are the deanery and the canon's residences and to the south the guard-room and the houses of the military knights, or pensioners. The round tower occupies the "middle ward"; on its flag-turret the Union Jack or the Royal Standard is hoisted according as the sovereign is absent or present. The buildings in the "upper ward," east of this, form three sides of a square; the state apartments on the north, the private apartments on the east and the visitors' apartments on the south. Along the north side of the castle extends the north terrace, commanding, from its position above a steep slope, splendid views across the river to Eton on the Buckinghamshire side, and far over the valley. The east terrace, continuing the north, overlooks the gardens in front of the private apartments, and the south terrace continues farther, as far as the George IV gateway. The Home Park lies adjacent to the castle on the south, east and north. The Great Park extends south of Windsor, where the land, rising gently, is magnificently timbered with the remnant of the old royal forest.

As early as the time of the Heptarchy a stronghold of some importance existed at Windsor, the great mound, which is moated, circular and about 125 ft. in diameter, being a remnant of this period. William the Conqueror was attracted by the forest as a hunting preserve, and obtained the land by exchange from Westminster Abbey, to which Edward the Confessor had given it. Thereafter the castle became what it remains, the chief residence of the English sovereigns. The Conqueror replaced the primitive wooden enclosure by a stone circuit-wall, and the first complete round tower was built by Henry III about 1272, but Edward III wholly reconstructed it on a more massive scale, about 1344, to form a meeting-place for his newly established order of Knights of the Garter. He selected this spot because, according to a legend quoted by the chronicler Froissart, it was on the summit of the mound that King Arthur used to sit surrounded by his Knights of the Round Table. The bulk of the existing round

tower is of Edward's time, but its walls were heightened and the tall flag-turret added in the reign of George IV. In addition to the Round Tower, Henry III. had constructed long lines of circuit-walls, crowned at intervals with smaller towers. He also built a great hall (the present chapter library) and other apartments, together with a chapel, which was afterwards pulled down to make room for the chapel of St. George. The beautiful little dean's cloister preserves a portion of Henry's work in the south wall, a contemporary portrait of the king appearing in distemper on one of the arches. Another chapel was built by him and dedicated to his favourite saint, Edward the Confessor. This graceful building, with an eastern apse, is now called the Albert Memorial Chapel; some of Henry III.'s work still exists in the lower part of its walls, but the upper part was rebuilt in 1501–1503 by Henry VII., who originally intended it as a burial place for himself and his line. The unfinished chapel was presented to Cardinal Wolsey by Henry VIII., was roofed in and became known as Wolsey's tomb-house on account of the magnificent tomb he had constructed in it by a Florentine sculptor. The chapel was completed and re-fitted during the last century as a memorial to Albert, Prince Consort, whose cenotaph stands before the altar, with the tombs of Prince Leopold, duke of Albany, and the duke of Clarence; the last erected by King Edward VII., who was himself buried here in May 1910. In a vault beneath the chapel George III. and members of his family are buried.

St. George's Chapel.—The chapel of St. George is one of the finest examples of Perpendicular architecture in England, comparable with two other royal chapels, that of King's College at Cambridge and that of Henry VII. at Westminster, which are a little later in date. The building was begun by Edward IV., who in 1473 pulled down almost the whole of the earlier chapel, which had been completed and filled with stained glass by Edward III. in 1363. The nave of St. George's was vaulted about the year 1490, but the choir groining was not finished till 1507; the hanging pendants from the fan vaulting of the choir mark a later development of style, which contrasts strongly with the simpler lines of the earlier nave vault. In 1516 the lantern and the rood-screen were completed, but the stalls and other fittings were not finished till after 1519. The chapel ranks next to Westminster Abbey as a royal mausoleum, though no king was buried there before Edward IV., who left directions in his will that a splendid tomb was to be erected with an effigy of himself in silver. Nothing remains of this except part of the wrought iron grille which surrounded the tomb, one of the most elaborate and skilfully wrought pieces of iron-work in the world, said to be the work of Quentin Matsys. The next sovereign buried here was Henry VIII., who directed that his body should be laid beside that of Jane Seymour, in a magnificent bronze and marble tomb which was never completed. Charles I. was buried here without service in 1649. Above the dark oak stalls hang the historic insignia of the Knights of the Garter, their swords, helmets and banners.

The deanery, adjoining the dean's cloister, is dated 1500, but the Winchester tower to the north-east of it is the work of the famous prelate and architect William of Wykeham, who was employed by Edward III. on the greater part of this extension and alteration of Henry III.'s work. The Horseshoe cloisters were restored in Tudor style by Sir Gilbert Scott.

The site of the upper ward was built upon by Henry II., and, to a greater extent, by Edward III., but only in the foundations and lowest story are remains of so early a period to be found. Charles II. completed the so-called Star Building, named from the representation of the star of the Order of the Garter on the north front. Here the state apartments are situated. They include the throne room, St. George's Hall, where meetings of the Order of the Garter are held, the audience and presence chambers, and the grand reception room, adorned with Gobelins tapestries, and the guard-room with armour. All these chambers contain also splendid pictures and other objects of art; but more notable in this connection are the picture gallery, the Rubens room or king's drawing-room, and the magnificent Van Dyck room. The ceilings of several of the chambers were decorated by Antonio Verrio, under the direction of Charles II. In the royal library, which is included among the private apartments, is a fine collection of drawings by the old masters, including three volumes from the hand of Leonardo da Vinci. Here is also a magnificent series of eighty-seven portraits by Holbein, highly finished in sepia and chalk, representing the chief personages of the court of Henry VIII. There are, moreover, examples by Michelangelo and Raphael, though the series attributed to these masters are not accepted as genuine in their entirety.

The Parks.—South of the castle, beside the Home Park, is the Royal Mews. Within the bounds of the park is Frogmore, with the Royal Mausoleum and that of the duchess of Kent, and the royal gardens. An oak-tree marks the supposed site of Herne's Oak, said to be haunted by the ghost of "Herne the hunter," a forest-ranger who hanged himself here, having fallen under the displeasure of Queen Elizabeth (Shakespeare, *Merry Wives of Windsor,* Act. iv. sc. 4). A splendid avenue of elms, the Long Walk, laid out in the time of Charles II. and William III., leads from George IV.'s gate on the south side of the castle straight into the heart of the Great Park, a distance of 3 m. Another fine and still longer straight avenue is Queen Anne's Ride, planted in 1707. Among various buildings within the park is Cumberland Lodge, built by Charles II. and taking name from the duke of Cumberland, who commanded the victorious royal troops at the battle of Culloden in 1746, and resided here as chief ranger. At the southern boundary of the park is a beautiful artificial lake called Virginia Water.

Windsor Town.—A few old houses remain in the town of Windsor, including houses which belonged to Jane Seymour and Nell Gwynn respectively, but the greater part is modernized. The church of St. John the Baptist was rebuilt in 1822, but contains some fine examples of Grinling Gibbons's wood-carving. The town hall was built in 1686 by Sir Christopher Wren, who represented the borough in parliament. The town was formerly celebrated for the number of its inns, of which there were seventy in 1650. The most famous were the "Garter" and the "White Hart," the first of which was the favourite of Shakespeare's Sir John Falstaff, and is frequently mentioned in *The Merry Wives of Windsor.*

History.—Windsor (*Wyndeshour, Wyndsore, Windlesore*) was probably the site of a Roman settlement, two Roman tombs having been discovered at Tyle-Place Farm in 1865, while a Roman camp and various antiquities were unearthed at St. Leonard's Hill in 1705. The early history of Windsor centres round the now unimportant village of Old Windsor, which was a royal residence under Edward the Confessor; and Robert of Gloucester relates that it was at a fair feast which the king held there in 1053 that Earl Godwin met with his tragic end. By the Confessor it was granted to Westminster Abbey, but was recovered in exchange for two other manors by William I., who erected the castle about 2 m. north-west of the village and within the manor of Clewer, round which the later important town of New Windsor was to grow up. The earliest existing charter of New Windsor is that from Edward I. in 1277, which was confirmed by Edward II. in 1315–1316 and by Edward III. in 1328. This constituted it a free borough and granted to it a gild merchant and other privileges.

Another charter was granted by Edward IV. in 1467. Further confirmations of existing privileges were granted by Edward IV. in 1477, by Henry VII. in 1499, by Henry VIII. in 1515 and by Edward VI. in 1549. A fresh charter was granted by James I. in 1603, was renewed by Charles II., and remained the governing charter until 1835. New Windsor sent two members to parliament from 1302 to 1335 and again from 1446 to 1865, omitting the parliaments of 1654 and 1656; by the act of 1867 it lost one member, and in 1918 was disfranchised.

The political history of Windsor centres round the castle, at which the Norman kings held their courts and assembled their witan. Robert Mowbray was imprisoned in its dungeons in 1095, and at the Christmas court celebrated at Windsor in 1127 David of Scotland swore allegiance to the empress Maud. In 1175 it was the scene of the ratification of the treaty of Windsor. The castle was bestowed by Richard I. on Hugh, bishop of Durham,

but in the next year was treacherously seized by Prince John and only surrendered after a siege. In 1217 Ingelram de Achie with a garrison of sixty men gallantly held the fortress against a French force under the count de Nevers. It was a centre of activity in the Barons' War, and the meeting-place of the parliament summoned by Henry in 1261 in rivalry to that of the barons at St. Albans. During the Civil War of the 17th century the castle was garrisoned for the parliament, and in 1648 became the prison of Charles, who spent the Christmas before his execution within its walls.

See J. E. Tighe, *Annals of Windsor* (1858); *Victoria County History: Berkshire;* A. Goddard, *Windsor* (1911); W. H. St. J. Hope, *Windsor Castle* (1913); A. V. Baillie, *Windsor Castle* (1927).

WINDSOR, a town of Hartford county, Connecticut, U.S.A., on the W. bank of the Connecticut river, at the mouth of the Farmington, adjoining Hartford on the north. It is served by the New York, New Haven and Hartford railroad. Pop. (1930) 8,290; 1940 federal census, 10,068. Windsor keeps its original village green, and a number of beautiful colonial houses, including the Ellsworth homestead, now a historical museum. The building of the Congregational Church (organized in England in 1630) dates from 1794. The first English settlement in Connecticut was a trading post established here in 1633 by Capt. William Holmes of the Plymouth Colony. In 1635 a more important, and permanent settlement was made by a company from Dorchester, led by the Rev. John Wareham, Roger Ludlow and others. Ancestors of Gen. Grant and Admiral Dewey were original landholders.

WINDWARD ISLANDS, a group and colony in the West Indies, consisting of the British islands of St. Lucia, St. Vincent, Grenada and Dominica, together with the Grenadines (*qq.v.*), a chain of small islands. They are constitutionally four separate colonies under a single governor, who resides in Grenada. In 1940 the U.S. leased a naval air base in St. Lucia.

WINE. Wine is the naturally fermented juice of fresh, ripe grapes. The term "wine" is sometimes used in connection with other products of the soil to denote a beverage made through fermentation, as in *fruit wine, citrus wine, apple wine* and *raisin wine;* but standing alone it can only mean what André L. Simon has called "the living blood of the grape."

Wine is, indeed, a living thing, brash in its youth, full-blossoming in its maturity, but subject, if not used in time, to senility, decay and death. It is gregarious, appearing at its best in the company of food, and as a constituent of food; and in the society of moderate men and women, priming their wit, assisting at their worship, and serving as a medicine for some of their ills.

HISTORY

Most of the world's wines come from varieties of a single grape species, *Vitis vinifera,* which probably originated around the Caspian sea and was carried thence into all continents. (*See* GRAPE.) The actual birthplace of wine is not known, but there is evidence that wine was being produced in Egypt about 2400 B.C. and in China before 2000 B.C. A picture of winegrowing in Asia Minor in Biblical times is found in both the Old and New Testaments.

From Asia Minor winegrowing spread, with civilization, to the shores of the Mediterranean. Hesiod, writing in Greece during the 8th century B.C., gave directions for care of the vine; eventually Greek handbooks on wine appeared. The Phoenicians took the vine into France about 600 B.C. The Romans are believed to have borrowed winegrowing from the Greeks, along with the Greek god of vines and vintages, Dionysus, renamed Bacchus. Horace praised an *ardens falernum* of the vintage year 121 B.C. Pliny, during the time of Christ, distinguished 50 different kinds of wine.

After Caesar's conquest of Gaul the Romans established wine production as an important agricultural pursuit in western Europe. Every country along the Mediterranean produced wine, principally for table use; among the Greek and Latin nations wine became, what it is for them today, the universal mealtime beverage. Minstrels sang of it and literature abounded with it. Debts and taxes were often paid in part with wine.

Great Britain's rise as a maritime power is partly traceable to the demand for wines; in the 14th century King Edward III and his wealthier subjects increased the number of their ships and sent them in protected convoys to Bordeaux for wine supplies.

Throughout the middle ages the church was the greatest single factor in the spread of vineyards and development of wines. Some of today's most famous European vineyards were established by religious orders centuries ago. The hand of the church was felt later in some of the newer wine-producing areas; in California, for example, viniculture was started in the years following 1769 by Franciscan priests.

METHODS OF PRODUCTION

The life of wine begins with fermentation, and this starts soon after the skins of the grapes are broken. This may be done either by mechanical crushers or by treading in troughs or vats as in some old world wine regions.

Vinous Fermentation is the phenomenon wherein the natural sugar in the juice of the grapes is converted into the preservative, alcohol, and other substances, most of which are essential in the wine. Wine grapes contain, when ripe, from about 12% to 30% of natural grape sugar, 70% to 85% of water and many acids, minerals and other constituents whose presence in varying quantities helps to produce the variations in body, colour, taste, aroma and bouquet of wines.

The fermentation is caused by the catalytic action of enzymes of living micro-organisms called *Saccharomyces ellipsoideus,* or wine yeasts. Strains of these yeasts, varying with differences in grapes and in vineyard soils, collect at vintage time on the skins of all ripe grapes, ready to begin the catalysis when they are brought into contact with the juice, as in crushing. Normally they deposit in sufficient quantity to ensure a proper fermentation despite any contrary efforts by other forms of yeast that may appear. Wine makers consider it beneficial, however, and for some operations essential, to employ cultivated strains of wine yeasts that have proved their efficiency. In Europe and the Americas, moreover, it is almost universal practice to inhibit spoilage bacteria and wild yeasts by adding a small amount of sulphur dioxide to the juice, or *must.*

The chemical action in fermentation is usually explained as the breaking down of each molecule of grape sugar, $C_6H_{12}O_6$ (consisting of 6 atoms of carbon, 12 of hydrogen and 6 of oxygen), into 2 molecules each of ethyl alcohol, C_2H_5OH, and carbon dioxide, CO_2. In thorough fermentation the grape sugar is converted into almost exactly equal portions of ethyl alcohol and carbon dioxide, with small amounts of glycerine, succinic acid and other substances; in the production of most kinds of wine the gaseous carbon dioxide is allowed to bubble off freely. During and after fermentation other constituents of the new wine react, producing esters and higher alcohols.

The alcohol content resulting from fermentation is governed by the sugar content of the juice and by other factors. As a rule, normal fermentation produces an alcohol content of not more than 12% to 14% by volume, and, since wine grapes grown in the cooler portions of the world do not, on the average, have a sugar concentration capable of yielding more than that, 14% alcohol by volume is commonly viewed, by tax and regulatory bodies, as the maximum for table wines, which usually are thoroughly fermented, or "dry."

Completely fermented wines somewhat higher in alcohol are possible in warmer regions, where the grapes develop more sugar, and also in a few of the cooler regions where the presence of favourable moulds permits the picking and fermenting of grapes after they have passed ripeness and lost some of their moisture through evaporation. Ordinarily in these cases, however, part of the sugar is left unfermented, to lend sweetness to the wine.

Some strains of yeast exceed others in their ability to survive in the increasing concentrations of alcohol they help to create. While sugar above a certain concentration will retard fermentation or prevent it entirely, it has been found possible, by using special yeast strains and adding small quantities of condensed must to the normal juice at intervals, to continue fermentation

until the alcohol yield surpasses that of the natural capacity of the grape. Yields of 18% alcohol by volume have been obtained in this way and, under laboratory conditions, even 21%, although the maximum produced by wine yeasts in ordinary practice is about 16%.

The rapidity of fermentation depends partly upon the amount of yeast present or introduced into the juice. Because of this, and because a plentiful supply of *Saccharomyces ellipsoideus* must be present from the start to combat unfavourable yeasts and bacteria, wine makers take pains to see that the wine yeast is sufficient and that conditions are right for its growth and activity.

Temperature of the fermenting must is extremely important. The alcohol tolerance of yeast and its enzyme systems decreases with increase in temperature. A favoured temperature for rapidity of fermentation for most yeasts is about 85° F.; for cold-tolerant sorts, considerably lower. Generally, the vigour of the yeast decreases above 85° and fermentation usually stops, or sticks, before 100° is reached. Below 70° the rate of fermentation also slows, practically ceasing at 50°. Within the limits of the activity of the yeast used, the lower the temperature the more complete the fermentation, the less the loss of alcohol through evaporation and through flight with the escaping carbon dioxide gas, and consequently the higher the total yield of alcohol. Moreover, many oenologists believe that in a long, slow fermentation at low temperatures the yeast produces more esters and other aromatic bodies and that hence the wine acquires more bouquet.

Yeasts require oxygen for their maximum development, but for a time most of them exert their greatest power of alcoholic fermentation in its absence. Therefore practical wine makers, after thoroughly aerating the must in the crushing, giving the yeasts a chance to multiply, prefer to conduct the fermentation itself with only a limited supply of oxygen. If the yeasts weaken in their action, after a period, they usually can be reinvigorated by fresh aeration. Excessive aeration during fermentation results in a flat wine of poor flavour and colour.

Various means of controlling the rate of fermentation have been developed, in addition to regulation of the oxygen supply. The rate may be decreased by lowering room temperature or using cooling coils, and adding a further measured amount of sulphur dioxide. It may be increased by raising room temperature or using heating devices.

Arresting Fermentation.—Some types of wine gain their popularity because they retain a portion of the sweet natural sugar of the grapes. To produce them it is often necessary, or advisable, to stop the fermentation before it can complete itself. This can be done, at any given stage, by using sufficient sulphur dioxide or by pasteurizing the must. Since, however, wines kept sweet by these methods cannot be stored or shipped in large containers without risk of refermentation and resultant injury, a surer method, developed early in the 18th century in Portugal, is used for some wine types. This is the addition to the fermenting must of grape brandy, the pure distilled essence of the grape. When enough is added, its alcohol content arrests the action of the yeast and ensures the stability of the wine.

For commercial wine types containing brandy a minimum of 17% alcohol by volume is advised by many authorities. The state of California, in its quality regulations, sets a minimum standard of 19.5% and a maximum of 21% for its growers producing these types; and percentages of about 19% to 21% are common around the world.

The term "fortification" has been widely used to designate the addition of brandy to grape musts, but many wine makers insist this is a misnomer because it erroneously implies that the purpose of the addition is to make the wine more potent when actually only enough brandy is added to ensure the wine's stability.

Aging and Racking.—After fermentation the new wine is drawn into storage containers to begin the steps of perfection and aging which take months or years, depending upon the type and quality of the wine. The aging usually starts in large casks or tanks, from 5,000 to as much as 100,000 gal. each, made of wood or of concrete lined with a protective coating.

The temperature for aging must remain uniform, ideally around 50° to 55° F. for most white and 60° to 65° for most red wines. To provide coolness many old wine cellars were built underground; newer ones, using insulation and sometimes cooling equipment to govern temperature, are generally at surface level.

During the aging period the wine "breathes," undergoing some degree of oxidation, as air penetrates the pores of the wooden casks or is admitted, under control, to the concrete tanks. The many complex natural elements contained in the wine slowly blend or "marry" for smoothness. Chemical changes, some not fully understood, take place, creating new elements of flavour and bouquet not found in grapes or in must or in new wine.

The wine slowly clarifies itself by depositing solids to the bottoms of the casks in the form of sediments, or lees. Periodically it must be drawn off from the lees, and its transfer from one cask to another for this purpose is called "racking." During the racking it profits by fresh aeration. Normally the wine is drawn off to successively smaller casks as it grows older and more mellow; for the smaller the container the greater is the surface through which it can breathe.

Most wines, however, and particularly those low in alcohol, are perishable, tending to turn to vinegar, when left in too free contact with air. Since wine in casks loses volume by evaporation, admitting air above it, it is necessary, in order to avoid spoilage, to keep the casks full by regularly adding more wine.

Eventually a point is reached where the wine can improve no further in cask; if left longer it may take on an excessively woody flavour, lose character or become overoxidized. When this point is attained the wine is pronounced "ripe for bottling," and it then is bottled.

Thereafter, extensive further improvement follows in the case of some wines—and in fact wine is the only beverage to improve in the bottle. Some vintners, before releasing such wines for sale, store the bottles on their sides in bins for a preliminary bottle-aging period of some months or even years.

Wines differ vastly in the time they require for aging. Most table wines reach ripeness for bottling 6 to 12 months after fermentation; the majority of these are best consumed at the age of one or two years, but others of them improve for a few years in bottle. Some of the better table wines are at their best when they have spent four or more years in wood and an equal or greater period in glass. A few rare wines improve half a century or even longer. In many families fine bottled wines are laid aside in home cellars at the birth of a son, to be opened when he reaches his majority; golden wedding anniversaries have been graced with wine laid down on the wedding day. Generally speaking, wines of higher alcohol have the greatest need and capacity for aging.

No wine can be successfully aged for a long time in glass unless the bottle is kept well and tightly corked. A cork tends to soften and shrink with age; when it does so the wine gradually loses by evaporation, too much air enters the bottle and the contents may deteriorate. Hence those who age bottled wines pay regular heed to their corks.

Blending.—Some of the world's great wines are produced from a single grape variety of a single year. Most wines, however, are blended, and for various reasons. Frequently wines produced from separate grape varieties and each possessing some but not every desirable characteristic are joined to provide a rounded whole; or grapes of several varieties may themselves be blended at the time of crushing. Sometimes a little new wine is blended into old to impart freshness or fruitiness of flavour. Sometimes, too, wines of different varieties, or of different years, are blended to provide uniformity in a winegrower's product—to make each year's wine, appearing under a given label, as closely as possible like that of the year before.

After blending, further aging is always necessary to ensure the smoothness of true "marriage."

CLASSES AND TYPES OF WINES

Wines are truly endless in their variety, differing in so many attributes as to defy too-rigid classification. In colour, for example, "white" wines, so-called, have no real whiteness but count-

less shades of gold, green or straw colour, and "red" wines range from the lightest of scarlets to the darkest of garnets. Some wines are pink (*rosé*), amber, or brownish-red (tawny).

In sweetness the range is as wide. At one extreme is a wholly "dry" wine which has had all of its sugar fermented away. At the other extreme, a sweet wine may contain as much as 15% by weight of unfermented sugar. Although most sweet wines are relatively high in alcohol, sweetness is not to be confused with alcoholic content; a very "dry" *sherry* may have no sweetness but up to 21% alcohol, while a very sweet *Sauternes* may have 6% of sugar and yet an alcohol content of only 10% to 14%.

Some wines are effervescent, revealing tiny active gas bubbles as soon as the bottles are opened. These are called "sparkling" wines to distinguish them from the great majority, which are "still." There are a few wines, called "petillant" in French, or "crackling," that are only slightly sparkling; others, notably young white wines from the Moselle valley, that, though still, suggest effervescence.

With such wide variations in wines it has been difficult to agree on a system of classification acceptable throughout the world. Increasingly, however, authorities have come to place all wines in five main classes designated by the principal uses to which they are put. These classes are *red table wines, white table wines, appetizer wines, dessert wines* and *sparkling wines.* There are many variations within each class, but each class is readily distinguishable from the others.

Red Table Wines.—Red wines produced for consumption at meals, which constitute the vast bulk of the world's wines, are usually, though not always, dry. Rich, sometimes tart and even astringent in flavour, they are preferred, as a rule, with red meats, pastes and highly seasoned foods. Their alcohol content ordinarily runs from 10% to 14% by volume.

The colour and taste qualities of red wines derive from the fact that the pulp and skins of the grapes are left with the juice during fermentation. The pigment from the skins joins the wine as colour, and other substances, principally tannin, quit the skins and seeds to influence the flavour. (Pink or *rosé* wines are produced, normally, by leaving the grapeskins with the must for only a fraction of the fermentation period.)

After fermentation the new red wine is drawn off for aging, and that portion remaining in the skins and pulp is pressed out in a wine press. The grape residue, pomace, left after pressing is a source of valuable by-products, including tartrates.

Red table wines, though appearing under many names and in many guises, are roughly grouped in most countries as *claret* and *Burgundy* types, the latter identifiable by their greater body, stronger flavour and bouquet and deeper colour. (*See* CLARET and BURGUNDY WINES.)

White Table Wines vary from extremely dry and tart to sweet and mellow, with delicate flavours that blend best at table with white meats, fowl and seafoods. Traditionally they are served chilled. In colour they range from pale straw to deep gold, and in alcohol content usually from 10% to 14%.

Most white wines are produced by fermentation of the juice alone, and therefore have little of the astringency that red wines get from the tannin of the grapeskins and seeds. However, some white wines are fermented with the skins if the grapes are white or near-white.

White table wines are more susceptible than reds to heat injury during fermentation; hence the fermentation is conducted at lower temperatures and is more prolonged, with greater need for close control. During aging, white table wines clarify more quickly and so can be bottled earlier than reds.

Two types of white table wines are more generally known than others: *Sauternes* and *Rhine wines.* Sauternes are golden-hued and full-bodied. Usually they are semi-sweet, but not always. In the United States, *e.g.,* some wine makers produce "dry Sauternes" containing from 0% to 1.5% natural grape sugar, "Sauternes" with 1.5% to 4%, and "sweet Sauternes" with 2.5% to 6%. (*See* SAUTERNES.)

Rhine wine, frequently called *hock,* is the popular type name applied in most countries to any thoroughly dry, tart, light-bodied white table wine of straw colour or slightly greenish hue. (*See* HOCK.)

Appetizer Wines, so-called because they are favoured for before-meal use, range from fully dry to semi-sweet, and hence are suitable for appetizer-time serving when too sweet a beverage might fail to sharpen the appreciation of the food to follow. The main types are *sherry* and *vermouth.*

Sherry, the most popular, is characterized by its "nutty" flavour. This is usually obtained, after the addition of pure grape brandy to the fermented or partly fermented juice, by an initial period of aging at warm temperatures, with partial exposure to oxygen and sometimes with the growth of a film-yeast on the surface. (*See* SHERRY.)

Most sherries have an alcohol content of 17% to 20% by volume. They vary in grape sugar content from 0% to 7% by weight, the percentage depending upon the wine maker, who can arrest the fermentation by adding brandy when the must still contains any desired degree of sweetness.

Vermouth is an aromatically flavoured wine in the production of which brandy has been added. The flavouring is accomplished by steeping herbs and other aromatic substances in the wine or by adding an infusion of herbs. Further aging follows. There are two principal kinds: dry and pale-amber (French type) and sweet and dark-amber (Italian type). Each vermouth producer has his own formula, some formulas using as many as 50 different herbs, barks, leaves, flowers and seeds. Vermouth has 15% to 20% of alcohol.

There are other appetizer wines, specialty products made by formulas using herbs and other flavouring substances. These are usually labelled "appetizer" or *apéritif* wine together with the proprietary name of the producer.

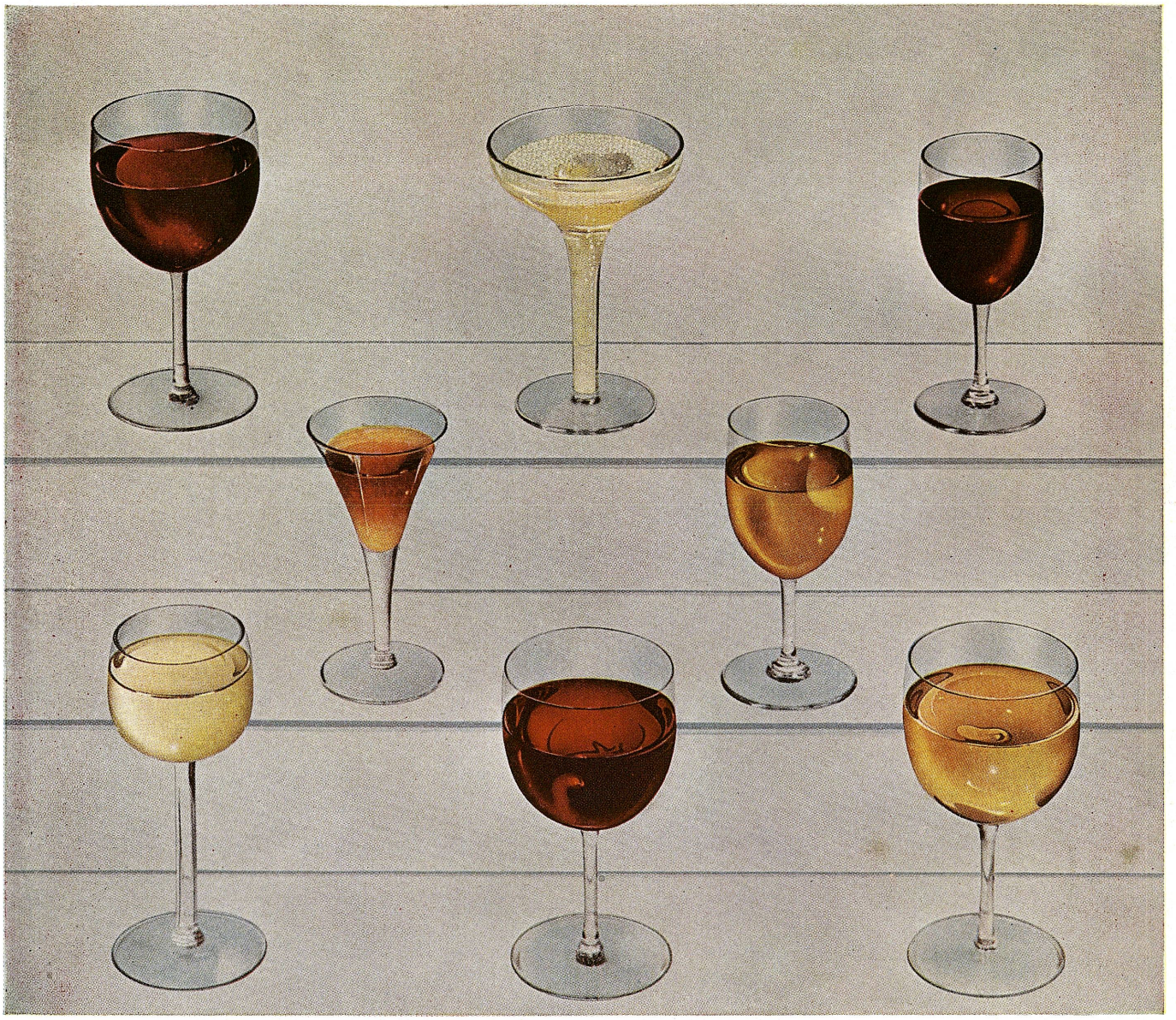
Dessert Wines get their class name from the fact that they are chiefly used after meals. The name has legal significance also: in many countries all still wines of more than 14% alcohol are grouped together for taxation purposes, usually as "dessert wines," in differentiation from the "table wines," or wines not over 14%, which receive lower tax rates. For legal purposes, and to some extent in use as well, appetizer wines like sherries and vermouths come under the dessert-wine heading. More typical of the class, however, are *Ports,* both red and white, and *Muscatels,* which generally contain around 20% alcohol.

Commonly in the production of dessert wines much of the grape sugar is retained by adding grape brandy to arrest the fermentation of the must. In the case of Muscatel, a very sweet wine, the fermentation is arrested early, and most Muscatels keep from 10% to 15% by weight of natural grape sugar. The brandy is added later for Ports, which usually contain 9% to 14% grape sugar, and still later for sherries. Brandies distilled from the same grape varieties as those used in the wine are preferred. (*See* PORT.)

Sparkling Wines are table wines that have been made naturally effervescent by a second fermentation, conducted in closed containers. They are white, pink or red, and they have a wide range of flavour characteristics and varying degrees of dryness or sweetness. Their usual alcohol content is 10% to 14% by volume, like that of still table wines. *Champagne,* through centuries a drink for banquets and festive occasions, is the most widely known of this class; the others usually take the title "sparkling" followed by the type name of the wine used as the base; *e.g., sparkling Burgundy.*

For the production of sparkling wine most wine makers require a blend of still table wines, especially selected for acidity, body and colour. To this are added a little sugar and a yeast capable of acting in the presence of already-developed alcohol. The second fermentation started thereby is conducted either in bottles, with strong corks clamped on to prevent escape of carbon dioxide, or in large airtight "bulk" containers.

After this fermentation, if the bottle method has been used, newly formed sediment is removed by painstaking hand processes called "riddling" and "disgorging." (*See* CHAMPAGNE WINES.) If the bulk method has been employed the sediment is left behind in the container, or in a filter, when the wine is drawn off to bot-



WIDELY KNOWN WINES IN TRADITIONAL GLASSES

Top row, left. Burgundy—full-bodied, deep red table wine. Glass 2 13/16 in. wide, 5 13/16 in. high

Top row, centre. Champagne—pale gold or straw-coloured sparkling wine. Glass 3 9/16 in. wide, 5 5/16 in. high

Top row, right. Port—rich, heavy-bodied, dark red dessert wine. Glass 2 1/16 in. wide, 5 3/16 in. high

Middle row, left. Sherry—appetizer wine of amber colour. Glass 2½ in. wide, 5 1/16 in. high

Middle row, right. Muscatel—golden-coloured, amber-toned dessert wine. Glass 2 1/16 in. wide, 5 3/16 in. high

Bottom row, left. Rhine Wine or "Hock"—dry white table wine, light-bodied, pale golden or slightly greenish in hue. Glass 2⅛ in. wide, 6¼ in. high

Bottom row, centre. Claret—light-bodied, red table wine. Glass 2 13/16 in. wide, 5 13/16 in. high

Bottom row, right. Sauterne—semisweet white table wine, golden-hued, full-bodied. Glass 2 13/16 in. wide, 5 13/16 in. high

tles. Most countries require that use of the bulk process be stated on the labels.

When a sparkling wine is poured from a bottle into glasses, carbon dioxide bubbles rise to the surface. As they leave the wine they carry with them some of the fragrant esters, making one strongly conscious of the wine's bouquet.

In a group apart from naturally sparkling wines are many white and red wines, both dry and sweet, made effervescent, not through a second fermentation in closed containers, but by artificial carbonation at the time of bottling. These are less expensive, and are known and marketed as *carbonated wines*.

Naming of Wines.—The most widely used wine type names have geographic origin, from the regions in which the types originated. Many others are varietal, representing the principal grape varieties employed. Others are proprietary, some being the names of their producers and others being fanciful titles adopted by individual vintners. Usage through centuries has given generic significance to a few wine type names of geographic origin. Thus such universally familiar type names as *claret, Burgundy, Sauternes, Rhine wine, Port* and *sherry,* all having geographic significance, in modern times came to be used internationally to designate any wines possessing the characteristics generally attributed to the original products.

At various times in the 19th and 20th centuries attempts were made by France and some other nations to restrain producers of other countries in the use of generic wine type names of European geographic origin. International agreements and many national wine laws and regulations have reflected such efforts. In most countries, including the United States, generic names of geographic origin may be used only when the actual place of origin is stated in direct conjunction with the type name, *e.g., Australian Burgundy, Argentine Champagne, California sherry, American claret,* etc.

In the United States, such varietal names as *Zinfandel,* denoting a claret-type wine of the Zinfandel grape, *Riesling,* a Rhine wine type produced from one or more of the Riesling grape varieties, and *Muscatel,* denoting a dessert wine of any of the several Muscat varieties, have been used since the middle of the 19th century. Subsequent to 1933 there was increased use of additional varietal names, including Cabernet, for claret-type wines of the Cabernet Sauvignon grape, Pinot noir, for Burgundy-type wines of the grape variety indicated, and Semillon, a California Sauternes type.

USES OF WINE

Wine is as old as civilization and no drink except water and milk has won such universal commendation through the ages. It is used to perform rites in churches; to observe memorable occasions; to launch ships; to minister to the sick; to welcome guests; to inspire the mind. It is essentially a drink of moderation; when used to excess, wine itself is abused.

Most of the world's wines are consumed with food, and in some countries they hold a place as food in themselves, appearing on the average table as regularly as bread. It has been demonstrated that natural grape sugars in wine are readily absorbed by the human system and are desirable in the diet, that the alcohol in wine is a quick source of caloric energy, that wine has a definite blood-building iron content, that it contains all of the 13 mineral elements recognized as needful to maintain human life.

Wine at the table promotes appetite, digestion and well-being. Saucelike, it accents the flavours of foods. Dry table wines, alone among all the common beverages of man, are produced entirely for mealtime use. In their many forms they contain all of the four taste elements to which the palate is sensitive—sweetness, acidity, saltiness and bitterness—to balance the same elements in solid foods. Moreover, they supply aroma, acidity and smoothness for foods that lack these qualities.

In those countries where wines are commonly used with food they also are commonly introduced into food in cooking. They lose their alcohol when subjected to heat, but chefs depend upon them to heighten the flavour and aroma of foods and to give them balance. In France, where wine with food is the general custom, wine within the food is so greatly favoured that most chefs never use water in cooking when they can use wine instead.

Food Affinities.—Connoisseurs have created a vast literature on the proper selection of wines to complement different foods. They have made little impression on millions of families in Europe and elsewhere who are satisfied to continue using a single type of red or white table wine with all meals. They have succeeded, however, in establishing certain points based on common experience of wine and food affinities. It has become generally agreed, for example, that heartiness in a dish calls for heartiness in a wine, delicacy for delicacy, and so on. Current theory indicates these partnerships:

Seafoods and fowl with white meat—a white table wine.
Fowl with dark meat—a white or red table wine.
Steaks, roasts, chops, game and pastes and other highly seasoned dishes—a red table wine.
Desserts—a sweet dessert wine, a sweet table wine or a sweet sparkling wine.
Cheeses—Port or Burgundy.
Nuts—Port.

WORLD PRODUCTION AND CONSUMPTION

Most of the world's grapes go into wine. A study by the U.S. tariff commission in 1939 showed the world average to be 84%. By countries the percentage varied: France and Algeria, about 99%; Italy, 95%; Spain, 92%; Greece and the United States, about 50%.

Production.—Total world wine production rises and falls sharply from year to year, mainly in relation to grape-growing conditions, but the general trend in the quarter-century prior to 1939 was upward. The tariff commission study cited, which did not, however, include some of the minor producing countries, showed a rise in world production from an average of approximately 3,250,000,000 U.S. gallons per year in the years 1903–13, inclusive, to more than 5,800,000,000 gal. in 1935; the next two years averaged about 4,250,000,000 gal.

Wine-growing countries are difficult to rank in their order of importance at any given time because their statistics vary in form and completeness and because in any single year their production may be affected by climatic departures, war or changing economic policy. A partial quantitative comparison may be made, however, by studying the gallonage statistics available for each country over a period of years, omitting the figures for those years palpably influenced by war, and averaging the figures for those of the remaining years that seem to reflect the country's latest production trend. A study of this nature, using statistics available for 1931–42, yields the following average figures, rounded out to the nearest 500,000 U.S. gallons, for the principal wine-growing countries:

France and French North African Possessions, Total	2,015,500,000		
France	1,513,000,000		
Algeria	464,500,000		
Tunisia	38,000,000		
Italy	1,024,000,000	Chile	85,500,000
Spain	469,000,000	Bulgaria	44,000,000
Rumania	245,500,000	Union of South Africa	32,500,000
Portugal	230,500,000	Turkey	25,000,000
Argentina	192,000,000	Austria	23,500,000
U.S.S.R.	132,000,000	Brazil	22,000,000
Greece	112,500,000	Australia	21,500,000
Yugoslavia	105,000,000	Switzerland	19,500,000
Hungary	104,500,000	Morocco	15,500,000
United States	90,500,000	Uruguay	15,000,000
Germany	85,500,000	Czechoslovakia	8,500,000

The foregoing table, based on reported wine gallonage only, does not make allowance for differences in wine types and quality, nor does it fairly reflect the relative tonnage of grapes used in wines. Particularly is this true for such countries as Spain, Portugal, the United States and Australia which produced, in the years studied, high proportions of dessert wines; for dessert wines, with their brandy, require for each gallon roughly twice the quantity of grapes used in table wines.

Consumption.—The countries that produce the most wine also consume the most. France, although the largest producer of all, long has found its own supply insufficient; before World War II it acquired approximately 25% to 30% more by imports, consum-

ing the great bulk of the wine produced in Algeria and Tunisia. Apart from the movement of North African wines, the late 1930s saw only about 2% of world wine production entering international trade; all of the principal wine exporting nations also imported some wines.

France long has led the nations in per capita consumption of wine. In the years 1931–35 its people used an average of 30.9 gal. of taxed wine per year, besides that consumed tax-free by thousands of individual growers. Annual per capita consumption in Italy during the same period averaged 24.5 gal.; in Spain, 18.9 gal.; in Argentina, only slightly less. Countries of low per capita consumption included the United States and the United Kingdom, with less than 1 gal. Just prior to the war the rate of consumption was rising rapidly in the United States.

WINE REGIONS OF THE WORLD

Wine can be produced in all regions where grapes ripen fully, but not all of these regions can produce grapes capable of yielding good wine. Good wine grape varieties are highly responsive to differences in climate, soil, exposure and methods of care, and the best wines of each country are those produced, painstakingly, from grape varieties that have found conditions to their liking. Europe before World War II produced roughly about 80% of the world's wines, but, like other continents, it could boast only a small proportion of fine, as distinguished from ordinary, wines.

France and Possessions.—Nearly every department of France yields wine. In 1935 there were 1,600,000 vineyard proprietors, of whom a third grew wines for their own family table use alone. Traditionally, 75% to 80% of French wines are red; most of the wines are table types, for common consumption; some of the best wine is exported; but France imports much more wine than it exports, getting, in particular, great quantities of ordinary wines from its North African territories, Algeria and Tunisia.

Of French wines approximately half, usually, are produced in the southern departments, mainly those along the Rhone and in the former provinces of Languedoc and Provence, to the west and east of Marseille; most of these wines are ordinary, but some, including *vermouths,* are of high quality.

The major portion of French fine table wine comes from four distinct districts in the Gironde department, which centres in the city of Bordeaux: the Médoc and St. Emilion districts for red wines, the Sauternes district for white wines and the Graves district for both red and white wines. (*See* CLARET; GRAVES: WINES OF; MÉDOC WINES; SAUTERNES.)

In west-central France, the former provinces of Touraine and Anjou, along the Loire, yield both red and white wines. Further east, the Côte d'Or, Saône-et-Loire and Yonne departments produce the Burgundies. (*See* BURGUNDY WINES.) Northeast of Paris is a small district, in the Marne department, which the French recognize as the home of *Champagne.* (*See* CHAMPAGNE WINES.) Alsace, between the main range of the Vosges and the Rhine, is a region of very dry white wines.

Italy.—Italy, the second-largest wine-producing country in the world, is also the second-largest wine-consuming country. There is great demand for brisk, young, red table wines of low cost, and wine-making practice, in general, answers this demand. Some excellent wines, however, are produced in various parts of Italy: *e.g.,* the cooler regions of the north have high-quality *Nebbiolo* and *Barolo* wines and sweet *vermouths;* Tuscany produces *Chiantis* in their typical straw-covered flasks; the area of Naples boasts the soft, delicate *Lacryma Christi;* Sicily exports the sweet, walnut-brown *Marsala.* Falerno, a product of the Naples area, is no longer so highly prized as Falernum was in ancient Rome.

Spain.—In normal times Spain has been Europe's leading exporter of wines, both ordinary and of higher grades. For its own consumption it produces mainly red table wines to be used within the year following the vintage. The regions of heaviest production are along the Mediterranean coast and in the southern interior, but wine is grown in most parts of Spain and in its Balearic and Canary Islands. In English-speaking countries Spain is best known for its *sherry* (*see* SHERRY), from the region around Jerez de la Frontera near Cadiz, and the dessert wine shipped from Malaga under that city's name. However, it has other good wines, among them *Tarragona,* a Port type from Catalonia, the *Rioja* wines of the upper Ebro valley and the wines of Valencia and Alicante.

Rumania.—Loss of territory in World War II confronted Rumania with the possibility of losing its rank as fourth-largest wine producer in Europe. Some of its good wines had been produced in Bessarabia, a region recaptured by the Russians. Some favoured white wines came from Riesling, Leanyka and Furmint grape varieties grown in Transylvania.

Portugal.—Portugal is best known for its *Port* wine (*see* PORT WINE), produced in the valley of the upper Douro and sold throughout the world, mainly by British concerns. Other wines of Port type, which may not use that name in Portugal or Great Britain, are grown principally on the Tagus and in the Estramadura region and shipped from Lisbon as *Lisbon wine.* A white table wine, *Bucellas,* and a red wine, *Collares,* are more liked by the Portuguese, who also consume much wine of commoner types. Madeira and the Azores Islands, under Portuguese rule, have long produced wines, those shipped from Madeira having undergone the addition of brandy and a period of heating.

Argentina.—Argentina is the largest wine-consuming as well as wine-producing country in the Americas. Most of its wines are red table types produced in the provinces of Mendoza and San Juan, in a high plateau region backed by the Andes. European and some North American grape varieties are used for the production of these and other wine types.

U.S.S.R.—The soviet union in the 1930s began expansion of the wine industry built under the tsars. The German invasion of 1941 interfered, but the efforts continued as vineyard areas were recovered. Wine-growing bulked large in the economies of such soviet republics as Armenia, Georgia and Azerbaijan in the Caucasus. Further north it was widely carried on in the Kuban valley, in the lower reaches of the Don, around the Sea of Azov and in the Crimea. Further east, in Asia, winegrowing was being encouraged in some of the trans-Caspian republics. Champagne figured strongly in the expansion plans.

Greece.—Greece and its islands produce many kinds of wine, ranging from very bitter, resinated sorts to thick, very sweet wines produced from raisin-type grapes. A Port-wine type named after the grape variety Mavrodaphne is widely distributed. There is some demand for table wines, including the *Marco* and the *Tegea,* a pink wine from Arcadia. Central Greece and Euboea are among the chief wine-producing areas.

Yugoslavia.—Fully two-thirds of the grape production of Yugoslavia comes from Croatia-Slavonia, Dalmatia and Serbia; but some of the country's better wines are produced in the Bosnia-Hercegovina section.

Hungary.—In viticultural areas scattered throughout Hungary much plain and some excellent wine is produced. Table wines, red and white, are the rule; but from a small, high region in the northeast, among the Carpathians, comes the superlative sweet wine *Tokay.* This wine, obtained from Io Furmint grapes left on the vines until partly dried, is of several grades; the best takes years to develop and is said to live and improve in bottle for centuries.

United States.—Grapes grow in each of the 48 states; in 1944 wine was produced commercially in 27 states. California is the source of 85% to 90% of the nation's wine; European grape varieties flourish there, and the state has such a range of climate, soil and topography throughout its length that it possesses eight distinct viticultural districts each capable of yielding good wines. This state in 1934 took the lead in elevating U.S. governmental wine standards, which are among the highest in the world.

East of the Rockies the European grapes as a rule do not thrive, but numerous native varieties, principally of the *labrusca* family, have been domesticated and crossbred to provide distinctive wines, into which California wines often are blended. The Finger Lakes region of New York and the Lake Erie region of Ohio are the most important single districts east of the Rockies.

Although dessert and appetizer wines form a large part of United States production, the proportion of red and white table wines and sparkling wines was increasing in the years prior to 1944.

Germany.—Germany, before the outbreak of World War II, produced chiefly white table wines, many of them high in quality. Its vineyards, mainly on steep riverside slopes in the south, produced *Rhine wines* and *Moselles* which set world standards for those white-wine types. (*See* HOCK and MOSELLE WINES.) Growers obtained different grades of wine from the same vineyard by carefully selecting and fermenting small lots of grapes and then aging the resulting wines separately.

Chile.—European wine grapes are grown with exceptional freedom from disease attack in volcanic soil extending for 10° of latitude from Coquimbo south to Valdivia. The wines produced there, in sheltered valleys and on hilly slopes, are generally at least average and in some cases high in quality.

Bulgaria.—Bulgaria produces both red and white table wines and some dessert types, mainly for use within its own borders. The districts best known for their wines include Pleven, Sistova, Ruschuk and Varna.

Union of South Africa.—Viticulture was started at the Cape in 1653, shortly after arrival of the first Dutch governor, Jan van Riebeek, and was advanced by French Huguenots after 1688. Until the 19th century the most famous South African wine was the dessert wine produced from Muscadelle grapes at Constantia, near Capetown. After that time winegrowing spread north and east, both to hillsides along the coast and to irrigated regions inland. Not only dessert wines but many varieties of white and red table wines have been developed, largely from European grape varieties.

Turkey.—Wines are grown in several parts of Turkey: both dry

and sweet red wines on the island of Tenedos, near the entrance to the Dardanelles; white wine in Smyrna; various types around Trebizond, on the Black sea, and around Lake Van, in what was formerly part of Armenia.

Austria.—After World War I a shrunken Austria was left with few famous vineyards, but it produced many red and white table wines of local repute. The chief areas of production were in Styria and in Lower Austria, near Vienna.

Brazil.—Seven states of Brazil produce wine, mostly from *labrusca* grape varieties from North America. Rio Grande do Sul leads, with 80% of the nation's vineyards in 1944. Brazilians favour sweet wines, especially Port and Muscatel, over dry types.

Australia.—South Australia yields the bulk of Australian wines, with New South Wales, Victoria, West Australia and Queensland following in that order. European grape varieties have been used since winegrowing began in Australia, near the start of the 19th century.

Great Britain.—The climate of Great Britain is not conducive to winegrowing, and only a comparatively small amount of so-called "British wine" is produced, with the aid of imported material. In 1939 the British-held island of Cyprus grew more wine than all of the United Kingdom.

Nevertheless, Britain has importantly affected the world wine picture: although not a great wine-consuming nation it has regularly imported wines since the 5th century and its tastes have influenced wine-growing practices in exporting countries. It has huge cellars where it blends and bottles imported wines for an export trade reaching around the world. Port wine was developed in Portugal, but to British taste and largely by Britons; Britons bottled Port and carried it abroad in British ships.

Other Areas.—Switzerland, Czechoslovakia and Albania grow locally popular wines. In North Africa, Morocco joins Algeria and Tunisia in producing sound, rather heavy wines. In Asia, various wine types are grown in Palestine, Syria, Iran and to a minor extent in parts of India, China and Japan. In North America, Canada averaged about 3,000,000 gal. annually just prior to 1942, using eastern American grape varieties; and Mexico produced a limited amount from European varieties. In South America, virtually every country produces some wines; the leaders, after Argentina, Chile and Brazil, are Uruguay, with American and European grapes, and Peru, with European varieties.

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(H. A. Cw.)

WINE-TABLE, a late 18th-century device for facilitating after-dinner drinking—the cabinetmakers called it a "Gentleman's Social Table." It was always narrow and of semicircular or horseshoe form, and the guests sat round the outer circumference. In the earlier and simpler shapes metal wells for bottles and ice were sunk in the surface of the table; they were fitted with brass lids. In later and more elaborate examples the tables were fitted with a revolving wine-carriage, bottle-holder or tray working upon a balanced arm which enabled the bottles to be passed without shaking. Wine-tables are now exceedingly scarce.

WINFIELD, the county seat of Cowley county, Kansas, U.S.A., is in south central Kansas at the junction of Timber creek and Walnut river at an altitude of 1,150 ft. It is on federal highways 77 and 160 and state highway 15 and is served by the Santa Fe, Missouri Pacific and Frisco railways and bus lines. Pop. (1940) 9,506. It is noted for agriculture and oil. Winfield is the home of St. John's (Lutheran) and Southwestern (Methodist) colleges. The city was founded in 1870, incorporated in 1871, and after 1921 it had a commission-manager form of government.

WINGATE, SIR FRANCIS REGINALD (1861–), British general and administrator in the Sudan, was born at Broadfield, Renfrewshire, on June 25, 1861, the seventh son of Andrew Wingate of Glasgow and Elizabeth Turner. He was educated at the Royal Military Academy, Woolwich, and became a lieutenant in the Royal Artillery in 1880. He served in India and Aden from 1881 till 1883, when he joined the Egyptian army, and in the Gordon relief expedition of 1884–85 was A.D.C. and military secretary to Sir Evelyn Wood. He took part in the operations on the Sudan frontier in 1889 and 1891. In 1894 he was governor of Suakin. His principal work was in the Intelligence of which he became director in 1892. He was a master of Arabic. He published in 1891 *Mahdiism and the Egyptian Sudan,* an account of the rise of the Mahdi and of subsequent events in the Sudan. He helped Father Ohrwalder and two nuns to escape from Omdurman in 1891. Wingate also arranged for the escape of Slatin Pasha in 1895. He translated Father Ohrwalder's narrative (*Ten Years in the Mahdi's Camp,* 1892) and Slatin's book (*Fire and Sword in the Sudan,* 1896).

As director of military intelligence he served in the campaigns of 1896–98 which resulted in the reconquest of the Sudan. In an interval (March–June 1897) he went to Abyssinia as second in command of the Rennell Rodd mission. He now became colonel, an extra A.D.C. to Queen Victoria, and was created K.C.M.G. Wingate led an expeditionary force which in Nov. 1899 defeated the remnant of the Dervish host at Om Debreikat, Kordofan, and was made K.C.B. In December, on Lord Kitchener being summoned to South Africa, Wingate succeeded him as governor-general of the Sudan and sirdar of the Egyptian army. In 1903 he became major-general and in 1908 lieutenant-general. In 1909 Wingate undertook a special mission to Somaliland to report on the military situation. In Dec. 1916 he relinquished the governorship of the Anglo-Egyptian-Sudan, and was high-commissioner for Egypt until Oct. 1919. He was created G.C.V.O. 1912, G.C.B. 1914, G.B.E. 1918, and a baronet in 1920.

WINKELRIED, ARNOLD VON. The incident with which this name is connected is, after the feat of William Tell, the best known and most popular in the early history of the Swiss Confederation. We are told how, at a critical moment in the great battle of Sempach, when the Swiss had failed to break the serried ranks of the Austrian knights, a man of Unterwalden, Arnold von Winkelried by name, came to the rescue. Commending his wife and children to the care of his comrades, he rushed towards the Austrians, gathered a number of their spears together against his breast, and fell pierced through and through, having opened a way into the hostile ranks for his countrymen.

Evidence of Chronicles.—The earliest known mention of the incident is found in a Zürich chronicle (discovered in 1862 by G. von Wyss), which is a copy, made in 1476, of a chronicle written about 30 years earlier; it occurs also in *De Helvetiae origine,* written in 1538 by Rudolph Gwalther (Zwingli's son-in-law). In both the hero is nameless. Finally, one reads the full story in Giles Tschudi's chronicle (1564), where the hero becomes "a man of Unterwalden, Arnold von Winckelried by name."

K. Bürkli (*Der wahre Winkelried,—die Taktik der alten Urschweizer,* Zürich, 1886) concluded that the phalanx formation of the Austrians, as well as the name and act of Winkelried, have been transferred to Sempach from the fight of Bicocca, near Milan (April 27, 1522), where a real leader of the Swiss mercenaries in the pay of France, Arnold Winkelried, met his death in much the same way.

WINKLE: *see* PERIWINKLE.

WINNEBAGO. This Siouan tribe of the west side of Lake Michigan at present divided between Wisconsin and Nebraska. Their closest ethnic relatives are the Siouan Iowa, Oto and Missouri to the south-west; culturally they affiliated rather with their Algonkin neighbours, such as the Menominee, Sauk and Fox.

WINNETKA, a residential suburb in Cook county, Illinois, on Lake Michigan, 17 miles north of Chicago, served by Chicago and North Western, and Chicago, North Shore and Milwaukee railways. Pop. 12,430 in 1940. Incorporated under special charter, 1869, it operates under a modified council-manager plan. Elections are free from partisan politics. The municipality successfully operates publicly owned electric and water utilities. The schools, internationally recognized, emphasize the development of individuality and adaptation of school work to individual differences. They stress education for social responsibility and give much attention to mental hygiene and educational research.

WINNIPEG (Cree, *Win,* murky; *nipiy,* water), the capital of Manitoba and chief city of western Canada. It is situated in the southeastern part of the province, at the juncture of the Assiniboine and Red rivers, 60 mi. N. of the United States boundary and 45 mi. S. of Lake Winnipeg, from which it takes its name. The population of Winnipeg in 1941 was 221,960, Greater Winnipeg 290,540 to include St. Boniface 18,157, St. James 13,892, St. Vital 11,993 and various suburbs.

The first white explorer in the west, La Verendrye, erected Fort Rouge here in 1738, but the place was abandoned until the next century, when the fur-trading companies—The Nor'-Westers of Montreal and the Hudson's Bay company—were engaged in bitter rivalry for the control of the west. In 1806 Fort Gibraltar was built by the Nor'-Westers, and a few years later the Hudson's Bay company erected Fort Douglas near by. Lord Selkirk, then head of the company, was the first to see possibilities of farming in the fertile Red river valley. In the years 1811–15 he brought out several hundred settlers from his native Scotland, and, in spite of hardships and neglect, they gradually built up a little colony. Meanwhile, the fur-traders' warfare culminated in bloodshed and in the merging of the two companies in 1821, under the name of the Hudson's Bay company. Fort Gibraltar, renamed Fort Garry, became a chief trading post and settlers' depot. In 1835 a second Fort Garry was built. As the settlers increased, in spite of the antagonism of the fur company, a straggling little hamlet grew up outside the walls of the fort, which was given the name of Winnipeg. The transfer of the territory by the Hudson's Bay company to the Canadian government in 1870, and the establishment of a governor at Fort Garry brought a new impetus to settlement, and an increase of shipping by the Red river, from St. Paul in Minnesota. With the completion of the Canadian Pacific railway in 1885, the western part of Canada gained direct communication with the east, and Winnipeg became a great distributing centre. This position it still holds. It is the western headquarters of the Canadian Pacific and the Canadian National railways. It has direct communication with the United States by the Soo Line, the Great Northern and the Northern Pacific railways. The opening of mining territory in the northern portions of Manitoba by the Hudson Bay railway, and the considerable development of a number of mining fields near the eastern boundary of Manitoba, have added to Winnipeg's importance as a distributor of machinery and many lines of goods. Winnipeg is a central point on the Trans-Canada air lines, with radiation air connection with northern districts.

There are numerous wholesale houses in Winnipeg and the mail-order business from Winnipeg is enormous. The aerial exploration of Northern Canada, which has excited much interest and the shipping of supplies and men to that section by aeroplane, have been established by Winnipeg companies. The exports of western Canada, chiefly, of course, agricultural, must pass through Winnipeg, as through a funnel, before being shipped east by the railroad. Winnipeg is thus the chief primary grain market in the world. Winnipeg holds annual fur auctions which are attended by buyers from all over the continent.

Cheap and abundant electric power, developed on the Winnipeg river by the Winnipeg Electric Railway company, and by the municipal corporation, has brought rapid industrial development. The most important products are: flour, grain products, implements, paper boxes, confectionery, meat and meat products, whitefish from the lakes, bricks and gypsum. At Winnipeg the Canadian Pacific railway operates the largest terminal in the world controlled by a single company (243 mi. of track) and extensive railway shops, and the Ford Motor company has a large assembling plant.

Winnipeg has wide streets, many of them planted with trees; two large parks, Kildonan and Assiniboine, and many small parks; and municipal golf links, besides several golf clubs. The water supply is derived from Shoal lake 100 mi. away. The University of Manitoba with its extensive grounds, Fort Osborne Military barracks and Deer Lodge Military hospital, where disabled veterans are cared for are located near the city although outside the limits proper. The most noteworthy of the different public buildings are the Manitoba parliament building (completed in the year 1920 at a cost of $8,443,000), the auditorium and the law courts.

St. Boniface on the other side of the Red river is a separate municipality with a population largely French-Canadian. It is the Roman Catholic headquarters of the west, and contains a cathedral, a convent, a hospital, an archiepiscopal palace and St. Boniface college. It has large stockyards and flour mills.

WINNIPEG, a lake and river of Canada. The lake is in Manitoba, between 50° 20′ and 53° 50′ N. and 96° 20′ and 99° 15′ W., has an area of 8,555 sq.mi., is at an altitude of 710 ft., is 260 mi. long, 25 to 60 mi. wide, and has several large islands, including Reindeer (70 sq.mi.) and Big Island (60 sq.mi.). It is nowhere more than 70 ft. deep. Its shores on the south are extremely marshy. The principal affluent rivers are: Red river, from the south; Winnipeg, Bloodvein, Berens and Poplar from the east; and the Dauphin and Saskatchewan from the west. It receives the surplus waters of lakes Manitoba and Winnipegosis, and discharges by the river Nelson into Hudson bay. The river Winnipeg rises near Savanne station in 48° 47′ N. and 89° 57′ W., and flows in a westerly direction under the names of Savanne, Seine and Rainy rivers to the Lake of the Woods; issuing thence as the Winnipeg, it flows northwest to the lake of the same name. The river has power installations totalling 500,000 h.p., chiefly supplying the city of Winnipeg.

WINNIPEGOSIS, a lake of Manitoba and Saskatchewan, Canada, between 51° 34′ and 53° 11′ N. and 99° 37′ and 101° 06′ W. Its greatest length is 122 mi.; greatest width 17 mi.; shoreline 570 mi.; and area, exclusive of islands, 2,000 sq.mi. Its greatest ascertained depth is 38 ft., and mean altitude 828 ft. above the sea. It drains by the Waterhen river through Waterhen lake into Lake Manitoba, and thence by the Little Saskatchewan into Lake Winnipeg. It was discovered by La Verendrye in 1739.

WINONA, a city of Minnesota, U.S.A., on the Mississippi river, 103 mi. S.E. of Saint Paul; the county seat of Winona county. It is on federal highways 14 and 61, and is served by the Burlington Route, the Chicago and North Western, the Chicago Great Western, the Chicago, Milwaukee, St. Paul and Pacific, and the Green Bay and Western railways, motor bus lines, and river barges. Pop. (1920) was 19,143 (84% native white) and was 22,490 in 1940 by the federal census. Winona is picturesquely located on a broad level terrace at the foot of steep bluffs rising 500 to 600 ft. above the river. It is the centre and headquarters of the Mississippi Wild Life and Fish refuge, established by congress in 1924. Winona is a manufacturing city, with many and varied industries (notably flour, proprietary medicines, spices, farm machinery, food products, shoes, fur clothing and automobile accessories). The site of Winona was long occupied by an Indian village, and it was frequently used as a landing place in the fur-trading days. White settlement began in 1851. The city was laid out in 1852 and chartered in 1857. A large part of it was destroyed by fire in 1860.

WINOOSKI, a city of Chittenden county, Vermont, U.S.A., on the Winooski river and the Central Vermont railway, adjoining Burlington on the northeast. Pop. (1920) 4,932 (24% foreign-born white); 5,308 in 1930 federal census and 6,036 in 1940. The city has important manufactures of woollen goods, screen doors and windows, and various other commodities. It is the seat of St. Michael's college (1905). Winooski was founded in 1772 by Ira Allen, and was known as Allen's Settlement.

WINSLOW, EDWARD (1595–1655), a founder of the Plymouth colony, was born in Droitwich, England, on Oct. 18, 1595. In 1617 Winslow removed to Leyden, united with John Robinson's church, and in 1620 was one of the "Mayflower pilgrims." His wife, Elizabeth (Barker) Winslow, having died soon after their arrival, he married, in May 1621, Mrs. Susannah White, the mother of Peregrine White (1620–1704), the first white child born in New England. This was the first marriage in the New England colonies. Winslow was one of the "assistants" from 1624 to 1647, except in 1633–34, 1636–37 and 1644–45, when he was governor of the colony. In 1643, he was one of the commissioners of the United Colonies of New England. On several occasions he was sent to England in the inter-

ests of Plymouth and Massachusetts bay. He left on his last mission as the agent of Massachusetts bay, Oct. 1646, and spent nine years in England, where he held minor offices under Cromwell. Winslow's portrait, the only authentic likeness of any of the "Mayflower pilgrims," is in the gallery of the Pilgrim Society at Plymouth, Massachusetts. His writings, though fragmentary, are of great value to the historian of the Plymouth colony. Some of them may be found reprinted in Alexander Young's *Chronicles of the Pilgrims* (Boston, 1841).

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His son, JOSIAH WINSLOW (1629–1680), was educated at Harvard college, was elected a deputy to the General Court in 1653, was an "assistant" from 1657 to 1673, and governor from June 1673 until his death.

WINSOR, JUSTIN (1831–1897), American historian, was born in Boston (Mass.) on Jan. 2, 1831. As a student at Harvard he showed his scholarly tastes by historical and literary articles and for a number of years thereafter continued his newspaper and periodical work. He found his true vocation, however, when his success as temporary superintendent of the Boston Public Library caused him to receive the permanent appointment and when in 1877 President Eliot took him to Harvard as librarian. He edited *The Narrative and Critical History of America* (8 vol. 1884–89), a mammoth co-operative work, for the rich bibliographical and historical notes of which he was largely responsible; he also wrote histories: *Christopher Columbus* (1891), *Cartier to Frontenac* (1894), *The Mississippi Basin* (1895), and *The Westward Movement* (1897). He died in Cambridge (Mass.) on Oct. 22, 1897.

WINSTED, a city of Litchfield county, Connecticut, U.S.A., 25 mi. N.W. of Hartford, on the Mad and the Still rivers. It is served by the New York, New Haven and Hartford railroad. Pop. (1920) 8,248 (80% native white); 1940 federal census, 7,674. The city has an elevation ranging from 600 to 1,500 ft. above sea level, and it lies in the midst of the beautiful Litchfield hills region. Winsted was settled in 1756, chartered as a borough in 1858 and incorporated as a city in 1915.

WINSTON-SALEM, a city of North Carolina, U.S.A., formed in 1913 by the consolidation of the city of Winston and the adjoining town of Salem; a port of entry and the county seat of Forsyth county. It is on federal highways 52, 158, 311 and 421, and is served by the Norfolk and Western, the Southern and the Winston-Salem Southbound railways. Pop. (1940) 79,815 by federal census. It is on the Piedmont plateau, at an altitude of 1,000 ft. Salem, the old part of the city, has 15 buildings erected prior to 1800. It is the seat of Salem academy and college for girls and young women (established by the Moravians as an academy in 1772). Winston-Salem Teachers' College for Negroes and the Bowman Gray School of Medicine of Wake Forest college are located there. Winston-Salem manufactures tobacco products, underwear, hosiery, furniture, air conditioning machinery and textiles and has a large tobacco leaf auction market; the city's total manufacturing in 1937 amounted to $343,859,476. Salem was founded in 1766 by members of the Moravian Church, to be the centre of a Moravian colony for which approximately 100,000 ac. in North Carolina had been purchased. It remained under exclusive Moravian control until 1849. In 1856 land was first sold to outsiders, and the town was incorporated. Winston was founded in 1851 as the county seat, and was named for Major Joseph Winston (1746–1815).

WINTERBERRY, the name given to several North American shrubs of the holly genus (*Ilex*) with deciduous leaves and persistent, showy fruit. The Virginia winterberry (*I. verticillata*), called also black alder, found from Connecticut to Wisconsin and south to Florida and Missouri, grows from 6 ft. to 25 ft. high, with slightly hairy leaves, about 3 in. long, and bright red fruit. The similar smooth winterberry (*I. laevigata*), found from Maine to Georgia, has smaller, very smooth leaves and orange-red fruit.

WINTER FAT (*Eurotia lanata*), a small North American shrub of the goose-foot family (Chenopodiaceae), native to subalkaline soils from Saskatchewan to Washington and south to Texas and California. It is a low white-woolly shrub, 1 ft. to 2 ft. high, with many slender branches, narrow leaves, and small flowers in axillary clusters, the fruiting involucres bearing tufts of silvery-white hairs. It is a valued winter forage for cattle.

WINTERGREEN, known botanically as *Gaultheria procumbens*, a member of the heath family (Ericaceae), a small creeping, evergreen, herb-like shrub with numerous short erect branches bearing in the upper part shortly-stalked oval, thick, smooth shining leaves with a sharp-toothed edge. The flowers are borne singly in the leaf axils and are pendulous, with a pale pink waxy-looking urn-shaped corolla. The bright crimson-red subglobular, berry-like fruit consists of the much-enlarged fleshy calyx which surrounds the small thin-walled many-seeded capsule. The plant is a native of shady woods on sandy soil, especially in mountainous districts, in southern Canada and the northern United States; it is quite hardy in England. The leaves are sharply astringent and have a peculiar aromatic smell and taste due to a volatile oil known as oil of wintergreen, which is used in medicine in the treatment of muscular rheumatism (for the therapeutic action *see* SALICYLIC ACID). Oil of wintergreen is chiefly a synthetic product. An infusion of the leaves was used, under the name mountain tea, in some parts of North America as a substitute for tea and the fruits are eaten under the name of deerberries. Other names for the plant are teaberry, checkerberry, boxberry, spiceberry and ground holly. Its counterpart on the Pacific coast is the salal or shallon (*G. shallon*), a slender shrub, 1 to 6 ft. high, with black berries; it is found in the coastal redwood belt of California and northward to British Columbia. The name is also applied to the pipsissewa (*q.v.*).

WINTERHALTER, FRANZ XAVIER (1806–1873), German portrait painter, was born at Menzen-Schwand, Black Forest, April 20, 1806. In 1823 he went to Munich to study under Stieler. He later established himself in Karlsruhe, where he became a protégé of Grand Duke Leopold. He excelled in the representation of elegant ladies, exhibiting regularly at the Salon 1835–68 and at the Royal Academy 1852–67. In 1857 he was made *officier* of the Legion of Honour. He died at Frankfurt July 9, 1873. His portraits include those of Louis Philippe (Calais), the duc d'Aumale (Chantilly), the Prince Consort (National Portrait Gallery, London), Queen Victoria, the duchess of Kent, Napoleon III and Empress Eugénie, the Empress of Russia, and others.

WINTER'S BARK, the bark of *Drimys winteri*, an evergreen tree belonging to the magnolia family (Magnoliaceae). It was formerly officinal in Europe, and is still held in esteem in Brazil and other parts of South America as a popular remedy for scurvy and other diseases. The plant is a native of the mountains and highlands from Mexico to the Strait of Magellan.

WINTER SPORTS. Winter sports in one form or another had achieved real popularity throughout Europe a decade or so before the end of the 19th century. In the Scandinavian countries, from which skiing moved to continental Europe, the development had come much earlier. The first mid-European ski club was founded at Munich, Germany, in 1890; Chamonix, France, was established as a winter resort in the season 1898–99; Switzerland had its first ski club by 1893. It is in this latter country more than anywhere else, perhaps, that winter sports have become a part of the life of the people. It is said that one of every four Swiss knows how to ski, and skiing has long been an essential requirement of the Swiss army. St. Moritz is probably the world's most famous winter sports resort. Davos, Pontresina, Gstaad and Zermatt are all internationally known.

While skiing leads all other winter sports in popularity, skating, tobogganing and bob-sledding may be enjoyed at most Swiss resorts.

The Olympic Games.—Winter sports won a place on the world Olympiad program for the first time in 1924. In February of that year leading skiers, skaters and bob-sledders from all over Europe and from the United States and Canada met at Chamonix,

France, to compete in a series of events from which the representatives of Norway emerged overwhelmingly victorious. The Norwegians triumphed again in 1928 at St. Moritz, Switzerland, lost to the United States at Lake Placid, N.Y., in 1932, but reasserted their supremacy in 1936 at Garmisch-Partenkirchen, Germany. The 1940 Winter Olympic games, originally assigned to Japan, but later rescheduled for Switzerland and then Germany, were abandoned with the outbreak of World War II.

The United States.—In the decade that followed the Olympic Winter games at Lake Placid in 1932, skiing and figure skating especially achieved great popularity in the United States. Bobsledding on Mt. Van Hoevenberg in the Adirondacks also attracted large numbers of enthusiasts.

In skiing, the emphasis was on fast downhill and slalom running as popularized by the Swiss and Austrians. Cross-country or "tour" skiing and ski jumping introduced by the Norwegians in the last quarter of the 19th century suffered a decline in popularity. However, after 1936, U.S. college skiers showed a noticeable new interest in these phases of the sport.

The great interest in skiing brought about the creation of a number of winter sports centres rivalling the pioneer resort of Lake Placid. In the east, New England became a favourite winter playground, and skiers also discovered magnificent possibilities for their sport on the high slopes of the Rocky mountains. Sun Valley (Idaho), Aspen (Colo.), Alta (Utah), Badger Pass (Calif.) and Mt. Hood (Oreg.) were among the many new names added to the nation's skiing map. At all these places, the emphasis on downhill running created a need for some mechanical means by which the skier might quickly and effortlessly return to the point of descent. The most common answer to this has been the rope-tow, which enables the skier to be drawn upwards by grasping an endless rope passing over grooved wheels suspended from a series of uprights. Far more complex and costly are the overhead chair-lifts such as that erected on Mt. Mansfield, Vt.

A National Ski association was founded at Ishpeming, Mich., in Feb. 1904. Under its auspices a competition to determine the nation's skiing champions is held each year. Many sectional and club-sponsored tournaments are also held.

The federal government has an interest in winter sports through the facilities that were made available in many national parks. In April 1944, Gov. Thomas E. Dewey of New York authorized an elaborate state-financed skiing centre on Whiteface mountain in the Adirondacks to be constructed after the war.

So great is the interest in figure skating in the United States, that in several sections it is carried over into the summer. At Colorado Springs, Colo., St. Paul, Minn., and Lake Placid, N.Y., devotees of this sport may skate from late June to early September on the artificial ice of indoor arenas. Boston, Philadelphia, New York, Providence (R.I.), Springfield (Mass.), Cleveland, Chicago, St. Paul and Los Angeles are but a few of the many cities with important skating clubs. At the end of each winter the U.S. Figure Skating association sponsors a competition to determine the national champions.

Canada.—The climate of Canada provides an abundance of snow and low temperatures suitable for winter sports, and Canadians take advantage of this from British Columbia to the Maritime provinces. In the west, the region around Banff in the Canadian Rockies offers a skiing terrain rivalling the best in the Alps. In eastern Canada, the Laurentian mountain area north of Montreal has become a favourite winter playground. Mont Tremblant lodge, opened in Feb. 1939 at Mont Tremblant, P.Q., is an ultramodern resort with accommodations for 300. It also possesses one of the finest overhead chair-lifts on the continent. In Canada, older winter sports such as hockey, curling and snowshoeing retain a popularity not found below the border. Curling bonspiels are held each winter in Montreal, Toronto and Winnipeg and attract thousands of spectators. Canadian hockey teams have won each Olympic championship with the exception of that held in Germany in 1936.

Australia–Chile.—Although the season, June to September, is the reverse of that of northern latitudes, winter sports are not unknown below the equator. Since the mid-thirties especially, the Chilean State railway and other agencies have gone to considerable pains to popularize skiing in Chile. Principal skiing fields are the Farellones, some three hours by rail from Santiago, the nation's capital. Other centres are at Portillo on the International railway between Chile and Argentina, and in southern Chile on the slopes of the volcano, Orsorno. Skiing was well established in Australia after the early years of the present century. Kosciusko, in New South Wales, 300 mi. from Sydney, is the oldest skiing centre. A winter sports hotel was opened there as early as 1909. In New Zealand, Mt. Cook offers superb skiing, and the mountain areas of Tasmania also attract many skiers. (G. CA.)

WINTERTHUR, a flourishing industrial town in the Töss valley, canton of Zürich, Switzerland, and by rail 17 mi. N.E. of Zürich. It is 1,450 ft. above sea level, and has a rapidly increasing population (in 1870, 19,496; in 1880, 25,924; in 1900, 40,961; in 1920, 49,969; in 1930, 53,925; and in 1941, 59,192), nearly all German-speaking and two-thirds Protestants.

The Roman settlement of *Vitudurum* (Celtic *dur,* water) was a little northeast of the present town, at the place now known as Ober Winterthur. It was refounded in the valley in 1180 by the counts of Kyburg (their castle rises on a hill, 4 mi. to the south of the town), who granted it great liberties and privileges, making it the seat of their district court for the Thurgau. In 1264 the town passed with the rest of the Kyburg inheritance to the Habsburgs, who showed very great favour to it, and thus secured its unswerving loyalty. It was a Habsburg stronghold for two centuries; but after the conquest of the Thurgau by the Swiss Confederates (1460–1461) it was sold to the town of Zürich (1467), its rights and liberties being reserved, and its history after that was that of the other lands ruled by Zürich.

Winterthur is the point of junction of seven lines of railway.

See J. C. Troll, *Geschichte d. Stadt Winterthur* (8 vols., 1840–50); and *Dict. géogr. de la Suisse,* vol. vi (1910).

WINTHER, CHRISTIAN (1796–1876), Danish lyrical poet, was born on July 29, 1796, at Fensmark, Praestö, where his father was priest. He began to publish verses in 1819. In 1851 he received a pension from the state, and for the next quarter of a century he resided mainly in Paris. Besides some nine or ten volumes of lyrical verse, Winther published *The Stag's Flight,* an epical romance in verse (1855); *In the Year of Grace,* a novel (1874); and other works in prose. He died in Paris on Dec. 30, 1876, but the body was taken to Denmark and was buried in the heart of the woods.

WINTHROP, JOHN (1588–1649), Puritan leader and first governor of Massachusetts, was born in Edwardston, Suffolk, England, Jan. 12 (old style), 1588. In 1602 he matriculated at Trinity college, Cambridge, but he did not graduate. He next practised law and achieved considerable success, being appointed, about 1623, an attorney in the court of wards and liveries, and also being engaged in the drafting of parliamentary bills. His income rose to the sum of £700 a year, when, for reasons now unknown, he suddenly in 1629 lost his appointment. A Puritan, he had made wide acquaintance among the leaders of the Puritan party. On Aug. 26, 1629, he joined in the "Cambridge Agreement," by which he and his associates pledged themselves to remove to New England, provided the government and patent of the Massachusetts colony should be removed thither. On Oct. 20, 1630, he was chosen governor of the "Governor and Company of the Massachusetts Bay in New England," and sailed in the "Arbella" in March 1630, reaching Salem, Mass., June 12 (old style), accompanied by a large party of Puritan immigrants. After a brief sojourn in Charlestown, Winthrop and many of his immediate associates settled in Boston in the autumn of 1630. There he lived until his death on March 26 (old style), 1649.

Winthrop's history in New England was very largely that of the Massachusetts colony, of which he was 12 times chosen governor by annual election, serving in 1629–34, 1637–40, 1642–44 and 1646–49, and dying in office. He was usually deputy governor and always assistant when not actually governor. He gave all his strength, devotion and fortune to the colonies. He was conservative and somewhat aristocratic, but just and magnanimous in

WINTER SPORTS

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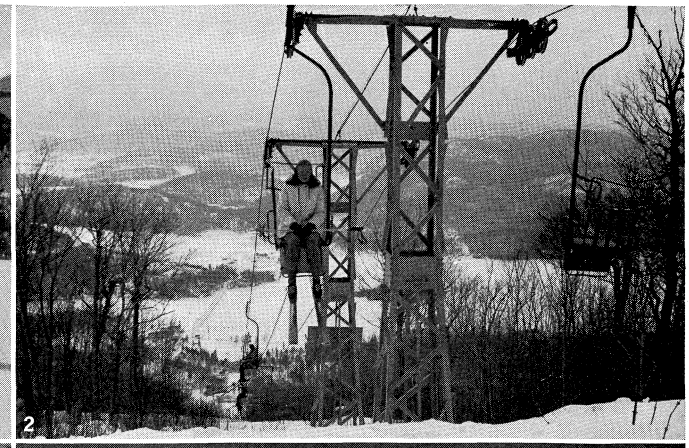
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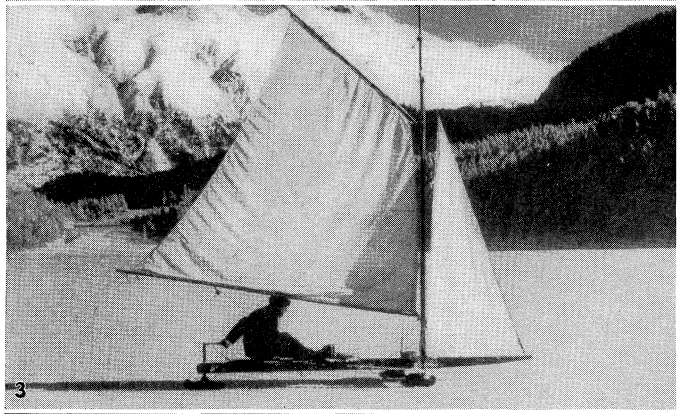
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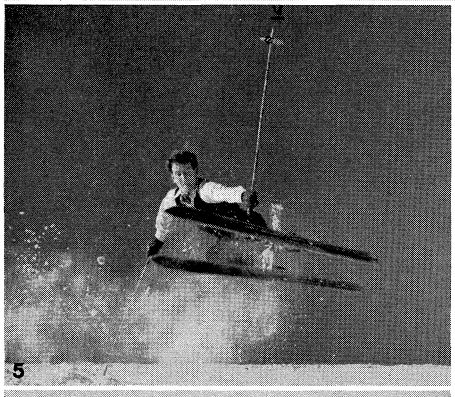
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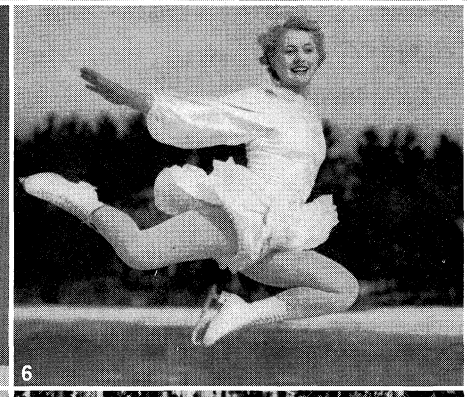
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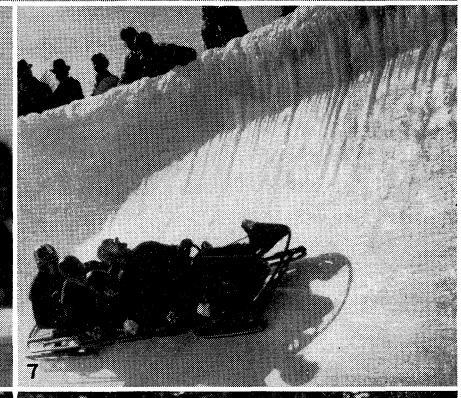
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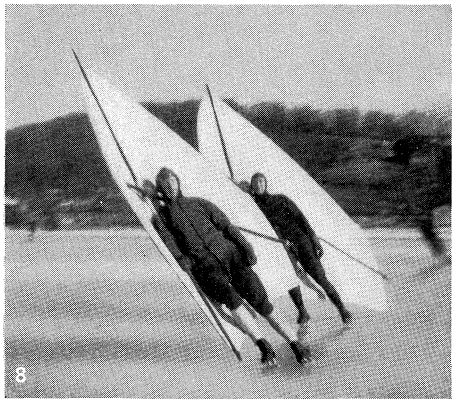
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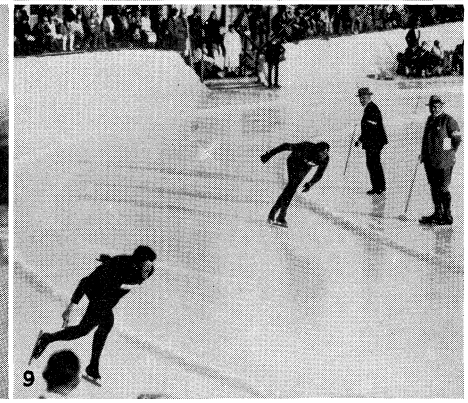
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BY COURTESY OF (1, 3, 4, 7) SWISS FEDERAL RAILROADS, (2) MONT TREMBLANT LODGE, (6) LAKE PLACID CLUB; PHOTOGRAPHS, (1) E. MEERKÄMPER, (2) VILLA DU LAC PHOTO SERVICE, (3) A. STEINER, (4) A. KLOPFENSTEIN, (5) ODIE MONAHAN, (6) I. L. STEDMAN, (7) BLAU, (8, 9, 10) UNDERWOOD & UNDERWOOD

WORLD-WIDE PARTICIPATION IN WINTER SPORTS

1. Ice hockey match at Davos, Switzerland
2. General view of chair-lift on Mt. Tremblant, Quebec
3. Ice sailing at St. Moritz, Switzerland
4. A skier at Adelboden in the Bernese Oberland, Switzerland
5. Tom Murstad, Norwegian skier, in single pole jump turn
6. Mlle. Melitta Brunner in a fawn leap on Lake Placid Club rink
7. American four-man team at the famous sunny corner of bobsleigh run at St. Moritz, Switzerland
8. Dave Cruickshank and W. C. Capes skate sailing on Lake Hopatcong, N. J.
9. International speed skating contest on the rink at Davos, in the Grisons, Switzerland
10. Hiram Mason, Jr., in annual dog-sled derby at Lake Placid, N. Y.

his political guidance even under circumstances of great difficulty. In 1634–35 he was a leader in putting the colony in a state of defence against possible coercion by the English Government. He opposed the majority of his fellow-townsmen in the so-called "Antinomian Controversy" of 1636–37, taking a strongly conservative attitude towards the questions in dispute. He was the first president of the Commissioners of the United Colonies of New England organized in 1643. He defended Massachusetts against threatened parliamentary interference once more in 1645–46. The colony's early success was due largely to his skill and wisdom.

Winthrop's *Journal,* an invaluable record of early Massachusetts history, was printed in part in Hartford in 1790; the whole in Boston, edited with valuable notes by James Savage, as *The History of New England from 1630–1649,* in 1825–26, and again in 1853; and in New York, edited by James K. Hosmer, in 1908. Many letters to him are found in the *Winthrop Papers* published by the Massachusetts Historical Society (*Collections*, series 4, vols. vi. and vii.; series 5, vol. i., 1863–71). His biography has been written by Robert C. Winthrop, *Life and Letters of John Winthrop* (1864, new ed. 1869); and by Joseph H. Twichell, *John Winthrop* (1892). *See* also Mrs. Alice M. Earle, *Margaret Winthrop* (1895).

WINTHROP, JOHN (1606–1676), known as John Winthrop the Younger, son of the preceding, born at Groton, formerly a small rural village lying about midway between Wadleigh and Sudbury in Suffolk, England, Feb. 12, 1606. He attended the Bury St. Edmunds grammar school and Trinity college, Dublin, studied law for a short time after 1624 at the Inner Temple, London, accompanied the expedition of the duke of Buckingham for the relief of the Protestants of La Rochelle. In 1631 he followed his father to Massachusetts and was an "assistant" in 1635, 1640, 1641 and from 1644 to 1649. He was the chief founder of Agawam (now Ipswich), Mass., in 1633; went to England in 1634 and returned the following year as governor (for one year) of Connecticut, under the Saye and Sele patent, sending out the party which built the fort at Saybrook. He was again in England in 1641–43, and on his return to Massachusetts established ironworks at Lynn and Braintree. He became magistrate of Connecticut in 1651; in 1657–58 was governor of the colony; and in 1659 again became governor, and was annually re-elected until his death in Boston on April 5, 1676. In 1662 he obtained in England the charter uniting the colonies of Connecticut and New Haven. In 1675 Winthrop was further honoured by being chosen a commissioner of the United Colonies of New England. In England he received the additional distinction of election to membership in the newly organized Royal Society.

His correspondence with the Royal Society was published in series 1 vol. xvi. of the *Massachusetts Historical Society's Proceedings. See* T. F. Waters' *Sketch of the Life of John Winthrop the Younger* (Ipswich, Mass., 1899); *John Winthrop* by E. T. James (London, 1925); *John Winthrop, Jr.* by F. J. Kingsbury—Amer. Antiq. Soc. (Worcester, 1898).

Winthrop's son, FITZ-JOHN WINTHROP (1638–1707), was educated at Harvard, though he did not take a degree; served in the Parliamentary Army in Scotland under Monck, and returned to Connecticut in 1663. As major-general he commanded the unsuccessful expedition of the New York and Connecticut forces against Canada in 1690; from 1693 to 1697 he was the agent of Connecticut in London; and from 1698 to 1707 was governor of Connecticut.

WINTHROP, ROBERT CHARLES (1809–1894), American orator and political leader, a descendant of Governor John Winthrop (1588–1649), was born in Boston, Mass., on May 12, 1809. He graduated at Harvard in 1828, studied law with Daniel Webster and in 1831 was admitted to the bar. He was a member of the Massachusetts house of representatives in 1834–40—for the last three years as speaker. From 1840 to 1850, except for a short intermission (April–Dec. 1842), he was a representative in the lower house in Congress. He soon became prominent and was speaker of the 30th Congress (1847–49), though his conservatism on slavery and kindred questions displeased extremists, North and South, who prevented his re-election as speaker of the 31st Congress. In July 1850 he was appointed to the seat in the U.S. Senate left vacant by Daniel Webster's resignation, but was defeated in the regular election held in the following year by a coalition of Democrats and Free Soilers. In the same year (1851) he was defeated for governor of Massachusetts by the same coalition. Thereafter he was never a candidate for political office. With the breaking up of the Whig Party he became an independent, and supported Millard Fillmore in 1856, John Bell in 1860 and Gen. G. B. McClellan in 1864. He was president of the Massachusetts Historical Society from 1855 to 1885. He died in Boston, on Nov. 16, 1894.

Among his publications were *Addresses and Speeches* (1852–86); *Life and Letters of John Winthrop* (1864–67); and *Washington, Bowdoin and Franklin* (1876). *See* R. C. Winthrop, Jr., *Memoir of R. C. Winthrop* (1897); and C. F. Adams, Jr., *Theodore Lyman and Robert Charles Winthrop, Jr.* (1906).

WINTHROP, a town of Suffolk county, Massachusetts, U.S.A., occupying a peninsula jutting out into Massachusetts bay 5 mi. N.E. of Boston, between Chelsea and Revere. It is connected with Boston by bus service. Pop. 16,852, 1930 federal census; 16,768 in 1940. It is a residential suburb and has large summer hotels, four yacht clubs and many private estates. Winthrop was set off from North Chelsea and incorporated as a town in 1852, being named after Deane Winthrop (1623–1704), whose home is still standing. In the early days the peninsula was known as Pullen Poynt, because the currents around it made hard pulling for the boatmen. From the middle of the 18th century many prominent Boston families had seaside homes here, and it remained a secluded retreat until the railway was built in 1876.

WINTON, an anthracite-mining borough of Lackawanna county, Pennsylvania, U.S.A., on the Lackawanna river, 9 mi. N.E. of Scranton; served by the Delaware and Hudson, the Lackawanna (for freight only) and the New York, Ontario and Western railways. Pop. (1940) 7,989.

WINWOOD, SIR RALPH (*c.* 1563–1617), English politician, was born at Aynhoe in Northamptonshire and educated at St. John's College, Oxford. In 1599 he became secretary to Sir Henry Neville (*c.* 1564–1615), the English ambassador in France, and he succeeded Neville in this position two years later, retaining it until 1603. In this year Winwood was sent to The Hague as agent to the States-General of the United Provinces, and according to custom he became a member of the Dutch council of state. His hearty dislike of Spain coloured all his actions in Holland; he was anxious to see a continuance of the war between Spain and the United Netherlands, and he expressed both his own views and those of the English government at the time when he wrote, "how convenient this war would be for the good of His Majesty's realms, if it might be maintained without his charge." In June 1608 Winwood signed the league between England and the United Provinces, and he was in Holland when the trouble over the succession to the duchies of Jülich and Cleves threatened to cause a European war. In this matter he negotiated with the Protestant princes of Germany on behalf of James I. Having returned to England Sir Ralph became secretary of state in March 1614 and a member of parliament. In the House of Commons he defended the king's right to levy impositions, and other events of his secretaryship were the inquiry into the murder of Sir Thomas Overbury and the release of Raleigh in 1616. Raleigh was urged by Winwood to attack the Spanish fleet and the Spanish settlements in South America, and the secretary's share in this undertaking was the subject of complaints on the part of the representatives of Spain. In the midst of these complex activities he died in London on the 27th of October 1617.

Winwood's official correspondence and other papers passed to the duke of Montagu, and are now in the possession of the duke of Buccleuch. They are calendared in the Report of the Historical Manuscripts Commission on the manuscripts of the duke of Buccleuch. *See* the *Introduction* to this *Report* (1899); and also S. R. Gardiner, *History of England,* vols. ii. and iii. (1904–1907).

WINZET, NINIAN (1518–1592), Scottish polemical writer, was born in Renfrew, and was probably educated at the university of Glasgow. He entered into conflict with Knox and other leading reformers. He appears to have acted for a time as confessor to Queen Mary. In July 1562, when engaged in the printing of his *Last Blast,* he narrowly escaped the vengeance of his opponents, who had by that time gained the upper hand in the capital,

and he fled (Sept. 3) with the nuncio Gouda to Louvain, and then to Paris. At Queen Mary's request he joined Bishop Leslie on his embassy to Queen Elizabeth in 1571, and remained with the bishop after his removal by Elizabeth's orders to ward at Fenny Staunton, Huntingdonshire. When Leslie was committed to the Tower, Winzet returned to Paris. There he continued his studies, and in 1574 left for Douai, where in the following year he became a licentiate. He was in residence at Rome from 1575 to 1577, and was then appointed by Pope Gregory XIII. abbot of the Benedictine monastery of St. James, Regensburg. There he died on Sept. 21, 1592.

Winzet's works are almost entirely controversial. In his *Buke of Four Scoir Thre Questions* (1563) he treats of church doctrine, sacraments, priesthood, obedience to rulers, free-will and other matters.

Winzet's vernacular writings have been edited by J. Hewison for the S.T.S. (2 vols., 1888, 1890). The *Tractates* were printed, with a preface by David Laing, by the Maitland Club (1835). For Winzet's career *see* Zeigelbauer, *Historia rei literariae* O.S.B. iii., Mackenzie, *Lives,* iii., and the Introduction to S.T.S., edit. *u.s.*

WIRE. The making of wire is one of the most ancient of the metal-working crafts. When man discovered the need of a piece of drawn-out bar or rod of any kind of metal for the purpose of ornaments, tools, hooks, or fastenings, then the first piece of wire was manufactured. It is more than likely that this was of copper or gold, as both of these metals would be found in their native state and would lend themselves to being beaten or drawn out. Samples of brass wire more than 2,000 years old have been discovered, and these, judging by the markings on their surface, seem to have been made by passing metal through the tapered hole of a drawplate.

The metal-working artists of Nuremberg in Bavaria, who formed wire by the use of the hammer alone, were styled wire-smiths, but later, when the drawplate was introduced, their designation was changed to wire-drawers or wire-millers, and as this occurred as early as 1351 and 1360 in the history of Augsburg and Nuremberg respectively, it is conceivable that the invention of the method of modern wire-drawing should be assigned to the 14th century. The earliest wire made by the use of the drawplate was manufactured by main force, the workmen pulling the wire directly through the tapered hole in the plate by attaching its end to a belt around his waist and stepping backwards away from the drawplate. The *windlass* type of pull was next adopted, and after this water power was applied.

It is possible that iron wire was manufactured about the middle of the 15th century in England, as at that period the importation into England was prohibited. In 1565 patents were granted to certain Dutchmen or Germans for the prosecution in England of various manufactures, among which was that of wire, and a works was set up at Tintern in Monmouthshire for the purpose of introducing and practising the art of wire-drawing. Previously all English iron wire appears to have been drawn by manual strength in the Forest of Dean and elsewhere. Copper and brass wire was manufactured about the year 1649 at Esher, and the first wire-mill in England was set up at Sheen, near Richmond, by Dutchmen, in 1662.

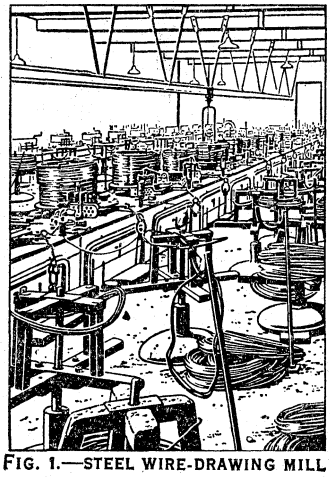

FIG. 1.—STEEL WIRE-DRAWING MILL

When the rolling of bars came into use, wrought iron for wire-drawing purposes was rolled into rods of about $\frac{1}{4}$ in. diameter, the weight of the piece usually being about 28 lb.; but the introduction of mild steel or ingot iron has changed the character of the wire-drawing trade.

The raw product which comes into a wire works is the rolled rod of $\frac{1}{5}$ in. or larger diameter from the steel mill, this having been rolled down from billets about 2 in. square. One of the most important processes in connection with the making of wire is the proper cleaning of rods, so as to free them entirely from any form of scale, this latter being extremely detrimental to good wire-drawing. The general practice is to submerge the rods in vats of

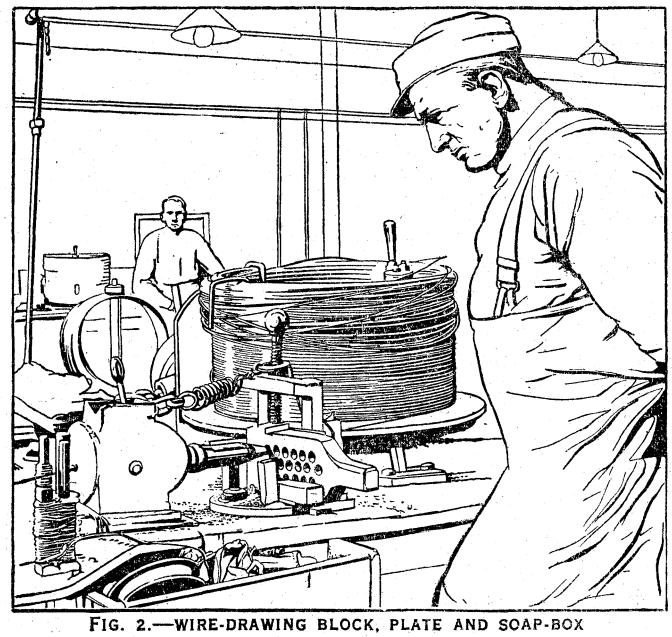

FIG. 2.—WIRE-DRAWING BLOCK, PLATE AND SOAP-BOX

dilute sulphuric or hydrochloric acid until this scale has been completely removed. The rods are then washed with water and passed through a fine spray of water until a greenish brown film of ferrous-hydrate has formed on the surface. The rods are then further coated by dipping into a vat of hot lime water and finally dried in ovens. These coating operations are extremely important because the subsequent drawing of the wire to fine gauges depends largely on good coatings.

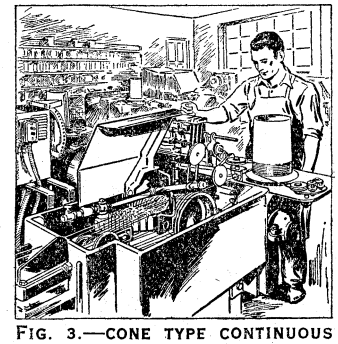

FIG. 3.—CONE TYPE CONTINUOUS WIRE-DRAWING MACHINE

Methods of Wire-drawing. —Two general processes of wire-drawing are in vogue—one known as the "dry" and the other as the "wet" method. A wire mill in which the dry method is used is shown in fig. 1. In the foreground the line of swifts or reels which carry the rods will be seen, whilst the blocks on to which the wire is wound after being pulled through the drawplate are shown along the centre of the benches in the background. A closer view of the soap-box, drawplate, and block is shown in fig. 2. This illustrates how the wire passes from the swift through the soap-box, the conical hole of the die, and on to the winding block. The die contains a large number of holes, this form of die enabling the wire-drawer to pass readily to a correct size of hole when the one in use has become worn. Grease placed in the box ahead of the die serves as a lubricant for one draft work, and powdered hard soap is generally used as a lubricant for two or more drafts.

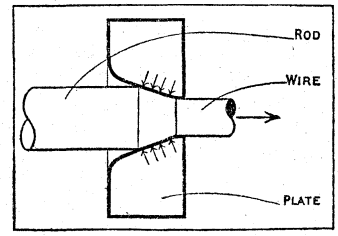

FIG. 4.—STEEL ROD BEING REDUCED TO WIRE IN PASSING THROUGH PLATE

In wet drawing the wire or rod is first coated with a thin film of copper, deposited by passing the rod or wire through a special solution containing sulphate of copper. The wire then passes through a soapy solution and on through the hole of the draw-

plate. This method of wire-drawing a hard metal within a shell or skin of a softer metal was first used by Dr. Woolaston for drawing fine wire in the beginning of the 19th century, and in practice it gives very good results. A wire mill in which wire is drawn by the wet process is shown in fig. 3.

A continuous process of wire-drawing is now in use for the production of steel, copper, brass, and other kinds of wire. The method consists in carrying the wire continuously from one block to another through interposed drawplates and thus on to a final winding block. The blocks may be on separate spindles or superimposed on a horizontal spindle, as shown in fig. 3. The advantage of this method is that it saves the handling of the wire between the various passes or drafts.

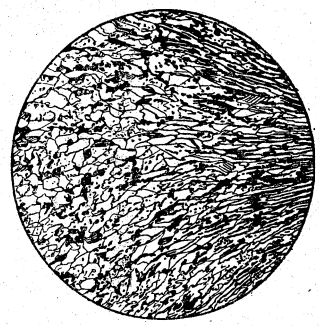

FIG. 5.—PHOTOMICROGRAPH, MAGNIFICATION 100 DIAMETERS, SHOWING CRYSTAL GRAINS BEING COMPRESSED

The hot-rolled rods used for the drawing of steel wire are usually in pieces weighing from 160 to 500 pounds. A 160lb. piece of 5 gauge (·212″) rod is about a quarter of a mile in length. This when drawn to 10 gauge (·128) increases to about three times its length; if drawn to 20 gauge (·036) its lengths will be about nine miles; and if drawn further to 30 gauge (·0124) it will have a length of about 70 miles. It will thus be seen that a 5 gauge rod being drawn down to 30 gauge increases its length about 280 times.

As the wire passes through the drawplate (fig. 4) it is subjected to enormous pressure, which in some cases amounts to as much as 150 tons per sq. inch. The "flow" of mild steel in passing through the hole of the plate is illustrated by fig. 5, in which full sized grains are shown on the left and the elongated or crushed grains on the right. The speed at which wire passes through a drawplate varies according to the diameter and quality of the material to be reduced. For soft steel this speed may run up to as much as 1,000 ft. per minute. The reduction of area per draft varies according to the quality of steel being drawn and the kind of wire required; it may be as high as 40% or as low as 10%.

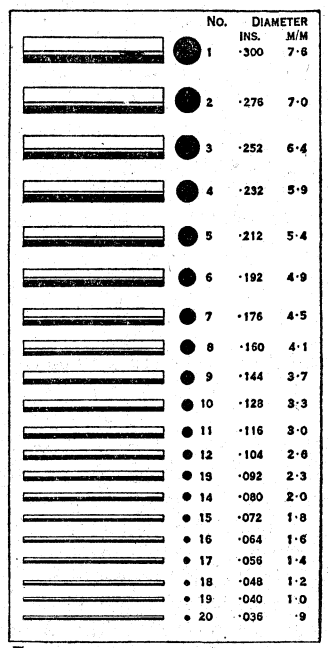

FIG. 6.—IMPERIAL STANDARD WIRE GAUGE

The physical properties of steel are altered as it passes through the wire-drawing process, the chief alteration being a rapid increase in its tensile strength and a reduction in its elongation. For instance, a 5 gauge rod having a tensile strength of 32 tons per sq. in. will, in drawing down to 17 gauge, have its tensile strength doubled.

The softer metals such as copper, and alloys such as brass, are drawn in a manner similar to steel, the difference being in the methods of cleaning and annealing; also, with the softer metals a larger use is made of methods of continuous drawing in which wires may be drawn down to very fine gauges by the simultaneous reduction of nine or more passes in one operation.

Wiredrawers' plates may be cast iron, plain carbon steel, or alloy steel, but in recent years these dies are usually made of a compound largely composed of tungsten carbide. Diamond-dies are used for fine copper and soft metals. (E. A. A.; X.)

WIRED WIRELESS: *see* ELECTRICAL POWER TRANSMISSION; ELECTRICITY SUPPLY: TECHNICAL ASPECTS.

WIRELESS TELEGRAPHY. This article is in two main sections: (1) the theoretical concept of wireless, primarily for the specialist, which follows immediately, and (2) the practical applications under the section *Communication,* below. J. Clerk Maxwell (in 1865 and 1873) stated that electric action is propagated through free space in the form of a disturbance traveling with the velocity of light. In 1888 Heinrich Hertz described his work on the electro-magnetic effects of rapid electrical oscillations, and showed that the result of such oscillations was the propagation of a periodical disturbance through space with the characteristics of wave motion. In the next year Hertz supplemented his experiments by a mathematical treatment of the electric and magnetic forces which are to be expected in the space surrounding electricity in vibration. Hertz's analysis, which was based on Maxwell's Electromagnetic Theory, supplies us with the theoretical basis of the method of producing electric waves now used in wireless communication. A wireless transmitter is a device for producing rapid oscillatory motion of electricity which is the origin of electric waves. Such electric waves are detected at a wireless receiving station by the effects of the rapidly varying electric and magnetic forces which constitute the electric wave-motion.

In the experimental oscillator used by Hertz the electricity may be considered as surging to and fro, simulating the action of an electric doublet the moment of which is alternately positive and negative. Let us suppose that such an electric doublet is situated at the centre O of a sphere of radius r so that its axis coincides with the axis OZ (*see* fig. 1). Further, let the electric moment of the doublet be a prescribed function of the time $F(t)$. The results of Hertz's analysis show that the electromagnetic field, due to the doublet, at any point r, θ on the sphere, consists of an electric force with tangential and radial components $E\theta$ and E_r respectively, together with a magnetic force $H\phi$ at right angles to both these components, where

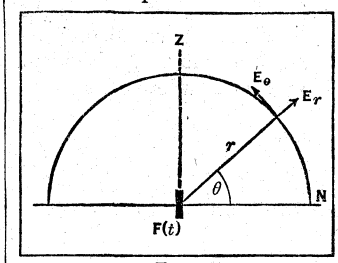

FIG. 1

$$E_\theta = \cos\theta\left(\frac{f}{r^3}+\frac{f'}{cr^2}+\frac{f''}{c^2r}\right), \qquad (1)$$

$$E_r = 2\sin\theta\left(\frac{f}{r^3}+\frac{f'}{cr^2}\right), \qquad (2)$$

and

$$H_\phi = \cos\theta\,\frac{f'}{cr^2}+\frac{f''}{c^2r}, \qquad (3)$$

where f, f' and f'' are written for $F\left(t-\frac{r}{c}\right)$, $F'\left(t-\frac{r}{c}\right)$ and $F''\left(t-\frac{r}{c}\right)$ respectively, since the values of the electric and magnetic forces depend on the events taking place at the origin $\frac{r}{c}$ seconds previously, c being the velocity of the electromagnetic disturbance in free space.

Since, in practical applications, we are mainly concerned with cases in which the electric moment varies periodically, and in which the observational point is at right angles to the axis of the doublet (*e.g.*, N in fig. 1) we may write $F(t)=M_0\sin\omega t$ and $\theta=0$. Thus (1) and (3) become

$$E = \frac{M_0\sin\psi}{r^3}+\frac{M_0\omega\,\cos\psi}{cr^2}-\frac{M_0\omega^2\sin\psi}{c^2r}, \qquad (4)$$

and

$$H = \frac{M_0\omega\,\cos\psi}{cr^2}-\frac{M_0\omega^2\sin\psi}{c^2r}, \qquad (5)$$

where $\psi=\omega\left(t-\frac{r}{c}\right)$, and the subscripts of E and H are omitted.

The terms in the expression for E may, for convenience, be named the electrostatic, induction and radiation terms respectively. In the expression for the magnetic force there are only the induction and radiation terms.

If we consider only points at such distances from the origin that

$$\frac{\omega r}{c} \gg 1$$

we see that the radiation terms are the outstanding ones in (4) and (5). The numerical value of the electric and magnetic intensities in such a case is therefore given by

$$E = H = \frac{M_0 \omega^2 \sin\omega\left(t - \frac{r}{c}\right)}{c^2 r} \sin\omega\left(t - \frac{r}{c}\right) \qquad (6)$$

Since $\frac{c}{\omega}$ is equal to $\frac{\lambda}{2\pi}$, where λ is the wave-length of the electromagnetic disturbance, we see that when the distance r is large compared with $\frac{\lambda}{2\pi}$ the electric wave consists of periodic electric and magnetic forces at right angles and in phase. The intensities of these forces vary inversely as the distance from the source.

For points sufficiently distant, the varying electric doublet may be considered as being produced by a fixed electric charge e at the origin, about which vibrates an equal and opposite charge along the Z axis. In this case M_0 is equal to ez_0 where z_0 is the amplitude of the vibrating charge. Since, also, such a vibrating charge may be considered as equivalent to an alternating current element of current amplitude i_0 and length ds, where $ez_0\omega = i_0 ds$, we have

$$M_0 = ez_0 = \frac{i_0 ds}{\omega}, \qquad (7)$$

so that, so far as maximum values of the periodic forces are concerned, (6) may be written

$$E = H = \frac{\omega i_0 ds}{c^2 r} = \frac{2\pi i_0 ds}{\lambda r c}. \qquad (8)$$

In practice the element ds is represented by the vertical portion of an exposed electrical conductor called the aerial through which an alternating current of amplitude i_0 and angular frequency λ flows. We see from (8) that the higher the aerial and the greater the frequency the greater are the electric and magnetic forces produced at a distant point. In practical units (8) may be written as

$$E = \frac{60\pi i_s h_s}{r\lambda} \text{ volts per metre,} \qquad (9)$$

where i_s is the amplitude of the aerial current in amperes, h_s is the "effective height" of the aerial in metres and r and λ are also expressed in metres. This is the fundamental formula of wireless transmission. For its practical application it is usual to recognize the fact that the aerial is erected above the conducting ground so that, as a result of the electrical image of the aerial in the ground, the electric force is doubled at all points. This way (9) becomes

$$E = \frac{377 i_s h_s}{r\lambda} \text{ volts per metre,} \qquad (10)$$

the practical transmission formula.

The aerial assembly approximating most closely to the case of a vertical element through which the current is uniform consists of a vertical wire aerial with a long flat top in which the capacity of the system may be considered to be concentrated. Such a system is represented diagrammatically in figure 2 where an inductance L is included to make the system oscillatory. The introduction of such an inductance was first proposed by O. Lodge in Patent specification No. 11575, 1897 as a method of reducing the decrement of damped electrical vibrations in a system, and also as a convenient method for adjusting the natural frequency of the circuit. For transmission the circuit is energized by an oscillation generator G which may be either a thermionic valve generator of sustained oscillations or a spark generator of damped electrical vibrations. To produce maximum current in the aerial system the natural oscillation frequency of the circuit should be equal to that of the oscillation generator. In practice the current throughout the entire vertical portion AB of the aerial (known as the "lead-in") is nearly constant, but, in the horizontal portion BC, the strength of the current and the potential relative to that of the earth vary from point. The inductance, capacity and resistance of the horizontal portion are, in fact, distributed throughout its length and the effective inductance, capacity and resistance of the whole will depend on the frequency of the oscillations. This case has been examined in some detail by J. M. Miller. Let R_1, L_1 and C_1 be the resistance, inductance and capacity per unit length of the horizontal portion of the aerial. The most important problem is to determine the constants of a simple circuit, such as is shown in fig. 3, which consists of the added or loading inductance L with its resistance R together with lumped resistance R_e, inductance L_e and capacity C_e, and which is equivalent to the aerial system. (Since the current through the lead-in is uniform, its inductance and resistance may be considered included in L and R.) The quantities L_e and C_e are defined as those which will give the same resonant frequency as the antenna system in fig. 2, while further, the quantities R_e, L_e and C_e must be such that the current in the two circuits, aerial and its equivalent, should have the same maximum value for the same applied electromotive force whether the electromotive force is damped or undamped. The expressions for R_e, L_e and C_e, in terms of R_1, L_1 and C_1, are, in general, complicated, but for frequencies which are low compared with the natural frequency of the antenna without the added inductance, we have

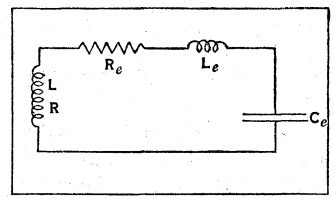

FIG. 2

FIG. 3

$$R_e = \frac{lR_1}{3} = \frac{R_0}{3},$$

$$L_e = \frac{lL_1}{3} = \frac{L_0}{3},$$

$$C_0 = lC_1 = C_0$$

where l is the length of the horizontal portion. The natural frequency f of the aerial, when loaded, is therefore given to a fair degree of accuracy by

$$f = \frac{10^6}{2\pi\sqrt{\left[\left(L + \frac{L_0}{3}\right) C_0\right]}}$$

and the wavelength λ, in metres, by

$$\lambda = 1884\sqrt{\left[\left(L + \frac{L_0}{3}\right) C_0\right]}$$

where the inductances are expressed in microhenries and the capacity in microfarads.

The wires of an antenna offer resistance to the current passing through it which is greater for high frequency currents than it is for steady currents because of the skin effect. In addition to this, the radiation of energy in the form of waves may be regarded as causing an increase in the apparent resistance. This increase in the resistance is known as the radiation resistance, which may be defined as that resistance which, if inserted in the vertical portion of the antenna, would cause as great a dissipation of energy as the energy radiated in waves. Its value may be shown to be

$$\frac{1580 h_s^2}{\lambda^2} \text{ ohms}$$

(h_s and λ being in the same units) for such a flat-topped aerial as we are considering and must be added to R_e together with the resistance of the coil L and the lead-in to give the total resistance of the aerial circuit.

Electric waves sent out from a transmitting system such as is shown in figure 2 produce a vertical electromotive force in a vertical wire at any point equal to Eh_r volts where h_r is the effective height of this vertical wire in metres and E is the electric field produced by the sending system as given by the fundamental transmission formula (10). The vertical wire may be made the aerial of the receiving system and tuned by means of an inductance to the frequency of the incoming waves. At resonance therefore, since Ohm's law holds, the current i_r in the receiving aerial system is given by

$$i_r = \frac{h_r E}{R_r} = \frac{377 h_r h_s i_s}{\lambda_r R_r} \qquad (11)$$

where R_r is the effective resistance of the receiving aerial. The received signal current is not detected in practice as a current in the receiving aerial, but as an electromotive force of maximum amplitude $2\pi f L^1 i_r$ between the ends of the tuning inductance L^1 in the receiving circuit. (*See* fig. 4a.) In modern practice the points A and B are connected to the input terminals of a thermionic valve amplifier which is a potential-operated device. After amplification the oscillatory potential is applied to some conductors (*e.g.*, crystal or valve detector) for which the relation between current and potential is not linear. The ultimate effect of the received signal oscillation is, therefore, a direct current through a crystal or through the anode circuit of a thermionic valve to which a telephone or galvanometer is arranged to respond.

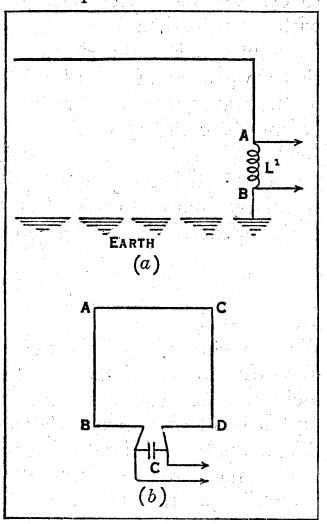

FIG. 4.—(A) RECEIVING ANTENNA. (B) RECEIVING COIL AERIAL

The receiving system need not be an open antenna; it may be a closed coil as illustrated in fig. 4b. In such a case, due to the slight difference in the phases of the electromotive forces introduced in the two vertical limbs (AB and CD) of the coil by the travelling waves a resultant electromotive force E_r, given by

$$E_r = \frac{2368 A N i_s h_s}{\lambda^2 r}$$

is introduced into the system, which, at resonance, produces an oscillatory current of value i_r where

$$i_r = \frac{2368 A N i_s h_s}{\lambda^2 r R}, \qquad (12)$$

R being the total effective resistance of the oscillatory circuit and N the number of turns of area A in the coil. When a closed coil is so used the tuning is usually performed by means of a condenser C and the signal detected as the oscillatory potential, of maximum amplitude $\frac{i_r}{2\pi f C}$ which is produced across its terminals. Although the frame aerial is not as efficient a collector of electric wave energy as an open antenna of comparable dimensions it possesses the valuable property of directivity in reception, in that waves travelling in a direction at right angles to the axis of the coil produce the maximum signal intensity whereas waves travelling in the direction of its axis produce no signal at all.

For the conveyance of intelligence by means of electric waves the amplitude of the transmitted wave is caused to vary. In the sending of Morse signals the amplitude is zero during a pause between signals (spacing interval) and a certain definite value during a signal dot or dash (marking interval), though, in certain systems, two different wave-lengths are emitted during the marking and spacing intervals while the receiver is tuned so as to receive only the marking wave-length. For the transmission of telephony the signal impulses from the microphone are amplified and caused to control the amplitude of the generator G in fig. 2. The result of the periodic variation of the emitted amplitude at a speech frequency is the simultaneous emission of two frequencies other than the normal frequency of emission. For example, if the angular frequency of the fundamental radio-frequency is ω, and that of the speech or modulation frequency is ρ, the signal amplitude may be represented by an expression such as

$$E(1 - b\sin\rho t)\sin\omega t,$$

where E and b are constants and t is the time. This expression is equal to $E\sin\rho t + Eb\cos(\omega+p)t - Eb\cos(\omega-p)t$. The station therefore emits the mean frequency $\frac{\omega}{2\pi}$ and the two "side-band" frequencies $\frac{\omega+p}{2\pi}$ and $\frac{\omega-p}{2\pi}$. The receiving assembly must therefore be sufficiently broadly tuned to permit of the reception of these side-bands as well as the mean frequency.

THE PROPAGATION OF WAVES

In approaching the somewhat complicated facts of signal transmission, it is of great assistance to bear in mind certain broadly-defined distinctions. In the first place transmission over distances small enough for the earth to be considered plane should be distinguished from transmission over longer distances where the curvature of the earth has to be taken into account. Secondly it should be recognized that the results obtained with short waves (*e.g.*, of wave-length less than 200 metres) are usually quite different from the results obtained with longer waves; and, thirdly, that the results for day and night conditions are often very different, especially in the case of short waves.

SHORT-DISTANCE TRANSMISSION

From measurements of the electric field strength due to a wireless sender of known aerial current, effective height and wave-length it has been possible to compare the observed values of field strength with those to be expected from the fundamental transmission formula (10). The first measurements of this type were made by W. Duddell and J. E. Taylor, who, in 1905, examined the relation between signal intensity and distance for overland and oversea conditions, using a wave-length of about 200 metres. Spark transmission was used and the current in the receiving aerial was measured by a thermogalvanometer. For oversea transmission the product of received signal current and distance was found to be constant, indicating agreement with the simple transmission formula, but for overland transmission the same product was found to fall in value with increase of distance. Since the observations were made at distances sufficiently small for the departure of the earth's surface from a plane to be inappreciable this discrepancy for overland transmission has been attributed to the dissipative influence of the ground.

A theoretical discussion of the propagation of plane waves over a plane surface of finite conductivity was published by J. Zenneck in 1907. The attenuation coefficient of the waves was shown to be inversely proportional to the square of the wave-length, so that the dissipative effect of the ground is most marked for short waves. The resistivity of the ground was also shown to introduce a forward tilting of the wave-front and a difference of phase in the horizontal and vertical electric fields in the air or in the earth. The complete problem of transmission over a plane surface of finite conductivity from an emitting source situated on the surface was examined by A. Sommerfeld in 1909, while a comparison of experimental results with his theory was made by J. A. Ratcliffe and M. A. F. Barnett, who, in 1927, measured the variation of signal strength with distance for the Daventry 1,600 metre wave-length transmitter. Satisfactory agreement with Sommerfeld's theory was obtained if the average conductivity of the ground was taken to be about 10^8 e.s.u., a value of the same order as that previously obtained by R. L. Smith-Rose and R. H. Barfield from measurements of the forward tilt of the electric force of waves travelling along the ground. A complete survey of the signal intensities received at different points round the London

(2LO) transmitter on a wave-length of 365 metres led R. H. Barfield to attribute the variation of signal attenuation with direction to the effect of trees, a marked attenuation being found when the waves traversed well-wooded areas.

The above-mentioned observations were made during daylight hours when steady and consistent signal intensities are recorded. At night-time at the longer distances, and particularly with the shorter wave-lengths the signals vary in an erratic manner. Such signal variation is known as fading. For wave-lengths within the broadcasting band (200–500 metres) these nocturnal variations are detectable at distances as short as 10 miles from the sender. As the distance is increased the signal variations become more marked, so that at a distance of 100 to 150 miles the intensity may vary from zero to a value twice the day-time value. At still greater distances where the day-time signal is very weak the chief effect of the withdrawal of sunlight is a marked increase of signal intensity which, though suffering considerable variation, does not frequently fall to zero as is the case at slightly shorter distances.

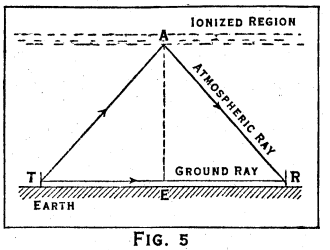

FIG. 5

Nocturnal signal variations have been shown to be due to waves of variable intensity and phase which arrive at the receiving station after being "reflected" by a layer of free electricity which exists in the upper atmosphere. The existence of this layer, which plays an all-important part in long-distance propagation, was first postulated by O. Heaviside and A. E. Kennelly in 1902 to account for the propagation of waves round the protuberance of the earth's surface. Its existence was proved by direct experiments carried out by E. V. Appleton and M. A. F. Barnett in England, and by G. Breit and M. Tuve in America in 1925. The principles of both experiments may be illustrated by means of fig. 5 in which a transmitter T is communicating to a receiving station at R by sending out continuous waves. Two sets of waves reach the receiver R, one set by the direct path TR along the ground and the other via the upper atmosphere by way of TAR. For simplicity it is assumed that the atmospheric waves are truly reflected by the Kennelly-Heaviside layer. Suppose the difference in path between the paths of the ground and atmospheric waves is D. We then have

$$n = \frac{D}{\lambda}, \tag{13}$$

where n is the number of wave-lengths the atmospheric ray, because of its longer path, arrives behind the ground ray at the receiver R. In the experiments carried out by Appleton and Barnett the wave-length of the transmitting station was slowly and continuously varied through a small range $\delta\lambda$ and the resulting signal maxima and minima due to the variation in n recorded. From (13) we have numerically

$$\lambda^2 \frac{\delta n}{\delta \lambda} = D, \tag{14}$$

so that if the number of signal maxima δn for a given wave-length change $\delta\lambda$ is found D may be calculated. From D the height of the layer AE may be deduced by simple triangulation. This height, for a wave-length of 400 metres, is normally found to be of the order of 100 km.

In the experiments of Breit and Tuve very short impulses of radio frequency energy were sent out from T, and as each impulse is received twice at R, first via the ground and secondly via the atmosphere, it is possible, from an oscillographic registration of the signals, to measure the difference in the times taken for the waves to traverse these two paths. Knowing the velocity c of electromagnetic radiation in free space it is therefore possible to find the difference in length of the two paths and thus find the height at which the atmospheric waves are deviated. Using 70 metre waves Breit and Tuve found heights varying from 90 km. to 230 km.

Variations in the effective height of the layer between night and day were found by Appleton and Barnett, confirming the view that the ionization in the upper atmosphere is due to solar influence. During the day the lower boundary of the layer is low and fairly-well defined. After sunset the withdrawal of the sun's rays cause the under-boundary to rise, due to recombination of ions in the lower regions. The slow rise continues until, about an hour before sunrise, the layer falls rapidly and resumes its day-time value.

To understand the difference in intensity of the down-coming rays between day and night it is necessary to examine the process by which the atmospheric waves are deviated by the upper atmosphere. For very long waves it is most likely that the gradient of ionization at the lower boundary of the layer is sufficiently large to cause a marked change of conductivity or dielectric constant within a wave-length, so that for such wave-length true reflection takes place. For the shorter wave-lengths it is usually accepted that the process of deviation is brought about by a gradual bending of the waves due to a gradual reduction of refractive index with height. The theory of this process has been examined by W. H. Eccles and J. Larmor. According to Larmor, electrons, with long mean free paths, are the effective agencies in the reduction of the refractive index. For N electrons per cc, of mass m and charge e, the refractive index is given by

$$\mu^2 = 1 - \frac{Ne^2}{\pi mc^2}\lambda^2. \tag{15}$$

We may thus picture the atmospheric ray trajectory as in figure 6 where the ray impinges on the layer at B at an angle of incidence θ_0. The reduction in the refractive index causes the ray to bend away from the normal so that it follows the track BAC. Such considerations raise the question as to what is actually measured in the direct methods of measuring the "height" of the layer as developed by Appleton and Barnett and by Breit and Tuve. A detailed consideration of the problem shows that in both cases the height FE in fig. 6 is measured. Thus the height is the same as would be deduced from measurement of the angle of incidence of down-coming waves received at the ground such as have been made by Appleton and Barnett and by R. L. Smith-Rose and R. H. Barfield. In all cases the height measured is greater than the actual maximum height AE of the atmospheric ray path.

The bending of the atmospheric waves is accompanied by absorption since the electrons in the layer, vibrating under the influence of the electric forces in the waves, are subjected to collisions by the gas molecules to which they communicate energy. The attenuation coefficient is greater the greater the pressure of the air at the point in question, and, other things being equal, is proportional to the square of the wave-length. Thus theoretical considerations suggest that a high layer and use of short waves provide the conditions most suitable for communicating over long distances.

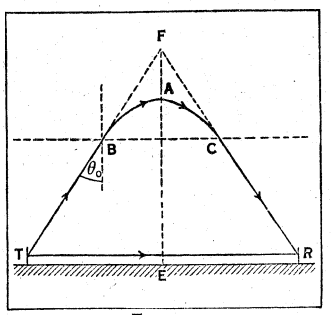

FIG. 6

The different types of fading experienced at different distances may now be explained. During the day-time, for wave-lengths of 400 metres, such as are used in broadcasting, the down-coming waves are weak at all distances, but are much increased in strength at night. At short distances (*e.g.*, 50 miles) a strong ground signal is received which is the same by day and by night. At greater distances (*e.g.*, 100 to 150 miles), although a steady ground signal is received during the day the signal at night is composed of ground waves and atmospheric waves of about equal intensity. As the down-coming waves vary both in intensity and phase, variations of the resultant signal from zero to twice the day-time value take place, corresponding to out-phase and in-phase conditions of the two sets of waves. At still greater distances the day-time signal

due to the ground waves is very weak so that at night the signal is almost wholly due to the down-coming waves. At this distance, therefore, although the signals vary a good deal, it is not often that they disappear entirely.

The critical region at which ground and atmospheric waves are approximately equal in intensity varies with the wave-length used. For longer waves of 1,600 metres, for which the ground waves are much less attenuated, this region is about 300 to 400 miles from the transmitter at night, while for shorter waves of 100 metres it may be only 10 miles distant.

Directional Reception.—As mentioned above, the use of a single coil or frame aerial as the receiving aerial permits of directional reception. The same device may therefore be used to find the direction in which waves are arriving at a receiving station, as was first pointed out by R. A. Fessenden in 1899. It is found in practice that the most convenient way of finding the direction in which waves are arriving is to rotate the loop until signals of minimum intensity are received. The axis of the loop then coincides with the direction of arrival of the waves. Other systems of direction finding such as the Bellini-Tosi system and the Robinson system operate on essentially the same principles for, in each case, the observation of apparent direction is carried out by setting some part of the rotating system, which revolves about a vertical axis, in a position in which the signal electromotive force is zero or, at the least, a minimum.

Although such systems, for medium and long wave-lengths, are found to give correct bearings during the day-time, the readings during the night are often liable to errors of as much as 90°. The signal minima are found to be blurred, displaced and variable while at the same time fading often occurs. Such nocturnal errors begin to make their appearance at distances of 30 miles from the transmitter for overland transmission and at 100 miles for oversea transmission. With increasing distance the magnitude of these effects at first increases but finally decreases, so that at long distances direction-finders give correct bearings.

An explanation of these vagaries was put forward by T. L. Eckersley in 1921 who suggested that the effects were due to the arrival at the receiver of down-coming waves from the ionized layer which were polarized so as to possess a component of electric force at right angles to the plane of propagation (*i.e.*, to the vertical plane containing the transmitting and receiving stations). As the effects are usually observed at distances at which the ground waves from the sending station are of appreciable intensity the problem is complicated by the fact that an interference system is produced between ground and atmospheric waves. The relevant details are illustrated in fig. 7, which is drawn in the plane of propagation.

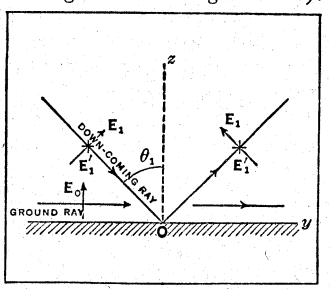

FIG. 7.—(THE X AXIS IS AT RIGHT ANGLES TO THE PAPER)

Let O be the site of the receiving station at which a ground wave (electric and magnetic vectors E_0 and H_0 respectively) and a down-coming wave, incident at angle θ_1, are received. The down-coming wave may be resolved into two components, one (E_1,H_1) with electric vector in the plane of propagation, and the other (E_1',H_1') with electric vector perpendicular to this plane. Following Eckersley these may be termed the normally and abnormally polarised components respectively. Assuming, as a simplification, that the ground approximates to a perfect conductor (which is sufficiently accurate for wave-lengths greater than about 300 metres) the electric and magnetic forces at O may be written

$$\begin{aligned} &E_x=0,\ H_x=H_0\sin\omega t+2H_1\sin(\omega t+\theta),\\ &E_y=0,\ H_y=2H_1'\cos\theta_1\sin(\omega t+\theta'),\\ &E_z=E_0\sin\omega t+2E_1\sin\theta_1\sin(\omega t+\theta),\ H_z=0 \end{aligned} \qquad (16)$$

where ω is the angular frequency of the waves and θ and θ' the phase differences between the ground wave and the normal and abnormal components of the down-coming wave respectively. The electromotive force induced in the coil when in the maximum position is proportional to H_x, and when in the minimum position to H_y. If the down-coming waves were normally polarized H_y would be zero and there would be no error.

The order of magnitude of the maximum error which might be experienced in any case may be found by taking the case in which E_0 and E_1' are in phase, and E_0 and E_1 are out of phase. The angular error ϕ in this case is given by

$$\tan\phi=\frac{2H_1'\cos\theta_1}{H_0-2H_1} \qquad (17)$$

As it is probable that H_1 and H_1' are of the same order of magnitude we see that, when the error is small, its magnitude depends on the ratio of the atmospheric and ground ray intensities and on the angle of incidence of the down-coming waves. When a strong ground wave is received the error will be small, so that the difference between the attenuation of ground waves overland and oversea is reflected in the different ranges at which errors become appreciable. Also the error is small at large distances when θ_1 approaches 90°.

It is possible to account for this abnormality in polarization in terms of the magneto-ionic theory proposed by E. V. Appleton in 1924, and independently by H. W. Nichols and J. Schelleng in 1925, in which the effect of the earth's magnetic field on wireless propagation is taken into account. According to this theory, if the electrical carriers in the upper atmosphere are of electronic mass, the formula (15) for the refractive index of the ionized layer is only valid for very short waves. A detailed examination of the problem shows that under the action of the earth's magnetic field, the upper atmosphere acts as a doubly refracting medium in that a linearly polarised wave entering it is split up, in general, into two elliptically polarized components of different absorption and refrangibility. Due principally to the difference in the absorption experienced by the two components in the lower region of the ionized layer the wave which ultimately emerges from the layer is chiefly composed of one of the components, and is thus, in general, elliptically polarized.

LONG-DISTANCE TRANSMISSION

1. **Long Waves.**—In December 1901 G. Marconi established communication over a distance greater than 2,000 miles between Poldhu (England) and St. John (Newfoundland), while the first quantitative relations between signal intensity, distance of transmission and wave-length were given by L. W. Austin, whose experiments, begun in 1910, have been continued since. As a result of transmissions carried out between Brant-Rock and Arlington on the east coast of America and various American cruisers, Austin was led to the empirical formula

$$E=\frac{377 i_s h_s}{r\lambda}e^{-(0\cdot0015r/\sqrt{\lambda})} \qquad (18)$$

for the electric force at a distance r from the transmitter. It will be seen that this formula, known as the Austin transmission formula, is similar to (10) but that an exponential term, known as the "absorption term," has been included. Austin's formula was based on day-time measurements at distances up to 2,000 kilometres. Its applicability up to distances of 4,000 km. was later verified by J. L. Hogan. In the "absorption term" both and λ are measured in kilometres.

L. F. Fuller, as the result of a series of measurements made between Honolulu and San Francisco, a distance of 3,880 km. with wave-lengths ranging from 3,000 to 11,800 metres, proposed for day-time transmission the formula

$$E=\frac{377 i_s h_s}{r\lambda}\sqrt{\frac{\theta}{\sin\theta}}\,e^{-(0\cdot0045r/\lambda^{1\cdot4})}. \qquad (19)$$

In this formula the absorption term is seen to be different from that proposed by Austin, while there is also introduced a term $\sqrt{\frac{\theta}{\sin\theta}}$, where θ is the geo-centric angle between sending and receiving stations. This latter term is introduced to allow for the fact that the earth's surface is spherical and therefore the

energy flux at a distance r measured along the surface of the earth is proportional to $\frac{\theta}{r^2\sin\theta}$ and not to $\frac{1}{r^2}$. Its inclusion amounts to a correction of 1% at a distance of 2,000 km. to a correction of 25% at 10,000 km.

Numerous field-strength measurements carried out in 1922 by engineers of the American Telegraph and Telephone Company and the Western Electric Company, in connection with tests preparatory to the inauguration of the trans-Atlantic wireless telephone service, suggested for day-time conditions an absorption term $e^{-(0\cdot005r/\lambda^{1\cdot25})}$ in the transmission formula instead of those proposed by Austin and Fuller. At night signal intensities, though erratic, were often high, sometimes reaching the value given by (10) (*i.e.*, [18] or [19] without the absorption term).

The theoretical problem corresponding to the case of propagation over such large distances as we are considering is that of the diffraction of waves round a conducting sphere. The ideal case of a perfectly conducting sphere surrounded by an infinite non-conducting dielectric was examined by H. M. Macdonald, Lord Rayleigh, H. Poincaré, J. W. Nicholson, H. March, W. V. Rybeynski and G. N. Watson. The general result of these investigations is that the signal intensities observed in practice are too large to be explained by diffractive bending alone, and it was this discrepancy which led, in the first place, to the postulation of a reflecting layer. The case in which a reflecting layer influences transmission has been examined quantitatively by G. N. Watson, whose formula, together with that obtained by the same writer for simple diffraction, are given below.

Diffraction Formula

$$E=\frac{0\cdot5365\,i_s h_s e^{-2\cdot39(\theta/\lambda^{\frac{1}{3}})}}{\lambda^{\frac{1}{6}}(\sin\theta)^{\frac{1}{2}}} \qquad (20)$$

Reflection Formula

$$E=\frac{A\,h_s\,i_s\,e^{-(\alpha r/\sqrt{\lambda})}}{\lambda(R\sin\theta)^{\frac{1}{2}}} \qquad (21)$$

where R is the radius of the earth, and

$$\alpha=\frac{1}{2H}\left\{\left(\frac{\rho_1}{2c}\right)^{\frac{1}{2}}+\left(\frac{\rho_2}{2c}\right)^{\frac{1}{2}}\right\}$$

where ρ_1 = resistivity of reflecting layer,
ρ_2 = resistivity of the earth,
H = height of the layer above the earth, and A is a constant.

A very complete discussion of the comparison of signal strength measurements with both of these formulae has been given by H. J. Round, T. L. Eckersley, K. Tremellen and F. C. Lunnon using measurements made by Marconi Company Engineers during 1922 and 1923 on an expedition sent to Australia. At smaller distances using (20) the agreement is fair, but at distances greater than 2,000 km. diffraction alone is wholly inadequate to explain the results. The same authors consider that for long waves (*e.g.*, 16,000 metres) the effects of reflection begin to be important at distances of about 700 km. and at distances greater than 2,000 km. the second formula of Watson (21) becomes applicable. They therefore put this in a practical form as

$$E=\frac{377\,i_s h_s e^{-(\alpha r/\lambda^{\frac{1}{3}})}}{\lambda(d_0 R\sin\theta)^{\frac{1}{2}}} \qquad (22)$$

which is easily seen to resemble the empirical formula of Austin very closely. In (22) d_0 is a constant having the dimensions of a length and which theoretically is equal to $\frac{3}{2}$ H.

The results of the Australian expedition show that during the day-time the absorption factor α is independent of the wave-length, but that it appears to vary with the direction of transmission. For example in trans-Atlantic measurements the attenuation in a West to East direction is lower than that in the opposite direction. Examples of the simultaneous reception of signals both ways round the earth were noted. The reception of abnormally large signal intensities at the Antipodes, found by Lieut. Guierre on the S.S. Aldebaran in 1920, was also confirmed.

Some mean values of the attenuation coefficient for various types of transmission are given below

European Stations received in the Atlantic	$\alpha=0\cdot0018$
American Stations received in the Atlantic	$\alpha=0\cdot00142$
European Stations received in the Pacific	$\alpha=0\cdot00095$

(2) **Medium Waves.**—Measurements across the Atlantic Ocean were made in 1923 by H. D. Arnold and L. Espenschied on a wave-length of 300 metres. Agreement with Austin's empirical formula was obtained during the day, but during the night, values agreeing with the simple formula (10) obtained by neglecting the absorption term in Austin's formula were obtained.

(3) **Short Waves.**—The wave-length used by H. Hertz in his original experiments was about 3 metres. The engineers who developed Hertz's discovery, foremost among whom was G. Marconi, found that longer wave-lengths gave greater ranges, and from 1895 onwards it was considered that the long waves were more suitable for long distance communication than short waves. Both during and after the World War of 1914–1918, however, more attention was paid to the short wave-lengths. The evolution of the thermionic valve had provided the radio-engineer with new tools for both transmission and reception. With it the generation of continuous waves down to wave-lengths of a few metres was a simple matter while, at the same time, its inclusion in wireless receiving sets as amplifier and detector had increased the sensitivity of such receivers many thousandfold. About the same time wireless amateurs both in England and America and also the engineers of the Marconi Company began to explore the use of short waves for long distance communication. Three main conclusions were drawn from the amateur and professional experiments. The first was that short waves travelled exceedingly long distances with very small attenuation, so that comparatively low-power stations were required to produce readable signals at the Antipodes. This characteristic of short waves could not have been predicted from the Austin formula and from our previous knowledge of the behaviour of long waves. Secondly it was found that, although the signal strength first fell off rapidly as the distance from a short-wave station was increased, the signals suddenly appeared in greater strength when a certain critical distance was reached, and only died out gradually as the distance was increased further. The critical distance at which the strong signal suddenly appeared, the so-called "skipped distance" was found to vary with wave-length, being greater the shorter the wave-length. For example for a wave-length of 30 metres the skipped distance was found to be about 600 km. but for 20 metre waves it was about 1,400 km. The third characteristic of short-wave transmission was that there often appeared to be two *optimum* wave-lengths, one most suitable for day transmission and the other for transmission by night, so that, by the use of both, communication over the whole of the day could be maintained.

An explanation of the "skipped distance" observed in short wave was first given by A. H. Taylor and E. O. Hulbert, who, in 1926, pointed out that according to (15) and for a constant value of the electron concentration in the upper atmosphere the reduction in the refractive index and thus the maximum angle through which waves may be deviated becomes smaller the smaller the wave-length. It was therefore suggested that the ray received at the edge of the skipped distance was critical in that it had been deviated at the level in the upper atmosphere where the electron concentration was greatest, and that waves meeting the layer with smaller angles of incidence than this critical ray actually penetrated the layer and escaped. This is tantamount to saying that there are no atmospheric waves of normal type received within the skipped distance because there is insufficient electricity in the layer to bend them back. It has, however, been found that it is possible to receive a very weak signal within the skipped distance which, since its intensity is found to vary considerably, must be attributed to down-coming waves. Such signals appear to come from all directions in that they show no directional effects and this has led T. L. Eckersley to suggest that the radiation responsible for these signals is scattered from the waves which are passing overhead and which are bent back

to the ground at greater distances.

The use of methods of concentrating radiation into a beam has been developed by the Marconi Company Engineers, and particularly by G. S. Franklin who has, after experimenting with parabolic reflectors after the manner of H. Hertz, designed an aerial consisting of a number of parallel vertical wires equally spaced behind which is a "reflecting screen" formed similarly of vertical wires. Such aerials are used in the series of wireless links between Great Britain and the Dominions which have been erected by the Marconi Company for the British Post Office. The use of similar aerial systems with reflectors for the receiving stations has two advantages. In the first place the use of many aerials brings about the collection of electric wave energy from over a fairly wide area thus increasing the received signal. Secondly the reflector acts as a kind of shield and protects the aerial from undesired signals and atmospherics coming in the opposite direction.

Since the attenuation of short wave signals is so low there is not a very great difference in the intensity of signals received both ways round the earth. In the case of 16-metre signals sent from America to Germany, E. Quäck has recorded oscillographically double signals with a spacing of 0·096 seconds. The first signal received was that travelling by the shorter journey across the Atlantic Ocean, while the second was that taking the long path via the Pacific Ocean. The same author has recorded instances of the fourfold reception of the same short wave signal, the first signal arriving via the direct path and being followed by signals that have travelled once, twice and thrice round the globe.

WIRELESS WAVE PROPAGATION AND SOLAR ACTIVITY

It has been shown by L. W. Austin that there exists a direct correlation between solar activity and the strength of long-wave wireless signals when averaged over long periods. On the other hand, G. W. Pickard, making signal strength observations on shorter wave-lengths, has found an inverse relationship between signal strength and sun-spot numbers. Moreover it is found that isolated magnetic storms yield evidence of a similar character for, on such occasions, although there have been exceptional cases, the general rule is that short-wave signals are weaker and long wave signals stronger in times of enhanced magnetic activity. As shown above, the general evidence suggests that long waves are reflected by the lowest of the ionized regions in the upper atmosphere, while short waves, which require a greater electronic density to bend them back, travel through these lower regions before being appreciably deviated. If, therefore, the effect of enhanced solar activity were to increase the ionization in the lower layers of the atmosphere there would result an increase in the intensity of the waves reflected from its surface and an increase in the absorption of waves passing through it. The variation in signal intensity found by Austin during the 11-year sun-spot cycle can be explained by assuming that the specific conductivity of the layer reflecting the long waves used is 1·5 times as great at sun-spot maximum as at sun-spot minimum. This figure is in agreement with the evidence of terrestrial magnetism.

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(E. V. A.)

COMMUNICATION

General Considerations.—Communication by Hertzian waves is the only practical method of transmitting messages beyond the horizon to recipients whose position is not known or whose position is continually changing. Hence wireless telegraphy and telephony have no rivals for the purpose of communicating with distant ships, aeroplanes, surveyors and explorers. Again, it is characteristic of wireless or radio communication that its waves tend to spread equally in all directions, and thus the messages can be made available to all who possess the necessary receiving apparatus. Examples of this quality are seen in the modern art of radio broadcasting and in the wireless call for help of a ship in distress. Here again, wireless has no competitor.

On the other hand wireless can give many of the services that have hitherto been rendered by land lines and submarine cables. Thus, in transatlantic telegraphy, wireless has been competing with the ocean cables for about twenty years with gradually increasing success. In some cases, especially in respect of long distances such as England to Australia, New York and Berlin to South America, the competition of radio with the cable has become very acute during the past three years because the erection of the necessary wireless stations requires only an insignificant capital outlay compared with that necessary for, say, ten thousand miles of submarine cable. These same considerations of cost often decide whether wireless or cable communication is to be chosen for linking a small island community with the rest of the world.

Wireless communications can be said to comprise every variety of traffic that can be handled by aid of wires. For instance, besides the transmission of Morse signals and of music or speech, wireless stations have been utilized for the transmission of pictures, of signatures, of facsimiles of printed pages and for television. In many cases, the rapidity of wireless transmission to any distance is as rapid as that possible over a few hundred miles of land line, and much faster than that possible through a hundred miles of submarine cable. Hence for work such as telephony, facsimile transmission and television, a wireless circuit accomplishes things

that are at present impossible on the transoceanic cables.

Wireless communication has, however, some of the defects of its qualities. Inasmuch as the emissions from a wireless station can be picked up by anyone who provides himself with suitable apparatus, there is little of that secrecy which belongs to communications which are compelled to pass along a copper wire of which the ends are in private hands. Consequently there is always a quantity of telegraphic and other traffic which preferably goes by wire. For instance, the London correspondents of foreign newspapers often refuse to transmit their news messages abroad by wireless because, if they do, the news may be printed in rival newspapers at the same moment as in their own. This defect may be overcome to some extent by coding, by very rapid transmission, or, better, by "scrambling" the messages, *i.e.*, making them unintelligible by aid of automatic mechanical devices at the transmitter, devices which can be used in the reverse sense at the authorized receiving station.

This comparison between wireless and wire will be incomplete unless the troubles that afflict both are mentioned. In the case of cables the chief source of interruption of a service is the breaking or leaking of the cable. Such an injury may take two or more weeks to repair; the only mitigation is to provide a duplicate cable or route. On all the great traffic paths of the globe such duplicates exist, and therefore it is found that the delays affect only relatively small communities. Another trouble afflicting the cable is that arising from magnetic storms; usually this averages only a few hours per annum. The principal troubles that afflict wireless communications are the breakdown of aerials in storms, the failure of machinery or power supply, "atmospherics" and "fading." The failures of a mechanical nature are often prepared against by duplicating, at least in part, the machinery. But for "atmospherics" and "fading" no real remedy has appeared as yet. Fortunately, atmospherics are much less troublesome with short waves than with long, and fading, on the other hand, is much less frequent with long waves than with short; and, therefore, in the case of an important wireless link a combination of long and short wave stations, operated from the same telegraph offices, could provide an almost continuous service. Such a combination, designed for distances of, say, four thousand miles, would probably not give quite as continuous a telegraphic service as a submarine cable and might not be any better financially.

International Regulations.—Since the emission of waves from a wireless station affects receiving apparatus over a wide area if the apparatus is attuned to the waves, it follows that every wireless station on the globe monopolizes a certain wave-length or frequency inside a certain area. Indeed, as it is impossible to tune transmitting or receiving apparatus with absolute accuracy, each station may be said to monopolize a band of frequencies. Therefore, to make telegraphic services useful, an allocation of a particular wave-length or frequency must be made to each station, due regard being taken of the area served by such station and of the proximity and needs of neighbouring stations. From this arose the necessity for international agreement and legislation, and a conference was called at Berlin in 1903, which prepared schemes for discussion at a second international conference meeting at Berlin in 1906. This conference discussed many details that had become of importance to the usefulness of wireless, including rules for handling and charging for telegrams, especially by ship's operators, and regulations for the prevention of interference and for the enforcement of penalties. At the succeeding conference in London in 1912 a radiotelegraphic convention was drawn up and was signed by nearly all the principal countries. This provided for the establishment of a central office for collecting and distributing information about the wireless services of the world, and arranged for it to take its place as a branch of the Bureau of the International Telegraph Union at Berne. This radiotelegraph office had about one thousand wireless stations on its list in 1912 and nearly twenty thousand in 1926. The growth in number is due chiefly to the increased use of wireless at sea, which was greatly stimulated by the signing in 1914 of the International Convention for the Safety of Life at Sea. This convention, which was arranged in London in 1913, specifies the minimum of equipment and staff to be carried by ships of the various grades and for the hours of service.

A most important international radio conference took place at Washington in the autumn of 1927. The revised arrangements have not yet been ratified by all the Powers concerned, but the allocations of wave-length to different services provisionally adopted will probably be universally accepted. They are as follows:—

Long Waves

Service	Frequency kilocycles	Approximate wave-length metres
Point-to-point	Below 100	Above 3,000
Mobile and point-to-point	100–110	2,725–3,000
Mobile, including naval vessels	110–125	2,400–2,725
Mobile, merchant vessels	125–150	2,000–2,400
Mobile, calling wave	143	2,100
Mobile	150–160	1,875–2,000
Broadcasting or mobile and point-to-point (as determined by regional agreement)	160–194	1,550–1,875
Broadcasting, mobile and point-to-point services for aircraft (subject to certain limitations)	194–285	1,050–1,550
Radio beacons	285–315	950–1,050
Aviation	315–350	850–950
Mobile and radio compass	350–550	545–850
Broadcasting	550–1,500	200–545
Small vessels	1,365	220

It is proposed to allow mobile stations and point-to-point stations to share short wave bands as shown in the following table. Certain parts of the bands shown here as "point-to-point" are available for amateur stations or for short-wave broadcasting stations or are shared with mobile services. Certain parts of the bands shown here as "mobile" are similarly shared with point-to-point services.

Short Waves

Mobile service		Point-to-point service (including amateurs and short-wave broadcasting)	
Frequency kilocycles	Approximate wave-length metres	Frequency kilocycles	Approximate wave-length metres
1,500–2,750	109–200	1,715–2,250	133–175
2,850–5,700	52·7–105	2,750–5,500	54–109
6,150–6,675	45–48·8	5,700–6,150	48·8–52·7
8,200–8,900	33·7–36·6	6,675–8,200	36·6–45
11,000–11,400	26·3–27·3	8,550–11,000	27·3–35·1
12,300–13,350	22·4–24·4	11,400–12,300	24·4–26·3
16,400–17,750	16·9–18·3	12,825–16,400	18·3–23·4
21,550–23,000	13·1–13·9	17,100–21,550	13·9–17·5
..	..	22,300–23,000	13·1–13·45

Variations from this table will probably be allowed to existing important stations; all waves below 13·1 metres (above 23,000 kilocycles) remain free for allocation nationally.

The conference, among other recommendations, laid stress upon one which forbids the installation of spark sets above 300 watts input power on new ships after 1929, and the abolition of all such sets now existing on old ships on December 31, 1939. As for spark stations on land, they are to be abolished as rapidly as is possible. Moreover, all except small ships are recommended to be fitted as early as possible to receive continuous waves from 500 to 3,000 metres.

In accord with the International Convention, every important country has enacted domestic legislation to enable the international provisions to be enforced. In Great Britain and Northern Ireland the control of wireless communications is in the hands of the Postmaster General, in virtue of the Wireless Telegraphy Act of 1904, which is renewed annually. The Act provides that no one shall install or work a wireless equipment, either for sending or receiving messages, without a licence; and that when an applicant for a licence proves that his object is for experimental

purposes solely, a licence shall be granted without rent or royalty. The application of the Act to shipping is regulated under the Merchant Shipping (Wireless Telegraphy) Act, 1919, and the Rules made by the Board of Trade under this Act. (W. E.)

In the United States of America commercial wireless communication services are operated by private enterprise. Under the Act of 1927 the Federal Government has certain regulating powers to grant licences for radio stations, to license operators, to apportion wave-length assignments and other similar powers necessary to preserve the "public interest, convenience and necessity." This law is administered by an appointive group of five men known as the Federal Radio Commission. The United States was signatory to and has ratified the International Radio Convention of 1927. (X.)

Marine Communication.—The 1914 convention bound all the contracting nations to pass legislation to compel all ships that sail from one country to another to be fitted with a radiotelegraphic installation if they have on board 50 or more persons in all, subject to a few exemptions. Moreover such ships carrying more than 25 passengers must maintain a continuous watch. Every ship so fitted must carry, besides its main installation, an emergency installation of approved design. Further, the master of any ship fitted with wireless who receives a call for assistance is bound to proceed to help those in distress if requested to do so. Since 1920, the ships of the British mercantile marine have been required to engage three operators for voyages other than coastwise taking more than 48 hours from port to port when carrying 200 or more passengers. Two operators must be carried by such vessels taking between 8 and 48 hours from port to port, and regulations have also been issued relative to the carrying of wireless watchers on board in place of one or more of the certified operators.

Until about the year 1922 nearly all ship and shore communication had been conducted by spark stations transmitting on 450 and 600 metres wave-length. These signals interfered greatly with the development of the new art of broadcasting especially near great ports, and consequently much consideration was given to the introduction of more modern apparatus on ships. The larger passenger ships and shore stations gradually adopted continuous wave methods, employing either the arc or the valve, with a wave-length of about 2,000 metres. This step not only avoided interference with broadcasting but also enabled communication to be established across great distances and made multiple telegraphy possible when desired. Nowadays one and the same shore station can utilise its antenna for transmitting signals on several wave-lengths simultaneously—say 1,800, 1,900, 2,000 and 2,200 metres—thus enabling that station to work with four ships at a time without interfering appreciably with any other service, such as popular broadcasting. The tendency of development in this direction is in favour of the installation of valve transmitters rather than arcs, and with such transmitters it is possible to operate very near to broadcasting wave-lengths without causing interference. These marine valve transmitters are now being manufactured by the principal firms in many countries, usually being equipped to transmit on about 600 metres and about 2,000 metres. Inasmuch as there are still many vessels sailing with apparatus incapable of receiving continuous wave signals, the transmitters just mentioned are provided with a simple form of rapidly vibrating interrupter which chops up the continuous waves so as to yield a musical note in the receiving apparatus of the older or smaller ships.

One result of the increasing use of continuous wave transmitters at sea is that telephony is now being tried as an accessory to telegraphy. In order to transmit speech from a continuous wave plant it is necessary to modulate the waves by aid of a microphone. This modification is described in that section of BROADCASTING dealing with transmitters. The range obtained by telephony is only about a quarter of that obtained when the same plant is used for heterodyne telegraphy. In 1929, however, experiments were successfully conducted in the field of ocean telephony which enabled Atlantic liners to maintain touch with both sides of the ocean throughout almost the entire passage. It ought to be noticed that the apparatus required and installed on ships for the purpose of receiving signals—either spark signals, telephony or interrupted continuous waves, or continuous wave telegraphic signals—is almost identical with that employed by the public in receiving broadcast matter. It may consist, for example, of a three valve amplifier having one high frequency amplifying valve, one detector valve and one low frequency amplifying valve, with suitable switches for cutting out one of these stages when signals are strong enough. Such receiving apparatus is described under BROADCASTING. The only difference between the receivers there described and those required at sea is introduced for the purpose of receiving continuous wave signals by the heterodyne method. For this purpose two main alternatives exist. In the one, variously called the self-heterodyne, autodyne or endodyne apparatus, a coil in the anode circuit of the high frequency triode valve is made to act inductively upon a coil in the grid circuit of the same valve in such a way as to generate electrical oscillations within those circuits.

The frequency of these oscillations is determined by a closed tunable circuit in either the anode or the grid circuit of the valve, and is adjusted to be slightly different from the frequency of the incoming signal waves. In consequence the incoming waves "beat" with the locally generated oscillations. The frequency of the beat can be adjusted by altering the frequency of the locally generated oscillations, and can in fact be varied so as to constitute, after rectification by the detector valve, an alternating electrical current in the final circuit of the apparatus, usually the head telephones of the listening operator. The other alternative method of heterodyne reception is named separate heterodyne for the sake of distinction. In this method an entirely separate piece of apparatus consisting of a triode valve with a tunable circuit and with the anode circuit back-coupled to the grid circuit for ensuring the generation of electrical oscillations, is adjusted to generate oscillations of frequency slightly different from that of the incoming waves. This piece of apparatus, named the auxiliary oscillator, is brought near enough to the receiving apparatus to induce therein oscillations of its own frequency, which interfere with the incoming waves and finally produce in the telephones of the operator an audible note of desired frequency. The loudness of this heterodyne note can be adjusted up to a certain limit by moving the auxiliary oscillator nearer to or farther from the receiving apparatus. In both these alternative methods of heterodyne reception great magnification is obtained by the introduction of the locally generated energy.

Direction Finding.—Wireless apparatus has been developed in recent years for determining the bearing of a distant transmitting station with an accuracy of two degrees of arc at distances up to 100 miles, and with nearly equal accuracy at much greater distances, provided that the electrical conditions of the atmosphere are fairly stable. By means of the information thus obtained a mariner or aviator can navigate his vessel during foggy weather, since fog has no bad effect on wireless signals. This branch of our subject has therefore become of very great importance. Several methods are available and in active use. In one method the direction finder is situated at a land station, the bearing of the ship or aircraft from that station is measured on receipt of a wireless message from the vessel, and is transmitted to it. In another method the direction finder is on the ship and the ship's operator measures the bearing of any charted wireless shore station that happens to be transmitting or which can be requested to transmit for the purpose of the measurement. This method has also been used in aeroplanes but is being discarded. Still another method is seen in the so-called rotating "beacon," which is really a wireless transmitting station fixed on land and provided with a directional antenna that can be rotated in azimuth so as to sweep its signals round the compass as it rotates. The beacon automatically emits a characteristic Morse signal continuously and also a special signal when its directional antenna is in a standard position. An observer at a distance, equipped with ordinary receiving apparatus, hears the signal wax and wane as the directional antenna rotates. Usually the

beacon rotates through six degrees per second, and emits the special signal when an observer on the north-south line would receive minimum signals; therefore an observer off that line need only count the number of seconds that elapse between the special signal and the time when he himself perceives that the continuous signals are least audible, in order to determine his angle from the north-south line by simply multiplying by six. The easier way of performing this operation is to use a stop watch with a seconds hand which makes, like the beacon, a complete revolution in one minute. The observer starts the watch on hearing the special signal and stops it at the instant of minimum signal; the angle turned through by the seconds hand is his bearing from the beacon.

Two types of apparatus have been much used in practice in carrying out the above-described methods of finding the bearing of a ship or an aeroplane. In one form the antenna is a flat coil of several turns of wire, fixed on a vertical axis so that the plane of the coil can be pointed in any desired azimuth. Such a coil emits radiation most strongly in its own plane when used as a transmitter, *i.e.*, when strong high frequency currents are passed through it; it absorbs radiation most strongly in its own plane when used as a receiver. On the other hand substantially nothing is radiated or absorbed in the horizontal direction perpendicular to its plane. Such a coil, used as the antenna of a receiving station, can locate the direction of any distant transmitting station either by turning it until signals are strongest, when its plane must point to the station, or until signals are weakest, when it must be broadside-on to the station. The minimum is sharper than the maximum and is therefore usually used in practice in order to gain accuracy. But measuring on the minimum implies that the message cannot be read; so if reading is desired the maximum setting must be sought, or, preferably, the method designed by J. Robinson may be employed. This consists in fixing to a vertical axle two flat coils with their planes vertical and perpendicular to each other. One coil is always connected to the receiving apparatus and is pointed to absorb the maximum signal from the distant station under observation. The other coil is therefore roughly broadside to that station—roughly, because the setting of the main coil to the maximum is intrinsically an inaccurate process. To improve this setting, the auxiliary coil is switched into series with the main coil, first with its ends connected one way and then the opposite way. If the setting is perfect, the auxiliary coil neither augments nor diminishes the signal strength; but if it is imperfect one position of the switch augments, the other diminishes the signal, and the setting is altered by trial to abolish this difference.

In the type of apparatus just described the antennae are coils of wire which are small enough to be easily manipulated. In the other type, which was invented by Bellini and Tosi in 1907 and developed by H. J. Round of recent years, the antennae are also coils but they are not movable and may therefore be large structures. Two coils are necessary and they are fixed in perpendicular vertical planes; as a rule each coil has only one turn and is supported on a mast or masts. Each coil is connected to one of a pair of small fixed coils inside the station building, these coils also being in perpendicular vertical planes. Within these fixed coils a smaller coil can rotate upon a central vertical axis, and this coil is connected to the detecting apparatus. The principle underlying the invention is that waves coming from any definite azimuth excite an antenna in proportion to the cosine of the angle their path makes with the plane of that antenna; the oscillatory current thus produced in an antenna passes through the corresponding small connected coil; the oscillatory field within the crossed coils has its resultant parallel to the direction of the waves; and the rotatable search coil is swung about to determine the direction of this resultant field. The combination of the two crossed coils and the search coil within them is known as a goniometer. It has been described in the preceding lines as applied to the reception of waves; but if powerful oscillatory currents be sent from any source into the search coil these induce currents in the crossed coils and the connected antennae which produce external radiation whose resultant direction is parallel to that of the search coil. Thus a radio goniometer may be used for directional transmitting as well as for directional receiving; in fact the Bellini-Tosi invention has effectively the same properties as the single moving coil antenna already described, both for receiving and transmitting, the principal difference in receiving being that more amplification is required with the moving coil antenna because it must be small enough to be rotated quickly by hand.

In the directional apparatus so far described the radiation or absorption is symmetrical about the vertical axis of the apparatus. This fact gives rise to an ambiguity of 180° in azimuth; for instance, after finding the direction of a station the operator may still be unable to say whether it is in front or behind him unless assisted by geographical or other considerations. This ambiguity may, however, be removed electrically by adding an ordinary straight antenna and the necessary tuning equipment to the existing direction finding apparatus. It can be shown that, by adjusting the phase and magnitude of the oscillatory current produced in this single wire, the radiation or absorption, as the case may be, in one direction can be annulled and in the other increased. In other words the direction finder is made uni-directional.

Long Distance Communication.—Wireless communication across great distances has progressed greatly during the past few years. An important step was taken in 1918 by the United States army in erecting the Lafayette station at Crois d'Hins near Bordeaux for transatlantic communication. This station was more than double the strength of any predecessor and achieved world ranges with a wave-length greater than 20,000 metres; the original plant comprised two Federal-Poulsen arcs rated at 1,000 kilowatts and supplied with current at 900 volts. Somewhat smaller equipments were installed at Nauen near Berlin, at St. Assise near Paris, at Rocky Point near New York, and also in many other countries, during the succeeding four years, nearly all of them using high frequency alternators of German, French or American design. In 1922 to 1923 the British Government completed arrangements for the establishment of an Empire wireless service under which the Post Office would erect at Rugby a station capable of direct communication with all parts of the Empire, and the Dominions would erect corresponding stations. Under these arrangements the Marconi Company in 1923 planned to handle extra-Empire communications from a group of even larger stations in Wiltshire. A little later the Government plans were modified to permit of Rugby conducting this work.

Meanwhile a few American amateurs, using waves shorter than 300 metres, succeeded in communicating across the Atlantic with the expenditure of very small power in December 1921; and by December 1922, American, British and French amateurs succeeded by hundreds in similar transmissions. In the early months of 1923 amateurs telephoned from New York to California by aid of small stations using 100 metre waves, and it was becoming clear that waves less than 100 metres in length were likely to be useful in practice. This was unexpected because the very thorough pioneer work of G. S. Franklin in 1920 and 1921, published in 1922, seemed to show that waves of 15 metres length, and even of 100 metres, were only suitable for distances less than 200 miles. But the surprising results obtained by the amateurs compelled professional attention, and early in 1923 the Radio Corporation of America erected a short-wave equipment in Maine, and the Marconi Company independently installed a similar plant at Poldhu, for experimental work. The first commercial long distance message by short wave was on September 11, 1923, when a ringside account of a prize fight was sent from Maine to Buenos Aires. By the end of the year experimenters were at work all over the world to such good effect that in the spring of 1924 the Radio Corporation erected five more short-wave commercial transmitters. In July 1924 the British Government ordered from the Marconi Company a number of short-wave stations for the purpose of completing the Empire scheme of communications. These stations were to be provided with reflectors of the type developed by G. S. Franklin in order to direct the radiation mainly towards corresponding stations to be erected in Canada, Australia, South Africa and India. All these Government stations were in operation by 1928 and are considered to be the most efficient short-

wave stations extant.

The use of reflectors at both the transmitting and receiving stations ensures that the signals, under favourable conditions, are 10 to 15 times as strong as they otherwise would be. In all cases, with or without reflectors, it is necessary to provide that each station shall be capable of operation on one of two or three wave-lengths, for across long distances waves shorter than, say, 30 metres are required for daylight transmission, and longer than 30 metres for night transmission. Four years' experience with short-wave transoceanic telegraphy and telephony has shown that it may suffer erratic and lengthy periods of fading which cause loss of signals or distortion of speech and, therefore, for such work as transatlantic telephony the long-wave plant is generally more trustworthy. Best of all is the collaboration of long-wave and short-wave telephony now being practised between America and Britain (and through Rugby with large areas of Europe). On the other hand short-waves have two great advantages over long waves—they are capable of much greater telegraphic speeds and the plant they require costs less to erect and operate. The relation between short- and long-wave systems is analogous to that between motor car and railway transport; the car is for many purposes better than the railway, but it is more subject to interruption and accident; for a long time to come progressive communities will require both forms of service.

The best way of giving an idea of the present state of large scale wireless engineering is to describe some typical modern stations. The Rugby station is designed for simultaneous transmission to all parts of the Empire and to ships on any sea, and for telephony to America. Its antenna is 820 feet high and carries a current of 700 amperes at a frequency of 16·7 kilocycles (18,000 metres). It occupies a site about 1½ miles long by 1 mile wide 4 miles south-east of Rugby. The antenna is supported on 12 insulated stayed steel masts 820 feet high, a quarter of a mile apart, and has a capacity of 0·045 microfarad, but can be divided so that when the portion on 8 masts is used the capacity is 0·033 microfarad. The primary source of oscillations is a small tuning fork maintained in vibration by a triode valve by the method of Eccles and Jordan; the nine-fold harmonic of the fork current is selected, filtered and amplified by three stages of low voltage triode valves, until about 100 watts of high frequency current is obtained. This current is amplified by a bank of high voltage valves of 2 kilowatts output, then by a bank of 30 kilowatts output, and finally by a bank of 540 kilowatts output, whence the current passes to a closed circuit which is coupled to the antenna. All stages are separated by metal screens to prevent retroaction that might lead to the generation of unwanted oscillations. The last three stages are fed with a direct current high-voltage dynamo set capable of delivering up to 1,500 kilowatts at 18,000 volts. About 50 kilowatts of direct current power is consumed in heating the filaments.

All the power for the station is taken from a public electricity supply at 12,000 volts 50 cycles. The intermediate circuit between the final bank of valves and the antenna consists of two condensers in series, values 1·05 and 0·25 microfarad, and an inductance coil variable from 400 to 600 microhenries, the last being coupled to an aerial coil of 40 microhenries which has a series tuning-coil variable from 900 to 4,000 microhenries. The antenna is a continuous conductor strung across the tops of the masts, passing from each mast to the next in a flat festoon; this conductor is a cylindrical cage of eight 7/14 S.W.G. silicon bronze wires stiffened by spiders 12 feet in diameter every 140 feet. The tension is such that the pull at the top of any mast never exceeds 10 tons; if this is exceeded the steel rope holding the insulators and the antenna is paid out automatically by a slipping brake until the tension is 10 tons. The insulators will withstand a pull of 20 tons and a high frequency voltage of about a quarter million volts. The earth system is a broad band of buried copper wires running round the site under the masts and the aerial. The transmitting key is operated at the Central Telegraph Office in London. For details a paper by E. H. Shaughnessy should be consulted.

As an example of a short-wave beam station we take the Post Office station at Bodmin. This has one reflecting antenna directed to Canada, the other to South Africa. A similar station at Grimsby transmits to India and Australia. The receiving station corresponding to Bodmin is at Bridgewater, that corresponding to Grimsby is at Skegness. The transmission to Canada is on 16·57 metres by day and 32·4 metres by night; to South Africa on 16·15 and 34·01 metres respectively. The primary source of oscillations is a back coupled master oscillator of the Arco and Meissner (Telefunken) type carefully screened by heavy metal casing. The high frequency current from this (about 80 watts) is amplified by a triode valve taking 2,000 volts, and this in turn by two more valves taking 6,000 volts, and finally by two ten kilowatt water-cooled valves operated at half their rated voltage of 15,000. The high frequency current is then taken along tubular feeders to the antenna to be supplied.

Two complete outfits like the above are needed for Canada and two for South Africa in order to supply the four wave-lengths. The Canada antenna is supported on five masts, the wires in two bays being suitable for the day wave-length and those in the other two bays for the night wave-length. The masts are steel structures 287 feet high with cross arms 90 feet long. The antenna and reflector wires hang vertically from steel rope triatics joining the cross arms. In the Canada aerial there are 24 antenna wires 19 feet apart and 48 reflector wires, the distance between the antenna plane and the reflector plane being 40 feet for the shorter wave and 24 feet for the longer. The reflector wires are divided in 8 insulated portions and the antenna wires are loaded with two spaced inductances. Power for the whole station is derived from three 92 kilowatt dynamos, which supply direct current for driving motor-alternators and auxiliary machinery. The direct current for the anodes is obtained by rectifying the transformed current from the alternators. The receiving station at Bridgewater has an antenna system very like that at Bodmin, namely a line of masts broadside to Canada, a line broadside to South Africa, each line comprising two bays for the 16 metre wave and two bays for the 32 metre wave. Actually the wave-lengths received are, from Canada 16·50 and 32·13 metres, from South Africa 16·08 and 33·71 metres. It will be seen that the most original feature of the station is the unidirectional antenna due to C. S. Franklin who overcame many difficulties in carrying a great enterprise to a successful issue.

The Radio Corporation of America has installed numerous short-wave transmitters for supplementing the transoceanic work of their long-wave high power stations. Most of those in commercial use are operating without reflectors and can therefore communicate in any direction. The first two stations were erected in 1923, and five others, with wave-lengths ranging from 95 to 43 metres, in the spring of 1924. Several others, using various wave-lengths down to 14 metres followed in 1925. The Californian station may be taken as typical of modern practice. At this station the primary source of oscillations is a quartz crystal maintained in vibration by a triode valve by the same principle as is the fork at Rugby, but the frequency of mechanical vibration of the crystal is nearly 800,000 per second while that of the fork is less than 2,000. From the current in the crystal circuit is selected the triple harmonic, and this is amplified to 300 watts. The current is now passed in turn through two amplifiers and selectors of increasing size, the triple frequency being selected at each step. The total multiplication of frequency is 27 and the final frequency therefore 21 millions per second (14 metres wave-length). Finally this current is amplified again by water cooled triode valves for delivery to the antenna. The antenna is a vertical or sloping wire about 20 feet long excited through a few turns at its middle which are placed in inductive relation with the tuned circuit of the last amplifier. Even so small an antenna can radiate 10 kilowatts at this frequency.

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Aviation and Wireless.—The possibilities of radio as an aid to flight are being actively developed along the following lines: (1) communication, (2) course navigation, (3) field localizing and (4) general. This last includes miscellaneous developments such as *radio altimeter devices*. *See* RADIO; AERONAUTICAL ARTICLES. *The radio directive beacon system* is a special kind of radio station usually situated just off the landing field. Instead of having the single antenna, as in the ordinary station, it has two loop antennae at an angle with each other. Each emits a set of waves which is directive, *i.e.*, stronger in one direction than another. When an aeroplane flies along the line exactly equidistant from the two beams of radio waves it receives a signal of equal intensity from the two. If the aeroplane gets off this line it receives a stronger signal from one than the other. The indicator on the instrument board shows when the signals from the two beams are received with equal intensity by means of two small vibrating reeds. The tips of the reeds are white in a dark background, so that when vibrating upon receiving signals they appear in a vertical straight line. The reed on the pilot's right is turned to a frequency of 65 cycles and the one on the left to 85 cycles. This system is to be installed on all American air routes. (X.)

WIRE MANUFACTURES. In addition to steel ropes, cables, barbed wire, nails and wire springs (*see* BARBED WIRE; CABLE; NAIL MANUFACTURE; WIRE ROPE; WIRE SPRINGS), wire is woven or shaped into an almost infinite variety of articles; the chief of these being wire-netting which is manufactured in many designs and sizes. The commonest form of wire-netting is that which is hexagonal in shape and which is woven by the twisting together of wires, this operation being carried out with a very ingenious kind of loom. The hexagonal meshes are respectively formed by the twisting together of two wires, this being brought about by the passing through the loom of line wires which are unwound from bobbins and wires which are pulled out from the shuttles—these latter wires being in the form of a spiral. The spirals or springs, as they are called, are very rapidly wound on to mandrils, this being carried out by four spindles running in parallel, the wire being guided on quite evenly and automatically until the required thickness of spring has been made. The spindles on to which the wire is wrapped are slightly tapered; consequently, after the full quantity of wire required has been spun on them they can be removed from the machine and the springs easily detached or slipped off by slight end knocking.

The shuttle on the loom is in the form of a cylindrical pipe with an opening on the side at the upper end, the ends of the shuttles being fitted to what are known as split pinions. The operator charges a shuttle with one of the springs, connecting the free end of wire of the spring to the end of the wire on the netting which has just been drawn from the shuttle. The operation of twisting is carried out by a shuttle spinning round its corresponding free wire, which is shown passing up from the bobbin. Whilst the wire is being twisted the netting is at the same time carried forward by the driven rollers on top.

In this way the two wires are twisted and so form one of the sides of the hexagon mesh. After one set of twists is made the shuttles are then moved to right or left by two reciprocating horizontal beams which carry with them the half-split pinions at the top and bottom of the shuttle to join up with the half-split pinions of an adjoining shuttle. As soon as the split-pinions are fixed in their new position a toothed horizontal rack moves forward or backward as the case may be rotating the pinions and thus making the following twist on the wire. From this motion it will at once be seen that the twists on netting are alternately right-hand and left-hand.

The tension in the netting is produced by passing the netting over a series of rollers, when finally it is wound on to a friction driven spindle at the back of the loom, this being rotated at a speed which enables the netting to go through the loom at a constant velocity.

Hexagonal netting is made with all sizes of mesh from about $\frac{3}{8}$ inch up to 8 inches, the most commonly used forms being about $1\frac{1}{2}$ inches to 2 inches.

The operation of a loom which is manufacturing netting of fine mesh comes next, and it will be understood how very fine the springs have to be wound to fit into the small tubular shuttles necessary for the fine mesh.

Fine wire is also woven into netting of various designs which is used for the reinforcing of glass.

Whilst nearly all netting is manufactured from annealed black wire some is occasionally fabricated from wire which has been specially galvanized to form a coat which will not crack.

The galvanizing of black wire netting is a very important operation as this process not only coats the wire with zinc to protect it from corrosion, but also welds the wire of the respective twists tightly together. Before the netting can be galvanized it has to be pickled or cleaned in hydrochloric acid for the removal of scale, after which it is placed on a mandril at the back of the galvanizing pot, and is carefully passed through the molten zinc, being drawn out at the front of the galvanizing bath, and rolled tightly on to a tapered mandril. When a complete 50 yards roll has come through the bath it is then detached from the mandril. When it is to be used for export purposes it is usually rewound much tighter so as to form a smaller diameter roll which takes up less space in shipping.

Wire Cloth, Reinforcing Fabric and Fencing.—Fine wire in steel, copper and brass is also woven into cloth, the wires usually being at right-angles to each other and thus forming square mesh. In addition steel wire is very largely used for forming fabric of square or rectangular mesh for reinforcing purposes, either for concrete in building or road mending. Usually fabric of this description is welded together at the joints. The welding of wire for this purpose is carried out by a specially designed machine into which the line wires are mechanically fed in parallel at the required distances apart. The cross wires automatically move into the machine at the desired position relative to the line wires, being instantly pressed on to the latter. As soon as the wires are in contact an electric current passes through fusing a little of the surface of the wires which being under pressure immediately welds them together, at the same time switching off the current. As the cross wires are welded on to the line wires there is an arrangement on the machine for carrying the fabric forward and wrapping it up into rolls of suitable diameter for transport.

Galvanized steel wire is very extensively used in the formation of woven wire fences, many methods of jointing being adopted to fasten the wires together where they cross. One of the simplest forms of fencing material is that of the chain-link order in which wires are spun together in the form of flat spirals. The manufacture of this is carried out by a very ingenious form of machine which takes the galvanized wire right from the coil and not only spins it into the form of a flat spiral, but at the same time threads it into the spiral previously formed, and after being cut off to the required length also twists the ends of the wire together. This form of chain link fabric gives not only a strong close mesh fence, but also one which is very flexible.

Wire Mattresses.—Galvanized and tinned wire is used very extensively in the construction of mattresses. For the ordinary woven mattress fine wire is run through a special forming machine which throws the wire out either singly or doubly in the shape of spirals, these being threaded together at the time of formation.

Other mattresses are made up with stronger galvanized wire in the form of links, these being put together and kept taut at the mattress frame with the aid of strong springs.

Wire-working.—The making up of wire into articles such as window guards, fire guards, cages, letter boxes, sieves or riddles, and many other forms, is a very extensive business, whilst there is no limit to the shapes wire is worked into with the many kinds

of ingenious machines which are in vogue. A great number of chains are formed from wire in which the links are automatically made, at the same time being coupled up to a former link whilst the ends of the wire are twisted up. Also, wire is used in the formation of welded chain links, machines being so constructed as to not only form the link but to bring the ends of same together and electrically weld them.

Flat wire and also wire in the form of a half-round section is used for the making of all forms of split-pinions, cotters, etc.

Wire is also used very extensively in the manufacture of not only wood screws, but also screws and bolts of many other forms, the operation and manufacture being carried out on special automatic heading machines; indeed, a good deal of the work which was formerly done in the way of hot heading is now done in the cold state in consequence of the better quality of material used and the much more highly developed machinery. Also, all kinds of rivets are made out of wire, the heads being formed in the cold state.

In addition, through the introduction of what is known as free cutting steel a great amount of turning and threading is done on wire for all kinds of articles and objects by automatic machines. It might be mentioned that free cutting steel is a steel which when cut or threaded cuts very clearly without drag, also leaving a smooth bright surface.

If the actual melting down of wire can be referred to as wire working it may be said that there is a large quantity of wire used in both oxy-acetylene and electric arc welding. Its use for these purposes covers not only the jointing up of steel plates, angles, bars, etc., but also a vast number of repairs in connection with same, and all forms of cast iron work.

Special kinds of high tensile wire are used in the formation of protective torpedo nets and similar purposes; also it is used as the stays on aeroplanes and airships, in shapes which are specially made to offer little resistance to the wind. It likewise forms the spokes of wheels for bicycles, motor-cars, etc.

It is used in the shoe, printing and cardboard-box trade very extensively for stitching purposes, and for binding it is commonly used as hay bands and as indicator protective bindings for cases containing apples and many other commodities.

In the electrical industry copper and aluminium wire is used in large quantities for conductor and other purposes, and for resisting corrosion at high temperatures special nickel-chromium wires are used as the elements in electric fires and other forms of heating apparatus; and although the name belies the statement great quantities of wire are used in connection with "wireless" apparatus, as aerials, connecting wires, coils, etc. (*See* also the articles on COPPER.) (E. A. A.)

WIRE ROPE. The first modern wire ropes were manufactured from iron wires on rope walks, this method being similar to that used in hemp rope manufacture. Since the year 1870 the development of wire rope stranding and laying machines has enabled ropes to be made without torsion being introduced into the strands or finished rope. Coincident with this was the development of high tensile strength steels enabling very strong wire ropes to be manufactured. The earlier uses of wire rope were for mine hoists, ship rigging, hawsers, mooring lines, and cargo hoists. These earlier wire ropes, as well as most modern ropes, were constructed of six strands of seven or more wires around a hemp core. Wire rope is now used on derricks, cranes, winches, coal and ore machinery, shovels and excavating machinery, elevators, mines, aeroplanes, dirigibles, slings, and many other kinds of equipment.

Aerial Ropeways.—Aerial ropeways or tramways which use a stationary cable as a track, with a movable cable for propelling buckets or cars, have been used in many places for conveying freight and ores, as well as passengers, for distances varying from half a mile up to 15 or 20 miles. It is known as a *bicable* system if two ropes are used and a *monocable* system if one rope is used. In the monocable system the buckets are attached by clamps to the moving cable which serves the same purpose as the two cables in the bicable system. The bicable system is employed in the construction of the majority of tramways.

Akin to tramways are various forms of cableways which are used for lifting and moving material. These consist of an overhead stationary wire rope which is employed as a track along which a wheel carriage is pulled by means of ropes. Such cableways are frequently used for logging ropes where heavy timber is being logged, as well as for the construction of large dams. (*See* ROPEWAYS AND CABLEWAYS.)

Types of Ropes.—Since wire for rope manufacture can be drawn in all sizes it is possible to make ropes of almost any degree of flexibility that may be required. This is necessary since wire rope, to bend around sheaves and drums, must possess flexibility as well as strength and ductility. A great number of constructions of rope have been developed to meet service requirements. Ropes composed of large wires, few in number, are least flexible; whereas ropes composed of a great number of wires are most flexible. Many different arrangements of wires are also possible. It is customary to use galvanized wire in the construction of ropes to protect them from corrosion; however, in some instances, corrosion resisting steels are also being used. The following summary of wire rope constructions covers the principal types in general use:

A. Ropes made of 6 strands of 7 wires each are most frequently used as hauling ropes when the sizes of drums and sheaves permit. When galvanized, this type of rope is also used for ships' standing rigging as required by Lloyd's, and the American Bureau of Shipping regulations.

B. Ropes made of 6 strands of 19 wires each are used for general hoisting and mine work.

C. Special flexible ropes made of 6 strands of 37 wires each are used for overhead travelling cranes and for service where drums and sheaves are comparatively small.

D. Ropes made of 8 strands of 19 wires each strand, containing a larger hemp core than is used in the case of ropes of 6 strands, are very flexible and are used on elevators and for light duty in other places.

E. Ropes made of 6 strands of 25 wires each, the centre wire of which is triangular, are known as flattened strand wire ropes and are used for general hoisting purposes. This construction possesses greater external surface to take care of wear. It is also made of 6 strands of 7 wires each; but this construction produces less flexible rope. This type of rope, on account of higher cost, is less frequently used.

F. Tiller rope is a compound rope consisting of 6 ropes, each composed of 6 strands, each strand containing 7 wires. This is the most flexible standard rope made and is used for hand rope on elevators, steering rope on small boats and for similar duties.

G. Rope made of 6 strands, each strand containing 12 wires arranged around hemp, a total of 7 hemp cores in all, is used as a flexible rope for mooring ships and for similar purposes. It is usually galvanized to conform to Lloyd's and the American Bureau of Shipping requirements.

H. Rope made of 6 strands of 24 wires each, arranged around a hemp core—making a total of 7 hemp cores—is a still more flexible rope for hawsers and mooring lines. It is usually galvanized to meet the requirements of Lloyd's and the American Bureau of Shipping.

J. Ropes made in the customary manner but having each strand wrapped with Marlin, known as Marlin-clad ropes, are used for cargo hoists, oyster dredging, mine planting, etc. They usually contain 5 strands, each strand composed of 19 wires.

K. Track strands, sometimes called smooth coil strands, made of 7, 19, 37, 61, and 91 wires or more, are used as track cables for tramways and cableways.

L. Locked coil cable, made of an inner series of wires, round in cross section, surrounded by intermediate layers of wires in key shape and having outside wires that lock into position, is largely used as track cable for overhead tramways and cableways. In some countries this type is also used by collieries for winding ropes.

M. Non-spinning or non-rotating rope ordinarily made of 18 strands, each strand containing 7 wires, is constructed with the inner layer of strands left lay and the outer layer of strands

right lay, thus producing a wire rope which will not twist when a load is raised or lowered on a single part of such rope.

N. Wire rope slings for handling heavy loads are made in a great variety of sizes and designs. The more common form of sling, known as a bridle sling, is made with 2, 3, or 4 ends with different fastenings on the ends for attaching to loads.

Breaking Loads.—The strengths of standard 6 x 19 hoisting ropes, as published by the American Steel & Wire Company, are shown in the table below.

The diameter of drums and sheaves for best results should be not less than 42 times the rope diameter for 6 x 7 rope, 34 times for 18 x 7 rope, 30 times for 6 x 19 rope, 18 times for 6 x 37 rope, and 21 times for 8 x 19 rope. Proportionately larger sheaves and drums will increase the rope life.

Manufacturing.—Much skill is required in the manufacture of wire for ropes. A high grade open hearth steel of suitable chemical content is cast into ingots, then rolled into billets and rods.

Wire is produced by passing rods through tapered conical dies until the diameter is reduced to the required size. Several heat treatments are necessary to enable wire to be reduced in diameter by drawing. This wire is tested and graded for strength, bending, and torsion qualities, and is then ready for rope making. Rope manufacture starts with winding wire on to spools which are put into a machine known as a stranding machine which, by rotation, assembles the requisite number of wires into a strand. Six large reels or spools of strands are again twisted around a core of hemp or wire in a large machine known as a layer. The finished rope is wound on reels or into coils for shipment. Various sizes and types of machines are required to produce the different sizes of rope. These machines operate at speeds ranging from 30 to 2,000 revolutions per minute.

		6 × 19 Construction			
		Cast steel 175,000 lb. per sq. inch Minimum	Mild plow 195,000 lb. per sq. inch Minimum	Standard plow 215,000 lb. per sq. inch Minimum	Improved plow 235,000 lb. per sq. inch Minimum
Diameter in inches	Weight per foot	Actual breaking strength	Actual breaking strength	Actual breaking strength	Actual breaking strength
	Lb.	Tons	Tons	Tons	Tons
2¾	12·10	212·	234·	256·	294·
2½	10·	176·	195·	214·	246·
2¼	8·10	144·	160·	176·	202·
2⅛	7·22	128·	143·	157·	181·
2	6·40	114·	127·	140·	161·
1⅞	5·63	100·	112·	123·	142·
1¾	4·90	88·	98·	108·	124·
1⅝	4·23	76·	85·	94·	108·
1½	3·60	65·	72·5	80·5	92·5
1⅜	3·03	55·	61·5	68·	78·5
1¼	2·50	46·	51·	56·5	65·
1⅛	2·03	37·	41·5	46·	53·
1	1·60	29·5	33·	36·5	42·
⅞	1·23	22·8	25·4	28·	32·2
¾	·90	16·8	18·7	20·6	23·7
⅝	·63	11·8	13·1	14·4	16·6
9/16	·51	9·6	10·6	11·7	13·5
½	·40	7·7	8·5	9·4	10·8
7/16	·31	6·	6·6	7·3	8·4
⅜	·23	4·5	5·	5·5	6·3
5/16	·16	3·2	3·5	3·9	4·5
¼	·10	2·1	2·3	2·5	2·9

WIRE SPRINGS. Spring making from wire is an important industry, as springs of this character are used for many purposes where resiliency is required. The functioning of safety-pins, brooches, bracelets and many other similar articles is regulated by the little spiral of wire which it contains; and the comfort of a modern bed mattress is entirely due to the small army of vertical wire springs which support the human body in any required position. It is the wire springs in elaborately upholstered furniture which give ease and comfort. Also, whilst the seating in motor-cars is made restful with wire, the engine itself depends upon springs to manipulate its valves, accelerator, brakes, etc. Indeed, the very machine which spins out the wire springs so beautifully, itself depends upon springs for the accurate movement of its parts.

Wire springs in the coiled form are sometimes cylindrical in shape as used in the seats of motor-cars, sometimes conical as used in spring mattresses, and sometimes in the form of a double cone as commonly used for general upholstering purposes.

The wire which is used for upholsterers' springs is drawn from steel rods of such a quality as to give the resulting wire an inherent stiffness without any form of heat treatment. But helical springs for automotive and similar purposes are usually coiled out of medium carbon steel wire very carefully tempered, which not only gives it the necessary physical properties to produce resilience but also to withstand the heat, vibration, and rapidity of movement required in this type of spring. Alloy steels are frequently used when certain of these requirements are excessive.

The manufacture of springs in the cold state from wire is a very simple operation. The wire is fed into a machine through a pair of tight fitting friction rollers, these then push it against a pair of free rollers fixed in an oblique position, which with the assistance of a guide "throw out" the coils of the spring.

Where a spring is required to be of varying diameter, it is arranged for the oblique pulleys to move in and out whilst the spring is being formed, this movement causing a variation in diameter of the coils. The same machine also carries with it a cutting device which automatically operates when the spring has been spun to its correct length. The next operation after spinning is the setting of the spring which is carried out by slipping it over a vertical bar, pressing it flat down and allowing it to spring back. When the spring has once been crushed down flat and allowed to come back to what may be called its natural height, it usually retains that height however many times it may subsequently be squeezed down. It may be mentioned that in many cases the operation of spring setting is performed by a machine which is specially designed for the purpose.

Wire springs which are used in connection with furniture or bedding usually have the free ends bent or knuckled over the adjoining coil, this operation being carried out with a somewhat ingenious machine. The operator places the ends of the springs on to the machine which automatically grips the end of the wire and twists it tightly over the next coil. Springs which are required to be made out of rod or bar for heavy service are coiled in the red-hot condition; after which they are carefully tempered by dipping in oil or other method of heat treatment. (E. A. A.; X.)

WIREWORM, a popular name for certain slender, hard-skinned grubs or larvae of the click beetles or Elateridae, a family of the Coleoptera (*q.v.*). These larvae pass a long life (up to six years) in the soil, feeding on the roots of plants, and they often cause much damage to farm crops. A wireworm may be known by its broad, quadrate head and cylindrical or somewhat flattened body, with firm, sclerotized cuticle. The subterranean habits of wireworms make it hard to exterminate them when they have once begun to attack a crop, and the most hopeful practice is, by rotation and by proper treatment of the land, to clear it of the insects before seed is sown. (*See* COLEOPTERA; ENTOMOLOGY: *Economic Entomology.*)

WIRKSWORTH, market town and urban district of Derbyshire, England, 14 mi. N.W. of Derby, on the L.M.S.R. Pop. (1938) 4,727. Area, 8.81 sq.mi. The cruciform Church of St. Mary has traces of Norman work, but is in great part Early English, with Perpendicular additions. Lead mining has been carried on since Roman times, but is almost extinct. Stone quarrying and the making of tape and tar macadam are the chief industries.

WIRT, WILLIAM (1772–1834), American lawyer and author, was born at Bladensburg, Md., on Nov. 8, 1772. His father, a Swiss immigrant, died when William was less than two years old. After attending school in Charles county, Md., the young Wirt in 1783 entered the grammar school of the Rev. James Hunt of Montgomery county, a man who exerted a powerful influence on his later career. The school was closed in 1787 and Wirt spent

some months as a private tutor before commencing the study of law in 1790. After the death of his first wife, whom he had married in 1795, Wirt moved to Richmond, where he was elected clerk of the Virginia House of Delegates and in 1802 was named a chancellor of the State. In 1802 he married a second time.

His literary career began in Aug. 1803 with the publication of the first of "The Letters of the British Spy" in *The Argus* of Richmond. These essays, containing the reactions of a hypothetical English visitor to Southern life, were well received, and the following year he published a second series, *The Rainbow*. About this time, too, he began work on a biography of Patrick Henry, which was published in 1817 as *Sketches of the Life and Character of Patrick Henry*. This work still maintains its place as an outstanding biography in Southern literature.

In 1807 Wirt had attracted considerable public attention with his eloquent prosecution of Aaron Burr at Richmond. The next year he was elected to the House of Delegates, and in 1816 President Madison appointed him U.S. attorney for the district of Richmond. On Nov. 13, 1817, President Monroe appointed him attorney-general of the United States. He administered this office with such efficiency that John Quincy Adams persuaded him to retain it for another term in 1825. Wirt retired in 1829 upon the election of Andrew Jackson to the presidency, except for a brief time in 1832 when he himself was nominated for the presidency by the Anti-Masonic Party. He died Feb. 18, 1834.

See John P. Kennedy, *Memoirs of the Life of William Wirt* (1849).

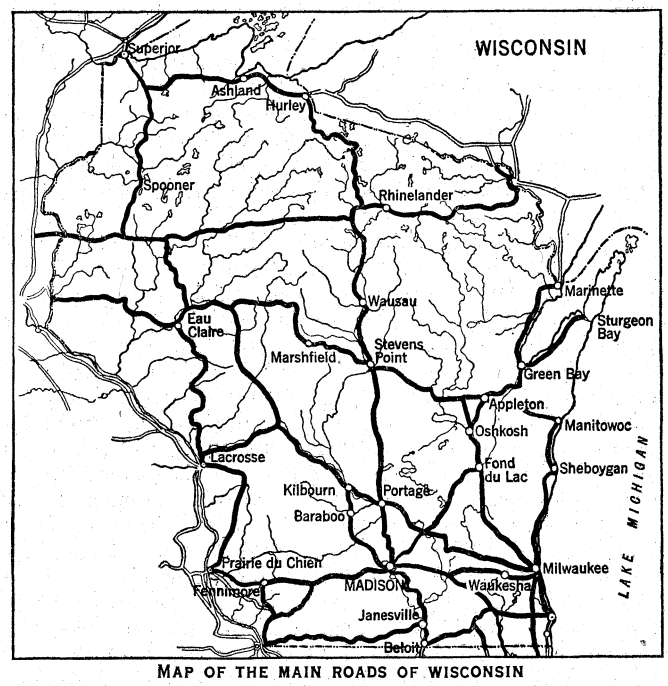
WIRTH, KARL JOSEPH (1879–), German statesman, was born at Freiburg im Breisgau on Sept. 6, 1879, the son of a foreman mechanic. Educated at Freiburg university, he became (1908) professor of natural science at the technical college in Freiburg. In 1913 he obtained a seat in the Baden diet, and in 1914 became a member of the Reichstag. In 1919 he was minister of finance for Baden and was elected to the Constituent Assembly of the Reich. In March 1920 he succeeded Erzberger as Reichsminister of Finance, a post which he held until Feb. 1922. In May 1921 he became chancellor on the occasion of the Allied ultimatum regarding reparations, with an avowed policy of the fulfilment of treaty obligation (*Erfüllungspolitik*). In August and September of that year he came into conflict with Von Kahr, the Bavarian premier, who refused to apply to Bavaria the state of national emergency which Wirth had proclaimed consequent on the murder of Erzberger. Wirth stood his ground, and Von Kahr was compelled to resign, but two months later the decision of the League of Nations on the partition of Upper Silesia between Germany and Poland led to a widespread revolt against the policy of fulfilment and to the secession of the German democrats, including Rathenau, from the cabinet. Wirth resigned, but resumed office on Oct. 26. He then sought to establish a "Great Coalition" which should include all but the Nationalists and the Communists, but failed to secure the support of the Social Democrats, although he had obtained a measure of agreement, for the People's Party abandoned their opposition to the forced loan of a milliard gold marks and the majority socialists postponed their demand for a gold levy. But the appointment of Rathenau as foreign minister alienated the People's Party, for Rathenau, though a great industrial magnate himself, was suspected by "heavy industry" of socialist tendencies. He was unable to carry out the necessary financial measures to stop the depreciation of the mark, and in Nov. 1922, when the mark had fallen to 9,000 to the $, again resigned, and Dr. Cuno (*q.v.*) formed a cabinet to cope with the financial crisis (*Kabinett der Arbeit*). Wirth resigned from the German Centre Party in Aug. 1925, but rejoined the party in 1926, after the reaffirmation of the party allegiance to the republic.

WISBECH, a municipal borough, market town, and port in Isle of Ely, England, on the L.N.E.R. It lies in the flat fen country, on the east bank of the river Nene, 11 mi. from its outlet on the Wash. Pop. (1938) 15,620. Area, 7.29 sq.mi. The church of St. Peter and St. Paul has a double nave, with aisles, the north arcade being Norman; but the rest of the building is mainly Decorated and Perpendicular. There are remains of a Norman west tower; the Perpendicular tower stands on the north side. The shipping trade is carried on both at the town itself and at Sutton bridge, 8 mi. lower down the river. The chief imports are timber and general merchandise, and the exports coal, corn and other agricultural products and salt. In the neighbourhood large quantities of fruit are grown, including apples, pears, plums, gooseberries and strawberries. The borough received a charter of a fair in 1327 and was incorporated in 1549.

See W. Watson, *History of Wisbech* (Wisbech, 1827); N. Walker and C. Thomas, *History of Wisbech* (Wisbech, 1849); *History of Wisbech* (Wisbech and London, 1833); C. Marlowe, *The Fen Country* (1925).

WISCONSIN, popularly called the "Badger State," is one of the North-central States of the United States. It is bounded north by Lake Superior and the upper peninsula of Michigan, east by Lake Michigan, south by Illinois and west by Iowa and Minnesota. The greater part of the western boundary is formed by the St. Croix and Mississippi rivers flowing southward. From south to north (42° 30′ N., 47° 3′ N.) the greatest length of the State is about 300 m. and from east to west (86° 49′ W., to 92° 54′ W.) its extreme breadth is about 260 miles. The lake shore boundaries on the north and east are over 500 m. in length. In area the state totals 56,154 sq.mi., of which 1,439 are water surface.

Physical Features.—The surface of Wisconsin is generally of a rolling or undulating character, interrupted only by the sharper ridges of changing geological strata, the bluff lands along the Wisconsin and Mississippi rivers, and isolated hills and ridges of older rocks which, especially in the north-central part of the State, have thrust themselves up through the younger sedimentary rocks. Rib Hill (1,940 ft.), the highest point in the State, near the town of Wausau in north-central Wisconsin, is an elevation of the latter character. So also are the Baraboo hills, a range in the south-central part of the State. The lowest part of the State is along the shore of Lake Michigan (579·76 ft. above sea level). The mean elevation is 1,050 feet. The divides which form the water sheds between Lake Superior, Lake Michigan and the



MAP OF THE MAIN ROADS OF WISCONSIN

valley of the Mississippi river and its tributaries—the three main drainage areas—are very slight. Of these areas that of Lake Superior is much the smallest. Its short, rapid streams seldom rise more than 30 m. S. of the lake shore. Of the streams flowing into Lake Michigan the Fox river (260 m.) is the most important. Rising in the south-central part of the State it flows north and east by a circuitous route through Lake Winnebago, and thence into Green bay. In its upper course it is joined from the north by Wolf river, an important tributary. The Menominee and Oconto are smaller rivers also flowing into Green bay, while

farther south the Sheboygan and Milwaukee rivers empty directly into the lake. The harbours along Lake Michigan are mainly enlarged mouths of rivers.

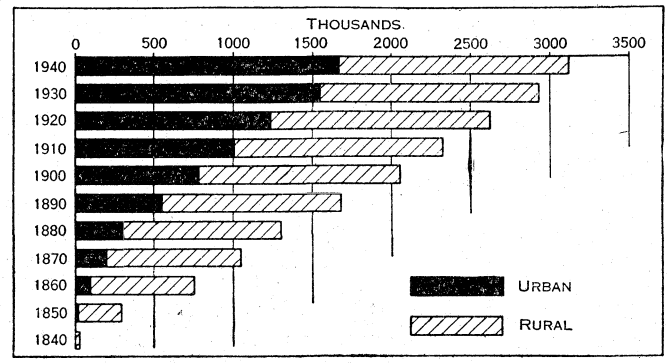
The largest by far of the drainage areas is that whose waters flow into the Mississippi river. The Wisconsin river, the principal tributary, rises on the upper Michigan border and flows south and west for 600 m. through the heart of the State to join the Mississippi near Prairie du Chien. It is navigable for light craft as far as Portage, 200 m. from its mouth. At this point the Fox river, flowing into Lake Michigan, is but a mile to the east across low, marshy ground. The proximity of the two rivers made this a frequent route for early explorers and fur-traders travelling by canoe from the lake to the Mississippi; a canal now connects them. North of the mouth of the Wisconsin the Mississippi receives several rivers of considerable length, the most important of which are the Black, Chippewa and St. Croix, the latter forming the Wisconsin-Minnesota boundary line for 135 miles. The southern part of the State is drained by a number of streams which find their way to the Mississippi after passing into Illinois. The largest of these are the Rock, Fox (of the Illinois) and Des Plaines rivers.

Glacial ice sheets covered all but the south-western quarter of Wisconsin and greatly influenced the topography and soils. They levelled the hills, filled in the valleys and ground and mixed the soils. In the terminal moraines invaluable sand and gravel deposits were left. The glacial ice was further responsible for the thousands of lakes which not only add to the beauty of the State and serve increasingly as summer resorts but also serve to control the water flow of the rivers and prevent floods. The largest of these is Lake Winnebago with an extreme length of 30 m. and breadth of 10 m., on the banks of which are several important manufacturing cities. In the south and east portions of the State the lakes are beautiful, clear bodies of water with sandy or gravelly shores, and, as a rule, high banks heavily wooded. Many of them are famous as summer resorts, notably Lake Geneva, Green lake, the lakes in Waukesha county and the famous "four lakes" near Madison. A second group of many hundreds of lakes is found in the highland district of northern Wisconsin, chiefly in Vilas, Oneida and Iron counties. Most of these are small, but there are few portions of the world where so large a proportion of the total area is occupied by lakes. A third group, also consisting of hundreds of small lakes lying close together, is to be found in north-western Wisconsin, especially in Washburn, Burnett, Polk, Barron and Sawyer counties.

In all parts of the State, except the driftless area of the south-west, numerous large and small marshes are also to be found, many of them representing filled in or drained lake beds. The driftless area is lakeless, and has in general a much rougher topography. In its limits much of the most attractive scenery of the State is to be found. Between the Wisconsin and Mississippi valleys is the Western Upland, a plateau, ordinarily about 1,200 ft. in elevation, but dissected in every direction by tributaries of the two rivers which bound it into a succession of ridges and coulees, the former from 300 to 500 ft. above the valley bottoms. The bluffs are wooded and often capped by picturesque limestone cliffs. Originally the greater portion of Wisconsin was covered with forests, although in the south and west there were large tracts of open prairie land. In the south the predominating trees were hickory, elm, oak and poplar. Along the shores of Lake Michigan, and extending inland a quarter of the distance across the State and northward through the Fox river valley, there was a heavy belt of oak, maple, birch, ash, hickory, elm and some pine.

Climate.—The climate of the State is influenced by the storms which move eastward along the Canadian border and by those which move northward up the Mississippi valley; that of the eastern and northern sections is moderated by the Great Lakes. The winters, especially in the central and north-western sections, are long and severe, and the summers in the central and south-western sections are very warm; but cold and heat are less felt than they are in more humid climates with less extreme temperatures. The average length of time between the last killing frost of spring to the first killing frost in the fall ranges from 170 days in the south-eastern corner of the State to 75 days near the Michigan boundary. It is much longer near the lakes and along the Mississippi river. The distribution of rainfall is remarkably uniform, the mean precipitation being about 31 inches. About half the rainfall comes in May, June, July and August, the period of greatest crop growth. The average snowfall is 45 in., though along Lake Michigan and in the northern part of the State it reaches an average of 53 inches.

Population.—The population of Wisconsin in 1840 was 30,945; in 1860 it was 775,881; in 1880, 1,315,497; in 1910, 2,333,860; and in 1940, 3,137,587. This last figure represents an increase of 6·8% over the population in 1930. The population per square mile was 57·3, as compared with 44·2 for the United States as a whole. Of the 1940 population, 1,679,144, or 53·5%, lived in urban places, that is, in cities and villages of 2,500 or more.



BY COURTESY OF THE U.S. BUREAU OF THE CENSUS

URBAN AND RURAL POPULATION OF WISCONSIN: 1840–1940

The number of occupied dwelling units returned in the housing census of 1940 was 827,265, which is approximately the same as the number of families. The average population per family (occupied dwelling unit) declined from 4·1 in 1930 to 3·8 in 1940. The white population of Wisconsin formed 99·2% of the total in both 1940 and 1930. The number of males per 100 females in the entire population of the state was 104·6, though there was a considerable excess of females in the urban population, the sex ratio being 96·4 for the urban and 114·8 for the rural population. The number of persons 65 years old and over in Wisconsin increased from 192,059, or 6·5% of the total population in 1930 to about 242,000, or 7·7%, in 1940. The population of the state and of its principal cities is summarized below:

Area	Population			Per cent of increase	
	1940	1930	1920	1930–40	1920–30
The State	3,137,587	2,939,006	2,632,067	6·8	11·7
Urban	1,679,144	1,553,843	1,244,858	8·1	24·8
Rural	1,458,443	1,385,163	1,387,209	5·3	—0·1
Per cent urban	53·5	52·9	47·3	..	..
Principal cities:					
Milwaukee	587,472	578,249	457,147	1·6	26·5
Madison	67,447	57,899	38,378	16·5	50·9
Racine	67,195	67,542	58,593	—0·5	15·3
Kenosha	48,765	50,262	40,472	—3·0	24·2
Green Bay	46,235	37,415	31,017	23·6	20·6
La Crosse	42,707	39,614	30,421	7·8	30·2
Sheboygan	40,638	39,251	30,955	3·5	26·8
Oshkosh	39,089	40,108	33,162	—2·5	20·9
West Allis	36,364	34,071	13,745	4·9	152·2
Superior	35,136	36,113	39,671	—2·7	—9·0

The first wave of settlement (1824–40) in the lead regions of southwestern Wisconsin was made up principally of southerners who had ascended by the convenient Mississippi route. The next wave (1835–50) consisted of those coming west from New York, Pennsylvania, Michigan and other eastern states who took up a large proportion of the land in the southeastern counties of Wisconsin. After them (1840–60) came the great tide of German and Norwegian immigration. The Germans settled mainly from Milwaukee west and north to the Fox river and Lake Winnebago. The Norwegians settled in Dane and other counties of south-central Wisconsin. Swiss, Swedish, Danish, Irish, Dutch, Belgian, Austrian and Polish colonies were also soon founded. The Germans total more than one third of the foreign stock.

Government.—The original constitution of the state, adopted in 1848, is still in force, though a number of amendments have been made. An amendment may be proposed by either house of the legislature, and if passed by a majority of the members of each house in two successive legislatures, it must be submitted for ratification by a majority vote of the people. A constitutional convention may be called if the proposal is adopted by a majority of the senate and assembly and voted upon favourably by the people at the following election. The legislature, composed of the senate and assembly, meets biennially in January of odd-numbered years. It may also be called into special session by the governor, but only to transact the specific business named in the governor's call. There were in 1940 100 assemblymen and 33 senators, the former chosen for two-year terms, the latter for four years.

Executive power is vested in a governor and a lieutenant governor, elected for two years. The governor has a veto on legislation which may be overridden by a two-thirds vote of the members present in each house. The lieutenant governor is president of the senate with a casting vote only. The administrative officers, a secretary of state, treasurer and attorney general, are elected for two years and in *ex-officio* capacity act also as commissioners of public lands. The secretary of state is also *ex-officio* auditor. A state superintendent of public instruction is elected for a four-year term. A number of very important governing commissions have been established, the chief ones being the industrial, tax and public-service commissions. The industrial commission has authority in matters involving relations between management and labour. With the rise of Wisconsin as an industrial state, the commission has become increasingly important, and its advanced policies have challenged the attention of the economic world. The public service commission has jurisdiction over the rates and service of railways and other public utilities. Each of the three commissions consists of three members, appointed by the governor with the consent of the senate. Other important commissions and departments are: the state highway, banking, conservation, insurance, and grain and warehouse commissions; the department of agriculture and markets; the bureaus of engineering, of personnel, of purchases, and of the budget; the boards of engineering, of health, of vocational education and of control (over charities and correction).

The judicial power of the state is vested in a supreme court of seven members, each elected for a term of ten years, which has appellate jurisdiction throughout the state. Two terms a year are held at Madison.

There were in 1940 20 circuit courts, the court in the second circuit (Milwaukee) having 9 branches.

Finance.—The assessed valuation of all tangible property for state tax purposes in 1929 was $5,975,952,415; but by 1934 it had declined to $4,133,546,513 and rose only to $4,393,151,680 by 1939.

Since 1931 only a negligible proportion of the state revenue has been derived from a general property tax although this source continues to be the main reliance of local governments and school districts. In 1939–40 revenues going into the state's general fund totalled $112,948,987, of which $12,170,329 was raised by a state levy on incomes; $2,782,887 by a surtax for old-age pensions; $14,801,473 by a tax on various classes of public-utility and transportation corporations; $1,875,209 by a tax on insurance companies; $2,384,202 by inheritance taxes; $6,381,036 by liquor taxes; $22,444,020 by a motor fuel tax; and $13,524,069 by automobile registration fees.

Expenditures for 1939–40 amounted to $114,587,978, of which $7,855,906 was charged to educational aids; $34,257,645 to highways; $17,437,167 to charitable aids; and $10,811,841 to support of the state university. In 1940 the state debt was only $1,184,000 or 37½ cents per capita.

Banks in Wisconsin numbered 580 in Oct. 1939, of which 105 were national banks. Their resources and liabilities totalled $1,068,856,000; their capital, surplus and undivided profits were $111,970,000; deposits amounted to $946,869,000, of which $444,000,000 were in the nature of time or savings accounts.

Education.—Wisconsin's population of school age (5–17 inclusive) was 687,324 in 1940. Its public-school enrolment for the same year was 535,175, as compared with 564,022 in 1930 and 465,243 in 1920. Of the 1940 enrolment, 374,864 pupils were in the elementary and 160,311 in the secondary grades. The steady decline of the school enrolment during the decade was generally ascribed to a decrease in the birthrate, the cessation of immigration and more accurate statistics. In the year 1939–40 there were 21,577 public-school teachers in the schools of the state whose average salary was $1,307. New laws giving tenure rights to teachers and fixing the school term at nine months accounted for slight increases in salary averages. Expenditures for public schools in the state in the year 1939–40 amounted to $51,791,020, or $16.57 per capita of the total population. Most of this amount was raised locally by the ordinary school tax, but almost $8,000,000 consisted of state aids appropriated by the legislature. The elementary and secondary public-school system is under the supervision of the state department of education, headed by the state superintendent elected for four years. The department also has charge of the school for the blind at Janesville and the school for the deaf at Delavan.

The state maintains nine teachers colleges which, listed in the chronological order of their establishment, are situated at Platteville, Whitewater, Oshkosh, River Falls, Milwaukee, Stevens Point, Superior, La Crosse and Eau Claire. All offer courses ranging from one to four years and grant the bachelor's degree to graduates of the four-year course. They are administered by a board of regents of normal schools composed of 11 members including the superintendent of public instruction *ex officio*. By act of the 1911 legislature, Stout institute, located at Menominee, was taken over by the state and is supported as a training school for vocational teachers. It is administered by the state board of vocational education. The University of Wisconsin (*q.v.*) is the highest of the state educational institutions.

It is estimated that there are about 115,000 pupils of grade- and high-school rank in the private and parochial schools and academies. Of private institutions of collegiate rank the leading are Beloit college at Beloit, Carroll college at Waukesha, Lawrence college at Appleton, Milwaukee-Downer (for women) at Milwaukee, Milton college at Milton, Marquette university at Milwaukee, Northland college at Ashland, Ripon college at Ripon, and St. Norbert college at West De Pere.

Charities and Corrections.—A department of public welfare controls most of the state charitable, curative, correctional and penal institutions. It also directs the activities of other agencies related to the work of these institutions, such as the juvenile and probation departments, and has supervisory and inspectional powers with respect to county asylums for the insane, county tubercular sanatoria, county and city care of the poor, private child welfare and child placing agencies and jails and lockups within the state. There are 13 state institutions under the management of this board, namely: state hospital for the insane at Mendota, Northern hospital for the insane at Winnebago, Central state hospital for the criminal insane at Waupun, Northern Wisconsin colony and training school for the feeble-minded and epileptics at Chippewa Falls, Southern Wisconsin colony and training school for feeble-minded and epileptics at Union Grove, industrial school for boys at Waukesha, industrial school for girls at Milwaukee (to be transferred to Oregon), state reformatory (for males) at Green Bay, an industrial home and a state prison for women both at Taycheedah, state prison at Waupun, workshop for the blind at Milwaukee and the state public school at Sparta. Supervision of state sanatoria for the care of tubercular patients was transferred in 1939 to the state board of health.

Agriculture and Livestock.—Wisconsin is one of the leading agricultural states of the United States. In 1940, 62·5% of the total area of the state or 22,876,494 ac. was farm land. Of this 10,280,526 ac. were classified as cropland, 2,757,420 ac. as pasture land and 9,838,548 ac. as woodland and miscellaneous. Farm population in 1940 was 873,462, an increase from 1930 of 0·1%; the number of farms was 186,735, an increase during the decade of 2·7%. During the same period the average size

of farms increased from 120·3 ac. to 122·5 ac.

The value of all farm lands and buildings was set in 1930 at $1,731,517,017, but by 1940 had declined to $1,188,559,407. On Jan. 1, 1938, the estimated value of all livestock in the state was $285,865,000, of which cattle accounted for 65·9% and horses and mules for 23%. Between 1930 and 1940 the value of farm buildings decreased from $745,932,000 to $592,488,721, but the value of implements and machinery increased from $170,279,000 to $173,830,861. Land values, however, declined steadily from $1,618,913,000 ($73.09 per acre) in 1920 to $985,585,000 ($45.06 per acre) in 1930 and to $596,070,686 ($26.06 per acre) in 1940. The highest land values are in the southern and eastern counties.

Cash farm income in 1940 was $303,203,000, of which $38,637,000 came from the sale of crops and $264,566,000 from livestock products. The chief crops and their acreage in 1940 were: tame hay, 4,086,000; corn (maize) 2,255,000; oats, 2,251,000; barley, 654,000; soybeans 311,000; rye 193,000; potatoes, 193,000; wild hay, 140,000; wheat, 86,000; tobacco, 24,500. The production of each crop (with yield per acre in parentheses) was as follows: tame hay, 7,416,000 tons (1·81); corn, 93,582,000 bu. (41·5); oats, 96,793,000 bu. (43·0); barley, 24,525,000 bu. (37·5); soybeans for beans, 648,000 bu. (17·5); soybeans for hay, 455,000 tons (1·85); rye, 2,509,000 bu. (13·0); potatoes, 15,054,000 bu. (78·0); wild hay, 154,000 tons (1·1); wheat, 1,743,000 bu. (20·3); tobacco, 36,532,000 lb. (1,491). Wisconsin's climate is so favourable that failure of any one crop is unknown.

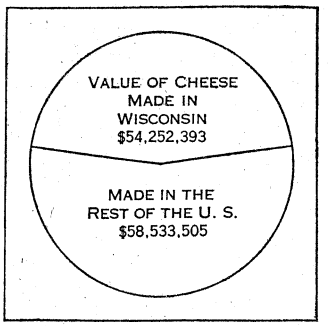
A very small proportion of Wisconsin's crops is marketed direct, but they are fed to the livestock on the farms, and the farmers receive their income chiefly from livestock products. Chief of these are dairy products, for Wisconsin is the leading dairy state in the United States. In 1937 it was estimated that 50% of all farm income came from farm milk produce. In 1941 Wisconsin ranked fourth among the states in the total number of cattle owned, the number being 3,542,000 and their value, $219,504,000. Of this number 2,289,000 were milch cows and heifers two years old or more, so that in the number of milch cows Wisconsin was far in the front of all other states. Doubtless it was the large proportion of Swiss, German and Danish settlers in Wisconsin that gave the cheese making industry its momentum, for very early these people were making and selling the famous cheeses of their native lands. In 1937 Wisconsin produced nearly 55% of all the cheese made in the United States. It also produced about one-third of the condensed and evaporated milk. In the production of creamery butter the state formerly ranked next to Minnesota, but after 1925 Wisconsin lost this relative position to Iowa and fell off in the absolute quantity of its output from 170,202,000 lb. in 1925 to 155,306,000 lb. in 1929 and 150,265,000 lb. in 1933. By 1938, however, the production of creamery butter in Wisconsin had risen to 188,933,000 lb., an all-time high record.

The dairy industry is so dominant in Wisconsin farm life that other livestock is forced into a minor position. Nevertheless in the southern part of the state swine are important. There were 1,689,000 swine valued at $15,959,000 in 1941, as compared with 1,611,993 valued at $18,671,225 in 1930. The number of chickens in the state on Jan. 1, 1940, was 16,361,000.

Sheep and lambs are much less important, although there is a place for them in the rough bluff country. In 1941 they numbered 513,000 and were valued at $3,320,000. The wool clip of 1940 was 2,918,000 lb.

Horses and mules on farms Jan. 1, 1941, numbered 505,000 and were valued at $47,849,000.

Manufactures.—Manufacturing, as the result of a remarkable growth, has become the chief industry of the state. The value of its products in 1900 was $360,818,942; in 1914, $695,172,000; in 1929, $2,152,382,000; but in 1933 was only $824,040,000; and in 1937, $1,772,310,000. Despite the increase (1900–29) in value of products, the number of manufacturing establishments decreased from 9,104 in 1914 to 7,415 in 1929 and to 6,318 in 1937, revealing a clear trend toward fewer and larger factories. The number of wage earners increased from 194,310 in 1914 to 264,646 in 1925 and was 234,067 in 1937. The total of wages paid rose from $112,193,000 in 1914 to $352,383,000 in 1929 and stood at $296,365,000 in 1937. Between 1914 and 1931 Wisconsin consistently held the rank of tenth among the states in the value of its manufactured products but dropped to twelfth place in 1933 (being overtaken by North Carolina and Missouri). By 1939 it was again tenth.



PROPORTION OF TOTAL UNITED STATES OUTPUT OF CHEESE PRODUCED IN WISCONSIN, 1937

Wisconsin's chief branch of manufacture is that connected with its great dairying industry. In 1937 its butter, cheese and condensed milk products were valued at a total of $175,539,638, an amount giving it the leadership among the states in dairy products. Something of the growth of this industry prior to the depression may be seen by comparing the amount of product in 1914 ($72,859,000) with that of 1925 ($209,260,384). The industry is the most widely diffused of all manufacturing industries in the state, its factories being small and close to the supply of raw material. Of the 6,318 manufacturing establishments in 1937, more than one-third were creameries or cheese factories. Next in the order of the amount of its output was the paper and pulp industry, which in 1937 produced goods valued at $128,226,460. Motor vehicles, manufactured to the value of $155,944,640 in 1925, were not separately listed in the census of manufactures for 1937 although motor vehicle bodies and parts worth $90,700,733 were produced. The output of malt and malt liquors in 1937 amounted to $94,275,803. Other major manufactures in the same year were: meat-packing products, sausage, sausage casings, etc., $80,177,471; foundry and machine-shop products, $24,217,965; boots and shoes (not rubber), $41,477,062; printing, publishing, $44,037,755; knit goods, $23,301,857; electrical machinery, apparatus and supplies, $50,495,855; canned and dried fruits and vegetables, preserves, etc., $26,468,623; paper boxes, envelopes and other paper products, $28,373,812; bread and other bakery products, $29,038,884; tanned, curried and finished leather, $34,640,267; furniture, $26,179,608; engines, turbines, tractors, water wheels and windmills, $33,776,587; machine tools and machine tool accessories, $14,825,064; clothing $6,816,947; lumber and timber products, $19,835,901; planing mill products, $19,086,829.

In 1910 Milwaukee was responsible for more than one-third of the state's manufacturing output and she is still the chief industrial centre of the state. Since 1914, however, other cities have developed considerable manufactures, especially Kenosha, Racine and Janesville. Racine and Janesville are famous producers of farm implements. Important enterprises are also located at West Allis, Madison, Oshkosh, Sheboygan, Beloit, Green Bay, Superior, La Crosse, Manitowoc, Fond du Lac, Eau Claire and Appleton. Madison, Beloit and Janesville are all in the Rock river valley, which is the route for two of the leading railroads from Chicago to the northwest. A more notable concentration of manufacturing cities is in the Fox river valley, including the shores of Lake Winnebago. Here are Oshkosh, Fond du Lac, Appleton and Green Bay. Their location makes them the centre for the papermaking and wood-working industries. This is also the region of greatest development in water power. It is noticeable that only one of the important cities, La Crosse, is on the Mississippi river, and one only, Superior, on Lake Superior.

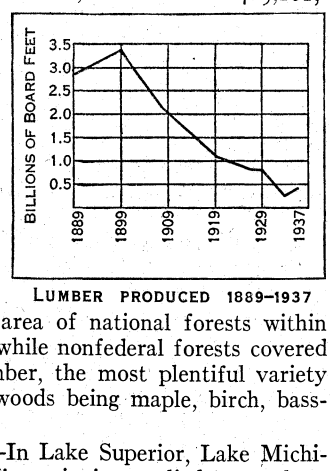
Mines and Quarries.—Wisconsin's mineral products are varied and though in value they fall far below the farm, forest and factory products of the state, they nevertheless amount to considerable sums each year. During the decade, 1920–30 the annual production ranged close to $20,000,000 and in 1929 exceeded $24,000,000. Mining activity, however, diminished in 1930 and subsequent years until 1933 when production stood at the low mark of $7,154,000. Thereafter, a slow recovery began, and in 1938 the state's mineral output was worth $10,636,741.

The lead mines of southwestern Wisconsin were the earliest developed, and they reached a peak production in the decade

1840–50 since which they have slowly declined. In 1918 there were produced 4,533 short tons valued at $643,686. In 1938 the production was but 320 short tons, worth but $29,440. Most of the lead is only a by-product of zinc mining which has become of main importance in the same region. The zinc-bearing ores are chiefly found below the water level, and their production was not stimulated greatly until the rise in price of zinc about 1900. The production of this metal amounted to 27,285 tons in 1920, 10,952 in 1922, 26,800 in 1926 and 2,073 in 1938. The value of the 1938 output stood at $199,008. Whereas early lead mining was largely carried on by individuals in shallow mines, the deeper zinc ores are mined almost exclusively by large companies using modern power machinery for mining and milling.

Of the great Lake Superior iron-producing district shared by Minnesota, Wisconsin and Michigan, Wisconsin possesses the smallest part. Two producing ranges extend into north Wisconsin, but the richer portions of each are in the upper peninsula of Michigan. The Wisconsin portion of the Penokee-Gogebic range is in Iron county, where most of the ore is mined, though one small mine operates in Dodge county. Production in 1935 amounted to 788,483 gross tons and in 1939 to 972,685, the latter output coming entirely from two mines in Iron county. The chief mineral output of Wisconsin is building and ornamental stone, the value of which was $4,590,528 in 1923 and $3,880,935 in 1938. Granite of many different colours is quarried. The lime product of 1938 was valued at $483,111. At hundreds of places in the state, clay deposits suitable for making brick and tile are to be found, and products of this industry in 1924 were valued at $1,063,164. In 1933 the value of clay products fell to $156,743, but it rose to $557,152 in 1937. Another important resource of the state is its mineral waters. Fuel briquets, however, lead in value with a total of $3,782,367 for 1937, 61·6% of the value of the entire output of the U.S.

Forests and Lumbering.—Originally all Wisconsin, except a few thousand square miles of prairie region in the south, was covered with forests, the heavier timber being in the northern half of the state. Wisconsin's many rivers, fairly even topography and nearness to the Great Lakes and Mississippi river favoured the rapid exploitation of these forests, and unrestricted and wasteful cutting went on apace. The most valuable original timber, the white pine, is almost exhausted as a result. The great age of lumbering in Wisconsin was from 1890 to 1905, for the last five years of which Wisconsin was the leading lumber-producing state of the United States. The value of rough lumber reached nearly $70,000,000 annually. In 1937 Wisconsin ranked seventeenth in the production of lumber, with a cut of 419,162,000 bd.ft. besides 31,548 squares of shingles (800 shingles to the square) and 19,665 thousand laths. In wood-pulp manufacture the state came second, with an output for 1937 of 638,217 tons (exceeded only by Washington). Its timber resources, however, are by no means exhausted. Its remaining stand is estimated at 2,000,000 million bd.ft., much of which is protected in national and state forests. In 1938 the area of national forests within its boundaries was 1,320,413 ac. while nonfederal forests covered 696,162 ac. Of the standing timber, the most plentiful variety is hemlock, the other principal woods being maple, birch, basswood, pine and elm.



LUMBER PRODUCED 1889–1937

Commerce and Transport.—In Lake Superior, Lake Michigan and the Mississippi river Wisconsin is supplied upon three sides by unusual facilities for water shipping. In addition to their actual commerce these waterways are of great importance because of the continual check they supply upon land transport rates. Since pioneer days and the building of east-west railways the Mississippi has lost its importance as an actual carrier, but the Great Lakes have not. In 1937 the chief lake ports were as follows:

	Receipts Short tons	Shipments Short tons
Ashland	678,000	6,329,000
Milwaukee	5,299,000	1,312,000
Green Bay	2,240,000	3,000

In addition Wisconsin shared in the business of the great Duluth-Superior port which in 1937 registered receipts of 11,227,000 short tons and shipments of 45,912,000 short tons.

The first railway in the state was constructed from Milwaukee westward in 1851 and completed to the Mississippi river at Prairie du Chien in 1857.

The first railways were built east and west with the idea of connecting the waterways as quickly as possible, but as the railways grew more independent the main lines were built in a general northwest and southeast direction so as to connect Chicago and Milwaukee with the cities of St. Paul and Minneapolis by lines as direct as possible. Other lines run from Milwaukee northwest to Ashland, Superior and Duluth. The railway mileage in the state amounted to 6,828 mi. in 1937 as compared with 7,638 mi. in 1915.

The largest systems are the Chicago and North Western, the Chicago, Milwaukee, St. Paul and Pacific and the Minneapolis, St. Paul and Sault Ste. Marie. For passenger service, railway lines have been supplemented since 1923 by an increasing network of motorbus lines running over the principal highways and connecting the chief cities.

There were in 1930, 81,784 mi. of rural roads of which 29,632 mi. were surfaced. Of the 10,012 mi. in the state highway system in 1937, 9,829 were surfaced, 5,499 of high type surface and 4,330 of low type. Expenditures on highways during 1938 (including federal aid) amounted to $35,991,000. Motor vehicle registrations numbered 782,562 in 1930 and 840,291 in 1938.

HISTORY

The region comprising the present state of Wisconsin was first explored by the French, who in their eagerness to find a "northwest passage" rapidly penetrated the Great Lakes waterways.

French Explorers and Traders.—Jean Nicolet came in 1634, having been sent by Samuel Champlain, then governor general of New France to investigate rumours of a distant race called the "People of the Sea" who, it was hoped, might be Asiatics. Nicolet landed at a point in Green bay and made a treaty of alliance with the "People of the Sea" whom he found were merely the populous tribe of Winnebago Indians then living in the neighbourhood. Champlain died shortly after Nicolet's return and no further explorations in the west were undertaken for 20 years. In 1654 Pierre Esprit, Sieur de Radisson and Medard Chouart, Sieur des Groseilliers, two French traders, visited Green bay and explored the country west and south. The vagueness of Radisson's journal leaves the interpretation of their itinerary much in doubt. Some scholars are disposed, from certain phases, to accord them the honour of having entirely crossed Wisconsin and discovered the Mississippi river, but this, while possible, is doubtful. The same explorers undertook a second voyage into the west in 1658–60 in which they were the first to skirt the Lake Superior shore of Wisconsin. On Chequamegon bay they built a log hut—the first white habitation, so far as is known, in the state—and the following winter made a long inland trip to the Ottawa villages in northern Wisconsin. In 1660 seven traders, accompanied by the Jesuit, Father René Ménard, the first missionary in Wisconsin, wintered at Chequamegon bay on Lake Superior; and Ménard, the next summer, perished while trying to reach the Huron villages near the sources of the Black river. In 1665 other traders came into Lake Superior and with them came Father Claude Allouez who, on the shores of Chequamegon bay, established the first permanent mission in Wisconsin. In 1668 Jean Peré began a three-year exploration of Lake Superior and its northward connections, and among other things verified the report of Father Allouez that copper was available in considerable quantities upon its shores. Within a few years after the first Frenchmen reached Lake Superior, the main copper deposits were known.

In 1668 Green bay was again visited, this time by Nicolas Perrot and Toussaint Baudry who made several trips to inland tribes on the Wolf and upper Fox rivers with whom they concluded trading treaties. Other traders came. In 1669 Allouez was succeeded at his Chequamegon mission by Father Marquette and went into the Fox river valley where at the first rapids he founded the mission of St. François Xavier, one of the most successful of those established by the Jesuits in the west. It became the centre for further missionary efforts to all the surrounding tribes. In 1671 Father Marquette was forced by Indian wars to abandon the Chequamegon mission and in 1673, in company with Louis Joliet, he set off down the Fox-Wisconsin water route to discover the Mississippi river of which the Indians had told them. On July 17 they reached the mouth of the Wisconsin and sailed out upon the Mississippi waters.

In 1679 Daniel Greysolon Du Luth explored the upper Mississippi, St. Croix and Black rivers. The same year Michel Accault, accompanied by Father Hennepin, explored the Mississippi along Wisconsin's western boundary until they met Du Luth who returned with them by the Wisconsin-Fox route to the St. François Xavier mission. Du Luth continued his explorations on the Mississippi and Lake Superior until 1689 when he left the west never to return. His work was supplemented by the Mississippi expeditions of Perrot, who in 1686 built Fort St. Antoine on Lake Pepin, an enlargement of the Mississippi river. Perrot was now the French commandant in Wisconsin and most influential with the Indian tribes. In 1671 Saint-Lusson at Sault Ste. Marie had taken formal possession of the Great Lakes region in the name of the king of France; in 1689 Perrot staged a similar ceremony at his Fort St. Antoine on the Mississippi river. The 18 years between the two events had marked the period of French discovery and occupation of Wisconsin. Traders entered the region in increased numbers, and to protect them from the Indians and to control the trade properly a military force was necessary.

In 1712 the slaughter of a band of Foxes near Detroit was the signal for hostilities which lasted almost continuously until 1740, and in which every tribe in the Wisconsin country was sooner or later involved either in alliance with the Foxes or with the French. This war seriously interfered with the French plan of trade and development. The difficulty of maintaining a chain of settlements which might have connected Canada and Louisiana was a contributing cause to the overthrow of French dominion. Wisconsin was little disturbed by the Seven Years' War. However, the French and Indians of Wisconsin contributed a force under the half-breed, Charles Michel de Langlade, which made the long journey to lower Canada to share in the war. With the fall of Montreal (1760), French rule in Wisconsin was over.

British Occupation.—The first period of British occupation was brief for on the outbreak of Pontiac's conspiracy in 1763, the evacuation of the Green bay fort was forced. When the conspiracy was crushed in 1765, Wisconsin was reopened to traders, and not only French and English, but American traders from the colonies entered the region. British prestige among the Indians and the French *habitants* was hurt by a policy of confining the Indian trade to the forts instead of permitting the traders to go into the Indian villages. Little as they cared for their British rulers the French and Indians in the region remained loyal to the British during the Revolutionary War. De Langlade again led his French and Indian forces against the American frontier communities west of the Alleghenies.

The close of the war, although it conveyed the region to the sovereignty of the United States, was not followed by American occupation. The newly formed North-west company, a British fur-trading organization, kept control of the posts, built new ones, extended their trade and dominated the region. The control of these posts was one of the issues in the War of 1812, for American traders were becoming powerful enough to demand that the British traders should be made to withdraw. The end of the war meant the termination of British influence in Wisconsin, and actual military occupation of the country by the United States came in 1816 with the establishment of garrisons at Green Bay (Ft. Howard) and Prairie du Chien (Ft. Crawford).

Incorporation with Michigan.—Wisconsin in 1800 had nominally been attached to Indiana Territory; and in 1809, on the admission of Indiana as a State, it was attached to Illinois. In 1818 Illinois was admitted to the Union and Wisconsin was incorporated in Michigan Territory. It was only at the latter date that American civil government in Wisconsin was established on an orderly and permanent basis. Until 1830 the fur-trade, controlled largely by the American Fur company, continued to be the predominating interest in the Wisconsin region, but then the growing lead-mining industry in the south-western part of the State began to overshadow the fur-trade. The lead-mining activity which began in 1824 was the first incentive to genuine settlement in the State since the fur-trade discouraged settlement except around the few trading posts. In 1830 there were about 2,500 miners in the region. Friction between these settlers and the Indians could not be avoided and in 1832 occurred the famous Black Hawk War, which broke the Indian power within the State. In addition the war made Wisconsin better known, and with the Indian menace removed there was an appreciable impetus to settlement. A series of Indian treaties in 1829, 1831, 1832 and 1833 extinguished the Indian titles and opened up vast areas to settlement.

In 1834 two land offices were opened, and by 1836, 878,014 ac. had been sold to settlers and speculators. In 1836 a special census showed a population of 11,000; in 1840 the number was about 40,000. From 1835 to 1845 settlers from the eastern States poured into the south-eastern part of the State, founding Milwaukee and other cities along the lake shore.

Wisconsin Becomes a Separate Territory.—When Michigan entered the Union in 1836 Wisconsin was erected into a separate Territory which at first included not only its present area, but the present Iowa and Minnesota and a portion of North and South Dakota. Henry Dodge was appointed the first territorial governor by President Jackson. The first territorial council met in 1836 at Old Belmont, now Leslie, Lafayette county, but in December of that year after a contest in which Fond du Lac, Milwaukee, Racine, Green Bay, Portage and other places contended for the honour, Madison was selected as the capital.

Population increased so rapidly that it was not long before a movement for the admission of Wisconsin as a State was taken up in earnest and on Aug. 10, 1846, an enabling act for that purpose passed Congress and was approved by President Polk. The first Constitution drafted was rejected by the people, however, owing to liberal articles relating to the rights of married women, prohibition of banks, the elective judiciary, etc. A second convention, thought to be more conservative than the first, drafted another Constitution which in 1848 received the approval of both the people and Congress so that the State was admitted. The State governmental officers were sworn into office in June with Nelson Dewey in the governor's chair. In the same year the free public school system was established, and the great stream of German immigration set in. Railway construction began in 1851.

At the time of its admission Wisconsin, still a frontier State, was strongly democratic in spirit. The incoming Germans were likewise of the same sympathies. But Wisconsin was also a strong anti-slavery State and as the Democratic Party affiliated itself more and more completely with the cause of slavery, it lost its hold on Wisconsin. In 1854, one of the first steps in the organization of the Republican Party was taken at Ripon, and in 1856 a Republican governor was elected. In 1854 also the State supreme court rendered a decision which declared the Fugitive Slave Law to be null and void in Wisconsin. In 1860 the State aided in the election of Lincoln and supported his administration during the Civil War. To the Northern armies Wisconsin furnished 91,379 troops out of a total population of 775,881. In 1874 a Democratic liberal reform administration came into office and in the legislative session which followed the Potter Law, one of the first attempts to regulate railway rates, was passed. The Republicans regained control in 1876 and modified the law. In 1889 the passage of the Bennett Law, providing for the enforcement of the teaching of English in all public and parochial schools, roused the Germans, both Catholic and Lutheran,

usually Republicans, so that they voted the Democratic ticket and installed a Democratic administration from 1890 to 1895 which repealed the law. After 1895 the Republican party grew more secure. It placed on the statute books a series of progressive enactments in regard to railway rate legislation, taxation, publicity of campaign expenditures, civil service, forest conservation and finally a direct primary law. In all these reforms a leading part was taken by Governor Robert M. La Follette (1901–06), elected to the U.S. senate in 1905 when the reform movement was at its crest. Opposition to his program resulted in a serious split in the Republican ranks; the opposition, taking the old name of "Stalwarts," captured the governorship (1915–21). La Follette, however, retained his senate post until his death in 1925 and carried the state's electoral vote for president in 1924. The progressive tradition was ably continued by Robert M. La Follette, Jr. in the senate since 1925 and by his brother Philip, elected governor in 1930, 1934 and 1936. These progressive Republicans supported Roosevelt in 1932, and as Progressives again in 1936. In 1938, however, the regular Republicans regained control of the state, electing Julius P. Heil, a Milwaukee industrialist, to the governorship. Heil was re-elected in 1940.

BIBLIOGRAPHY.—The *Wisconsin Blue Book*, published biennially by the state, furnishes much valuable information; see also bulletins published by the various state departments and commissions. For archaeology consult *The Wisconsin Archaeologist* (1901 *et seq.*) a quarterly magazine published by the Wisconsin Archaeological society. The Wisconsin State Historical society publishes a series of *Collections* (1927) and a series of *Proceedings* (68th report issued 1921); also the *Wisconsin Magazine of History* (1917 *et seq.*). *See* also H. Campbell, *Wisconsin in Three Decades* (1906); R. G. Thwaites, *Wisconsin* (1908); F. C. Howe, *Wisconsin, An Experiment in Democracy* (1912); Charles McCarthy, *The Wisconsin Idea* (1912); R. La Follette, *Autobiography* (1913); E. B. Usher, *Wisconsin, Its Story and Biography* (1914); A. O. Barton, *La Follette's Winning of Wisconsin* (1922); M. M. Quaife, *Wisconsin, Its History and Its People* (1924); W. F. Raney, *Wisconsin, A Story of Progress* (1940); *Wisconsin* (American Guide Series, Writers' Program, WPA, 1940); Reports of U.S. bureau of the census; L. P. Kellogg, *The French Regime in the Northwest* (1925). (C. R. FI.; J. D. H.)

WISCONSIN, UNIVERSITY OF, a co-educational institution of higher learning at Madison, Wis., the capital of the state. It was established in 1848, is under state control, is supported largely by the state and is a part of its educational system. The university occupies a picturesque and beautiful site on an irregular tract of 600 ac., including both wooded hills and undulating meadow-lands stretching for a mile along the shores of Lake Mendota. The main building, Bascom Hall, which crowns University hill, is exactly one mile from the state capitol. The university includes a college of letters and science made up of a library school, schools of commerce, journalism and music, with general courses in liberal arts and special courses in chemistry and pharmacy; a college of engineering with courses in chemical, civil, electrical, mechanical and mining engineering; a college of agriculture with a government experiment station, long, middle and short courses in agriculture, a department of home economics, a dairy course, farmers' institutes and an extension service; a law school; a medical school; a graduate school; a school of education including physical and art education; and an extension division including departments of correspondence study, debating and public discussion, group and community service. There is a summer session of either 6 or 8 weeks for undergraduates and graduates. Instruction is given in the summer session in all colleges. Several scientific institutions are associated with the university, including the U.S. forest products laboratory, the U.S. weather bureau, Washburn observatory, Wisconsin psychiatric institute, the Wisconsin geological and natural history survey, the state laboratory of hygiene and the state toxicological laboratory.

In June 1941 the university library and the state historical library, housed in the state historical library building, contained 1,100,000 bound volumes and 400,000 pamphlets; the special libraries housed in other buildings bring the totals up to 1,580,000 bound volumes and 565,000 pamphlets. In 1940–41 there were 11,376 students enrolled in the two semesters of the regular year —7,656 men and 3,720 women. The summer session enrolled 4,672 students. The faculty for the regular year for both residents and extension work consisted of 1,413 men and 323 women, making a total of 1,736. Admission to the university is by examination or certificate from accredited high schools or academies. Tuition is free for residents of the state. Courses in the first two years are largely prescribed; in the last two years, elective under a prescribed system of majors and minors. The university is governed by a board of regents of ten members of whom one, the state superintendent of public instruction, is an ex-officio member. The other nine members are appointed by the governor for a term of nine years and must be confirmed by the state senate.

(R. Fs.)

WISCONSIN RAPIDS, a city near the centre of Wisconsin, U.S.A., on the Wisconsin river; the county seat of Wood county. It is served by the Chicago and North Western, the Chicago, Milwaukee, St. Paul and Pacific, the Green Bay and Western and the Soo Line railways. Pop. (1940) 11,416 (89% native white). It is in the heart of a dairy region which ships great quantities of cheese and is the centre of the second largest cranberry-producing region in the United States. Hydroelectric power is generated by local plants.

Among the important manufactures are paper and pulp, gasoline and kerosene stoves, camping equipment, men's clothing, dairy products, paint and fibre cartons. A state forest nursery is situated on Nepco lake, just south of the city. Under the name of Grand Rapids, a city on the east bank of the river was chartered in 1869.

In 1900 it annexed Centralia, on the west bank; and in 1920 the present name was adopted.

WISDOM, BOOK OF. This book of the Apocrypha was not—as its title runs—composed by King Solomon, but emanates from the more intellectual circles of the Jewish Diaspora in Alexandria. It falls naturally into three parts which may or may not be the work of a single writer: (*a*) chs. i, 1; vi, 8 in which, in opposition to the views of the ungodly, the author argues that so far as the righteous are concerned, death is not the end: on the contrary "their hope is full immortality"; (*b*) vi. 9–xi. 1 which is written more particularly to portray Wisdom; (*c*) xi. 2–xix. an historical retrospect which is introduced in order to explain the origins and calamitous results of idolatry.

The book belongs to the closing period of the evolution of the Jewish Wisdom Literature (*q.v.*). No part of it would appear to have been written earlier than 150 B.C. Though Thackeray favours 130–100 B.C., Gregg 125–100 and Gfrörer 100 B.C., some modern opinion (*e.g.*, Goodrick) tends to favour a date as late as A.D. 40 (as indeed did Farrar). On the hypothesis of diversity of authorship, Holmes assigns the earlier part of the book to 50–30 B.C. and the last chapters (in his estimation an intentional addition to the first part) to 30 B.C. to A.D. 10. In this case the author was a younger contemporary of Philo (with whom Jerome identified him), slightly a senior of Jesus of Nazareth; and he had not long written his book when it fell into the hands of St. Paul, provided the author of the Epistle to the Hebrews with ideas and with terminology in which to express them, and, somewhat later, influenced, though to a much smaller extent, the authors of Epistles of 1 Peter, St. James and of the Fourth Gospel.

The whole book, as is now generally maintained, originally was written in Greek, and almost certainly in Alexandria by an Alexandrian Jew (or Jews) versed in the Septuagint translation of the Old Testament. To what extent was the author really acquainted with Plato's writings and with Plato's thought, with Pythagorean speculations; with Stoicism and with the Greek mystery cults?

For example, his doctrine of God's transcendence and unity reaches the high-water mark of Jewish theology and piety. He does not abandon the thoroughly Jewish conception of "spirit" as the agent and medium of the transcendent Deity's self-revelation to the Universe and to His chosen people; he even refers twice to the "Word" in this connection without any indication that he has hellenized it as Philo did. But in his description of his favourite intermediary between earth and Heaven, "Wisdom," it is difficult not to suppose that he was (though not so directly as some scholars have urged) influenced by the Stoic doc-

trine of the *anima mundi.* In the end, however, he shows that he has not really gone so far in the direction of hypostatizing "Wisdom" as did the author of Proverbs ch. ix. (*See* especially, Goodrick, *The Book of Wisdom,* Additional Notes D and F, pp. 404–410, 416–419.)

Till comparatively recently the view that the author was an exponent of the doctrine of the pre-existence of souls was unchallenged. The crucial passage is viii. 19, 20, which had hitherto been read in the light of other passages such as i. 4, ix. 15, xi. 17, which might seem to presuppose the evil of matter which was originally "formless" and the body as the prison of the soul in true Platonic fashion. But in 1908 F. C. Porter (*Studies in Memory of W. R. Harper*) put forward the revolutionary thesis that the author's statement in the passage has as its background neither Platonic nor Pythagorean speculations. It is, he urged, a native Hebrew evolution of primitive Semitic beliefs as to the union of the Divine breath with the material clay which results in the production of an individual man.

The tendency of the author's eschatology is equally problematical. It would appear that even if he contents himself with believing in the immortality of the *soul* only, he conceives of this as ensuring the conscious survival of the individual's personality. It is therefore difficult to believe that he does not refer to these same *dead* righteous rather than (as some urge) to the living righteous. It would seem that he did not completely abandon contemporary Jewish eschatological speculations of a materialistic or semi-materialistic nature for Greek ideas as to the immortality of individual souls. He accepted both without evolving a real synthesis of them, probably without grasping the necessity for one, as was obviously his tendency in regard to several other doctrines in which he held to his Jewish beliefs though attracted by their Hellenistic counterparts and the terminology of pagan philosophers who had won his admiration.

BIBLIOGRAPHY.—*See* especially Gregg in *Camb. Bible* (1909); Holmes in Charles' *Apocrypha and Pseudepigrapha of the Old Testament,* i. 518-534; Goodrick in *Oxford Church Bible Commentary* (1913), where copious references will be found. (D. C. S.)

WISDOM LITERATURE. The extant writings of the Jewish sages are contained in the books of Job, Proverbs, Ben-Sira, Tobit, Ecclesiastes, Wisdom of Solomon, Fourth Maccabees, to which may be added the first chapter of Pirke Aboth (*q.v.*), certain of the Elephantine Papyri and isolated sections (*e.g.,* the parable of Jotham) and verses in the historical prophetical Books, as well as Pss. viii.; xix. 2–7; xxix. 3–10; xxxvii., xlix., lxxiii., xc. 1–12; xcii. 6–8 (5–7), cvii. 17–32, cxix., cxxxix., cxliv. 3 f., cxlvii. 8 f. The climax of the intellectual element in this movement is to be found in Philo.

Most of the extant literature doubtless dates only from the post-exilic period. But the Book of Proverbs (*q.v.*) contains minor collections of proverbs which are now recognized as pre-exilic in origin, while individual maxims contained in this and other books may be part of the heritage of post-exilic days from a comparatively hoary antiquity. The Wisdom Movement among the Hebrews was, in fact, no isolated phenomenon, and at no period in its development did it exist, as it were, in a watertight compartment. As the mythology of the Hebrews, their earlier religious ideas in general, many of their deities and several elements in their ecclesiastical calendar were shared with and mostly derived by them from neighbouring peoples, so too it was with the aspect of their culture comprised under the general term "Wisdom." From Mesopotamia to Egypt there existed an "international" stock of traditional Wisdom which passed and repassed from nation to nation, each adding its quota to the common stock, and each adapting to the needs and the requirements of its own culture what it received from those of others. Edom was a famous centre of such "Wisdom" activity in Palestine, and the Hebrew Humanists more than once admit their indebtedness to those of Edom. But the great creative centres of "Wisdom" activities were to be found in Babylonia and Egypt.

Doubtless the early Hebrew exponents of Wisdom at times did more than merely borrow, Hebraise, and conserve the proverbs of other nations. Hebrew tradition, at any rate, points to the reigns of Solomon and Hezekiah as epochs of outstanding importance in the development of Hebrew Wisdom literature. Certainly by the reign of Hezekiah the "wise men" formed a definite stratum in Jerusalem society, and like the priests, prophets and military leaders sought to shape, in accordance with their own economic and political ideals, the fortunes of the Jewish state.

But, as the post-exilic period advanced, and Jewish history and theology unfolded themselves, new problems arose for which no satisfactory explanation could be given by the old religion of the pre-exilic type, the new priestly development, the new scribism, and the still newer "Chasidaean" piety. Prophecy of the pre-exilic and exilic type was dead, and the principle of inspiration for which it stood found its expression more especially in Apocalyptic (*q.v.*). The latter, however, made its greatest appeal to the masses. It remained for the exponents of Wisdom to attempt to solve these problems in a form acceptable to men of culture and to specialize in the instruction of the youth of aristocratic families.

Their intellectual instincts led them to look, not to Persia whence Apocalyptic took so much of its imagery and some of its central ideas, but to the new world of the Mediterranean. With this world they were becoming increasingly familiar owing to the conquests of Alexander the Great and his successors, the rise of Greek cities in Palestine and the spread of Greek culture in Palestine and elsewhere, particularly in Egypt where the Jewish community mostly prospered and kept in close touch with their co-religionists in Jerusalem. The book of Wisdom (*q.v.*) emanated from this Alexandrian centre of Wisdom in the first Christian century, just as Egyptian Jewry in pre-hellenistic days had produced the book of Tobit (*q.v.*). Ecclesiastes and Proverbs (*qq.v.*) chs. i.–viii., on the other hand, are examples of the hellenizing Wisdom literature of Palestine, while Ecclesiasticus belongs to the period before Hellenism had contributed much of moment to the sages of Palestine.

The new problems which confronted these later sages were numerous, both in the practical and in the theoretical sphere. In the former, general looseness of life had to be combated. In the latter, they had to face questions such as the following: If God is transcendent, how can He still be held to intervene in mundane matters? If God is the ruler of the whole universe, is it possible, in the face of facts, still to maintain that His government of it is moral? In particular, what is the bearing of the problem of suffering upon this question? If He is the God of the individual soul, does He abandon that individual at death? Each Wisdom writer gave his own answer to these questions. Sometimes there is substantial agreement: sometimes they contradict each other. The answers of the authors of Proverbs i.–viii., Ecclesiasticus and Wisdom were constructive. In Ecclesiastes, in its original form, and in Prov. xxx. 2–4 instances have been preserved of a sceptical element in the Wisdom Movement.

BIBLIOGRAPHY.—T. K. Cheyne, *Job and Solomon, or The Wisdom of the Old Testament* (1887); Friedländer, *Griechische Philosophie in Alten Testament* (1904); Meinhold, *Die Weisheit Israels in Spruch, Sage und Dichtung* (1908); Oesterley, *The Books of the Apocrypha, Their Origin, Teaching and Contents* (1916). *See* further the Bibliographies to PROVERBS, BOOK OF (for the earlier aspects) and WISDOM, BOOK OF for the later developments. (D. C. S.)

WISE, HENRY ALEXANDER (1806–1876), American politician and soldier, was born at Drummondtown (or Accomac), Va., on Dec. 3, 1806. He graduated from Washington (now Washington and Jefferson) college, Pa., in 1825, and began to practise law in Nashville, Tenn., in 1828. He returned to Accomac county, Virginia, in 1830, and served in the National House of Representatives in 1833–37 as an anti-nullification Democrat, but broke with the party on the withdrawal of the deposits from the United States Bank, and was re-elected to Congress in 1837, 1839 and 1841 as a Whig, and in 1843 as a Tyler Democrat. From 1844 to 1847 he was minister to Brazil. In 1855 he was elected governor of the State (1856–60) as a Democrat. John Brown's raid occurred during his term, and Wise refused to reprieve Brown after sentence had been passed. He strongly opposed secession, but finally voted for the Virginia ordinance, was commissioned brigadier-general in the Confederate army and served throughout the war. He died at Richmond, Va., on Sept. 12, 1876. He wrote *Seven Decades of the Union 1790–1860* (1872).

See the *Life* of H. A. Wise, by his grandson, B. H. Wise (1899).

WISE, ISAAC MAYER (1819–1900), American-Jewish theologian, was born in Bohemia. From the moment of his arrival in America (1846) his influence made itself felt. In 1854 he was appointed rabbi at Cincinnati. Some of his actions, as his compiling of a new prayer-book, roused considerable opposition. He was opposed to political Zionism, and in keeping with this denial of a Jewish nationality, he believed in national varieties of Judaism, and strove to harmonize the synagogue with local circumstances and sympathies. After a campaign lasting 25 years he was instrumental in founding the Union of American-Hebrew congregations in Cincinnati in 1873, and as a corollary in 1875 the Hebrew Union college, of which he was president and which has trained a large number of the rabbis of America. Wise also organized various general assemblies of rabbis, and in 1889 established the Central Conference of American rabbis. He was the first to introduce family pews in synagogues, and in many other ways "occidentalized" Jewish worship. He was not only a leader in liberal Judaism but also a scholar and the author of many works. He died in Cincinnati on March 26, 1900.

Rabbi Wise's *Reminiscences* (1901) were translated with an intro. by David Philipson (1901), who with Louis Grossman prepared a biographical sketch for the *Selected Writings* (1900). A tentative bibliography was prepared by A. S. Oko. *See* also D. Philipson, *The Reform Movement in Judaism* (1907); M. B. May, *Isaac Mayer Wise* (1916); and Henry Berkowitz, *Intimate Glimpses of the Rabbi's Career* (1921).

WISEMAN, NICHOLAS PATRICK STEPHEN (1802–1865), English cardinal, was born at Seville on Aug. 2, 1802, the child of Anglo-Irish parents recently settled in Spain for business purposes. On his father's death in 1805 he was brought to Waterford. He was educated at Ushaw college, near Durham, and at the English college in Rome, of which he became vice-rector in 1827, and rector in 1828. He held the rectorship for twelve years. From the first a devoted student and antiquary, he studied the oriental mss. in the Vatican library, and a first volume, entitled *Horae Syriacae,* published in 1827, gave promise of a great scholar. Leo XII. appointed him curator of the Arabic mss. in the Vatican, and professor of oriental languages in the Roman university. At this date he had close relations, personal and by correspondence, with Mai, Bunsen, Burgess (bishop of Salisbury), Tholuck and Kluge. His student life was, however, broken by the pope's command to preach to the English in Rome; and he visited England in 1835–1836, and delivered lectures on the principles and main doctrines of Roman Catholicism in the Sardinian Chapel, Lincoln's Inn Fields, and in the church at Moorfields, now pulled down. In 1836 he founded the *Dublin Review.* In the winter of 1838 he was visited in Rome by Macaulay, Manning and Gladstone.

In 1840 he was consecrated bishop, and sent to England as coadjutor to Bishop Walsh, vicar-apostolic of the Central district, and was also appointed president of Oscott College near Birmingham. Oscott, under his presidency, became a centre for English Catholics, where he was also visited by many distinguished men, including foreigners and non-Catholics. The Oxford converts (1845 and later) added considerably to Wiseman's responsibilities. It was by his advice that Newman and his companions spent some time in Rome before undertaking clerical work in England. Shortly after the accession of Pius IX. Wiseman was appointed temporarily vicar-apostolic of the London district, the appointment becoming permanent in February 1849. On his arrival from Rome in 1847 he acted as informal diplomatic envoy from the pope, to ascertain from the government what support England was likely to give in carrying out the liberal policy with which Pius inaugurated his reign. In response Lord Minto was sent to Rome as "an authentic organ of the British Government," but the policy in question proved abortive.

Residing in London in Golden Square, Wiseman threw himself into his new duties with many-sided activity, working especially for the reclamation of Catholic criminals and for the restoration of the lapsed poor to the practice of their religion. He was zealous for the establishment of religious communities, both of men and women, and for the holding of retreats and missions. He preached (July 4, 1848) at the opening of St. George's, Southwark, an occasion unique in England since the Reformation, 14 bishops and 240 priests being present, and six religious orders of men being represented.

The progress of Catholicism was undeniable, but yet Wiseman found himself steadily opposed by a minority among his own clergy, who disliked his Ultramontane ideas, his "Romanizing and innovating zeal."

In July 1850 he heard of the pope's intention to create him a cardinal, and expected to be permanently recalled to Rome. But on his arrival there he ascertained that a part of the pope's plan for restoring a diocesan hierarchy in England was that he himself should return to England as cardinal and archbishop of Westminster. The papal brief establishing the hierarchy was dated Sept. 29, 1850.

Wiseman travelled slowly to England, via Vienna; and when he reached London (Nov. 11), the whole country was ablaze with indignation at the "papal aggression," which was misunderstood to imply a new and unjustifiable claim to territorial rule. But Wiseman wrote an admirable *Appeal to the English People* in which he explained the nature of the pope's action, and argued that the admitted principle of toleration included leave to establish a diocesan hierarchy.

In July 1852 he presided at Oscott over the first provincial synod of Westminster. In 1854 Wiseman was in Rome when the definition of the dogma of the immaculate conception of the Blessed Virgin (Dec. 8), was promulgated. In 1855 he applied for a coadjutor, and George Errington, bishop of Plymouth, his friend since boyhood, was appointed, with the title of archbishop of Trebizond.

Two years later Manning was appointed provost of Westminster and he established in Bayswater his community of the "Oblates of St. Charles."

In the summer of 1858 Wiseman paid a visit to Ireland, where, as a cardinal of Irish race, he was received with enthusiasm. In 1863, addressing the Catholic Congress at Malines, he stated that since 1830 the number of priests in England had increased from 434 to 1,242, and of convents of women from 16 to 162, while there were 55 religious houses of men in 1863 and none in 1830. The last two years of his life were troubled by illness and by controversies in which he found himself, under Manning's influence, compelled to adopt a policy less liberal than that which had been his in earlier years. Thus he had to condemn the Association for the Promotion of the Unity of Christendom, with which he had shown some sympathy in its inception in 1857; and to forbid Catholic parents to send their sons to Oxford or Cambridge, though at an earlier date he had hoped (with Newman) that at Oxford at least a college or hall might be assigned to them.

Wiseman died on Feb. 16, 1865. On Jan. 30, 1907, his body was removed with great ceremony from Kensal Green and reburied in the crypt of the new cathedral at Westminster.

Wiseman was one of the most learned men of his time. He was the friend and correspondent of many foreigners of distinction, among whom may be named Döllinger, Lamennais, Montalembert and Napoleon III. He combined with the principles known as Ultramontane no little liberality of view in matters ecclesiastical. He insisted on a poetical interpretation of the Church's liturgy; and while strenuously maintaining her Divine commission to teach faith and morals, he regarded the Church as in other respects a learner; and he advocated a policy of conciliation.

See the biography by Wilfrid Ward, *The Life and Times of Cardinal Wiseman* (2 vols., 1897; fifth edition, 1900). (A. W. Hu.; X.)

WISHART, GEORGE (*c.* 1513–1546), Scottish reformer, was accused of heresy in 1538, and fled to England, where a similar charge was brought against him at Bristol in the following year. In 1539 or 1540 he started for Germany and Switzerland, and returning to England became a member of Corpus Christi college, Cambridge. In 1543 he went to Scotland in the train of a returning embassy. Wishart began to preach in 1544, at Perth, Edinburgh, Leith and Haddington. At Ormiston, in Dec. 1545, he was seized by the earl of Bothwell, and transferred by order

of the privy council to Edinburgh castle on Jan. 19, 1546. Thence he was handed over to Cardinal Beaton, who had him burnt at St. Andrews on March 1.

See Knox's *Hist.;* Reg. P. C. Scotland; Foxe's *Acts and Monuments;* Hay Fleming's *Martyrs and Confessors of St. Andrews;* Cramond's *Truth about Wishart* (1898) and *Dict. of Nat. Biogr.* vol. lxii.

WISLICENUS, JOHANNES (1835–1902), German chemist, was born on June 24, 1835 at Klein-Eichstedt, in Thuringia, and emigrated to America with his father. In 1855 he was appointed lecturer at the Mechanics' Institute in New York. Returning to Europe in 1856, he continued his studies at Zürich university, where he was subsequently professor of chemistry from 1865 to 1872. He then obtained the chair of chemistry at Würzburg, and in 1885, on the death of A. W. H. Kolbe, was appointed to the same professorship at Leipzig, where he died on Dec. 6, 1902. His work on the lactic acids cleared up many difficulties concerning the combination of acid and alcoholic properties in hydroxy-acids in general, and resulted in the discovery of two substances differing in physical properties though possessing a structure of proved chemical identity. So far back as 1873, before the publication of the doctrine of J. H. van't Hoff and J. A. Le Bel, Wislicenus expressed the opinion that the ordinary constitutional formulae did not afford an adequate explanation of certain carbon compounds, and suggested that account must be taken of the *verschiedene Lagerung ihrer Atome im Raume.* Later (see *Die räumliche Anordnung der Atome in organischen Molekülen,* 1887) he extended the application of the van't Hoff-Le Bel theory to "geometrical isomers"—substances like fumaric and maleic acids which have identical formulae but are dissimilar chemically. Wislicenus and his pupils studied a number of cases of this type of isomerism. He is also known for his work on aceto-acetic ester and its application as a synthetical agent and for his syntheses in the penta-methylene series. He was awarded the Davy medal by the Royal Society in 1898.

WISMAR, a seaport town of Germany, in the *Land* of Mecklenburg, at the southern end of the Bay of Wismar, one of the best harbours on the Baltic, 20 mi. by rail N. of Schwerin. Pop. (1939) 35,005. Wismar is said to have received civic rights in 1229, and came into the possession of Mecklenburg in 1301. In the 13th and 14th centuries it was a flourishing Hanse town, with important woollen factories. A plague carried off 10,000 of the inhabitants in 1376. By the peace of Westphalia in 1648 it passed to Sweden, and in 1815 to Mecklenburg. It was severely bombed in World War II.

WISSEMBOURG or WEISSENBURG, a town of France, capital of an arrondissement in the department of Bas-Rhin, on the Lauter, at the foot of the eastern slope of the Vosges mts., 42 mi. N.E. of Strasbourg by the railway Basle-Strasbourg-Mannheim. Pop. (1936) 5,309. It grew up round a Benedictine abbey, founded in the 7th century by Dagobert II, and became the seat of a famous school. Here Otfrid, a native of the district, completed (*c.* 868) his Old High German Gospel book. (*See* GERMAN LITERATURE.)

The town became a free imperial city in 1305. It has been the scene of two memorable battles. In Oct. 1793 the Prussians and Saxons under the Austrian general Wurmser stormed the "Weissembourg Lines." On Aug. 4, 1870, the Germans, under the crown prince of Prussia, gained there the first victory of the Franco-German War (*q.v.*).

WISTARIA, a genus of climbing woody vines of the family Leguminosae, inhabiting China, Japan and eastern North America, commonly called wisteria. The garden wisterias are mostly *W. sinensis* of China, and *W. floribunda* of Japan. Their violet-blue flowers, borne in long racemes, are effective floral decorations against a house wall or on trellis-work. The silky wisteria (*W. venusta*), with velvety leaves and large white flowers, is a native of China. The North American species, *W. frutescens,* found in southern states, has lilac-purple, fragrant flowers.

WISTER, OWEN (1860–1938), American writer, was born in Philadelphia, July 14, 1860. On graduating from Harvard in 1882 he intended to devote himself to music. He went abroad for study; but family reasons forced him to return, and he spent several years in Arizona and New Mexico. He then entered the Harvard law school, graduating in 1888, was admitted to the bar in 1889 and for two years practised in Philadelphia. Thereafter he devoted his time to literary work.

His novel *The Virginian* (1902) has the distinction of doing as much to shape the romantic conception of the cowboy West as any other single factor. *Red Men and White* (1896) and *Lin McLean* (1898) also contributed to the legends of the cunning horse thief, the chivalrous rancher and the vanishing red man. *Philosophy 4* (1903), a diverting college story, and the romance *Lady Baltimore* (1906) were very popular. Wister's other publications include *Ulysses S. Grant* (1900), *The Seven Ages of Washington* (1907), *The Pentecost of Calamity* (1915) and *Neighbours Henceforth* (1922).

WITAN or **WITENAGEMOT,** the council of the Anglo-Saxon kings. It was in no sense a popular assembly, and its composition was determined by the king's pleasure. He would naturally wish to consult his greater nobles and his bishops, and such men are normally found in attendance at his councils. The ecclesiastical element was sometimes reinforced by the abbots of important monasteries. The king's household officers were usually present, and the council generally includes a varying number of thegns without specific duties at court. The general character of the council underwent little change throughout the Old English period, though it inevitably tended to become a larger body as the king of Wessex developed into a king of all England. Its essential duty was to advise the king on all matters touching which he chose to ask its opinion. It attested his grants of land to churches or laymen, it consented to his issue of new laws or new statements of ancient custom, and it helped him to deal with rebels and persons suspected of disaffection. King Alfred asked its advice about the testamentary disposition of his private inheritance. In late Old English times the witan had ceremonial functions. It attended the king when he received ambassadors, and in the 11th century, if not earlier, joined him in public feasting at Easter, Whitsuntide, and Christmas, commonly meeting for this purpose at Winchester, Westminster and Gloucester. At other times the king would summon his witan to attend him wherever he might choose. Important meetings of king and council were held in royal manors such as Wantage in Berkshire, Calne in Wiltshire and Andover in Hampshire. In its composition and duties the witan closely resembled its successor, the *Commune Concilium* of the Anglo-Norman kings; the fundamental difference between these bodies being the feudal tie which connected the baronial councillors of the Norman time with the king. (F. M. S.)

WITCHCRAFT. The actual meaning of this word appears to be the art or craft of the wise, as the word "witch" is allied with "wit," *to know.* From about the 15th century the word has been almost exclusively applied to workers of magic, whether male or female. Magicians and sorcerers are known in all parts of the world; among savage communities they are usually credited with supernatural powers by their fellow-tribesmen (*see* MAGIC). Divination (*q.v.*) or foretelling the future is one of the commonest forms of witchcraft; when this is done in the name of the deity of one of the established religions it is called prophecy; when, however, the divination is in the name of a pagan god it is mere witchcraft. This distinction is very clear in the account of the contest between Moses and Pharaoh's magicians as given in Exodus; but in the demotic story, which appears to give the Egyptian version of the incident, the wise priest of Egypt defeats the miserable foreign sorcerer whom he had saved from the water when a child.

Mediaeval Witches.—In England the legal definition of a witch is, according to Lord Coke, "a person who hath conference with the Devil to consult with him or to do some act."

The word "devil" (*q.v.*) is a diminutive from the root "div," from which we also get the word "divine." It merely means "little god." It is a well-known fact that when a new religion is established in any country, the god or gods of the old religion becomes the devil of the new.

When examining the records of the mediaeval witches, we are dealing with the remains of a pagan religion which survived, in England at least, till the 18th century, 1,200 years after the introduction of Christianity. The practices of this ancient faith can

be found in France at the present day, though with the name of the deity changed; and in Italy *la vecchia religione* still numbers many followers in spite of the efforts of the Christian Church.

The number of the witches put to death by the inquisitors and other persecutors in the 16th and 17th centuries is a proof of the obstinate paganism of Europe. Whole villages followed the beliefs of their ancestors; and in many cases the priests, drawn from the peasant class, were only outwardly Christian and carried on the ancient rites; even the bishops and other high ecclesiastics took part. As civilization increased and Christianity became more firmly rooted, the old religion retreated to the less frequented parts of the country and was practised by the more ignorant members of the community. This is very noticeable in the innumerable trials of the 15th to the 18th centuries.

The Witch-cult.—The religion consisted of a belief in a god incarnate in a human being or an animal, and thus resembled in many ways the religions of numerous primitive peoples of the present day. This god, who was always called the Devil by the Christian recorders of the trials, appeared to his worshippers disguised in various animal forms or dressed inconspicuously in black. The earliest form of the animal disguise is the figure of the man clothed in a stag's skin with antlers on his head, which is among the palaeolithic paintings in a cave in Ariège in southern France. Another early example is carved on a slate palette of the prehistoric period of Egypt; in this case the man is disguised as a jackal. The goat disguise is not found in Great Britain though common in France and Germany, where it is probably the survival of the god Cernunnos. In the British Isles the usual forms were the bull, the dog and the cat.

The rites with which this god was worshipped are known to all students of primitive or savage religions, ancient and modern. The sacred dances, the feasts, the chants in honour of the god, the liturgical ritual, and above all the ceremonies to promote fertility, occurred at public assemblies as now in the islands of the Pacific or in Africa. The fertility rites attracted the special attention of the recorders of the legal trials. But to the followers of the old god these rites were as holy as the sacred marriage was to the ancient Greeks; to them, as to the Greeks, it was the outward and visible sign of the fertility of crops and herds which should bring comfort and wealth and life itself.

The assemblies or "Sabbaths" took place four times a year; on Feb. 2 (Candlemas), May-eve (known later as Roodmas), Aug. 1 (Lammas), and November-eve (All Hallow E'en). To these joyous meetings came all the worshippers, from far and near, to the number of many hundreds, old and young, men, women and children, till the scene was like a great fair with dancing and singing and feasting. The celebrations began in the evening, lasted all night, and ended at dawn. These were the great Sabbaths, and the dates show that the year was divided at May and November. This division shows that the religion dates back to a primitive period, probably before the introduction of agriculture though after the domestication of animals, for the festivals emphasize the seasons of the breeding of animals. There were, however, smaller meetings (known in France as *"esbats"*), which took place weekly or at short irregular intervals. To these came the principal members of the cult, who held a position analogous to the priesthood. There were in each district a band of such persons, in number 13, *i.e.*, a chief or "devil" and 12 members. This band was known as a "Coven." They celebrated the religious rites, they practised as healers under the leadership and instruction of their divine master, and were the consultants in all cases where "witchcraft" was required. The earliest record of a Coven is in the *Handlyng Synne*, a work of the early 14th century, in which the (Christian) priest's daughter and 12 "fools" danced in the churchyard as a *coueyne*. The next record is in the 15th century in the trial of Gilles de Rais, where it is apparent that he and his associates were 13 in number in the practice of their rites. In the later trials the word Coven is continually used, and the number in a Coven is always 13.

One of the most impressive and important rites was the sacrifice of the god, which took place at intervals of seven or nine years. The accounts suggest that the sacrifice was by fire (for similar sacrifices *see* Frazer's *Golden Bough*).

The Familiars.—There are two kinds of familiars, the divining familiar and the domestic familiar. The divining familiar is common to the whole of Europe and is found in all records of the trials. In ancient Rome divination by animals, especially by birds, was known as "Augury," and was considered a legitimate means of learning the future, but when it was practised by "witches" in the 16th and 17th centuries their persecutors claimed that they were inspired by the Devil. As a rule the witches were instructed by their chief in the method of divining by animals, and he usually appointed the class of animal which each witch was to use. Thus Agnes Sampson of North Berwick divined by dogs, so also did Elizabeth Style in Somerset; John Walsh of Netherberry in Dorset had "a gray blackish culver," and Alexander Hamilton in Lothian divined by a "corbie" or a cat. In France the familiar was always a toad, which was consulted before going on a journey or undertaking any enterprise.

Spells and Charms (*qq.v.*).—Forms of words with manual gestures are used in all countries and in all periods to produce results which cannot be obtained by physical means. They may be used for good or evil purposes, for the benefit of the user or for the benefit of someone else. A good harvest, a good catch of fish, a favourable wind for a ship, victory over an enemy, could all be obtained by formulae of words addressed to the appropriate power. But as the power was always incomprehensible, not to say freakish, it was necessary that it should be approached by those who knew the right methods. Sacrifice (*q.v.*) in the temples of the ancient civilization was among the means to propitiate the god and render him favourable to the petitions of his worshippers. When, however, there was more than one god, it is obvious that if a prayer were ineffectual in one temple nothing could be easier than to petition another deity.

Among the ritual methods to destroy an enemy one of the most ancient as well as the most dramatic was the making of an image, generally in wax, to represent the enemy, and gradually destroying it. The earliest record of this charm is in the trial of some women and officers of the harem of Rameses III. in Egypt, about 1100 B.C. They made wax images of the Pharaoh with magical incantations, but unfortunately the record gives only the outline of the trial without details.

Transformation into Animals (*see* LYCANTHROPY).—The belief that certain persons can transform themselves into animals is common to all parts of the world. The power belongs to the *shaman* or priest. A wound inflicted on a human being when in animal shape is believed to be visible when the person resumes his human form. The method of transformation was by putting on the skin of the animal, as did Sigmund the Volsung when he became a wolf. This being the case, it is obvious that the wounds received by the transformed person must certainly have remained when he returned to his proper shape.

The Suppression of Witchcraft.—In comparing the witches and witch-cult of the middle ages with the rites and beliefs of pagan religions, whether ancient or modern, it becomes abundantly clear that in Europe traces of the ancient heathenism survived the adoption of Christianity. It was only when the new religion had gained sufficient strength that it ventured to try conclusions with the old. Backed by the civil law, it overcame the old religion, not only by persuasion but by the use of force, just as it destroyed the ancient religion of Egypt and in later times the religion of the Aztecs. That the old religion was not an ordinary heresy is clearly shown by the fact that in England, Scotland, France, Germany, Italy, Switzerland, the Netherlands and in New England in the days of Cotton Mather, the clergy as well as the laity hunted down and brought to trial and death persons suspected of witchcraft. For particulars of the Salem witchcraft delusion, *see* SALEM.

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WITCHES' BROOM, or "hexenbesen," the name applied to peculiar broomlike outgrowths on the branches of a number of trees. They consist of a closely set cluster of fine slender branches, generally arranged more or less parallel to each other, and often originating from an enlarged axis. They may be caused by the attack of a mite (*Eriophyes rudis*) associated with species of the fungus *Taphrina,* but in most cases are due to a plant parasite alone, either a fungus or one of the scaly or dwarf mistletoes (*Razoumofskya* spp.), especially on pine, larch and fir. The following witches' brooms caused by fungi are of note: *Taphrina laurencia* on ferns (*Pteris* spp.); *Taphrina cerasi* on cherry; and three other species affecting birch, alder and ironwood.

WITCHHAZEL, the common name for a North American shrub, *Hamamelis virginiana* (family Hamamelidaceae), native to low woods from Nova Scotia to Minnesota and south to Florida and Texas. It grows from 10 to 25 ft. high, with smooth, wavy-toothed leaves, somewhat unequal at the base. The showy bright-yellow flowers, borne in profuse axillary clusters, appear in autumn as the leaves are falling. The fruit, a hard, woody capsule that matures during the ensuing summer, contains two black shining seeds, which are forcibly ejected when ripe. A fluid extract, prepared from the leaves, is used as a tonic and a lotion. The name witchhazel is derived from the use of the twigs as divining rods, just as hazel twigs were used in England. The North American witchhazel is occasionally planted for ornament, as are *H. japonica* of Japan, and *H. mollis* of China. *H. macrophylla,* with leaves roughened by persistent tubercles, is a small tree of the southern gulf states of the U.S.A.

WITCH OF AGNESI: *see* CURVES, SPECIAL.

WITHER, GEORGE (1588–1667), English poet and satirist, son of George Wither, of Hampshire, was born at Bentworth, near Alton, June 11, 1588. He went to Magdalen College, Oxford. He wrote an elegy (1612) on the death of Prince Henry, and a volume of gratulatory poems (1613) on the marriage of Princess Elizabeth, but his uncompromising character soon got him into trouble. In 1611 he published *Abuses Stript and Whipt,* twenty satires against Revenge, Ambition, Lust and other abstractions. In 1613 five editions appeared, and he was lodged in Marshalsea prison. The influence of Princess Elizabeth, supported by a loyal "Satyre" to the king, secured his release after a few months. He had figured as one of the interlocutors, "Roget," in his friend William Browne's *Shepherd's Pipe,* with which were bound up eclogues by other poets, among them one by Wither, and during his imprisonment he wrote what may be regarded as a continuation of Browne's work, *The Shepherd's Hunting* (printed 1615), eclogues in which the two poets appear as "Willie" and "Roget" (in later editions "Philarete"). The fourth of these eclogues contains a famous passage in praise of poetry. After his release he was admitted (1615) to Lincoln's Inn, and in the same year he printed privately *Fidelia,* a love elegy, of which there is a unique copy in the Bodleian. Other editions of this book, which contained the lyric "Shall I, wasting in despair," appeared in 1617 and 1619. In 1621 he returned to the satiric vein with *Wither's Motto. Nec habeo, nec careo, nec curo.* Over 30,000 copies of this poem were sold, according to his own account, within a few months. Like his earlier invective, it was said to be libellous, and Wither was again imprisoned, but shortly afterwards released without formal trial on the plea that the book had been duly licensed. In 1622 appeared his *Faire-Virtue, The Mistress of Phil' Arete.*

Wither began as a moderate in politics and religion, but from this time his Puritan leanings became more and more pronounced, and his later work consists of religious poetry, and of controversial and political tracts. His *Hymnes and Songs of the Church* (1622–1623) were issued under a patent (later disallowed) of King James I. ordaining that they should be bound up with every copy of the authorized metrical psalms offered for sale. (*See* HYMNS.) Wither was in London during the plague of 1625, and in 1628 published *Britain's Remembrancer,* a voluminous poem on the subject, which he had to print with his own hand in consequence of his quarrel with the Stationers' Company. In 1635 he was employed by Henry Taunton, a London publisher, to write English verses illustrative of the allegorical plates of Crispin van Passe, originally designed for Gabriel Rollenhagen's *Nucleus emblematum selectissimorum* (1610–1613). The book was published as a *Collection of Emblemes, Ancient and Moderne,* of which the only perfect copy known is in the British Museum. The best of Wither's religious poetry is contained in *Heleluiah: or Britain's Second Remembrancer,* printed in Holland in 1641. Besides hymns proper, the book contains songs of singular beauty, especially the Cradle-song ("Sleep, baby, sleep, what ails my dear").

Wither had served as captain of horse in 1639 in the expedition of Charles I. against the Scottish Covenanters, but three years after the Scottish expedition, at the outbreak of the Great Rebellion, he is found definitely siding with the parliament. He sold his estate to raise a troop of horse, and was placed by a parliamentary committee in command of Farnham Castle. After a few days' occupation he left the place undefended, and marched to London. His own house near Farnham was plundered, and he himself was captured by a troop of Royalist horse, owing his life to the intervention of Sir John Denham on the ground that so long as Wither lived he himself could not be accounted the worst poet in England. After this episode he was promoted to the rank of major. He was present at the siege of Gloucester (1643) and at Naseby (1645). He had been deprived in 1643 of his nominal command, and of his commission as justice of the peace, in consequence of an attack upon Sir Richard Onslow, who was, he maintained, responsible for the Farnham disaster. In the same year parliament made him a grant of £2,000 for the loss of his property, but he apparently never received the full amount. An order was made to settle a yearly income of £150 on Wither, chargeable on Sir John Denham's sequestrated estate, but there is no evidence that he ever received it. A small place given him by the Protector was forfeited "by declaring unto him (Cromwell) those truths which he was not willing to hear of." At the Restoration he was arrested, and remained in prison for three years. He died in London on May 2, 1667.

His extant writings, catalogued in Park's *British Bibliographer,* number over a hundred. Sir S. E. Brydges published *The Shepherd's Hunting* (1814), *Fidelia* (1815) and *Fair Virtue* (1818), and a selection appeared in Stanford's *Works of the British Poets,* vol. v. (1819). Most of Wither's works were edited in twenty volumes for the Spenser Society (1871–1882); a selection was included by Henry Morley in his *Companion Poets* (1891); *Fidelia* and *Fair Virtue* are included in Edward Arber's *English Garner* (vol. iv., 1882; vol. vi. 1883), and an excellent edition of *The Poetry of George Wither* was edited by F. Sidgwick in 1902.

WITHERITE, a mineral consisting of barium carbonate ($BaCO_3$), crystallizing in the orthorhombic system, and named after W. Withering, who in 1784 recognized it to be chemically distinct from barytes. The crystals are invariably twinned together in groups of three, giving rise to pseudo-hexagonal forms somewhat resembling bipyramidal crystals of quartz; the faces are usually rough and striated horizontally. The colour is dull white or sometimes greyish, the hardness is 3·5 and specific gravity 4·3. The mineral occurs in veins of lead ore near Hexham in Northumberland, Alston in Cumberland, Anglezark, near Chorley, Lancs., and a few other localities. It is the chief source of barium salts, and is mined in considerable amounts in Northumberland. It is used for the preparation of rat poison, in the manufacture of glass and porcelain, and formerly for refining sugar. (L. J. S.)

WITHERSPOON, JOHN (1723–1794), Scottish-American divine and educator, was born at Gifford, Yester Parish, Scotland, probably on Feb. 5, 1722 or 1723. He was educated at the Haddington grammar school and the University of Edinburgh (M.A.,

1739), where he completed his theological studies in 1743. He was called to the parish of Beith in 1745 and in 1757 became pastor at Paisley. His militant tendencies, which made him a prominent figure during the American Revolution, manifested themselves at the invasion of the Young Pretender and in his ecclesiastical controversies. These he waged by sermon, debate, pamphlet and essay, revealing himself as a keen dialectician, an effective satirist and a convincing and entertaining speaker. Among his chief publications of this period are *Ecclesiastical Characteristics* (1753), *Essay on Justification* (1756) and a three-volume collection of his essays and doctrinal sermons (1764).

Witherspoon's popularity as a preacher is shown by his refusal of calls to Dundee, Dublin and Rotterdam; but his acceptance of a second call to the presidency of Princeton in 1768 marked a turning-point in his career. Thereafter, although he was received warmly by the American Presbyterian Church and although he took a prominent part in the meetings of the synod and was first moderator of the general assembly which he had advocated, he was more distinguished as an educator and as a statesman than as a clergyman. He seems to have brought to the struggling little college centred in Nassau Hall a vision of its potentialities as a cultural agency as well as a training-school for ministers. He opened a grammar school, announced graduate courses, encouraged the undergraduate societies, added Hebrew and French to the curriculum, provided scientific equipment and set out immediately on a quest for more money and more students. From arrival he was an enthusiast about America. He encouraged Scottish immigration, and in the dispute with the mother country ranged himself uncompromisingly on the side of the colonists. He presided over the Somerset county committee of correspondence in 1775–76; was a member of two provincial Congresses and of the New Jersey constitutional convention in the spring of 1776; and in 1776–79 and 1780–82 he was a member of the Continental Congress. He was the only clergyman to sign the Declaration of Independence; and in general he played a creditable part in the congressional body both in debate and on committees. He was especially distinguished for the soundness of his financial views, some of which were published later in his *Essay on Money* (1786). He died on his farm, Tusculum, near Princeton, Nov. 15, 1794.

The first edition of Dr. Witherspoon's *Works* was published in four volumes in Philadelphia in 1800 with a biographical account by Dr. John Rodgers. A nine volume edition was published in Edinburgh in 1804–05. *See* his *Lectures on Moral Philosophy* (1918), edited by V. L. Collins, and the biography by the latter (2 vols., 1925).

WITNESS, in law, a person who is able from his knowledge or experience to make statements relevant to matters of fact in dispute in a court of justice. The relevancy and probative effect of the statements which he makes belong to the law of evidence (*q.v.*). In the present article it is only proposed to deal with matters concerning the position of the witness himself. In England, in the earlier stages of the common law, the jurors seem to have been the witnesses, for they were originally chosen for their knowledge or presumed knowledge of the facts in dispute, and they could (and can) be challenged and excluded from the jury if related to the parties or otherwise likely to show bias.

Competency.—Modern views as to the persons competent to give evidence are very different from those of Roman law and the systems derived from it. In Roman law the testimony of many persons was not admissible without the application of torture, and a large body of possible witnesses was excluded for reasons which have now ceased to be considered expedient, and witnesses were subject to rules which have long become obsolete. Witnesses must be *idonei* or duly qualified. Minors, certain heretics, infamous persons (such as women convicted of adultery), and those interested in the result of the trial were inadmissible. Parents and children could not testify against one another, nor could slaves against their masters, nor those at enmity with the party against whom their evidence was offered. Women and slaves could not act as witnesses to a will. There were also some hard and fast rules as to number. Seven witnesses were necessary for a will, five for a *mancipatio* or manumission, or to determine the question whether a person were free or a slave. As under the Mosaic law, two witnesses were generally necessary as a minimum to prove any fact. *Unius responsio testis omnino non audiatur* are the words of a constitution of Constantine. The evidence of a single witness was simply *semi-plena probatio,* to be supplemented in default of a second witness, by torture or reference to oath. The canon law followed the Roman law as to competence, but extended the disabilities to excommunicated persons and to a layman in a criminal charge against a clerk, unless he were actually the prosecutor. The evidence of a notary was generally equivalent to that of two ordinary witnesses. The evidence of the pope and that of a witness who simply proved baptism or heresy (according to some authorities) are perhaps the only other cases in which canon law dispensed with confirmatory evidence. It is probable that the incompetence of Jews as witnesses in Spain in the 14th and 15th centuries was based on what is termed "want of religion," *i.e.,* heresy or unwillingness to take the Christian oath on the gospels. But in England until their expulsion they were on the status of slaves (*captivi*) of the king. A policy similar to that of the Roman law was followed for centuries in England by excluding the testimony of parties or persons interested, of witnesses for a prisoner, and of infamous persons, such as those who had been attainted or had been vanquished in the trial by battle, or had stood in the pillory. All these were said *vocem non habere.* In the days of trial by battle a party could render a witness against him incompetent by challenging and defeating him in the judicial combat. Women were generally regarded as wholly or partially incompetent. English law had also certain rules as to the number of witnesses necessary. Thus under a statute of 1383 (6 Rich. II. st. 2 c, 5) the number of compurgators necessary to free an accused person from complicity in the peasant revolt was fixed at three or four. Five was the number necessary under the *Liber feudorum* for proving ingratitude to the lord.

In the course of the gradual development of the law of evidence, which is in a sense peculiar to the English system, the fetters of the Roman rules as to witnesses were gradually shaken off. In civil cases all disabilities by interest, relationship, sex or crime have been swept away. The witness need not be *idoneous* in the Roman sense, and objections which in Roman law went to his competence, in English law go to his credibility. The only general test of competency is now understanding. It excludes lunatics, idiots, dotards and children of tender years; a person convicted of perjury is said to be competent if convicted at common law, but incompetent if convicted under the act of Elizabeth. No trial ever takes place now under this act, and on this point the act seems to have been virtually repealed by Lord Denman's act (1843; 6 and 7 Vict. c. 85). The disqualification is not absolute as to lunatics; as to children it is sometimes made to depend on whether they are able to understand the nature of the witness's oath. And in certain cases within the Criminal Law Amendment Act, 1885, and the Prevention of Cruelty to Children Act, 1904, the unsworn evidence of children of tender years is admissible but needs corroboration.

Non-judicial witnesses are those who attest an act of unusual importance, for the due execution of which evidence may afterwards be required. They are either made necessary by law, as the witnesses to marriages and wills, or used by general custom, as the witnesses to deeds. In some cases the attestation has become a mere form, such as the attestation of the lord chancellor to a writ of summons. (*See* WRIT.)

Number.—The rule of English law as to the number of witnesses necessary is expressed in the phrase *testes ponderantur non numerantur.* But there are certain exceptions, all statutory. Two witnesses are necessary to make a will valid; two are required to be present at a marriage and to attest the entry in the marriage register; and in the case of blasphemy, perjury, personation and most forms of treason, two or more witnesses are necessary to justify conviction. Witnesses to bills of sale under the Bills of Sale Act, 1882, and witnesses on a charge of personation at elections, are required to be "credible." And in the case of dishonour of a foreign bill of exchange the evidence of a notary public is required, probably a survival from the law merchant or a concession to Continental practice. A warrant of attorney must

be attested by a solicitor, and certain conveyances of property held on charitable uses must be attested by two solicitors. In certain civil cases the evidence of a single witness is not sufficient unless corroborated in some material particular—not necessarily by another witness—*e.g.*, in actions of breach of promise of marriage, or affiliation proceedings and matrimonial causes, or where unsworn evidence of children is admissible. In practice, but not in strict law, the evidence of an accomplice is required to be corroborated.

In criminal cases an accused person could not formerly be sworn as a witness or examined by the court, though he was free to make statements. The origin of this rule is by some traced to the maxim *nemo tenetur prodere seipsum,* by others to the theory that the petty jury were the prisoner's witnesses. Moreover, witnesses for the defence could not be examined on oath in cases of treason and felony until 1702 in England, 1711 in Ireland and 1735 in Scotland. The husband or wife of the accused could not be examined on oath as a witness either for the prosecution or the defence except in prosecutions for treason or for personal injuries done by one spouse to the other. This exclusion was in accord with the disqualification of parties to civil causes; but there was a lack of reciprocity, for the prosecutor was a competent witness because the Crown is the nominal prosecutor. The rule had to a certain extent a beneficial effect for the defence, in saving the accused from cross-examination, which in certain periods and in political trials would have led to abuse. On the abolition of other disqualifications that of the accused was left. This inconsistency led to much legal discussion and to piecemeal and, ultimately, complete change in the law. Between 1872 and 1897 some 26 acts were passed rendering accused persons and their wives or husbands competent (but not in general compellable) witnesses in particular criminal cases; and finally, by the Criminal Evidence Act, 1898, which abrogates the common law rule above, and in practice supersedes, but does not repeal, the particular statutes just mentioned, and does not apply to Ireland, every person charged with an offence, whether solely or jointly, and the wife or husband of such person is rendered a competent witness for the defence, subject to certain specified conditions. For these conditions, and for the rules regulating the attendance, oaths, examination, and privileges of witnesses, *see* EVIDENCE.

The attestation of documents out of courts of justice is ordinarily not on oath; but where the documents have to be proved in court the attesting witnesses are sworn like others, and the only judicial exception is that of witnesses ordered to produce documents (called in Scotland "havers") who are not sworn unless they have to verify the documents produced. Questions as to competence (including questions of the right to affirm instead of swearing or as to the proper form of oath) are settled by examination by the court without oath on what is termed the *voir dire.* The evidences of judicial witnesses is taken *viva voce* at the trial, except in interlocutory proceedings and in certain matters in the chancery division and in bankruptcy courts. Where the witness cannot attend the court or is abroad his evidence may be taken in writing by a commissioner delegated by the court, or by a foreign tribunal under letters of request issued by the court in which the cause is pending. The depositions are returned by the delegated authority to the court of trial. Under English law evidence must be taken *viva voce* in a criminal trial, with a few exceptions, *e.g.*, where a witness who has made a deposition before a magistrate at an earlier stage in the case is dead or unable to travel, or in certain cases within the Merchant Shipping Acts, or of offences in India or by Crown officials out of England. In Europe *commissions vogatoires* are freely used to obtain written depositions for the purpose of criminal trials, and are allowed to be executed in England.

On charges of treason lists of the witnesses to be called by the Crown must be supplied to the accused. In ordinary indictable cases there is no such obligation, but the names of the witnesses for the Crown are written on the back of the indictment; and where the witnesses have not been examined at the preliminary enquiry it is now established practice to require notice to the accused of their names, and a précis of what they will be called to prove. In Scotland, in all indictable cases, a list of witnesses must be served on the accused (the panel) (1887, c. 35), and the same rule is observed in France. In the United States the same course is adopted where a capital offence is charged.

(W. F. C.; S. L. PH.)

WITNEY, a market town and urban district in the Banbury parliamentary division of Oxfordshire, England, on the river Windrush, a tributary of the Thames, 75½ mi. W.N.W. of London on a branch of the G.W. railway. Pop. (est. 1938) 5,417. Area 2.4 sq.mi. Witney is the seat of an old-established industry in blanket-making, and gloves and other woollen goods are also made. The great church of St. Mary is cruciform with a lofty central tower and spire. The tower is Early English, but the church exhibits the other styles, including a remarkable Norman porch.

The manor of Witney was held by the see of Winchester before the Conquest. It was sold in 1649, but was given back to the bishopric at the Restoration. In the middle of the 18th century it was leased by the bishop of Winchester to the duke of Marlborough. Witney was a borough by prescription at least as early as 1278, and sent representatives to parliament fairly regularly from 1311–12 to 1359–60. There is reference to a fulling mill in a charter of King Edgar dated 909. In 1641 the blanket-makers petitioned the crown against vexatious trade regulations; in 1673 the town is described as "driving a good trade for blankets and rugs." In 1710 the blanket-makers obtained a charter making them into a company, consisting of a master, assistants, two wardens and a commonalty.

See J. A. Giles, *History of Witney* (1852); *Victoria County History, Oxon;* W. J. Monk, *History of Witney* (1894).

WITOWT or WITOLD (1350–1430), grand-duke of Lithuania, son of Kiejstut, prince of Samogitia, first appears prominently in 1382, when the Teutonic Order set him up as a candidate for the throne of Lithuania in opposition to his cousin Jagiello (*see* WLADISLAUS), who had treacherously murdered Witowt's father and seized his estates. Witowt, however, convinced himself that the German knights were far more dangerous than his Lithuanian rival; he accepted pacific overtures from Jagiello and became his ally. When Jagiello ascended the throne of Poland as Wladislaus II. in 1386, Witowt was at first content with the principality of Grodno; but jealousy of Skirgiello, one of Jagiello's brothers, to whom Jagiello committed the government of Lithuania, induced Witowt to ally himself once more with the Teutonic Order (treaty of Königsberg, May 24, 1390). He strengthened his position by giving his daughter Sophia in marriage to Vasily, grand-duke of Muscovy; but he never felt secure beneath the wing of the Teutonic Order, and when Jagiello removed Skirgiello from the government of Lithuania and offered it to Witowt, the compact of Ostrow (5th of August 1392) settled all differences between them.

Nevertheless, subsequent attempts on the part of Poland to subordinate Lithuania drove Witowt for the third time into the arms of the Order, and by the treaty of Salin in 1398, Witowt, who now styled himself *Supremus Dux Lithuaniae,* ceded his ancestral province of Samogitia to the knights, and formed an alliance with them for the conquest and partition of Pskov and Great Novgorod. He nourished the grandiose idea of driving out the hordes of Tamerlane, freeing all Russia from the Tatar yoke, and proclaiming himself emperor of the North and East. This dream of empire was dissipated by his terrible defeat on the Lower Dnieper by the Tatars on Aug. 12, 1399. He was now convinced that the true policy of Lithuania was the closest possible alliance with Poland. A union between the two countries was effected at Vilna on Jan. 18, 1401, and was confirmed and extended by subsequent treaties. Witowt was to reign over Lithuania as an independent grand-duke, but the two states were to be indissolubly united by a common policy. The result was a whole series of wars with the Teutonic Order, which now acknowledged Swidrygiello, another brother of Jagiello, as grand-duke of Lithuania; and though Swidrygiello was defeated and driven out by Witowt, the Order retained possession of Samogitia, and their barbarous methods of "converting" the wretched inhabitants finally induced Witowt to rescue his fellow-country-

men at any cost from the tender mercies of the knights.

In the beginning of 1409 Witowt concluded a treaty with Jagiello at Novogrudok for the purpose, and on July 19, 1410, the combined Polish-Lithuanian forces, reinforced by Hussite auxiliaries, crossed the Prussian border. The rival forces encountered at Grünewald, or Tannenberg, and there on July 14 or 15, 1410, was fought one of the decisive battles of the world, for the Teutonic Knights suffered a crushing blow from which they never recovered. After this battle Poland-Lithuania began to be regarded in the west as a great power, and Witowt stood in high favour with the Roman curia. In 1429, instigated by the emperor Sigismund, whom he magnificently entertained at his court at Lutsk, Witowt revived his claim to a kingly crown, and Jagiello reluctantly consented to his cousin's coronation; but before it could be accomplished Witowt died at Troki, on Oct. 27, 1430.

See Jozef Ignacz Kraszewski, *Lithuania under Witowt* (Pol.) (Wilna, 1850); Augustin Theiner, *Vetera Monumenta Poloniae* (Rome, 1860–1864); Karol Szajnocha, *Jadwiga and Jagiello* (Pol.) (Lemberg, 1850–1856); Teodor Narbutt, *History of the Lithuanian Nation* (Pol.) (Wilna, 1835–1836); *Codex epistolaris Witoldi Magni* (ed. Prochaska, Cracow, 1882). (R. N. B.)

WITTE, SERGE JULIEVICH, COUNT (1849–1915), Russian statesman, was born at Tiflis, where his father (of Dutch extraction) was a member of the Viceregal Council of the Caucasus. After completing his studies at Odessa University and devoting some time to journalism in close relations with the Slavophils and M. Katkov, he entered in 1877 the service of the Odessa State railway, and facilitated the transport of troops to Turkey in 1877–8. He now became general traffic manager of the South-Western railway of Russia and member of an Imperial commission which had to study the whole question of railway construction and management throughout the empire. Vishnegradski, minister of finance, recognized his ability and made him head of the railway department in the finance ministry. In 1892 he was promoted to be minister of ways of communication, and in 1893 he succeeded Vishnegradski, as minister of finance.

Witte was an ardent disciple of Friedrich List and sought to develop home industries by means of moderate protection and the introduction of foreign capital for industrial purposes. At the same time he succeeded by drastic measures in putting a stop to the great fluctuations in the value of the paper currency and in resuming specie payments. The rapid extension of the railway system was also largely due to his energy and financial ingenuity, and he embarked on a crusade against the evils of drunkenness by organizing a government monopoly for the sale of alcohol. In foreign policy he extended Russian influence in northern China and Persia. Witte struggled for what he considered the liberation of his country from the economic bondage of foreign nations. During his ten years' tenure of the finance ministry he nearly doubled the revenues of the empire, but he made for himself a host of enemies. He was transferred, therefore, in 1903 from the influential post of finance minister to the ornamental position of president of the committee of ministers.

The disasters of the war with Japan, and the rising tide of revolutionary agitation, compelled the government to think of appeasing popular discontent by granting administrative reforms, and the reform projects were revised and amended by the body over which M. Witte presided. But the Witte reforms were obstructed by the other departments, especially by the police. Naturally the influence of a strong man made itself felt, and the president became virtually prime minister; but he did not advance very far in this legislative work, and later he was transformed into a diplomatist and sent to Portsmouth, N.H., U.S.A., in August 1905, to negotiate terms of peace with the Japanese delegates. In these negotiations he showed great energy and decision, and contributed largely to bringing about the peace. On his return to St. Petersburg he had to deal, as president of the first ministry under the new constitutional régime, with a very difficult political situation (*see* RUSSIA: *History*); he was no longer able to obtain support, and early in 1906 he was dismissed. His last service to the emperor had been to raise a large loan in France which made the government practically independent of the Duma. He died at St. Petersburg (Leningrad) on March 12, 1915.

See *Memoirs of Count Witte* ed. A. Yarmolinsky (London and New York, 1921), indispensable to the study of the period; also a study of his career as minister of finance by D. Loutokhin (1915), and his diaries, posthumously published in *Pravda* (1918).

WITTELSBACH, the name of an important German family, taken from the castle of Wittelsbach, which formerly stood near Aichach on the Paar in Bavaria. In 1124, Otto V., count of Scheyern (d. 1155), removed the residence of his family to Wittelsbach, and called himself by this name. His descendants bore simply the title of counts of Scheyern until about 1116, when the emperor Henry V. recognized Count Otto V. as count palatine in Bavaria. His son, Count Otto VI., who succeeded his father in 1155, accompanied the German king, Frederick I., to Italy in 1154, where he distinguished himself by his courage, and later rendered valuable assistance to Frederick in Germany. When Henry the Lion, duke of Saxony and Bavaria, was placed under the imperial ban in 1180, Otto's services were rewarded by the investiture of the dukedom of Bavaria at Altenburg. Bavaria was ruled by the Wittelsbachs from that time onwards until the revolution of 1918, and the history of the house is closely connected with the history of Bavaria (*q.v.*). The ancestral castle of Wittelsbach was destroyed in 1208.

In 1329 the most important of various divisions of the Wittelsbach lands took place. By the treaty of Pavia in this year, Louis IV., German king, formerly duke of Bavaria, granted the Palatinate of the Rhine and the upper Palatinate of Bavaria to his brother's sons, Rudolph II. (d. 1353) and Rupert I. Rupert, who from 1353 to 1390 was sole ruler, gained the electoral dignity for the Palatinate of the Rhine in 1356 by a grant of some lands in upper Bavaria to the emperor Charles IV. It had been exercised from the division of 1329 by both branches in turn. The descendants of Louis IV. retained the rest of Bavaria, but made several divisions of their territory, the most important of which was in 1392, when the branches of Ingoldstadt, Munich and Landshut were founded. These were reunited under Albert IV., duke of Bavaria-Munich (1447–1508) and the upper Palatinate was added to them in 1628. Albert's descendants ruled over a united Bavaria, until the death of Duke Maximilian III. in 1777, when it passed to the Elector Palatine, Charles Theodore. The Palatinate of the Rhine, after the death of Rupert I. in 1390, passed to his nephew, Rupert II., and in 1398 to his son, Rupert III., who was German king from 1400 to 1410. On his death it was divided into four branches. Three of these had died out by 1559, and their possessions were inherited by the fourth or Simmern line, among whom the Palatinate was again divided. (*See* PALATINATE.)

In 1742, after the extinction of the two senior lines of this family, the Sulzbach branch became the senior line, and its head, the elector Charles Theodore, inherited Bavaria in 1777. He died in 1799, and Maximilian Joseph, the head of the Zweibrücken branch, inherited Bavaria and the Palatinate. He took the title of king as Maximilian I.

The Wittelsbachs gave three kings to Germany, Louis IV., Rupert and Charles VII. Members of the family were also margraves of Brandenburg from 1323 to 1373, and kings of Sweden from 1654 to 1718.

See J. Döllinger, *Das Haus Wittelsbach und seine Bedeutung in der deutschen Geschichte* (Munich, 1880); J. F. Böhmer, *Wittelsbachische Regesten bis 1340* (Stuttgart, 1854); F. M. Wittmann, *Monumenta Wittelsbacensia* (Urkundenbuch, Munich, 1857–1861); K. T. Heigel, *Die Wittelsbacher* (Munich, 1880); F. Leitschuh, *Die Wittelsbacher in Bayern* (Bamberg, 1894).

WITTENBERG, a town in the Prussian province of Saxony, Germany, on the Elbe, 59 mi. by rail southwest of Berlin, on the main line to Halle and at the junction of railways to Falkenberg, Torgau and Rosslau. Pop. (1939) 37,180.

Wittenberg is mentioned as early as 1180. It was the capital of the little duchy of Saxe-Wittenberg, the rulers of which afterwards became electors of Saxony. The Capitulation of Wittenberg (1547) is the name given to the treaty by which John Frederick the Magnanimous was compelled to resign the electoral dignity and most of his territory to the Albertine branch of the

Saxon family. It was occupied by the French in 1806, and re-fortified in 1813 by command of Napoleon; but in 1814 it was stormed by the Prussians. Its defences were dismantled in 1873.

Wittenberg is interesting chiefly on account of its close connection with Luther and the dawn of the Reformation, and several of its buildings are associated with the events of that time. Part of the Augustinian monastery in which Luther dwelt, at first as a monk and in later life as owner with his wife and family, has been fitted up as a Luther museum. The Augusteum was built in 1564–83 on the site of the monastery. The Schlosskirche, to the doors of which Luther nailed his famous 95 theses in 1517, dates from 1439–99; it was, however, seriously damaged by fire during the bombardment of 1760, was practically rebuilt, and has since been restored. The old wooden doors, burnt in 1760, were replaced in 1858 by bronze doors, bearing the Latin text of the theses. In the interior of the church are the tombs of Luther and Melanchthon. The parish church, in which Luther often preached, was built in the 14th century, but has been much altered. It contains a magnificent painting by Lucas Cranach the elder, representing the Lord's Supper, Baptism and Confession, also a font by Herman Vischer (1457). The university of Wittenberg, founded in 1502, was merged in the university of Halle in 1815. Luther was appointed professor of philosophy here in 1508; and the new university rapidly acquired a considerable reputation from its connection with the early Reformers. In opposition to the strict Lutheran orthodoxy of Jena it represented the more moderate doctrines of Melanchthon. The ancient electoral palace is another of the buildings that suffered severely in 1760; it now contains archives. Melanchthon's house and the house of Lucas Cranach the elder (1472–1553), who was burgomaster of Wittenberg, are also pointed out. The spot, outside the Elster gate, where Luther publicly burned the papal bull in 1520, is marked by an oak tree. Statues of Luther, Melanchthon and Bugenhagen embellish the town.

See Meynert, *Geschichte der Stadt Wittenberg* (Dessau, 1845); Stier, *Die Schlosskirche zu Wittenberg* (Wittenberg, 1860); Zitzlaff, *Die Begrabnisstätten Wittenbergs und ihre Denkmäler* (Wittenberg, 1897); and Gurlitt, "Die Lutherstadt Wittenberg," in Muther's *Die Kunst* (Berlin, 1902).

WITU or VITU, a sultanate of East Africa included in the Tanaland province of Kenya Colony. It extends along the coast from the town of Kipini at the mouth of the Ozi river (2° 30′ S.) to the northern limit of Manda bay (2° S.); area 1,200 sq.m. The chief town, Witu, is 16 m. N. of Kipini. The state was founded by Ahmed-bin-Fumo Luti, the last Nabhan sultan of Patta (an island off the coast), who was defeated by Seyyid Majid of Zanzibar. Ahmed, about 1860, took refuge in the forest district, and made himself an independent chief, acquiring the title of Simba or the Lion. In 1885 Ahmed was induced to place his country under German protection, but in 1890 as the result of the Anglo-German agreement of that year the protectorate was transferred to Great Britain. In 1894 Omar-bin-Hamed of the Nabhan dynasty—an ancient race of Asiatic origin—was recognized as sultan, and Witu settled down to a peaceful life.

WIVELISCOMBE (wĭv′ĕls-kŭm), a market town of Somerset, England, 9½ mi. W. of Taunton by the G.W.R. Pop. (1931) 1,262. It was an urban district from 1894 to 1933.

Traces of a large Roman camp may still be seen to the south-east of Wiveliscombe (*Wellescombe, Wilscombe, Wiviscombe*), which is near the line of a Roman road, and hoards of Roman coins have been discovered in the neighbourhood. The town probably owed its origin to the suitability of its position for defence, and it was the site of a Danish fort, later replaced by a Saxon settlement. The overlords were the bishops of Bath and Wells.

WLADISLAUS (WLADISLAW), the name of four kings of Poland and two Polish kings of Hungary[1].

[1]In Hungarian history the Polish Wladislaus (Mag. Ulászló) is distinguished from the Hungarian Ladislaus (László). They are reckoned separately for purposes of numbering. Besides the Wladislaus kings of Poland, there were three earlier dukes of this name: Wladislaus I. (d. 1102), Wladislaus II. (of Cracow, d. 1163) and Wladislaus III., duke of Great Poland and Cracow (d. 1231). By some historians these are included in the numbering of the Polish sovereigns, King Wladislaus I. being thus IV. and so on.

WLADISLAUS I. (1260–1333), king of Poland, called Lokietek, or "Span-long," from his diminutive stature, was the re-creator of the Polish realm, which at the end of the 13th century had split up into 14 independent principalities, and become an easy prey to her neighbours, Bohemia, Lithuania and the Teutonic Order. In 1296 the gentry of Great Poland elected Wladislaus, then prince of Cujavia, to reign over them; but later changing their minds, placed themselves under the protection of Wenceslaus, king of Bohemia, who was crowned at Gnesen in 1300. Wladislaus obtained the support of Pope Boniface VIII., and on the death of Wenceslaus in 1305 Wladislaus succeeded in uniting beneath his sway the principalities of Little and Great Poland. He had a long struggle with the towns and the prelates headed by Muskata, bishop of Cracow. He managed to suppress the magistrates of Cracow, but had to invoke the aid of the Teutonic Order to save Danzig from the margraves of Brandenburg; whereupon the Order not only proceeded to treat Danzig as a conquered city, but claimed possession of the whole of Pomerania. Wladislaus appealed to Pope John XXII. (1317) and ultimately (Feb. 9, 1321) obtained locally a judgment with costs against the Order, which however, appealed to Rome and got the judgment reversed. The result was a six years' war (1327–33) between Poland and the Order, in which all the princes of Central Europe took part, Hungary and Lithuania siding with Wladislaus, and Bohemia, Masovia and Silesia with the Order. It was early on Sept. 27, 1332, that Wladislaus, with his Hungarian allies, inflicted upon the knights their first serious reverse, at Plowce. In March 1333 he died. He had laid the foundations of a strong Polish monarchy, and with the consent of the pope revived the royal dignity, being crowned king of Poland at Cracow on Jan. 20, 1320.

See Max Perlbach, *Preussisch-polnische Studien zur Geschichte des Mittelalters* (Halle, 1886); Julius A. G. von Pflugk-Harttung, *Der deutsche Orden im Kampfe Ludwigs des Bayern mit der Kurie* (1900).

WLADISLAUS II., JAGIELLO (1350–1434), king of Poland, was one of the 12 sons of Olgierd, grand-duke of Lithuania, whom he succeeded in 1377. From the first Jagiello was involved in disputes with the Teutonic Order, and with his uncle, Kiejstut, who ruled Samogitia independently. By the Treaty of Dawidyszek (June 1, 1380) he contracted an alliance with the knights, and two years later, enticed Kiejstut and his consort to Krewo and there treacherously murdered them (Aug. 15, 1382). This foul deed naturally drove Witowt (*q.v.*), the son of Kiejstut, into alliance with the Order. But the two soon made common cause against the knights and invaded Prussian territory. In search of allies, Wladislaus in 1384 offered his hand to Jadwiga, the young queen of Poland, on condition they shared the Polish crown. Jadwiga renounced her previous fiancé, William of Austria. Jagiello was elected king of Poland as Wladislaus II.; on Feb. 15, 1386, he adopted the Catholic faith, and on Feb. 18 he married Jadwiga. He at once proceeded to convert Lithuania to his new faith. At Vilna, on Feb. 17, 1387, a stately concourse of nobles and prelates, headed by the king, proceeded to the grove of secular oaks beneath which stood the statue of Perkunos and other idols, and in the presence of an immense multitude hewed down the oaks, destroyed the idols, extinguished the sacred fire and elevated the cross on the desecrated heathen altars, 30,000 Lithuanians receiving Christian baptism. A Catholic hierarchy was immediately set up. Ruthenia with its capital Lemberg was persuaded to acknowledge the dominion of Poland; and there on Sept. 27, 1387, the hospodars of Walachia and Moldavia submitted voluntarily to Polish suzerainty.

The knights endeavoured to re-establish their position by sowing dissensions between Poland and Lithuania. In this for a time they succeeded (*see* WITOWT); but in 1401 Jagiello recognized Witowt as independent grand-duke of Lithuania (union of Vilna, Jan. 18, 1401), and their union was cemented in the battle of Grünewald, which shook the fabric of the Order to its foundations.

Jagiello was married four times. At the dying request of the childless Jadwiga he espoused a Styrian lady, Maria Cillei, who bore him a daughter, also called Jadwiga. His third wife, Elizabeth Grabowska, died without issue, and in 1422 Jagiello married Sonia, princess of Vyazma, a Russian lady rechristened Sophia, who bore him two sons, Wladislaus and Casimir, both of whom

ultimately succeeded him. Jagiello died at Grodko near Lemberg in 1434. During his reign Poland had risen to the rank of a great power, a position she was to retain for nearly 200 years.

WLADISLAUS III. (1424–1444), king of Poland and Hungary, the eldest son of Wladislaus II., Jagiello, by his fourth wife, Sophia of Vyazma, was born at Cracow, Oct. 31, 1424, succeeding to the throne in his tenth year. He had a turbulent minority; but Poland was wisely controlled by Zbigniew Olesnicki, while Wladislaus himself defeated the arch-traitor Spytek of Melztyn at Grotnik on May 4, 1439. On the sudden death of the emperor Albert, who was also king of Bohemia and Hungary, the Hungarians elected Wladislaus king, and he was crowned at Buda in July 1440. For three years, however, he had to fight against the partisans of the widowed Empress Elizabeth, till Pope Eugenius IV. mediated between them to enable Wladislaus to lead a crusade against the Turks. At the head of 40,000 men, mostly Magyars, and with Hunyadi commanding under him, Wladislaus made a glorious campaign in the Balkans in 1443, and by the Peace of Szeged (July 1, 1444), the Sultan Murad II., engaged to surrender Serbia, Albania and whatever territory the Ottomans had ever conquered from Hungary, including 24 fortresses, besides paying an indemnity of 100,000 florins in gold. After swearing to observe the treaty, however, Wladislaus broke it two days later in the name of religion, and invaded the Balkans a second time, losing his life and more than a fourth of his army at Varna on Nov. 10, 1444. (*See* also POLAND and HUNGARY.)

WLADISLAUS IV. (1595–1648), king of Poland, son of Sigismund III., king of Poland, and Anne of Austria, succeeded his father on the throne in 1632. He had already served with distinction under Zolkiewski in the Muscovite campaigns of 1610–12, and under Chodkiewicz in 1617–18; and his first official act was to march against the Muscovites, who had declared war against Poland immediately after Sigismund's death, forcing the Muscovite general, after bloody engagements (Aug. 7–22, 1632), to raise the siege of Smolensk and surrender (March 1, 1634). Wladislaus then concluded peace (May 28), conceding the title of tsar to Michael Romanov, who renounced all his claims upon Livonia, Estonia and Courland, besides paying a war indemnity of 200,000 rubles. Wladislaus then marched to Lemberg, and under threat of invasion the Porte offered terms, which were accepted in October, whereby each Power engaged to keep its borderers, the Cossacks and Tatars, in order, and divide between them the suzerainty of Moldavia and Walachia, the sultan binding himself always to place philo-Polish hospodars on those thrones. In the following year the long-pending differences with Sweden were settled, very much to the advantage of Poland, by the truce of Stumdorf (Sept. 12, 1635). Thus externally Poland was everywhere triumphant. Internally, however, things were in their usual deplorable state owing to the suspicion, jealousy and parsimony of the estates. When Danzig rebelled openly against dues lawfully imposed by the king, and a Danish admiral broke the blockade and almost destroyed the flotilla Wladislaus had sent against the rebellious city, the *Sejm* connived at the destruction of the national navy and the depletion of the treasury, "lest warships should make the crown too powerful." For some years after this humiliation, Wladislaus sank into a sort of apathy; but the birth of his son Sigismund (by his first wife, Cecilia Renata of Austria, in 1640) gave him fresh hopes and energy. With the aim of bringing about a royalist reaction, he founded the Order of the Immaculate Conception, consisting of 72 young noblemen who swore a special oath of allegiance to the Crown, and were to form the nucleus of a patriotic movement antagonistic to the constant usurpations of the diet. After the *Sejm* had frustrated this attempt, Wladislaus, assisted by the grand hetman of the Crown, Stanislaw Koniecpolski, tried to use the Cossacks, who were deeply attached to him, to chastise the *szlachta,* at the same time forcing a war with Turkey, which would make his military genius indispensable to the republic. Simultaneously Wladislaus contracted an offensive and defensive alliance with Venice against the Porte, a treaty directly contrary, indeed, to the *pacta conventa* he had sworn to observe. The ill-prepared enterprise fell through; and the king, worn out, disillusioned and broken-hearted at the death of his son (by his second wife, Marie Ludwika of Angoulême, Wladislaus had no issue), died at Merecz on May 20, 1648.

See W. Czermak, *The Plans of the Turkish Wars of Wladislaus IV.* (Pol.) (Cracow, 1895); V. V. Volk-Karachevsky, *The Struggle of Poland with the Cossacks* (Rus.) (Kiev, 1899); *Letters and other Writings of Wladislaus IV.* (Pol.) (Cracow, 1845).

WLOCLAWEK, a town of Poland in the province of Warsaw. Pop. (1931) 56,277. Situated on the left bank of the Vistula, about 100 mi. below Warsaw, Wloclawek has always been an important city, being the capital of the district of Kujawia and the seat of one of the ancient Catholic bishoprics. The mediaeval cathedral, built in the "Vistula Gothic" style, still exists. The region suffered much in the 14th century from the invasions of the Teutonic Knights. The diocese of the bishops included all eastern Pomerania. Germany occupied the town in 1939.

WLODIMIERZ-WOLYNSKI or **WLODZIMIERZ,** town of Poland, province of Volhynia; population, mainly Jewish. The town is the ancient capital of Volhynia, but it soon declined in importance on the rise of Luck and other towns. Near the town are the ruins of a church supposed to have been built by Vladimir, grand prince of Kiev in 973. It became the capital of the independent princes of Volhynia. Its name was Latinized as Lodomeria by the Austrians when they occupied it. It was occupied by the U.S.S.R. in 1939 and Germany in 1941.

WOAD, a herbaceous plant, known botanically as *Isatis tinctoria* (family Cruciferae), which occurs sporadically in England in fields, on banks and chalk-pits. The erect branched stem, 1 to 3 ft. in height, bears sessile leaves and terminal clusters of small yellow flowers; the brown pendulous pods are ½ in. long. The ancient Britons stained themselves with this plant. It is still cultivated in Lincolnshire.

WOBURN, a city of Middlesex county, Massachusetts, U.S.A., 10 m. N.N.W. of Boston; served by the Boston and Maine railroad. Pop. (1930) 19,434 (21½% foreign-born white); 1940 federal census, 19,751. The city has an area of 12·6 sq.mi., and embraces several villages. Its property valuation is $20,406,560 and it has excellent residential and recreational facilities. There is some manufacture of leather, chemicals and machine-shop products. In the burial ground are the graves of the ancestors of four presidents (Cleveland, Harrison, Pierce and Garfield). The public library, on the Common, was designed by H. H. Richardson. Among the colonial houses are the birthplace of Count Rumford (built about 1714, and kept as a museum) and the Baldwin mansion (1661), the home of Loammi Baldwin (1780–1838), "the father of civil engineering in America." Woburn was settled about 1638–40, and in 1642 was set off from Charlestown and incorporated as a town. The town was chartered as a city in 1888.

WOCHUA, a pygmy people of Africa, living in the forests of the Mabode district, south of the Welle. They were discovered (1880–1883) by Dr. W. Junker, who described them as "well proportioned, though the oval-shaped head seemed somewhat too large for the size of the body." Some are of light complexion, like the Akka and Batwa, but as a general rule they belong to the darker, crisper-haired, more genuine negro stock.

WODEN, a deity of the Anglo-Saxons, the name being the Anglo-Saxon counterpart of the Scandinavian Odin (*q.v.*). In German he was Wodan or Wuotan. Information is lacking as to how far the character and adventures attributed to Odin were known to other Teutonic peoples. Clearly, however, the god was credited with special skill in magic, both in England and Germany, and was also represented as the dispenser of victory. By the Romans he was early identified with Mercurius; "Wednesday" (Woden's day) is *dies Mercurii.*

WOFFINGTON, MARGARET [PEG] (1714?–1760), English actress, was born at Dublin, of poor parents on Oct. 18, probably in 1714. As a child of ten she played Polly Peachum in a Lilliputian presentation of *The Beggar's Opera,* and danced and acted in Dublin theatres until 1740, when her success as Sir Harry Wildair in *The Constant Couple* secured her a London engagement. In this, and as Sylvia in *The Recruiting Officer,* she

had a great success; and at Drury Lane and Covent Garden, as well as in Dublin, she appeared in all the plays of the day. Among her best impersonations were the elegant women of fashion, like Lady Betty Modish and Lady Townley, and in "breeches parts" she was unapproachable. She built and endowed almshouses at Teddington, where she lived after her retirement in 1757. She died there in 1760.

See Austin Dobson's introduction to Charles Reade's novel *Peg Woffington* (1899), and Augustin Daly's *Woffington: a Tribute to the Actress and the Woman* (1888).

WÖHLER, FRIEDRICH (1800–1882), German chemist, was born at Eschersheim, near Frankfort-on-the-Main, on July 31, 1800. In 1820 he entered Marburg university, and next year removed to Heidelberg, where he worked in Leopold Gmelin's (1788–1853) laboratory. Gmelin advised him not to attend the lectures in chemistry, because for him they would be a waste of time. Intending to practise as a physician, he took his degree in medicine and surgery (1823) but was persuaded by Gmelin to devote himself to chemistry. He studied in Jons Jakob Berzelius' laboratory at Stockholm for a year, and there began a lifelong friendship with the Swedish chemist. Their correspondence was published in 1901. This fruitful year has been described in Wöhler's *Jugenderrinerungen eines Chemikers* (*Berichte der deutschen chemischen Gesellschaft,* 1875). He then taught in the technical schools of Berlin (1825–31) and Cassel (1831–36). In 1836 he was appointed to the chair of chemistry in the medical faculty at Göttingen. He brought this department to a high rank, and many prominent chemists from all over the world were trained there. An imposing statue was unveiled in 1890. This professorship he held until his death on Sept. 23, 1882, although he had retired from active teaching long before.

In 1827 Wöhler first obtained metallic aluminum by heating the chloride with potassium, and he prepared many of the salts from the metal. In the following year he isolated beryllium by the same method. His great contribution to the development of chemistry was the synthesis of the natural product urea (*q.v.*) in 1828. This aided greatly in the overthrow of the vitalistic doctrine, which distinguished organic from inorganic materials. He worked with Justus von Liebig (*q.v.*) in a number of important investigations. One of the earliest was the investigation, published in 1830, which proved the polymerism of cyanic and cyanuric acid. The most famous was their study on the oil of bitter almonds (benzaldehyde) and the radicle benzoyl (1832), which Berzelius said could be regarded as the dawn of a new day. The investigation of uric acid (1837) was likewise of fundamental importance in the history of organic chemistry. The correspondence of these lifelong friends was published in 1888 by A. W. Hofmann (*q.v.*). Most of Wöhler's work, however, lay in the field of inorganic chemistry. He isolated boron and silicon and prepared silicon nitride and hydride. He prepared phosphorus by the modern method, discovered calcium carbide and showed that it could be used to prepare acetylene. He showed the analogy between the compounds of carbon and silicon. He discovered quinone, hydroquinone and quinhydrone. He just missed the discovery of vanadium and niobium. His studies touched practically every known element. He also obtained pure titanium and showed the similarity between this element and silicon and carbon.

The Royal Society's *Catalogue* enumerates 276 separate memoirs written by Wöhler apart from 43 in which he collaborated with others. In 1831 he published *Grundriss der anorganischen Chemie* and in 1840 *Grundriss der organischen Chemie.* Still more valuable for teaching purposes was his *Mineralanalyse in Beispielen* (1861), which first appeared in 1853 as *Praktische Übungen in der chemischen Analyse.* He translated three editions of the *Lehrbuch* of Berzelius and most of the volumes (4–27) of the Berzelius *Jahresbericht* into German from the original Swedish. He assisted Liebig and Poggendorff in the *Handwörterbuch der reinen und angewandten Chemie* and was joint editor with Liebig of the *Annalen der Chemie und Pharmacie.*

A memoir by Hofmann appeared in the *Berichte der deutschen chemischen Gesellschaft* (1882), reprinted in *Zur Errinerung an vorangegangene Freunde* (1888). *See* also B. Jaffe, *Crucibles* (1930); E. F. Smith, *Journal of Chemical Education* (1928); E. Thorpe, *Essays on Historical Chemistry* (1923). (R. E. O.)

WOHLGEMUTH, MICHAEL (1434–1519), German painter, was born at Nuremberg in 1434. In 1472 he married the widow of the painter Hans Pleydenwurff, whose son Wilhelm worked as an assistant to his stepfather. Wohlgemuth was the head of a large workshop, in which many different branches of the fine arts were carried on by a great number of pupil-assistants, including Albert Dürer. In this *atelier* not only large altar-pieces and other sacred paintings were executed, but also elaborate retables in carved wood, consisting of crowded subjects in high relief, richly decorated with gold and colour. Wood-engraving was also carried on in the same workshop, the blocks being cut from Wohlgemuth's designs. The *Schatzbehalter der wahren Reichthümer des Heils,* printed by Koburger in 1491; and the *Historia mundi,* by Schedel, 1493–1494, usually known as the *Nuremberg Chronicle,* are both illustrated by woodcuts by Wohlgemuth and Pleydenwurff.

By Wohlgemuth are the retable dated 1465, now in the Munich gallery; the retable of the high altar in the church of St. Mary at Zwickau (1479); and the great retable painted for the Austin friars at Nuremberg, now in the museum. This last consists of a great many panels. He died at Nuremberg in 1519.

See Bürger Schmitz Beth, *Die deutsche Malerei der Renaissance* (1919).

WOKING, a town and urban district in the Farnham parliamentary division of Surrey, England, 24 mi. S.W. of London by the S. railway. Pop. (1938) 40,800. Area, 24.2 sq.mi. The modern town, which is growing rapidly, has sprung up near the site of an older town. The river Wey and the Basingstoke canal pass through the parish. St. Peter's church dates from the 13th century. Modern structures include a public hall, and an Oriental institute including a museum of Eastern antiquities, a mosque built in 1889 and residences for Orientals. In the vicinity are a crematorium and Brookwood cemetery.

WOLCOT, JOHN (1738–1819), English satirist and poet, known under the pseudonym of PETER PINDAR, was baptized at Dodbrooke, Devonshire, on May 9, 1738. He was apprenticed to his uncle, John Wolcot, a surgeon at Fowey, and he took his degree of M.D. at Aberdeen in 1767. In 1769 he was ordained, and went to Jamaica with Sir William Trelawny, the governor. In 1772 he became incumbent of Vere, Jamaica, but on the death of his patron (1772) he returned to England, and settled as a physician at Truro. In 1781 Wolcot went to London, and took with him the young Cornish artist, John Opie, whose talents in painting he had been the first to recognize. He soon achieved fame by a succession of pungent satires on George III. Two of Wolcot's happiest satires on the "farmer king" depicted the royal survey of Whitbread's brewery, and the king's naïve wonder how the apples got into the dumplings. He had a broad sense of humour, a keen eye for the ridiculous, and great felicity of imagery and expression. Some of his serious pieces—his rendering of Thomas Warton's epigram on *Sleep* and his *Lord Gregory,* for example—reveal an unexpected fund of genuine tenderness. He died at Latham Place, Somers Town, London, on Jan. 14, 1819, and was buried near Samuel Butler, the author of *Hudibras,* in St. Paul's, Covent Garden.

Polwhele, the Cornish historian, was well acquainted with Wolcot in his early life, and the best account of his residence in the west is found in vol. i. of Polwhele's *Traditions* and in Polwhele's *Biographical Sketches,* vol. ii. Cyrus Redding was a frequent visitor at the old man's house, and has described Wolcot's later days in his *Past Celebrities,* vol. i., and his *Fifty Years' Recollections,* vols. i. and ii.

WOLCOTT, ROGER (1679–1767), American administrator, was born in Windsor (Conn.), Jan. 4, 1679, the son of Simon Wolcott (died 1687). He was a grandson of Henry Wolcott (1578–1655), who emigrated to New England in 1628; assisted John Mason and others to found Windsor (Conn.), in 1635; and was a member of the first general assembly of Connecticut in 1637 and of the house of magistrates from 1643 to his death. (Henry Wolcott the younger [died 1680] was one of the patentees of Connecticut under the charter of 1662.) Roger Wolcott was a member of the Connecticut general assembly in 1709, one of the bench of justices in 1710, commissary of the Connecticut forces in the expedition of 1711 against Canada, a member of the council in 1714, judge of the county court in 1721, and of the superior court in 1732, and deputy governor and chief justice of the superior court in 1741. He was second in command to Sir William Pepperrell, with rank of major general in the expedition (1745) against Louisbourg, and was governor of Connecticut in 1751–54. He died in what is now East Windsor, on May 17, 1767.

He wrote *Poetical Meditations* (1725), an epic on *The Agency*

of the Honourable John Winthrop in the Court of King Charles the Second (printed in vol. iv., series 1, *Collections* of Massachusetts Historical Society). His *Journal at the Siege of Louisbourg* is printed in pp. 131–161 of vol. i (1860) of the *Collections* of the Connecticut Historical Society.

His son OLIVER WOLCOTT (1726–1797) was graduated from Yale in 1747 and studied medicine with his brother Alexander (1712–95). In 1751 he was made sheriff of the newly established Litchfield county and practised law in Litchfield. He was a member of the council in 1774–86 and of the Continental Congress in 1775–76, 1778 and 1780–84, and a commissioner of Indian affairs for the northern department in 1775. During the War of Independence he was active in raising militia in Connecticut. He was one of the signers of the Declaration of Independence; commanded Connecticut militia that helped to defend New York city in Aug. 1776; in 1777 organized more Connecticut volunteers and took part in the campaign against Gen. John Burgoyne; and in 1779 commanded the militia during the British invasion of Connecticut. In 1784, as one of the commissioners of Indian affairs for the northern department, he negotiated the treaty of Fort Stanwix (Oct. 22) settling the boundaries of the Six Nations. In 1786–96 he was lieutenant governor of Connecticut, and in Nov. 1787 was a member of the Connecticut convention which ratified the Federal Constitution. He became governor in 1796 upon the death (Jan. 15) of Samuel Huntington, and served until his death on Dec. 1, 1797.

His son Oliver wrote a sketch of him in Sanderson's *Biography of the Signers of the Declaration of Independence* (Philadelphia, 1820–27).

Oliver's son, OLIVER WOLCOTT, Jr. (1760–1833), was graduated from Yale in 1778, studied law in Litchfield, and was admitted to the bar in 1781. With Oliver Ellsworth he was appointed (May 1784) a commissioner to adjust the claims of Connecticut against the United States. He was controller of public accounts of Connecticut and auditor of the Federal Treasury. In June 1791 he became controller of the Treasury, and in Feb. 1795 succeeded Alexander Hamilton as secretary of the Treasury. At the end of 1800 he resigned after a bitter attack by the press. He re-entered politics as a leader of the "Toleration Republicans," and in 1817 presided over the State convention which adopted a new constitution, and in the same year was elected governor, serving until 1827. He died in New York city June 1, 1833.

His grandson George Gibbs (1815–1873) in 1846 edited *Memoirs of the Administration of Washington and John Adams . . . from the Papers of Oliver Wolcott, Secretary of the Treasury*. Wolcott wrote *British Influence on the Affairs of the United States Proved and Explained* (1804).

WOLF, FRIEDRICH AUGUST (1759–1824), German philologist and critic, was born on Feb. 15, 1759, at Hainrode, in the province of Hanover. He was educated at Nordhausen grammar school and Göttingen university. There he chose philology as his faculty, which then had no existence, and succeeded in carrying his point. He was dissatisfied with Heyne's treatment of Homer, and the two fell out. Later his edition of the *Symposium* obtained for him a chair at Halle. The moment was a critical one in the history of education. The literary impulse of the Renaissance was almost spent; scholarship had become dry and trivial. A new school, that of Locke and Rousseau, sought to make teaching more modern and more human, but at the sacrifice of mental discipline and scientific aim. Wolf was eager to throw himself into the contest on the side of antiquity. In Halle (1783–1807), by the force of his will and the enlightened aid of the ministers of Frederick the Great, he was able to carry out his long-cherished ideas and found the science of philology.

During his time at Halle Wolf published his commentary on the *Leptines* of Demosthenes (1789) and a little later the celebrated *Prolegomena* to Homer (1795). This book, the work with which his name is chiefly associated, was thrown off in comparative haste to meet an immediate need. It has all the merits of a great piece of oral teaching—command of method, suggestiveness, breadth of view. From it originated the great Homeric controversy and Wolf's main points, oral tradition, deliberate revision after reduction to writing, and plurality of authorship, are still the crucial questions. The French invasion swept away the university, and the rest of his life was spent at Berlin, where he had another professorship. His most finished work, the *Darstellung der Altertumswissenschaft,* though published at Berlin (1807), belongs essentially to the Halle time. At length his health gave way. He was advised to try the south of France. He got as far as Marseilles, and died there on Aug. 8, 1824.

Mark Pattison wrote an admirable sketch of Wolf's life and work in the *North British Review* of June 1865, reproduced in his *Essays* (1889); *see* also J. E. Sandys, *Hist. of Class. Schol.* iii. (1908), pp. 51–60. Wolf's *Kleine Schriften* were edited by G. Bernhardy (Halle, 1869). Works not included are the *Prolegomena,* the *Letters to Heyne* (1797), the commentary on the *Leptines* (Halle, 1789) and a translation of the *Clouds* of Aristophanes (1811).

WOLF, HUGO (1860–1903), German composer, was born on the 13th of March 1860 at Windischgraz in Styria. His father, who was in the leather trade, was a keen musician. From him Hugo learned the rudiments of the piano and the violin. After an unhappy school life, in which he showed little aptitude for anything but music, he went in 1875 to the Conservatoire. He appears to have learned very little there, and was dismissed in 1877 because of a practical joke in the form of a threatening letter to the director, for which he was perhaps unjustly held responsible. In 1884 he became musical critic to the *Salonblatt,* a Viennese society paper, and contrived by his uncompromisingly trenchant and sarcastic style to win notoriety.

The publication at the end of 1887 of twelve of his songs seems to have definitely decided the course of his genius, for about this time he retired from the *Salonblatt,* and resolved to devote his whole energies to song-composition. The nine years which followed practically represent his life as a composer. They were marked by periods of feverish creative activity, alternating with periods of mental and physical exhaustion, during which he was sometimes unable even to bear the sound of music. By the end of 1891 he had composed the bulk of his works, on which his fame chiefly rests, 43 Mörike Lieder, 20 Eichendorff Lieder, 51 Goethe Lieder, 44 Lieder from Geibel and Heyse's *Spanisches Liederspiel,* and 22 from Heyse's *Italienisches Liederbuch,* a second part consisting of 24 songs being added in 1896. Besides these were 13 settings of lyrics by different authors, incidental music to Ibsen's *Fest auf Solhaug,* a few choral and instrumental works, an opera in four acts, *Der Corregidor,* successfully produced at Mannheim in June 1896, and finally settings of three sonnets by Michelangelo in March 1897. In September of this year the malady which had long threatened descended upon him; he was placed in an asylum, released in the following January, only to be immured again some months later by his own wish, after an attempt to drown himself in the Traunsee. Four painful years elapsed before his death on the 22nd of February 1903.

What little success he obtained was due to the efforts of friends, critics and singers, to make his songs known, to the support of the Vienna Wagner-Verein, and to the formation in 1895 of the Hugo-Wolf-Verein in Berlin. No doubt it was also a good thing for his reputation that the firm of Schott undertook in 1891 the publication of his songs, but the financial result after five years amounted to 85 marks 35 pfennigs (about £4 10s.). He lived in cheap lodgings till in 1896 the generosity of his friends provided him with a house, which he enjoyed for one year.

Wolf's place among the greatest song-writers is due to the essential truth and originality of his creations, and to the vivid intensity with which he has presented them. No other composer has exhibited so scrupulous a reverence for the poems which he set. To displace an accent was for him as heinous an act of sacrilege as to misinterpret a conception or to ignore an essential suggestion. Fineness of declamation has never reached a higher point than in Wolf's songs. (W. FD.)

WOLF (*Canis lupus*), wild member of the typical section of the genus *Canis* (*see* CARNIVORA). Excluding some varieties of domestic dogs, wolves are the largest members of the genus, and have a wide geographical range, extending over nearly the whole of Europe and Asia, and North America from Greenland to Mexico, but are not found in South America or Africa, where they

are replaced by other members of the family. They present great diversities of size, length and thickness of fur, and coloration, although resembling each other in all important structural characters. The Eurasian wolf (*C. lupus*) enters north-western India, but in the peninsula is replaced by the jackal-like *C. pallipes*. In North America, besides the races of *C. lupus* there is a southern species (*C. niger*), the black and red wolves.

The ordinary colour of the wolf is gray. In northern countries the fur is longer and thicker, and the animal larger and more powerful than farther south. It is especially known to man in the countries it inhabits as the devastator of sheep flocks. Wolves catch their prey by running it down in open chase, which their speed and remarkable endurance enable them to do. Except during summer when the young families of cubs are being separately provided for by their parents they assemble in troops or packs, and by their combined efforts are able to overpower and kill deer, antelopes and wounded animals of all sizes.

The history of the wolf in the British Isles and its gradual extirpation was thoroughly investigated by J. E. Harting in his *Extinct British Animals*. Wolf-hunting was a favourite pursuit of the ancient Britons as well as of the Anglo-Saxons, and it was not until the reign of Henry VII (1485–1509) that wolves appear to have become extinct in England. In Scotland the wolf maintained its hold for a much longer period. There is a well-known story of the last of the race being killed by Sir Ewen Cameron of Lochiel in 1680, but there is evidence of wolves having survived in Sutherlandshire well into the following century. In Ireland the date of their extinction has been placed, upon the evidence of doubtful traditions, as late as 1766.

It is owing to their position that the British Islands have been able to clear themselves of these animals, for France, with no natural barriers to prevent their incursions from the east, is liable every winter to visits. In America wolves are now unknown east of the Mississippi and Lake Huron, but are numerous in Alaska and in northern Canada. (*See* TIMBER WOLF.) In the U.S.S.R. wolves have not only been abundant, but numerous cases of rabies have occurred among them. In Tasmania, the name wolf is applied to the thylacine (*q.v.*).

WOLFDIETRICH, German hero of romance. The tale of Wolfdietrich is connected with the Merovingian princes, Theodoric and Theodebert, son and grandson of Clovis; but in the Middle High German poems of *Ortnit* and *Wolfdietrich* in the *Heldenbuch* (*q.v.*) Wolfdietrich is the son of Hugdietrich, emperor of Constantinople. Repudiated and exposed by his father, the child was spared by the wolves of the forest, and was educated by the faithful Berchtung of Meran. After the emperor's death Wolfdietrich was driven from his inheritance by his brothers. Berchtung and his 16 sons stood by Wolfdietrich. Six of these were slain and the other ten imprisoned. After long exile in Lombardy at the court of King Ortnit the hero returned to deliver the captives and regain his kingdom. Wolfdietrich's exile and return suggested a parallel with the history of Dietrich of Bern, with whom he was often actually identified; and in the *Anhang* to the *Heldenbuch* it is stated, in despite of all historical considerations, that Wolfdietrich was the grandfather of the Veronese hero. Among the exploits of Wolfdietrich was the slaughter of the dragon which had slain Ortnit (*q.v.*). He thus took the place of Hardheri, the original hero of this feat. The myth attached itself to the family of Clovis, around which epic tradition rapidly gathered. Hugdietrich is generally considered to be the epic counterpart of Theodoric (Dietrich), eldest son of Clovis. After his father's death he divided the kingdom with his brothers. Wolfdietrich represents his son Theodebert (d. 548), whose succession was disputed by his uncles, but was secured by the loyalty of the Frankish nobles. But father and son are merged by a process of epic fusion in Wolfdietrich.

Ortnit and *Wolfdietrich* have been edited by Dr. J. L. Edlen von Lindhausen (Tübingen, 1906). G. Sarrazin, in *Zeitschr. für deutsche Phil.* (1896), compared the legend of Wolfdietrich with the history of Gundovald, as given by Gregory of Tours in books vi. and vii. of his *Hist. Francorum*.

WOLFE, CHARLES (1791–1823), Irish poet, son of Theobald Wolfe of Blackhall, Co. Kildare, was born on Dec. 14, 1791. He was educated at English schools and at Trinity college, Dublin, where he matriculated in 1809 and graduated in 1814. He was ordained priest in 1817, and obtained the curacy of Ballyclog, Co. Tyrone, which he shortly exchanged for that of Donoughmore in the same county. He died at Cork on Feb. 21, 1823, in his 32nd year. Wolfe is remembered solely by his stirring stanzas on the "Burial of Sir John Moore" written in 1816 in the rooms of Samuel O'Sullivan, a college friend, and printed in the *Newry Telegraph*.

WOLFE, HUMBERT (1885–1940), C.B. (1925), poet and writer, was born in Milan on Jan. 5, 1885, and educated at Bradford Grammar School and Wadham College, Oxford. He entered the civil service in 1908, and in 1918 was appointed principal assistant secretary to the ministry of labour. He was also substitute member on the governing body of the International Labour Office. His first publications were *London Sonnets* and *Shylock reasons with Mr. Chesterton* (both published in 1920); these were followed by *Circular Saws*, a volume of tales, in 1923.

In 1924 appeared *Kensington Gardens* and in 1925 *The Unknown Goddess*, which contain poems, delicate, original and moving; *Lampoons* (1925) and *News of the Devil* (1926) prove his powers as a writer of satire. His output of verse thereafter was plentiful and regular: after *Humoresque* in 1926 came *Others Abide* (translations from the Greek Anthology), *Requiem* and *Cursory Rhymes* (1927), and *The Silver Cat* and *This Blind Rose* (1928); in these his talent is thought by some to have lost freshness. In 1930 he published *The Uncelestial City*, a long satire in verse, and eight years later a play in free verse, *The Silent Knight*, was produced in London. *Dialogues and Monologues* (1928) was a volume of literary criticism. Wolfe died Jan. 5, 1940.

WOLFE, JAMES (1727–1759), was born at Westerham, Kent, on Jan. 2, 1727. He was the elder son of Lt.-col. Edward Wolfe, an experienced soldier, who afterwards rose to the rank of lieutenant-general, and of Henrietta, daughter of Edward Thompson, of Long Marston, Yorks. He received his brief education at private schools, the first at Westerham, the second at Greenwich. From his earliest years he was determined to be a soldier, despite his weak health, which just prevented him from sailing as a volunteer with the ill-fated Cartagena expedition of 1740. In 1741 he received a commission in the Marines, but, having transferred into the line, he was sent to Flanders in the spring of 1742 as an ensign in the 12th Foot. Until the close of the War of the Austrian Succession, he was continuously on active service, being present at the battles of Dettingen, Falkirk, Culloden and Laffeldt, where he was wounded. His zeal, intelligence and gallantry won him the regard of his superiors, notably the duke of Cumberland. In 1743 he was appointed adjutant of the 12th; next year he received a captain's commission in the 4th; in 1745 and 1747 he served as brigade-major; while in Scotland he was aide-de-camp to Gen. Hawley.

In 1749 Wolfe, with the rank of major, was appointed acting-commander of the 20th Foot, whose lieutenant-colonel he became in the following year. He was with this regiment for eight years, during which it was stationed at several towns in Scotland and, from 1753, at various places in the south of England.

In 1757 Wolfe was appointed quartermaster-general in Ireland, but before entering upon his duties he was chosen by Pitt for the same position in the expedition against Rochefort. Though the enterprise failed utterly, Pitt and the English public had substantial grounds for their belief that it would have succeeded if plans for landing suggested by Wolfe had been acted upon by the commanders-in-chief. Wolfe was consequently selected to serve as brigadier under Amherst in the force which was to attempt the capture of Cape Breton and Quebec in 1758. At the siege of Louisbourg he played a conspicuous and brilliant part.

Meanwhile, Wolfe had been made colonel of the 67th, but soon after his return home Pitt gave him the command of the expedition which was to renew the attempt to take Quebec. He was to have the local rank of major-general, and, though technically under Amherst, to enjoy full discretion in his conduct of operations. Leaving England in Feb. 1759, Wolfe mustered his troops, rather more than 9,000 in number, at Louisbourg; and thanks to

the marvellous seamanship and the unselfish co-operation of Admiral Saunders, they arrived without mishap before Quebec in the last week of June. Wolfe's first intention was to land above, though near, the town, so as to attack the weak fortifications from the plains of Abraham; but the plan was abandoned, probably owing to the misgivings of Saunders. The British, however, seized the heights on the south shore of the St. Lawrence, opposite Quebec, which they were thus able to bombard, and established a camp at the mouth of the Montmorency river, between which and the city, Montcalm had entrenched nearly all his army. Perplexed by Montcalm's deliberate inactivity, Wolfe, on July 31, made an ill-conceived, unsuccessful and costly assault on the French lines. Wolfe, at this crisis, felt it his duty to consult his three brigadiers. When they counselled a landing to the west of Quebec, he readily concurred, and in a few days more than 3,000 men were transferred to ships above the town. Instead, however, of landing above Quebec, he resolved to take a force downstream and disembark it secretly at the Ause du Foulon, a cove only $1\frac{1}{2}$ m. from the city. This operation he successfully carried out in the early hours of Sept. 13. Montcalm was constrained to make a precipitate attack, and the British musketry decided the issue in a few minutes. Wolfe, however, was mortally wounded by a musket-ball, and died after the French gave way.

R. Wright, *Life of James Wolfe* (1864), still most valuable; F. Parkman, *Montcalm and Wolfe* (2 vols., 1885); A. G. Doughty and G. W. Parmelee, *The Siege of Quebec and Battle of the Plains of Abraham* (6 vols., 1901–03); W. Wood, *The Fight for Canada* (1905); H. R. Casgrain, *Wolfe and Montcalm* (Makers of Canada) (1905); B. Willson, *The Life and Letters of James Wolfe* (1909); *Logs of the Conquest of Canada* (edit. W. Wood, 1909); *Capt. Knox's Journal*, edit. A. G. Doughty (3 vols., 1913); A. Wolfe-Aylward, *Pictorial Life of James Wolfe* (1926).

WOLFE, THOMAS CLAYTON (1900–1938), American author, was born Oct. 3, 1900, at Asheville, N.C., and was educated at the University of North Carolina and at Harvard. From 1924 to 1930 he taught at New York university. His best known novels were *Look Homeward, Angel* (1929), *From Death to Morning* and *Of Time and the River* (1935). He died Sept. 15, 1938.

WOLFENBÜTTEL, a town of Germany, in the *Land* of Brunswick, situated on both banks of the Oker, 7 mi. S. of Brunswick on the railway to Harzburg. Pop. (1939) 25,116. The library is rich in Bibles and books of the early Reformation period, and contains some fragments of the Gothic bible of Ulfilas.

A castle is said to have been founded on the site of Wolfenbüttel by a margrave of Meissen about 1046. When this began in 1267 to be the residence of the early Brunswick or Wolfenbüttel line of counts, a town gradually grew up around it. The town passed into possession of the Brunswick-Wolfenbüttel family in 1671, and for nearly 100 years was the ducal capital.

WOLFF (less correctly WOLF), **CHRISTIAN** (1679–1754), German philosopher and mathematician, the son of a tanner, was born at Breslau on Jan. 24, 1679. At the University of Jena he studied first mathematics and physics, to which he soon added philosophy. In 1703 he qualified as *Privatdozent* in the University of Leipzig, where he lectured till 1706, when he became professor of mathematics and natural philosophy at Halle through the influence of Leibniz, of whose philosophy his own system is a modification. In Halle Wolff limited himself at first to mathematics, but presently added physics, and eventually all the main philosophical disciplines. But the claims which Wolff advanced on behalf of the philosophic reason (*see* RATIONALISM) appeared impious to his theological colleagues. Halle was the headquarters of Pietism, which, after a long struggle against Lutheran dogmatism, had itself assumed the characteristics of a new orthodoxy. Wolff's professed ideal was to base theological truths on evidence of mathematical certitude, and strife with the Pietists broke out openly in 1721, when Wolff, on the occasion of laying down the office of pro-rector, delivered an oration "On the Practical Philosophy of the Chinese" (Eng. trans. 1750), in which he instanced the moral precepts of Confucius as evidence of the power of human reason to attain by its own efforts to moral truth. For ten years Wolff was subjected to attack, until in a fit of exasperation he appealed to the court for protection. His enemies, however, told Frederick William I. that, if Wolff's determinism were recognized, no soldier who deserted could be punished, since he would only have acted as it was predetermined that he should. Wolff was at once deprived of office and ordered to leave Prussia on pain of death. He crossed over into Saxony, where the landgrave of Hesse received him with every mark of distinction, and the circumstances of his expulsion drew universal attention to his teaching at Marburg, where he was now established. Over 200 books and pamphlets appeared for or against Wolff's doctrine before 1737, not reckoning the systematic treatises of Wolff and his followers. One of the first acts of Frederick the Great was to recall Wolff (1740) to Halle. In 1743 he became chancellor of the university, and in 1745 he received the title of *Freiherr* from the elector of Bavaria. But his matter was no longer fresh, he had outlived his power of attracting students, and his class-rooms remained empty. He died on April 9, 1754.

Wolff's most important works are as follows: *Anfangsgründe aller mathematischen Wissenschaften* (1710; in Latin, *Elementa matheseos universae*, 1713–15); *Vernünftige Gedanken von den Kräften des menschlichen Verstandes* (1712; Eng. trans. 1770); *Vern. Ged. von Gott, der Welt und der Seele des Menschen* (1719); *Vern. Ged. von der Menschen Thun und Lassen* (1720); *Vern. Ged. von dem gesellschaftlichen Leben der Menschen* (1721); *Vern. Ged. von den Wirkungen der Natur* (1723); *Vern. Ged. von den Absichten der natürlichen Dinge* (1724); *Vern. Ged. von dem Gebrauche der Theile in Menschen, Thieren und Pflanzen* (1725). The last seven may be described briefly as treatises on logic, metaphysics, moral philosophy, political philosophy, theoretical physics, teleology, physiology: *Philosophia rationalis, sive logica* (1728); *Philosophia prima, sive Ontologia* (1729); *Cosmologia generalis* (1731); *Psychologia empirica* (1732); *Psychologia rationalis* (1734); *Theologia naturalis* (1736–37); *Philosophia practica universalis* (1738–39); *Jus naturae* and *Jus Gentium* (1740–49); *Philosophia moralis* (1750–53). His *Kleine philosophische Schriften* have been collected and edited by G. F. Hagen (1736–40).

In addition to Wolff's autobiography (*Eigene Lebensbeschreibung*, ed. H. Wuttke, 1841) and the usual histories of philosophy, *see* W. Schrader in *Allgemeine deutsche Biographie*, xliv.; C. G. Ludovici, *Ausführlicher Entwurf einer vollständigen Historie der Wolff'schen Philosophie* (1736–38); J. Deschamps, *Cours abrégé de la philosophie wolffienne* (1743); F. W. Kluge, *Christian von Wolff der Philosoph* (1831); W. Arnsperger, *Christian Wolffs Verhältnis zu Leibniz* (1897); H. Pichler, *Über Christian Wolffs Ontologie* (Leipzig, 1910); H. Ostertag, *Der philosophische Gehalt des Wolff-Manteuffelschen Briefwechsels* (Leipzig, 1910).

WOLFF, SIR HENRY DRUMMOND (1830–1908), English diplomatist and Conservative politician, the son of Joseph Wolff, entered the foreign office as a clerk. In 1874–1880 he sat in parliament for Christchurch, and in 1880–1885 for Portsmouth, being one of the small group known as the "Fourth Party." In 1885 he went on a special mission to Constantinople in connection with the Egyptian question, and as the result various awkward difficulties, hinging on the sultan's suzerainty, were got over. In 1888 he was sent as minister to Tehran, and from 1892 to 1900 was ambassador at Madrid. He died on the 11th of October 1908. Sir Henry, who received the K.C.M.G. in 1862, and other honours later, was a chief mover in founding the Primrose League.

WOLFF, PIERRE (1865–), French dramatist, was born at Paris, Jan. 1, 1865. He began his literary career under the auspices of his uncle, the brilliant and witty journalist Albert Wolff. Like most of the outstanding playwrights of his time, he wrote his first plays for the Théâtre Libre, where his *Jacques Bouchard* was produced in 1890. *Leurs Filles* (1891) is in a similar vein of mordant and provocative irony. In his later works, Wolff tended more and more to take an indulgent if not optimistic view of human relations. He achieved fame in the early years of the 20th century with *Le Secret de Polichinelle* (1903), *L'Age d'aimer* (1904), and, above all, *Le Ruisseau* (1907), which deals with the moral recovery of a fallen creature. *Les Marionnettes* was produced at the Comédie Française in 1910, and established his popularity. The best of his post-war plays is undoubtedly *Les Ailes brisées* (1920). Wolff has collaborated with Dunernois, with

whom he wrote *Après l'amour,* in which Lucien Guitry achieved one of his last successes.

WOLF-FERRARI, ERMANNO (1876–), Italian composer, was born at Venice on Jan. 12, 1876, his father being a distinguished German painter and his mother an Italian. He studied with Rheinberger at Munich, and on his return to Venice brought out his oratorio, *La Sulamite.* He then went to Germany and revised his early opera, *Cinderella,* for production at Bremen in 1902. This was followed by *Le dame curiose* and *I quattro rusteghi* (1906), both of which were performed at Munich. His first great success came with *Il segreto di Susanna,* a one-act comedy, first given at Munich in 1909 and quickly taken up in other places. Still more popular was *The Jewels of the Madonna* (Berlin 1911), which gave him an international reputation. He has also written a chamber symphony, *Rispetti* for soprano, op. 11, and a pianoforte quintet (1920). From 1902–12 Wolf-Ferrari was director of the Liceo Benedetto Marcello in Venice.

WOLFRAMITE or **WOLFRAM,** a mineral consisting of an isomorphous mixture in varying proportions of the tungstates of iron and manganese, $FeWO_4$ and $MnWO_4$. Varieties with dominant iron are often called ferberite, with dominant manganese, hübnerite, but since iron and manganese have nearly the same atomic weight the percentage of tungsten reckoned as WO_3 (about 76%) shows little variation and the difference is of no commercial importance. Wolframite crystallizes in the monoclinic system, usually in prismatic forms, without end-faces, and there is a very perfect pinacoidal cleavage. The colour is dark brown or black, with a metallic lustre especially on cleavage faces. Hardness 5–5·5 and density 7·2–7·5.

Wolframite is very commonly associated with tin-ore in lodes and veins in and around granites. This form occurs in Cornwall; north-west Spain and north Portugal; Saxony; Tavoy (Lower Burma); the Malay Peninsula; Queensland; Tasmania. In the United States the biggest producer is Boulder Co., Colorado, where there is no tin, but many gold veins.

Wolframite is the chief ore of the metal tungsten, which is used as a constituent of high-speed and other special steels, as well as certain non-ferrous alloys; for the filaments of electric lamps; and for various other technical uses, often as sodium tungstate. During the World War there was a tremendous demand for tungsten steel for munition making, and many new sources of wolframite were developed. (R. H. Ra.)

WOLFRAM VON ESCHENBACH, the most important and individual poet of mediaeval Germany, flourished during the end of the 12th and beginning of the 13th century. He was one of the brilliant group of Minnesingers whom the Landgrave Herrmann of Thuringia gathered round him at the historic castle of the Wartburg. We know by his own statement that he was a Bavarian, and came of a knightly race, counting his achievements with spear and shield far above his poetical gifts. The Eschenbach from which he derived his name was most probably Ober-Eschenbach, not far from Pleinfeld and Nuremberg; there is no doubt that this was the place of his burial, and so late as the 17th century his tomb was to be seen in the church of Ober-Eschenbach, which was then the burial place of the Teutonic knights. Wolfram probably belonged to the small nobility, for he alludes to men of importance, such as the counts of Abenberg, and of Wertheim, as if he had been in their service. Certainly he was a poor man, for he makes frequent and jesting allusions to his poverty. Bartsch concludes that he was a younger son, and that while the family seat was at Eschenbach, Wolfram's home was the insignificant estate of Wildenburg (to which he alludes), now the village of Wehlenberg. Wolfram seems to have disdained all literary accomplishments, and in fact insists on his unlettered condition both in *Parzival* and in *Willehalm.* But this is somewhat perplexing, for these poems are beyond all doubt renderings of French originals. Were the poems read to him, and did he dictate his translation to a scribe? The date of Wolfram's death is uncertain. We know that he was alive in 1216, as in *Willehalm* he laments the death of the Landgrave Herrmann, which took place in that year.

Wolfram von Eschenbach lives in, and is revealed by, his work. He has left two long epic poems, *Parzival* and *Willehalm* (the latter a translation of the French chanson de geste *Aliscans*), certain fragments, *Titurel* (apparently intended as an introduction to the *Parzival*), and a group of lyrical poems, *Wächter-Lieder.* These last derive their name from the fact that they record the feelings of lovers who, having passed the night in each other's company, are called to separate by the cry of the watchman, heralding the dawn. These *Tage Lieder,* or *Wächter Lieder,* are a feature of Old German folk-poetry, of which Wagner has preserved the tradition in the warning cry of Brangaene in the second act of *Tristan.*

The problem of the source of the *Parzival* is the crux of mediaeval literary criticism. (*See* Perceval.) The *Parzival* is a soul-drama; the conflict between light and darkness, faith and doubt, is its theme, and the evolution of the hero's character is steadily and consistently worked out. The teaching is of a character strangely at variance with the other romances of the cycle. Instead of an asceticism, based upon a fundamentally low and degrading view of women, Wolfram upholds a sane and healthy morality; chastity, rather than celibacy, is his ideal, and a loyal observance of the marriage bond is, in his eyes, the very highest virtue.

Wolfram has moments of the highest poetical inspiration, but his meaning, even for his compatriots, is often obscure. He is in no sense a master of language, as was Gottfried von Strassburg. This latter, in a very interesting passage of the *Tristan,* passes in review the poets of the day, awarding to the majority praise for the excellence of their style, but one he does not name, only blaming him as being so obscure and involved that none can tell what his meaning may be; this un-named poet has always been understood to be Wolfram von Eschenbach, and in a passage of *Willehalm* the author refers to the unfavourable criticisms passed on *Parzival.* Wolfram and Gottfried were both true poets, but of widely differing style. Wolfram was, above all, a man of deeply religious character, and it seems to have been this which specially impressed the mind of his compatriots; in the 13th-century poem of *Der Wartburg-Krieg* it is Wolfram who is chosen as the representative of Christianity, to oppose the enchanter Klingsor von Ungerland. (J. L. W.)

Parzival was printed at Augsburg in 1477; other editions were issued at Magdeburg (1833) and Leipzig (2 vols., 1858) by A. Schulz, and at Berlin (1898) by W. Hertz. *Titurel* was also printed, probably at Augsburg, in 1477; *the Leben und Dichten Wolfram's von Eschenbach* was edited by San Marte (A. Schulz) (2 vols., Magdeburg, 1836–41), and *Wolfram von Eschenbach* (*Werke*) by A. Leitzmann (Munich, 1902 etc.). *See* also S. Singer, *Wolframs Willehalm* (1918); A. Schreiber, *Neue Bausteine zu einer Lebensgeschichte Wolframs von Eschenbach* (1922); M. F. Richey, *Gahmuret Anschevin: a contribution to the study of W. von Eschenbach* (1923); W. Kupferschmid, *Ueber den Wortschatz der Berner Parzival-Handschrift* (1923); I. Buechel, *Die Bezeichnungen für psychologische Begriffe in Wolframs Parzival* (1925); K. Laserstein, *Wolfram von Eschenbacn germanische Sendung* (1928).

WOLGAST, a seaport town in the Prussian province of Pomerania, Germany, on the river Peene, which separates it from the island of Usedom, 30 mi. by rail E. of Greifswald. Population 7,633. Wolgast became a town in 1247, and after being the residence of the duke of Pomerania-Wolgast, it was ceded to Sweden in 1648. It was captured in 1675 by Frederick William, elector of Brandenburg. It was restored to Germany in 1815.

WOLLASTON, WILLIAM HYDE (1766–1828), English chemist and natural philosopher, was born at East Dereham, Norfolk, Aug. 6, 1766. Wollaston was educated at Charterhouse, and afterward at Caius college, Cambridge. He received his medical degree in 1793, and practised for several years. His failure to receive a favourable hospital post led him to abandon his profession and devote himself to original research. He was elected a fellow of the Royal society in 1793 and became its secretary in 1806. He voluntarily made way for Humphry Davy when he could have been made president. A brain tumour caused paralysis of his hands, so he spent the last days calmly dictating an account of several discoveries, which were published posthumously. He died in London Dec. 22, 1828. He was eccentric and reserved; he lived alone and in seclusion. His experiments were done in private and their results grudgingly disclosed. He was one of the

few men with whom Henry Cavendish (*q.v.*) was at ease.

Most of Wollaston's original work deals more or less directly with chemical subjects, but diverges on all sides into optics, acoustics, mineralogy, astronomy, physiology, botany and even art. In chemistry he made a specialty of the platinum metals. He discovered how to work platinum on a practical scale and he made a fortune (£30,000) from the secret, which, however, he disclosed in a posthumous paper (1829). He was the first to detect the metals palladium (1804) and rhodium (1805) in crude platinum. In 1808 he discovered instances of multiple proportions among the alkali oxalates, sulphates and carbonates. He proposed the use of "equivalents" instead of John Dalton's "atoms." He predicted the necessity of acquiring a geometrical conception of the relative arrangement of the elementary atoms in all three dimensions of solid extension, thus foreshadowing the work of Jacobus van't Hoff and Joseph Le Bel. He invented a slide rule for chemists. He discovered cystine (1810). In 1809 he proved the elementary character of columbium (niobium) and titanium. In 1801 he gave experimental proof of the identity of functional and voltaic electricity.

In optics he was the first (1802) to observe dark lines in the solar spectrum. These are known as the Fraunhofer lines. Of the seven lines he saw, he regarded the five most prominent as the natural boundaries or dividing lines of the pure simple colours of the prismatic spectrum, which he supposed to have four primary divisions. He described the reflecting goniometer in 1809; this in its way brought about a revolution in the methods of mineralogy and crystallography. Previously, the goniometer had to be applied directly to facets of the crystals. Consequently only angles of large crystals could be measured. Wollaston's goniometer permitted measurement of the angle formed by rays of light reflected from these facets and hence angles of even minute crystals could be measured accurately. The camera lucida (1818) greatly aided microscopists and others who had to make accurate drawings of very small objects. He provided microscopists with the "Wollaston doublet," and applied concavo-convex lenses to the purposes of the oculist. His cryophorus was described in 1813, in a paper "On a Method of Freezing at a Distance."

In 1821, after Hans C. Oersted (1777–1851) had shown that a magnetic needle is deflected by an electric current, Wollaston attempted to transform that deflection into a continuous rotation, and also to obtain the reciprocal effect of a current rotating round a magnet. He failed in both respects, and when Michael Faraday (*q.v.*), who overheard a portion of his conversation with Davy on the subject, was subsequently more successful, he was inclined to assert the merit of priority, to which Faraday did not admit his claim.

In geological circles Wollaston is famous for the medal which bears his name, and which (together with a donation fund) is annually awarded by the council of the Geological Society of London, being the result of the interest on £1,000 bequeathed by Wollaston for "promoting researches concerning the mineral structure of the earth." The first award was made in 1831.

An appreciative essay on Wollaston will be found in George Wilson's *Religio Chemici* (1862). *See* also E. Ferguson, *Journal of Chemical Education* (1941). (R. E. O.)

WOLLASTONITE, a rock-forming mineral consisting of calcium metasilicate, $CaSiO_3$, crystallizing in the monoclinic system and belonging to the pyroxene (*q.v.*) group. It differs, however, from other members of this group in having cleavages, not parallel to the prism-faces, but in two directions perpendicular to the plane of symmetry. Crystals are usually elongated parallel to the axis of symmetry and flattened parallel to the ortho-pinacoid, hence the early name "tabular spar"; the name wollastonite is after W. H. Wollaston. The mineral usually occurs as white cleavage masses. The hardness is 5, and specific gravity 2.85. It is a characteristic product of contact-metamorphism, occurring, especially with garnet, diopside, etc., in crystalline limestones. Crystals are found in the cavities of the ejected limestone blocks of Monte Somma, Vesuvius. At Santa Fé in the State of Chiapas, Mexico, a large rock-mass of wollastonite carries ores of gold and copper; here are found large pink crystals which are often partially or wholly altered to opal. (L. J. S.)

WOLLIN, an island of Germany, in the Prussian province of Pomerania, the more easterly of the islands at the mouth of the Oder which separate the Stettinisches Haff from the Baltic sea. It is divided from the mainland on the east by the Dievenow channel, and from Usedom on the west by the Swine. It has an area of 95 sq.mi. Heath and sand alternate with swamps, lakes and forest on its surface, which is flat, except for low hills in the south-west. Cattle-rearing and fishing are the chief resources of the inhabitants. Some of the villages are summer bathing resorts. Wollin, the only town, is situated on the Dievenow, and carries on the industries of a small seaport. Pop. (1933) 4,942.

Near the modern town once stood the ancient and opulent Wendish city of Wolin or Jumne, called Julin by the Danes, and Winetha or Vineta (*i.e.*, Wendish town) by the Germans. The Northmen made a settlement here about 970, and built a fortress on the "silver hill," called Jomsburg, which is often mentioned in the sagas. The stronghold of Jomsburg was destroyed in 1098 by King Magnus Barfod of Norway. This is probably the origin of the legend that Vineta was overthrown by a storm or earthquake and overwhelmed by the sea. Some submarine granite rocks near Damerow in Usedom are still popularly regarded as its ruins. The town of Wollin became in 1140 the seat of the Pomeranian bishopric, which was transferred to Kammin about 1170. Wollin was burnt by Canute VI of Denmark in 1183, and was taken by the Swedes in 1630 and 1759 and by the Brandenburgers in 1659 and 1675.

WOLLONGONG, an important town and seaport of New South Wales, Australia. Pop. (1933) 11,403. It lies in, and is typical of, the Illawarra district which extends south of Sydney from near Clifton to the Shoalhaven river (*c.* 48 miles). Tectonic and erosional processes have produced a narrow strip (2–12 miles broad, widening southwards) of lowlands backed by steep and often precipitous scarp (Illawarra "Range": Mount Kembla: 1,752 ft.). Along this stream-dissected scarp the seams of the Sydney coal basin are frequently exposed and can be worked by horizontal adits. The lowlands with their mild and equable climate (av. ann. temps. *c.* 70–54° F.; av. ann. rainfall: 38–47 in.), hilly terrain, fertile soils and favourable position made this one of the earliest, and later one of the leading, dairying districts of Australia, and agriculture also flourishes in parts. Coal is mined at Bulli (*q.v.*), Mount Kembla, Clifton and other places, though the exposed nature of the coast tends to hamper direct loading on to vessels.

WOLSELEY, GARNET JOSEPH WOLSELEY, VISCOUNT (1833–1913), British field marshal, eldest son of Major Garnet Joseph Wolseley of the King's Own Borderers (25th Foot), was born at Golden Bridge, Co. Dublin, on June 4, 1833. Educated at Dublin, he obtained a commission as ensign in the 12th Foot in March 1852, and was transferred to the 80th Foot, with which he served in the second Burmese War. Promoted to be lieutenant and invalided home, he exchanged into the 90th Light Infantry, then in Dublin. He accompanied the regiment to the Crimea, and did duty with the Royal Engineers in the trenches before Sevastopol. After the fall of Sevastopol Wolseley was employed on the quartermaster-general's staff and was one of the last to leave the Crimea in July 1856. After six months' duty with the 90th Foot at Aldershot, he went with it again, in March 1857, to join the expedition to China under Major-General the Hon. T. Ashburnham. Wolseley embarked in command of three companies in the transport "Transit," which was wrecked in the Strait of Banka. The troops were saved, and were taken to Singapore, whence, on account of the Indian Mutiny, they were despatched with all haste to Calcutta. Wolseley served at the relief of Lucknow under Sir Colin Campbell in November, and in the defence of the Alambagh position under Outram, taking part in the actions of Dec. 22, 1857, Jan. 12 and 16, 1858, and the repulse of the grand attack of Feb. 21. In March he served at the final siege and capture of Lucknow. He was then appointed D.A.Q.G. on the staff of Sir Hope Grant's Oudh division, and was engaged in all the operations of the campaign. In the autumn and winter of 1858 he took part in the Baiswara, trans-Gogra and trans-Rapti campaigns, ending with the complete suppression of the rebellion. Having received his Crimean majority in March 1858, he was in April 1859 promoted to be lieutenant-colonel, and received the Mutiny medal and clasp. When Grant was nominated to the command of the British troops in the Anglo-French expedition to China in 1860, Wolseley accompanied him as D.A.Q.G. On his return home he published the *Narrative of the War with China in 1860*. In 1867 he was appointed deputy quartermaster-general in Canada. In 1869 his *Soldiers' Pocket Book for Field Service* was published, and has since run through many editions. In 1870 he commanded the Red river expedition to put down a rising under

Louis Riel (*q.v.*).

Appointed assistant adjutant-general at the war office in 1871 he worked hard in furthering the Cardwell schemes of army reform. From this time till he became commander-in-chief Wolseley was the prime mover and the deciding influence in practically all the steps taken at the war office for promoting the efficiency of the army under the altered conditions of the day. In 1873 he commanded the expedition to Ashanti, and, having made all his arrangements at the Gold Coast before the arrival of the white troops in January 1874, was able to complete the campaign in two months, and re-embark them for home before the unhealthy season began. This campaign made his name a household word in England. He fought the battle of Amoaful on Jan. 31, and, after five days' fighting, ending with the battle of Ordahsu, entered Kumasi, which he burned. He received the thanks of both Houses of Parliament, a grant of £25,000, promotion, and other honours. On his return home he was appointed inspector-general of auxiliary forces, but had not held the post for a year when he was sent to Natal as governor and general commanding. In 1878 he went as high-commissioner to the newly acquired possession of Cyprus, and in 1879 to South Africa to supersede Lord Chelmsford in command of the forces in the Zulu War, and as governor of Natal and the Transvaal and high commissioner of South-East Africa. On his arrival at Durban in July he found that the war in Zululand was practically over, and after effecting a temporary settlement he went to the Transvaal. Having reorganized the administration there and reduced the powerful chief Sikukuni to submission, he returned home in May 1880 and was appointed quartermaster-general.

In 1882 he was appointed adjutant-general, and in August of that year was given the command of the British forces in Egypt to suppress the rebellion of Arabi Pasha. (*See* EGYPT: *Military Operations.*) Having seized the Suez Canal, he disembarked his troops at Ismailia, and after a very short and brilliant campaign completely defeated Arabi Pasha at Tel-el-Kebir, and suppressed the rebellion. He was promoted general for distinguished service in the field, and raised to the peerage as Baron Wolseley of Cairo and Wolseley. In 1884 he was again called away to command the Nile expedition for the relief of General Gordon and the besieged garrison of Khartum. The expedition arrived too late: Khartum had fallen, and Gordon was dead; and in the spring of 1885 complications with Russia over the Penjdeh incident occurred, and the withdrawal of the expedition followed. Wolseley was now created a viscount and a knight of St. Patrick. He continued at the war office as adjutant-general until 1890, when he was given the command in Ireland. He was promoted to be field marshal in 1894, and was nominated colonel of the Royal Horse Guards in 1895, in which year he was appointed commander-in-chief. His powers were, however, limited by a new order in council, and after holding the appointment for over five years, he handed over the office to Earl Roberts in 1901.

Lord Wolseley married in 1867 Louisa, daughter of A. Erskine. He published *The Decline and Fall of Napoleon* (1895), *The Life of John Churchill, Duke of Marlborough, to the Accession of Queene Anne* (1894), and *The Story of a Soldier's Life* (1903).

He died at Mentone March 25, 1913, the title going by special remainder to his only daughter, Frances. He was buried in St. Paul's Cathedral, and an equestrian statue of him on the Horse Guards' Parade, Whitehall, London, was unveiled in 1920.

WOLSEY, THOMAS (*c.* 1475–1530), English cardinal and statesman, born at Ipswich about 1475, was son of Robert Wolsey (or Wuley, as his name was always spelt) by his wife Joan.

Thomas was educated at Magdalen college, Oxford. He is said to have graduated B.A. at the age of fifteen (*i.e.*, about 1490); but his earliest definite appearance in the records is as junior bursar of Magdalen college in 1498–1499, and senior bursar in 1499–1500, an office he was compelled to resign for applying funds to the completion of the great tower without sufficient authority (W. D. Macray, *Reg. of Magdalen College,* i. 29–30, 133–134). He must have been elected fellow of Magdalen some years before. As master of Magdalen college school he had under his charge three sons of Thomas Grey, first marquess of Dorset, who presented him (1509) to the rectory of Limington in Somerset. He had been ordained priest in 1498.

Rapid Rise.—At Limington he came into conflict with the sheriff, Sir Amias Paulet, who is said by Cavendish to have placed Wolsey in the stocks; Wolsey retaliated long afterwards by confining Paulet to his chambers in the Temple for five or six years. Dorset died in 1501, but Wolsey found other patrons. Before the end of that year he obtained a dispensation to hold two livings in conjunction with Limington, and Archbishop Deane appointed him his domestic chaplain. After Deane's death in 1503, Wolsey became chaplain to Sir Richard Nanfan, deputy of Calais, who apparently recommended him to Henry VII. Nanfan died in 1507, but the king made Wolsey his chaplain and employed him in diplomatic work. In 1508 he was sent to James IV. of Scotland, and in the same year he pleased Henry by his expeditious despatch of the business in connection with the king's proposal of marriage to Margaret of Savoy. His ecclesiastical preferments, of which he received several in 1506–1509, culminated in his appointment by Henry to the deanery of Lincoln on Feb. 2, 1509.

Henry VIII. made Wolsey his almoner immediately on his accession, and the receipt of some half-dozen further ecclesiastical preferments in the first two years of the reign marks his growth in royal favour. In 1511 Wolsey became a privy councillor, and secured a controlling voice in the government. The control of affairs had been shared between the clerical and peace party led by Richard Fox (*q.v.*) and Archbishop Warham, and the secular and war party led by Surrey. Wolsey turned the balance in favour of war, and his administrative energy found scope in the preparations for the English expedition to Biscay in 1512, and for the campaign in northern France in 1513. He arranged peace with France and a marriage between Mary Tudor and Louis XII. in 1514, and reaped his reward in the bishoprics of Lincoln and Tournai, the archbishopric of York, which was conferred on him by papal bull in September, and the cardinalate, which he had sent Polydore Vergil to beg from Leo X. in May 1514, but did not receive till the following year. Nevertheless, when Francis I. in 1515 succeeded Louis XII. and won the battle of Marignano, Wolsey took the lead in assisting the emperor Maximilian to oppose him; and this revival of warlike designs was resented by Fox and Warham, who retired from the government, leaving Wolsey supreme. Maximilian proved a broken reed, and in 1518 Wolsey brought about a general pacification, securing at the same time his appointment as legate *a latere* in England. He thus superseded Warham, who was *legatus natus,* in ecclesiastical authority; and though legates *a latere* were supposed to exercise only special and temporary powers, Wolsey secured the practical permanence of his office.

Foreign Policy.—The foreign policy followed after the election of Charles V. (*see* HENRY VIII.) as emperor, was Wolsey's policy. Friendship with the emperor served Wolsey's personal interests, and at the conference of Calais in 1521 Wolsey had ranged himself with the emperor. Parliament had in 1513–1515 showed signs of strong anti-clerical feeling; Wolsey probably hoped to distract attention from the church by a spirited foreign policy, as Henry V. had done a century before. He had, moreover, received assurances from the emperor that he would further Wolsey's candidature for the papacy; and although he protested to Henry VIII. that he would rather continue in his service than be ten popes, that did not prevent him from secretly instructing his agents at Rome to press his claims. Charles, however, paid Wolsey the sincere compliment of thinking that he would not be sufficiently subservient on the papal throne; while he wrote letters in Wolsey's favour, he took care that they should not reach their destination in time; and Wolsey failed to secure election both in 1521 and 1524. This ambition distinguishes his foreign policy from that of Henry VII., to which it has been likened. Henry VII. cared only for England; Wolsey's object was to play a great part on the European stage.

In any case the decision taken in 1521 was a blunder. Wolsey's assistance helped Charles V. to that position of predominance which was strikingly illustrated by the defeat and capture of Francis I. at Pavia in 1525; and the balance of power upon which

England's influence rested was destroyed. Her efforts to restore it in 1526–1528 were ineffectual; her prestige had depended upon her reputation for wealth derived from the fact that she had acted in recent years as the paymaster of Europe. But Henry VII.'s accumulations had disappeared; parliament resisted in 1523 the imposition of new taxation; and the attempts to raise forced loans and benevolences in 1526–1528 created a storm of opposition. Still more unpopular was the brief war with Charles V. in which Wolsey involved England in 1528. The sack of Rome in 1527 and the defeat of the French before Naples in 1528 confirmed Charles V.'s supremacy. Peace was made in 1529 between the two rivals without England's being consulted, and her influence at Wolsey's fall was less than it had been at his accession to power.

The Divorce.—This failure reacted upon Wolsey's position at home. His domestic was sounder than his foreign policy. By his development of the star chamber, by his firm administration of justice and maintenance of order, and by his repression of feudal jurisdiction, he rendered great services to the monarchy. But the inevitable opposition of the nobility to this policy was not mitigated by the fact that it was carried out by a churchman; the result was to embitter the antagonism of the secular party to the church and to concentrate it upon Wolsey's head. The control of the papacy by Charles V., moreover, made it impossible for Wolsey to succeed in his efforts to obtain from Clement VII. the divorce which Henry VIII. was seeking from Charles' aunt, Catherine of Aragon. Wolsey has been said to have been the originator of the divorce scheme. There is no evidence that he first suggested it, though when he found that Henry was bent upon it, he pressed for two points: (i.) that an application should be made to Rome, instead of deciding the matter in England, and (ii.) that Henry, when divorced, should marry a French princess. The appeal to Rome was a natural course to be advocated by Wolsey, whose despotism over the English church depended upon an authority derived from Rome; but its success depended upon the problematical destruction of Charles V.'s power in Italy. At first this seemed not improbable; French armies marched south on Naples, and the pope sent Campeggio with full powers to pronounce the divorce in England. But he had hardly started when the French were defeated in 1528. Their ruin was completed in 1529, and Clement VII. was obliged to come to terms with Charles V., which included Campeggio's recall in Aug. 1529.

Wolsey's Fall.—Wolsey clearly foresaw his own fall, the consequent attack on the church and the triumph of the secular party. Parliament, which he had kept at arm's length, was hostile; he was hated by the nobility, and his general unpopularity is reflected in Skelton's satires and in Hall's *Chronicle*. Even churchmen had been alienated by his suppression of monasteries and by his monopoly of ecclesiastical power; and his only support was the king, who had now developed a determination to rule himself. He surrendered all his offices and all his preferments except the archbishopric of York, receiving in return a pension of 1,000 marks (equal to six or seven thousand pounds a year in modern currency) from the bishopric of Winchester, and retired to his see, which he had never before visited. A bill of attainder, passed by the Lords, was rejected at Cromwell's instigation and probably with Henry's goodwill by the Commons. The last few months of his life were spent in the exemplary discharge of his archiepiscopal duties; but a not altogether unfounded suspicion that he had invoked the assistance of Francis I., if not of Charles V. and the pope, to prevent his fall involved him in a charge of treason. He was summoned to London, but died on his way at Leicester abbey on November 30, 1530, and was buried there.

Character.—The completeness of Wolsey's fall enhanced his former appearance of greatness, and, indeed, he is one of the outstanding figures in English history. His qualities and his defects were alike exhibited on a generous scale; and if his greed and arrogance were colossal, so were his administrative capacity and his appetite for work. "He is," wrote the Venetian ambassador Giustiniani, "very handsome, learned, extremely eloquent, of vast ability and indefatigable. He alone transacts the business which occupies all the magistrates and councils of Venice, both civil and criminal; and all state affairs are managed by him, let their nature be what it may. He is grave, and has the reputation of being extremely just; he favours the people exceedingly, and especially the poor, hearing their suits and seeking to despatch them instantly." As a diplomatist he has had few rivals and perhaps no superiors. But his pride was equal to his abilities. The familiar charge, repeated in Shakespeare, of having written *Ego et meus rex,* while true in fact, is false in intention, because no Latin scholar could put the words in any other order; but it reflects faithfully enough Wolsey's mental attitude. Giustiniani explains that he had to make proposals to the cardinal before he broached them to Henry, lest Wolsey "should resent the precedence conceded to the king." "He is," wrote another diplomatist, "the proudest prelate that ever breathed." He arrogated to himself the privileges of royalty, made servants attend him upon their knees, compelled bishops to tie his shoe-latchets and dukes to hold the basin while he washed his hands, and considered it condescension when he allowed ambassadors to kiss his fingers; he paid little heed to their sacrosanct character, and himself laid violent hands on a papal nuncio. His egotism equalled Henry VIII.'s; his jealousy and ill-treatment of Richard Pace, dean of St. Paul's, referred to by Shakespeare but vehemently denied by Dr. Brewer, have been proved by the publication of the Spanish state papers; and Polydore Vergil, the historian, and Sir R. Sheffield, speaker of the House of Commons, were both sent to the Tower for complaining of his conduct. His morals were of the laxest description, and he had as many illegitimate children as Henry VIII. himself. For his son, before he was eighteen years old, he procured a deanery, four archdeaconries, five prebends and a chancellorship, and he sought to thrust him into the bishopric of Durham. For himself he obtained, in addition to his archbishopric and lord chancellorship, the abbey of St. Albans, reputed to be the richest in England, and the bishopric first of Bath and Wells, then of Durham, and finally that of Winchester. He also used his power to extort enormous pensions from Charles V. and Francis I. and lavish gifts from English suitors.

During the first half of his government he materially strengthened the Tudor monarchy by the vigorous administration of justice at home and by the brilliance of his foreign policy abroad. But the prestige he secured by 1521 was delusive; its decline was as rapid as its growth, and the expense of the policy involved taxation which seriously weakened the loyalty of the people. The concentration of civil and ecclesiastical power by Wolsey in the hands of a churchman provided a precedent for its concentration by Henry VIII. in the hands of the crown; and the personal example of lavish ostentation and loose morals which the cardinal-archbishop exhibited cannot have been without influence on the king, who grew to maturity under Wolsey's guidance.

The *Letters and Papers of Henry VIII.*, vols. i.–iv., supplemented by the *Spanish and Venetian Calendars,* contain almost all that is known of Wolsey's public career, though additional light on the divorce has been thrown by Stephen Ehses' *Römische Dokumente* (1893). Cavendish's brief *Life,* which is almost contemporary, has been often edited. Fiddes's huge tome (1724) is fairly exhaustive. Brewer, in his elaborate prefaces to the *Letters and Papers* (reissued as his *History of the Reign of Henry VIII.*), originated modern admiration for Wolsey; and his views are reflected in Creighton's *Wolsey* in the "Twelve English Statesmen" series, and in Dr. Gairdner's careful articles in the *Dict. Nat. Biog.* and *Cambridge Modern History.* A less enthusiastic view is adopted in H. A. L. Fisher's volume (v.) in Longmans' *Political History* (1906) and in A. F. Pollard's *Henry VIII.* (1902 and 1905). *See* also E. Law, *England's First Great War Minister: how Wolsey made a new army and navy* (1916) and *Cardinal Wolsey at Hampton Court* (1923).

WOLVERHAMPTON, market town; municipal, county and parliamentary borough, Staffordshire, England, 125 mi. N.W. of London, on the L.M.S. and G.W. railways. Pop. (1938) 145,300. Area 14 sq.mi. It lies at the northwestern edge of the group of great manufacturing towns extending southeast to Birmingham, but there are residential suburbs to the west, where the country is well wooded. The situation is elevated and healthy. The church of St. Peter, dedicated 994, is a fine cruciform building, part being 13th century work. A free grammar school, founded in 1515 by Sir Stephen Jermyns, occupies modern buildings (1876). There are a Blue Coat school (1710) and a school of art. South Staf-

fordshire is the oldest centre of the iron trade in England. There are enormous foundries and the town manufactures ironmongery and steel goods, especially locks, machinery, tools, cycles, enamel and galvanized ware, papier-mâché, rubber goods, chemicals, colours, varnishes, etc. Market gardening is carried on in the west and north of the town. An annual fair is held at Whitsuntide.

Wednesfield (pop. 13,920), and Willenhall (28,100) are neighbouring urban districts, with populations employed in similar manufactures.

The town of Wolverhampton (*Handone, Wolvernehamptone, Wollernehampton*) grew up round the church of St. Mary, probably founded in 996 by Wulfruna, who endowed it with extensive lands. The estates are enumerated in Domesday. In 1204 John granted the manor of Wolverhampton to the church, and at the Reformation it was held by the dean of the collegiate body; in 1553 Edward VI granted the college and manor to Dudley, duke of Northumberland, but Mary refounded the college and restored its property. Henry III (1258) granted the Wednesday market, which is still held, and a fair for eight days, beginning on June 29. During the Great Rebellion Wolverhampton was royalist. In 1751 its chief and noted manufacture was locks. In 1848 it was incorporated a municipal borough and a county borough in 1888. It was first represented in parliament in 1832, sending two members, but since 1885 it has sent three. The borough was extended in 1927 and 1933.

The Civic hall assembly rooms were opened in 1938 and a town planning scheme was prepared.

WOLVERINE: *see* GLUTTON.

WOLVERTON, an urban district of Buckinghamshire, England, near the river Ouse, 52½ mi. N.N.W. of London by the L.M.S. Ry. Pop. (1938) 12,780; area 7.3 sq.mi. Its modern growth was due to the establishment of carriage works by the railway company. The technical college (1926) is important.

WOMBAT, the typical representative of the marsupial family Vombatidae (*see* MARSUPIALIA). All the teeth are of continuous growth, having persistent pulps. The incisors are large and chisel-like, as in rodents. The body is broad and depressed, the neck short, the head large and flat, the eyes small, and the tail vestigial. The limbs are equal, stout and short. The feet have broad, naked soles; the forefeet have five toes, each with a long nail. The hind-feet have a short nailless first toe; the second, third, and fourth toes partially united by skin, the fifth distinct and shorter; these four with long nails. The wombat of Tasmania (*Vombatus ursinus*) and the similar but larger *V. platyrhinus* of southern Australia belong to the typical group of the genus, with short ears, coarse fur, and naked muzzle. On the other hand, in the hairy-nosed wombat (*Lasiorhinus latifrons*) of South Australia, the fur is silky, the ears more pointed, and the muzzle hairy.

BROAD-NOSED WOMBAT (VOMBATUS PLATYRHINUS), AUSTRALIA

In form and action wombats resemble small bears, having a similar shuffling walk, but they are shorter in the legs and have broader backs. They live on the ground, or in burrows or holes among rocks, and feed on grass, roots, and other vegetable substances. They sleep during the day but wander forth at night in search of food. They are shy and gentle, though they bite strongly when provoked. The prevailing colour is brownish grey. The large wombat of the mainland is variable in colour, some individuals being pale yellowish brown, others dark grey and some black. The length of the head and body is about 3ft. Fossil wombats, some of larger size than any now existing, have been found in the Pleistocene of Australia.

WOMBWELL, an urban district in the West Riding of Yorkshire, England, 4 mi. S.E. of Barnsley on the L.M.S. and L.N.E. railways. Pop. (1938) 17,780. Area 6 sq.mi. The population is employed chiefly in the extensive collieries.

WOMEN, DISEASES OF: *see* GYNAECOLOGY.

WOMEN, EDUCATION OF. Prior to the middle of the 19th century there was little provision for women or girls to engage in serious study except in the early middle ages. Between the 6th and 10th centuries there were good scholars and Latinists among the nuns, and the convents provided instruction to girls in the same subjects as that given to boys. Later the education received in the convent schools became increasingly meagre. The wave of enthusiasm for learning in the 16th century affected a limited number of women, mainly among the aristocracy.

Great Britain.—The movement for effecting a reform in Great Britain began in several quarters. In 1848 Queen's college (F. D. Maurice) led the way in providing scholarly intellectual training for girls. Bedford college (Mrs. Jesser Reid) followed in 1849: the North London collegiate school (Miss Buss) in 1850. Cheltenham Ladies' college (Miss Beale) first provided sound education under a boarding school system on the lines of that of the great public schools for boys. Between 1860 and 1870 the movement was promoted in various ways: (1) The schools inquiry commission (1864–67) threw light on the miserable deficiencies in the education of girls. (2) Various associations were formed:—*e.g.*, the North of England Council for promoting the Higher Education of Women (1867); the London Schoolmistresses' Association (1866); the Association for promoting the Higher Education of Women in Cambridge (1869). (3) Local examinations were opened to women (Cambridge 1865, Oxford 1870).

From 1870 things moved fast. The Education Act of that year made education compulsory for girls ("the three Rs"; domestic arts) as well as boys. Girton college (Miss Emily Davies), already started at Hitchin in 1869, was established close to Cambridge in 1873. In 1871 Merton hall, Cambridge (Henry Sidgwick, Miss A. J. Clough) was opened, to become Newnham hall in 1876 and Newnham college in 1880. In 1871 the Women's Education Union (Mrs. William Grey) was begun, parent of the Girls' Public Day School Company (the Misses Gurney) which between 1873 and 1901 founded 38 day schools where girls could receive an education parallel with the best afforded to boys. The reorganization of trusts facilitated by the Endowed Schools Act of 1869 provided excellent schools at low fees by devoting to girls a new and increased share of the funds at their disposal—*e.g.*, Harpur trust, Bedford (1873), Grey Coat and Christ's hospitals, King Edward's schools, Birmingham, Hulme trust, Manchester, St. Paul's, etc. Good boarding schools were started (*e.g.*, Miss Lawrence's, Brighton—now Roedean—1885). The Education Act of 1902 included girls in all its provisions for new secondary schools.

In all provided and grant-earning schools and those recognised as efficient the curriculum is now like that in boys' schools; the same examinations are entered for. In general less stress is laid on the classics, mathematics and physical science. Some periods are set aside for cookery, needlework, etc. The provision of science teaching and science laboratories has recently been much improved. In some schools a business training is afforded after the matriculation stage alternative to advanced courses for those who proceed to the universities. In 1926–27 there were 160,022 girls in grant-earning schools, the average leaving age being 16 years 2 months. The efficiency of the schools was made possible by the opening of the universities to women—at first as regards lectures and examinations only, later by full membership of every British university except Cambridge, which bestows only titular degrees on women. At first the proportion of graduate to non-graduate teachers was low, now in all recognised schools there is a small minority only of non-graduate mistresses. Most head mistresses demand training as well as a degree from their mistresses. Secondary training is afforded in the university departments of education; at the Maria Grey training college (1878) and St. Mary's college, London; the Cambridge training college (1884). Government grants for training are made to women as to men with a less maintenance allowance. Women sit equally with men on the teachers' registration council. The number of women in the universities has steadily increased in the present century. In 1926–27 in the faculties of art, science and medicine they numbered 7,873 (Oxford 800, Cambridge 472, London 3,136, provincial universities 3,465). State and county scholarships and four-year-scholar-

ships for intending teachers have contributed to this increase. All teaching posts are nominally open to women. Only in London and Wales have women held professorships.

In Scotland the universities are open to women. Glasgow has the largest number of women students of all British universities (1,464). In the Secondary day schools, boys and girls work side by side. There are good boarding schools for girls only; *e.g.*—St. Leonard's school, St. Andrews (1877); George Watson's, Edinburgh. (*See* also EDUCATION: *England,* etc.; *Secondary Education,* etc.)

The Continent.—On the continent the universities are, generally speaking, open to women. Girls receive a solid education in state schools in France, Germany, the Scandinavian countries and Holland. Educational legislation of the last few years shows a tendency to assimilate the curricula in girls' schools to those for boys except in countries where dual schools have been the rule (*e.g.,* Italy, Czechoslovakia) where the tendency has been in a contrary direction. In France the assimilation is absolutely complete. Competition for all certificates and "agrégations" is now secured to women, though posts in boys' secondary schools and in the universities are still practically confined to men. (*See* also EDUCATION: *France, Germany,* etc.).

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UNITED STATES

The first settlers brought with them from Europe the traditional belief that marriage was the only reputable vocation for women. During the colonial period the dame schools appear to be the first place and up to a short time prior to the Revolution practically the only place outside the home where girls might secure elementary instruction, though they were organized to prepare boys for the grammar schools. In certain localities girls were favoured. In New Hampshire when Hampton engaged a schoolmaster in 1649, and when Dover did likewise in 1658, it was with the understanding that instruction be given to all children both male and female. In Philadelphia in 1689 the Society of Friends established their public school, the predecessor of the famous William Penn charter school which was open to all classes and to both sexes. At Nazareth, Pa., the Moravians organized a school for girls in 1750. These, however, were the exception. In time the grammar schools greatly increased in number, though only a few admitted girls and then only at certain hours or at certain times of the year. In 1784 Dorchester, Mass., permitted girls to attend from June 6 to Oct. 1. In 1789 Boston established the "double-headed school," and a private school for girls, the "academy," was opened at Medford, Mass., which was the forerunner of similar institutions eventually established in large numbers.

In 1821 Emma Willard established her Female Seminary at Troy, N.Y., and in 1837 Mary Lyon founded Mt. Holyoke seminary at South Hadley, Mass. Similar schools followed in New England and in the South. By the middle of the 19th century the public high school had developed to provide secondary education for the great mass of the people and very largely to displace the academy and the seminary. Co-education is almost universal in the public schools; the number of girls attending them has become slightly in excess of that of boys, and equal educational opportunities are provided for both sexes. For the benefit of girls, courses in home economics have been added in practically all high schools and in the upper grades of the best grammar schools.

Higher Education for Women.—In 1833 Oberlin college, founded in Oberlin, O., signified its willingness to admit women. In 1865 Vassar college was established at Poughkeepsie, N.Y., and was the first separate college of unquestioned standing for women. In 1839 the first State normal school was established at Lexington, Mass., and in 1842 the New England Female Medical college was founded.

Preparation in the fields of medicine, journalism, dentistry, law, science, architecture and engineering is obtainable in the universities and technical schools. Secondary and higher liberal education is passing through a period of readjustment. Professional education is being standardized in the hope of producing more liberal and better trained persons. Vocational education is developing rapidly. (M. S. D.)

WOMEN'S COLLEGES

The history of the women's college in America may be said to fall into three periods, each of the first two covering 40 years, the third from 1915 on. The first period, roughly estimated from 1835 to 1875, was the age of beginnings. The institutions of this period were almost without exception seminaries; among them, Wheaton at Norton, Mass., opened in 1835, and Mount Holyoke at South Hadley, in 1837. Both were founded as permanent institutions for women. Mount Holyoke's first curriculum was evidence of Mary Lyon's intention that although not called a college, it should furnish to women as good educational opportunities as the colleges for men then offered. Several other women's colleges of to-day were established as seminaries during this period, Wells, Lake Erie, the Western, Mills, Rockford, Milwaukee-Downer. The South shared in this interest, a development cut short by the Civil War. Hollins college in Virginia, a co-educational seminary, in 1852 dropped the course for boys, thus becoming the first chartered institution for girls in the State.

Among the earliest institutions authorized to grant degrees to women were the Wesleyan Female college at Macon, Ga., founded in the '30s, and Elmira college in Elmira, N.Y., opened in 1855. The first women's college having an endowment and curriculum sufficient, from the point of view of the times, to realize this ideal, was Vassar college, incorporated in 1861 and opened in Poughkeepsie, N.Y., in 1865.

The Second Period.—The period 1875 to 1915 was one of expansion, and was marked by an advance in the education of women, such as the world had never before seen. Three types of institution were developed: the separate college for women; the woman's college affiliated with the university; co-education. Coincident with the beginning of this period came the opening of two important colleges, both in Massachusetts: Smith at Northampton, established by Sophia Smith; Wellesley at Wellesley, founded by Mr. and Mrs. Henry F. Durant in memory of their only son. Ten years later Bryn Mawr college, founded by Joseph W. Taylor, was opened at Bryn Mawr, Pa. The same year the Woman's College of Baltimore City was incorporated, under the auspices of the Methodist Church, with Dr. Goucher, the first president, after whom it was subsequently named, as the chief factor. In 1888 Mount Holyoke obtained its college charter, five years later withdrawing the seminary course.

During this period several of the earlier seminaries became colleges: Rockford in Illinois, Lake Erie and the Western in Ohio, Milwaukee-Downer in Wisconsin, Mills in California, the Woman's College of Pennsylvania at Pittsburgh. Wells college in Aurora, N.Y., secured its college charter in 1870 after two years as a seminary. The leading Southern colleges for women date from this period: Agnes Scott college at Decatur, Ga. (1889), Randolph-Macon College for Women at Lynchburg, Va. (1893) and Sweet Briar at Sweet Briar, Va. (1906).

An outstanding illustration of another type of college for women is Simmons college in Boston, established by the will of John Simmons "as an institution in which might be given instruction in such branches of art, science and industry as would best enable women to earn an independent livelihood," and granted a charter in 1899. Somewhat like Simmons college are Skidmore at Saratoga Springs (1911), and Russell Sage at Troy, N.Y. (1916).

The Connecticut College for Women, at New London, Conn., opened in 1915, "owes its foundation to the wish and purpose of people of Connecticut to provide within the State adequate facilities for the higher education of women," the movement for its establishment being begun by the College Club of Hartford.

Holding a place midway between the college on a separate foundation and co-education is the women's college affiliated with the university. The first one of this type was the H. Sophie Newcomb Memorial, opened at Tulane university in New Orleans in 1887. It was followed in 1888 by the Women's college at Western Reserve university, Cleveland, the outgrowth of an informal system of co-education, dating from 1872; Barnard at Columbia in 1889, ten years after President Barnard had urged co-education at Columbia college; the Women's college of Brown university, authorized in 1892 to confer the Brown degree and made a department of the university in 1897. Radcliffe college, incorporated in 1894 and authorized to confer the bachelor's and master's degrees and Ph.D. subject to the approval of the president and fellows of Harvard college, dates from the organization in 1879 of the Society for the Collegiate Instruction of Women "for the purpose of providing systematic instruction for women by professors and other instructors in Harvard university."

Since the beginning of the present century, other "affiliated colleges" have been established, such as the William Smith college in Geneva, N.Y., opened as "co-ordinate" with Hobart college, in 1908; and in 1910, Jackson college, taking the place of entire co-education at Tufts college, Mass. By the so-called "segregation policy," started at the University of Chicago in 1902, and meaning separate instruction for women during the first two years of their undergraduate course, the university provision for women comes partially under the head of the affiliated college.

The Third Period.—The third period of the women's college in the United States—from 1915 on—bids fair to be as distinctive as the preceding epochs. It is not likely that the number of senior colleges will increase in the same proportion, even if the numbers seeking admission should continue, since the cost of establishing a college and the conception of necessary equipment are so much greater. A possible exception is along the line of the junior college. A development of the last few years, the junior college idea has taken possession of some of the long-established institutions for girls, such as Bradford academy, as well as being the type of an interesting new experiment—the Sarah Lawrence college for women in Bronxville, N.Y. It has been most widely developed in the co-educational sections of the country—the middle and far West, especially on the Pacific coast. The success of a junior college like Stephens college in Columbia, Mo., modelled on the women's college of the East, indicates a swing of the pendulum toward that form of education, at least for the first half of the college course.

Other indications are the establishment of Scripps college, opened in 1927 as the first one of the projected group of "Claremont colleges" in Claremont, Calif., of which Pomona, a long-established co-educational institution, is the "mother," and the division of Occidental college in Pasadena into two institutions, one for men and one for women. Until these recent developments, Mills college was the only separate college for women on the Pacific coast.

Popularity of Women's Colleges.—An outstanding characteristic of the college for women has been its increasing popularity. The fact that the leading colleges have had a large number of applicants from whom to choose has probably had an influence in several "trends." (1) The careful selection of candidates for admission has resulted in a group qualified for the most part to do college work and in turning into other fields those not fitted for the liberal arts course, a benefit to the individual as well as to college and community. (2) It has helped the college to hold to its own field of work. Since World War I, there has been a marked strengthening of the liberal arts course, a course which the colleges for women have continued more consistently than any other institution of higher education. The curriculum has been enriched and made more flexible but with slight concession to the strictly vocational. (3) It has led to stress on the education of the individual, rather than education *en masse*. The introduction of the "honour" as well as the "pass" course; the general examination in the major subject; an approach to the tutorial system; sectioning on the basis of ability—these and other developments, resulting in greater attention to the individual student, have been marked changes. (4) There has been an increase in the number of graduates going in for advanced work in various lines. (5) There has been an increase in the variety of professions and employments entered by graduates of the women's colleges. There have been a large number of graduates of women's colleges holding distinguished academic positions, distinguished posts in medicine, scientific research, journalism, social work and the arts, as well as in national and international organizations.

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WOMEN, LEGAL POSITION OF. It is well known that at the common law the political and legal disabilities of women in Great Britain were many and serious. For illustration, women under the common law had no general right to vote and were disqualified to hold any important public office. Consequently, they could take no substantial part in the government of their country. Upon marriage the rights of the wife were merged and lost in those of the husband. Husband and wife became a unit; and the wife had no independent legal existence. In questions as to the custody and education of children, the rights of the father were preferred over those of the mother in almost every respect. Until 1938, the husband could secure a decree of divorce on the ground of his wife's infidelity while the wife had no such corresponding right or remedy. The restrictions and disqualifications of which the foregoing are examples had by 1942 been almost entirely removed by statute. In essential matters men and women stood for the most part in equality before the law. It is interesting to note that when the right to vote was granted to women in 1918, they made quick use of the great power which had been conferred upon them. In 1919, the Sex Disqualification (Removal) act was passed, which went far to remove all disqualifications because of sex. Undoubtedly, legislation will continue to be enacted for the purpose of bringing about a complete equality of the sexes before the law, and it is to be hoped that this high object will before many years be completely attained. These reforms have been largely accomplished by the enactment of a series of statutes for the most part after the turn of the century which to a great extent did away with these unjust restrictions and disqualifications. The legal position of women can be conveniently ascertained by the consideration of the more important of these great statutes and of the effect which they produced.

The Right of Women to the Crown.—Even at common law a woman had the right to ascend the throne of England and to assume its crown. The title to the crown was at that time governed, with some slight modifications, by the feudal rules of hereditary descent formerly applicable to land. Unless there were statutory prohibitions, therefore, the crown would descend lineally to the issue of the reigning sovereign, males being preferred to females. As an example, on the death of Henry VIII, there survived his son Edward and his two daughters Mary and Elizabeth. Edward, being male, was preferred in the succession and first took the crown. As he had left no issue, his sisters Mary and Elizabeth in turn succeeded him. There was consequently at common law no prohibition against a woman being the Queen of England. The present title to the crown depends upon the Act of Settlement, 1700. By this statute it was provided that the Princess Sophia, the Electress of Hanover, should be next in succession to the crown "which should continue to the said princess and to the heirs of her body." On the death of Queen Anne in the year 1714 without issue, George I, the heir of Sophia, ascended the throne and the crown was still in 1942 held by his successors. Among the outstanding, if not the leading sovereigns, have been Queen Elizabeth and Queen Victoria.

The Right of Women to Vote.—So long as women did not possess the privilege of franchise they were of necessity in a position subservient to that of men who had that right. In a constitutional monarchy such as that of England, the predominant force

is the popular will expressed by the voters in the election of the House of Commons. While women could not vote for membership in that house and could not sit as members therein, they had little or no direct voice in the government of their country. The struggle for equal suffrage extended over many years and was marked at times by much turmoil and bitterness. The first statute which gave to women a general right to vote was the Representation of the People act, 1918, which in effect gave equal suffrage rights to men and women. This act was succeeded by other statutes on the same subject, ending in the law entitled the Representation of the People (Equal Franchise) act, 1928, which provided that all these statutes might be cited together as the Representation of the People acts. This legislation not only admitted women to the franchise but gave them the vote on equal terms with men. In the hands of women, therefore, was for the first time placed the weapon of the vote. They possessed the right under these statutes to vote not only for members of the house of commons but for members of the councils, either town or county, and other like governmental bodies.

The Right of Women to Hold Office: Sex Disqualification (Removal) Act, 1919.—Although women now had the right to vote for members of the house of commons, they were disqualified from sitting as members of that house and from holding almost all other important public offices. This was of course a highly anomalous condition. Beyond question, it was the new-found power in the hands of women that brought about the enactment of the Sex Disqualification (Removal) act, 1919. The passage of this law was a very long step in the direction of legal equality between men and women. It provided that a person shall not be disqualified by sex or marriage from the exercise of any public function or from being appointed to or holding any civil or judicial office or post or from entering upon or assuming or carrying on any civil profession or vocation or for admission to any incorporated society (whether incorporated by royal charter or otherwise), and "a person shall not be exempted by sex or marriage from the liability to serve as a juror." This general and sweeping language was modified by provisos that Orders in Council might be made relating to admission of women to the civil service and the conditions on which they might be appointed therein, and giving power to reserve to men any positions in the civil service overseas or in any foreign country. There was also a provision that any judicial officer might make an order that the jury be composed of men only or of women only, and might hear and pass upon any application by a woman to be exempted from service as a juror, with other rules on the same subject. The general intendment and effect of this broad law was to permit women to hold any public office, high or low, and to practise any profession or business, subject to rather unimportant regulations, and to serve as jurors.

The Right of Women to Hold Peerages.—At common law, even from the earliest times, women had the authority to hold title in the peerage. They have, however, never had the right to sit or vote in the house of lords. They hold merely the rather empty title. After the passage of the Sex Disqualification (Removal) act, 1919, it was claimed that the fact that women had not sat in the house "is due to the ordinary disqualification imposed by the common law of England upon persons of the female sex and that disqualification has been removed by the Act of 1919." The contention was advanced by the Viscountess Rhondda, who was a peeress of the United Kingdom in her own right. It was heard by the Committee for Privileges in the house of lords. That committee held that she was not entitled by virtue of that act to a seat in the house of lords. This conclusion was reached chiefly on the ground that it was not the intention of parliament, by the enactment of the law, to give to peeresses the right to a seat in the house of lords, this decision being based on the proposition that if parliament had intended to effect so radical a change in the constitution of the house of lords, it would have used words more specific and definite in the statute.

Women, therefore, even after the Act of 1919, were not permitted to sit or vote in the house of lords, although they could continue to enjoy the title to the peerage.

The Right of Women to Serve in the House of Commons and to Hold Other Public Offices.—At common law, women were disqualified to be elected to serve in the house of commons. By the statute Parliament (Qualification of Women) act, 1918, it was provided that "A woman shall not be disqualified by sex or marriage from being elected to or voting as a member of the Commons House of Parliament" (5 *Halsbury's Laws of England,* 219). Women, after that act, served as members in the house of commons. They sat in the councils, boards and other governmental bodies. They served as justices of the peace and as members of the police force and in other public capacities. They had not up to 1942 served on the bench of the higher courts.

The Right of Women to Carry on Any Civil Profession or Vocation and to Be Admitted to Any Corporate Society.—By the Sex Disqualification (Removal) act, 1919, it was expressly provided that a woman shall not be disqualified from carrying on any civil profession or vocation or for admission to any incorporated society. They serve in the law as barristers and solicitors, in medicine, as physicians, surgeons and veterinary surgeons. They are to be found in all the branches of the civil service except that they had not up to 1942 received the right of admission to the consular or diplomatic service abroad. There was a specific provision in the Act of 1919 which allowed the authorities to reserve to men these foreign diplomatic appointments. Although women are admitted to the civil service (except in the foreign diplomatic branches), the rate of compensation for women in the civil service is as a rule less than for men. The Church of England has not admitted women to the priesthood but many other organized churches in England, such as the Baptists, Wesleyans and others, do permit women to serve as ministers. Also, women have availed themselves freely of the privilege of entering incorporated societies such as the Institute of Actuaries, the Institute of Bankers and the like.

The Rights of Women as Industrial Employees.—In the statutes regulating industrial employment such as The Factory and Work Shops act, 1901, the Employment of Women and Children act, 1920, and similar laws, there are many clauses intended for the protection of women and applying only to women; for example, the provisions that they shall not work (with certain exceptions) on Sunday or at night or for more than a certain number of hours each week in different industries, with other like protective regulations. As in the civil service, the rate of compensation for women in industrial occupations is less than for men. The Trade Board acts direct that minimum rates of wages may be fixed for different classes of workers. Under this provision a lower rate of pay has been fixed for women than for men. It seems to be the policy of the law that although women may be admitted to the civil service and to practically all industrial employments, they are to be paid, except in a few instances, at a lower rate than men. Working women are also entitled, in a general way, to participate in the benefits of national insurance. They are allowed a cash maternity benefit from the birth of each child. Also, they receive allowances for the educational expenses of children of school age. Under proper circumstances, they are also entitled to receive pensions under the National Insurance plan. (In regard to the rights of working women which have been outlined, *see* LABOUR LAW; TRADE BOARD; NATIONAL INSURANCE.)

The Nationality of Married Women.—This subject is covered by British Nationality and Status of Aliens act, 1914, as amended in 1918 and 1922. Generally speaking, under this law, a married woman is considered to be of British nationality if her husband is British and of alien nationality if he is alien. There are certain exceptions set forth in the act; for example, if the husband, being British, changes his nationality after marriage, the wife has a right to retain her British status. If a British woman is married to an alien who after the marriage becomes an alien enemy, then the wife, with the consent of the secretary of state, may declare that she resumes her British nationality.

The Right of Married Women to Own Property and to Make Contracts.—By the passage of Married Women's Property acts of 1882 and 1893, a great reform was enacted. At the common law, the legal existence of the wife during marriage was regarded as merged into that of the husband. The wife was (with some unimportant exceptions), incapable of acquiring or enjoying any property, real or personal, independent of her husband. The harshness of this doctrine was to some extent modified through application by the courts of the doctrines of equity. There were also some statutory modifications but they were not of consequence. However, in 1882, by the passage of the Married Women's Property act of that year, a complete reversal of this common law doctrine took place. In that statute, which was effective Jan. 1, 1883, it was provided that "a married woman shall in accordance with the provisions of this act be capable of acquiring, holding and disposing by will of any real or personal property as her separate property in the same manner as if she were a *femme sole* without the intervention of any trustee." This doctrine is in force in England. There have been, of course, some minor statutory modifications, but the general rule holds good that a woman married after Jan. 1, 1883, can acquire, hold and dispose of her property, real and personal, as if she were unmarried (16 *Halsbury's Laws of England,* 613 *et seq.*). Likewise, under the common law, a married woman had no capacity at law to contract unless she was living apart from her husband under a decree of judicial separation or had obtained a protection order or was carrying on a separate trade in the city of London. This latter exception was based upon an old custom of that city (16 *Halsbury's Laws of England,* 682, note [L]). By the Act of 1882, it was provided that a married woman shall be capable of entering into and rendering herself liable in respect of and to the extent of her separate property on any contract. (Married Women's Property act, 1882, 1 [sec. 2]). There are various other provisions in the statute enlarging the right of a married woman to contract, but limiting that right to such separate property as she might have at the time of the contract. This continued to be the law until the enactment of the Married Women's Property act in 1893, which held that "Every contract hereafter entered into by a married woman otherwise than as an agent . . . shall bind all separate property which she may at that time or thereafter be possessed of or entitled to." This act was effective on Dec. 5, 1893. The result is as stated by Lord Halsbury:

"A contract entered into by a married woman on or after January 1, 1893, and before December 5, 1893, was not binding on her at all unless she had at the time of the contract some separate property which she might reasonably be deemed to have intended to bind, and it was therefore necessary in any action on such contract for the plaintiff to allege and prove that at the time of making it she had

some separate property in respect of which she might reasonably be deemed to have contracted."

He then goes on to say that every contract entered into by a married woman otherwise than as agent on and after Dec. 5, 1893, generally speaking, binds all separate property which she may at the time of the contract or thereafter be possessed of or entitled to (16 *Halsbury's Laws of England,* 1682–84). There was additional legislation after these two acts increasing the right of a married woman to own and dispose of property, real and personal, and to make contracts. This legislation merely follows the general principle laid down in the two Married Women's Property acts. These two laws have been a great charter for the liberties of the married woman in regard to her civil rights.

The Right of Married Women to Make Wills.—At common law a married woman could make a will disposing of her equitable interest in any real or personal property held to her separate use but she could not dispose of the legal estate in such property. By the Matrimonial Causes act, 1857, her right to dispose of her separate property by will was enlarged and by the Married Woman's Property act of 1882 it was still further extended (16 *Halsbury's Laws of England,* 631–34). By the Law Reform (Married Women and Tortfeasors) act, 1935, she was empowered to dispose by will of all her property, real or personal, as if she were a *femme sole,* and the will operates to dispose of all the property to which she was entitled at the time of her death (34 *Halsbury's Laws of England,* 40).

The Rights of Women under the Health and Unemployment Insurance Laws and also under the Pension Laws.—With certain modifications and exceptions it is the general policy of these laws (among the more important of which are the National Health Insurance act, 1924, and the Widows, Orphans and Old Age Pension act, 1928) that women, whether married or single, shall be included within their provisions. For example, a woman who has an insured husband, even if not herself insured, is entitled to a cash maternity benefit at the time of the birth of a child. She is also entitled to receive under certain circumstances during the life of her husband a weekly pension, which continues after his death. She also receives under certain conditions weekly cash benefits for her children of school age. On the other hand, it is provided that a woman who is employed by her husband shall not have the benefits of unemployment and health insurance.

The Rights of Women under the Criminal Law.—Generally speaking, the responsibility of women for violations of the Penal Statutes is the same as that of men. There are some relics of the old common law theory of the unity of husband and wife. Under that law there was a presumption in the case of certain crimes that where a crime was committed by a wife in the presence of the husband the wife acted under coercion of the husband and was not individually responsible. This presumption was abolished by the Criminal Justice act, 1925. Still, however, upon a prosecution of any crime other than treason or murder, it is a good defense to prove that the crime was committed in the presence of and under the coercion of the husband (9 *Halsbury's Laws of England,* 24). The husband and wife cannot be charged with conspiracy because they are in law one person. The wife cannot be charged with harbouring her husband after he has committed a crime. In other words, she cannot be charged as an accessory after the fact because under the law she is not compelled to discover his crime (16 *Halsbury's Laws of England,* 710–11). With these and other rather unimportant exceptions, the responsibility of a married woman for a crime is the same as that of a man.

The Rights of Women in Respect to Divorce and the Custody of Children.—The differences and disputes between husband and wife with the attendant questions concerning the custody of the children of the marriage involve what are perhaps the most important and sacred rights of women. The history of divorce in England is curious. The common law had no jurisdiction over matrimonial causes. These controversies were held to be the peculiar concern of the church. They were heard and determined, therefore, in the ecclesiastical courts under the canon and not the common law. These tribunals did not grant any absolute divorce dissolving the marriage tie. They did decree under certain conditions divorce *ā mensā et thoro* or decree of separation under certain conditions. The ecclesiastical courts also granted annulment of the marriage upon the judicial finding that there had never been any valid marriage between the parties. But the marriage itself if valid in its inception was indissoluble. It is therefore not remarkable that there came into existence a method of parliamentary divorce *ā vinculo.* This was a difficult and expensive process. But until the enactment of the Matrimonial Causes act, 1857, it was the only method of securing in England an absolute divorce. There were during a century and a half preceding the enactment of that law about 280 such parliamentary divorces (10 *Halsbury's Laws of England,* 631). Absolute divorce by judicial process was, as has been said, first authorized in England by the Matrimonial Causes act, 1857. By that law which took effect on the first of Jan. 1858, and which applied only to England and Wales, an absolute divorce could be granted upon the petition of the husband for the infidelity of the wife; or upon the petition of the wife for the incestuous or bigamous infidelity of the husband or for such infidelity coupled with cruelty or with desertion for more than two years. It is evident this act was flagrantly unjust in its discrimination against women. A number of statutes were passed for the purpose of remedying at least in part this unfairness; also there was a growing pressure of public opinion for additional grounds for divorce. Finally, by the Matrimonial Causes act, 1937, which came into operation on Jan. 1, 1938, a divorce law was enacted which was fair and just to both men and women. By this law either spouse could obtain a divorce upon proof of infidelity, desertion, cruelty or insanity. There was a further provision intended to discourage precipitate divorces by forbidding, except by leave of the court in exceptional cases, the presentation of a divorce petition until after three years had elapsed from the date of the marriage (5 *Encyclopaedia of the Laws of England,* 100–102). Not only did the English law rectify the injustice which denied equal rights of divorce to women; it went still further in giving to women their just rights as mothers over their children. Under the harsh rule of the common law the father had the jurisdiction over and the right to the custody of the child during infancy except that in the case of a daughter such right terminated on her marriage under age. The right existed even as against the mother. At common law the mother of the infant child had generally during the lifetime of the father no rights as against him with respect to the custody and control of such child (17 *Halsbury's Laws of England,* 663–64). This cruel discrimination was finally abolished by the Guardianship of Infants act, 1925. This law provides that where "the custody or upbringing of the infant or the administration of any property belonging or held in trust for an infant or the application of the income thereof is in question, the court in deciding that question shall regard the welfare of the infant as the first and paramount consideration, and shall not take into consideration whether from any other point of view, the claim of the father or any right at common law possessed by the father in respect of such custody, upbringing, administration or application is superior to that of the mother or the claim of the mother is superior to that of the father. . . . The mother of the infant shall have the like powers to apply to the court in respect of any matter affecting them as are possessed by the father." These rules are applied by all the English courts in all proceedings, including divorce, in which the custody of children comes up for decision (5 *Encyclopaedia of the Laws of England,* 136).

The Law Concerning Women in Scotland and Northern Ireland.—Both in Scotland and in Northern Ireland there are some differences in the law on this subject from the law which exists in England. But there are in general the same legislative measures in the three jurisdictions tending to equalize the legal rights of men and women.

UNITED STATES OF AMERICA

When the United States acquired its independence the common law of England was in force in each state. This common law consisted of the common law of England as modified by such English and colonial statutes and customs as were applicable (12 *Corpus Juris,* Common Law, sec. 3, p. 177). There was a presumption that this common law was in force in the original states and in such states as were carved out of British territory. By the Louisiana purchase and in other ways the nation came to include many states which had never been British territory. Among these states may be mentioned Florida, Texas, Kansas, Louisiana and California; and there are many others (31 *C.J.,* Common Law, sec. 32–33, pp. 200–201). In these latter states the Roman or civil law with Spanish and French modifications was in force at the time they were acquired by the United States. However, even in these states so far as possible the principles of English common law were applied but there was no presumption that it existed. Generally speaking, therefore, it may be said that when the United States became an independent nation the rights of women were those which existed at the common law with some rather unimportant modifications. The disabilities and restrictions imposed upon women by the common law were gradually relaxed in the different states and territories by a succession of constitutional amendments and statutes. This American legislation followed the general lines of the English statutes. The result is that by 1942 great progress had been made toward attaining equality in law for men and women in the United States. There are still many discriminations, some of them highly unjust. It is believed that the amendment pending before the 77th congress known as the "Equal Rights Amendment" will eventually remove these differences and bring about a complete equality in the law. In view of the great number of the states and territories in the United States it is impossible to recite all the different legislative measures of this character. The most that can be done is to state generally the trend of such legislative action in its most important respects.

The Right of Women in the United States to Vote.—There was a long and at times a very bitter controversy, as in England, concerning the right of suffrage for women. When the 14th Amendment was passed it was thought by many to confer the immediate right of suffrage for women. In this movement for suffrage, one of the great leaders was Susan B. Anthony. She took the view that this amendment was self-executing and gave to women the right to vote. Accordingly, she cast her ballot, for which she was indicted. Upon her trial the court held that the 14th Amendment did not confer upon women the right to vote, and that further action by the state was necessary to give that privilege. (*U.S.* v. *Anthony,* 24 F.Cas. No. 14,459, 11 Blatch F. 200). Several of the states passed constitutional amendments and statutes giving the right to vote to women. Finally

in 1920, the 19th Amendment was enacted, which provided:

"The right of the citizens of the United States to vote shall not be denied or abridged by the United States or by any state on account of sex."

After that day, the right of women and of men to vote was equal in the United States.

The Right of Women in the United States to Hold Office.—Women hold the most exalted public offices. They have been governors of various states; they are members of the United States senate and of the house of representatives. There was in 1942 a woman in the national cabinet. There is no legal reason why a woman may not be president or vice-president of the United States. The only substantial limitation on the right of women to hold office is found in the state of Oklahoma. The constitution of that state bars women from such offices as governor, lieutenant governor, attorney-general and other state offices. Also in the state of Wisconsin women may not serve as clerks of legislative committees or other employees of the state legislature. With these exceptions the right of women to hold office in the United States is unlimited.

THE RIGHT OF MARRIED WOMEN TO OWN PROPERTY AND TO MAKE CONTRACTS

At common law married women had few independent rights. As Blackstone said: "The husband and wife are one and that one is the husband." However, by constitutional amendment and by appropriate legislation the different states very largely abolished these disabilities which prohibited married women from owning property or making contracts. They have substantially the same rights as men in this respect. But there are some inequitable discriminations against married women in respect of these rights.

The Rights of Married Women in Those States in Which the System of Community Property Exists to Own Property and to Make Contracts.—Attention has already been called to the fact that some states were carved out of territory which was never the property of Great Britain. The original 13 states of course were created from British territory. However, many of the states which later became members of the union were created from lands which never had been British. In some of these states which were not originally British ground, there exists the system of community property.

"The general principle underlying the system of community property is that all property acquired during marriage by the industry and labor of either the husband or the wife or both, together with the produce and increase thereof, belongs beneficially to both during the continuance of the marital relation." (31 *C.J.*, Husband and Wife, Community Property, sec. 1069, p. 8).

This system obtains in the states of Arizona, California, Idaho, Louisiana, New Mexico, Nevada, Texas and Washington. It also prevails in Puerto Rico and in the Philippine Islands. There are also traces of the institution in other states which were not originally British territory. The obvious effect of this system is to create a partnership relation between husband and wife as to property acquired after marriage. There is a great volume of legislation by which this institution has been modified and adapted to modern conditions. It will be quite impossible to attempt within the scope of this article any recital or discussion of these laws. It may be said, however, that in community property states the property of married persons is divided into—

"(1) The separate property of the wife; (2) the separate property of the husband; (3) the community property in which both spouses have certain defined rights." (31 *C.J.*, Husband and Wife, sec. 1082, p. 16.)

Generally speaking, each spouse has ownership of and control over his or her separate estate. In the several community property states there are substantial differences in the relative rights of husband and wife as to this joint estate known as the community property. In general, both husband and wife have beneficial interests in such property. The husband's rights, however, are active while those of the wife are passive. The wife's interest remains in abeyance until the termination of this relationship (31 *C.J.*, Husband and Wife, sec. 1172, pp. 79–80). As a result of this general principle the husband has the general management and control of the community property. He may lease, mortgage or sell it subject to the obligation that he must not defraud the wife in her interests. Of course, the proceeds of such lease, mortgage or sale will continue to be community property.

Also it is provided that:

"Either spouse may dispose by Will of his or her interest in the community property" (68 *C.J.*, Wills, sec. 118, p. 501).

It will be seen that there is a radical difference between the rights of husband and wife in the community property states and those in which the institution does not exist. On the one hand, the system favours the wife because it recognizes marriage at any rate as a quasi partnership in which the wife has an equal beneficial interest although she has not the same power of disposition. On the other hand, the husband is recognized as the head and master of the community property with the attendant rights to manage and dispose of such property, having due regard to the interests of the wife. There has been much discussion as to the origin of this system. On this subject it has been said:

"The origin of the community property system has never been satisfactorily determined. . . . It seems to be fairly well settled that it was not derived from the Roman law. Intermediately it has been certainly traced to the laws of France and Spain. . . . It was unknown to the common law." (31 *C.J.*, Husband and Wife, Community Property, Section 1073).

It was said by Chief Justice White on this subject in the case of *Garrozi* v. *Dastas*, 204 U.S. 64–78:

"We need not consider whether the community was derived from the Roman law, from an express provision of the early Saxon law, or from the ancient customary law of the Continent. For, however derived, the very foundation of the community and its efficacious existence depend on the power of the husband, during the marriage, over the community, and his right, in the absence of fraud or express legislative restriction, to deal with the community and its assets as the owner thereof. The purpose of the community, as expounded from the earliest times, whilst securing to the wife on the dissolution of the marriage an equal portion of the net results of the common industry, common economy and common sacrifice, was yet, as a matter of necessity, during the existence of the community, not to render the community inept and valueless to both parties by weakening the marital power of the husband as to his expenditures and contracts, so as to cause him to be a mere limited and consequently inefficient agent."

He goes on to say:

"The rights of the wife are dormant during the marriage, because the husband is charged to watch over and conduct the affairs of the conjugal society. But this right, which is inert, as long as the husband is at the head of the affairs of the community, becomes active when the marital authority ceases to exist. The wife is like a silent partner, whose rights arise and reveal themselves when the partnership ceases." (Troplong, *Contrat de Mariage, id.* p. 79.)

It will be seen, therefore, that the rights of married women to hold property and to contract in those states which have the community property system are different from the like rights of married women in other states and in the United Kingdom.

The Rights of Women in the United States to Serve as Jurors and in Other Public Capacities and also to Carry on Any Civil Profession or Vocation.—In all the states there has been legislation allowing women to carry on civil professions and occupations. In many of the states, women are permitted to serve as jurors. In some states they have the option as to whether they shall serve or not according to their choice. These statutes vary in the different states. In some states a greater measure of liberty in these respects is allowed to women than in others. In many states there is not as yet full equality of rights between men and women in these matters. But the general trend of these laws is to grant these rights to women. Also in this connection it may be noted that the rights of women to share in the benefits of social service legislation including unemployment insurance and other like systems is universally recognized. They also participate in the benefits of the pension laws.

The Rights of Women in the United States under the Criminal Law.—There is no longer the conclusive presumption that a crime committed by a married woman in the presence of her husband or under his compulsion is coercion. There is still, however, a presumption of coercion by him in cases where a wife commits a crime in her husband's presence. The burden of proof is then on the prosecution to prove the absence of coercion. This presumption, however, does not apply in cases of the most serious crimes such as murder or treason. Moreover, the presumption can always be rebutted by evidence. If it can be proved that the crime was committed independently by the wife and that as a matter of fact there was no coercion, she can be convicted alone upon an offence committed in the presence of her husband. (30 *C.J.*, Husband and Wife, sec. 419–21, pp. 790–94.)

The Rights of Women in the United States in Respect to Divorce and the Custody of Children.—The changes in these respects by statute in the United States were substantially the same as those occurring in the United Kingdom. In all of the states except South Carolina in 1942, absolute divorce was recognized; and the right of the wife to divorce was admitted. There were in some states discriminations as to the grounds for divorce, the law being more favourable to the husband than to the wife. Also the rigorous rule of the common law which gave absolute control and custody of the children to the father has been very largely abolished. In most of the states the law provides that in these matters of custody and control regard must be had only to the welfare of the child; the right of neither parent is paramount. The courts will consider all the circumstances and will make such decree as will best serve the interests of the child.

The Rights of Women as Industrial Employees.—Women are permitted by law in the United States to share generally in the benefits of labour legislation. They are allowed to be members of labour unions with the rights and privileges of such members. There is, however, one important exception. There are in many states laws which prevent women from working at night in certain industries. Also there are laws and regulations which prohibit women from working for as many hours during the day as men are allowed to work. Similarly, there are minimum wage laws setting a standard

below which the wages of women may not fall without a corresponding regulation as to men. These statutes and rules are said to be framed for the benefit of women. Undoubtedly in most cases they are enacted for that purpose. There has been a vast deal of discussion concerning these discriminatory measures. There is a large and growing group which held that this legislation, though well meant, is wholly mistaken; and that in the long run any discrimination is harmful.

It is claimed that such laws constitute a serious handicap to women in the industries. They are prevented from securing employment which they could otherwise obtain. As was said in a case in the District of Columbia concerning a minimum wage law:

"The hotel manager was not compelled to employ her (the woman in question) at a fixed wage; and her position went to a man who was willing to perform the service at a lower wage than that fixed by the Board. . . . The law to promote the good morals and general welfare of the community cast her adrift."

In the court decisions which uphold these discriminatory statutes stress is laid on the fact that the differences of physical structure between men and women disqualify women from work as hard and as continuous as that which men can perform. In the case of *Adkins* against *Children's Hospital,* 261 U.S. 525, the supreme court held an act of congress fixing minimum wage standards for adult women in the District of Columbia to be unconstitutional as an arbitrary restraint upon the liberty of contract. In the prevailing opinion written by Mr. Justice Sutherland, the court called attention to the fact that in many previous decisions these laws had been sustained on the ground of the differences of physical structure between men and women. Justice Sutherland then went on to say:

"But the ancient inequality of the sexes otherwise than physical, as suggested in the Muller case (p. 421) has continued with diminishing intensity. In view of the great—not to say revolutionary—changes which have taken place since that utterance, in the contractual, political and civil status of women, culminating in the 19th Amendment, it is not unreasonable to say that these differences have now come almost if not quite to the vanishing point. In this aspect of the matter, while the physical differences must be recognized in appropriate cases, and as legislation fixing hours or conditions of work may properly take them into account, we cannot accept the doctrine that women of mature age, *sui juris,* require or may be subjected to restrictions upon their liberty of contract which could not lawfully be imposed in the case of men under similar circumstances. To do so would be to ignore all the implications to be drawn from the present-day trend of legislation, as well as that of common thought and usage, by which woman is accorded emancipation from the old doctrine that she must be given special protection or be subjected to special restraint in her contractual and civil relationships" (*id.* p. 554).

This case was a long step in the direction of the equality of rights between men and women. The legislation which had fixed different hours of labour for women, which had prescribed minimum rates of wages for women and in other respects had been discriminatory as between the sexes, seemed doomed to extinction by the doctrine of this decision. However, the hopes of those who held these views were destroyed by the decision in the case of the *West Coast Hotel Company* v. *Parish,* 300 U.S. 279 (1937). In this case the supreme court completely changed its position and upon a vote of 5 to 4 expressly reversed the doctrine in the Adkins case. The opinion was written by Chief Justice Hughes. He held that the minimum wage and other like discriminatory statutes constitute a legitimate exercise of the police power.

After arguing this point he said:

"We think that the views thus expressed are sound and that the decision in the Adkins case was a departure from the true application of the principles governing the regulations by the state of the relation between employer and employe" (*id.* p. 397).

Under this decision of the highest court in the United States this discriminatory legislation prevailed and will continue to do so.

The Equal Rights Amendment.—Those who were opposed in 1942 to the views set forth in the West Coast Hotel case looked for relief to a proposed amendment to the Federal Constitution pending before congress, and known as the "Equal Rights Amendment." This proposed amendment reads as follows:

"Men and women shall have equal rights throughout the United States and every place subject to its jurisdiction."

This amendment was under consideration before appropriate committees both in the senate and in the house of representatives in 1942. Those who favoured the amendment called attention to the repeated pronouncements by federal and state courts as well as by legislatures and other governmental bodies that the equality of the rights of citizens is a principle of republican government. If and when the amendment is carried, then that principle will be established in the Republic. (G. G. B.)

WOMEN, WAR WORK OF. It is impossible here to attempt to describe the special work done by women of all the belligerent countries in 1914–18; this article, therefore, is confined to an outline of women's war work as organized in the United Kingdom and the United States.

I. IN GREAT BRITAIN

On Aug. 3, before the official declaration of war, the executive committee of the National Union of Women's Suffrage Societies decided to suspend political action and devote the organizing capacity of the Union to meet the changed conditions. The London branch started a free bureau under the name of "Women's Service" to direct the efforts of the thousands of non-professional women eagerly desirous of finding useful work. Many young women began at once to prepare themselves for nursing, joined voluntary aid detachments and worked in auxiliary hospitals. The raising of funds and making of comforts for the units of the original Expeditionary Force absorbed others, and the arrival of the Belgian refugees in England before the end of August caused the formation of 2,500 local Belgian relief committees, of whom the members were mostly women. Clubs to help the wives of soldiers and sailors were started.

By the spring of 1915, when the country began to feel the drain on its man-power, the Marchioness of Londonderry founded the Women's Legion, which from the first was intended to be a corps of paid women replacing paid men. A khaki uniform was worn and the women were subject to regulations and discipline. Ultimately over 40,000 were enrolled. This corps was the link between the independent voluntary associations of women, such as the Emergency Corps, formed on the outbreak of the war, and the official women's services, two of which were sections of the Women's Legion.

Work on Land.—Throughout 1915 and 1916 efforts were made by voluntary organizations, such as the Women's Legion and the Women's Defence Relief Corps, as well as by the Government, through the war agricultural committees of the Board of Trade, to induce women to offer their services on the land and to persuade farmers to accept them. The Women's Land Army was instituted early in 1917 as a women's branch of the Ministry of Agriculture.

Munition Making.—By the spring of 1915 shell work for women was beginning; in March women tram conductors started work at Glasgow, and girls were employed as telegraph operators in Liverpool. In connection with the demand for skilled workers, the London Society for Women's Suffrage, which promoted the introduction of women into occupations hitherto reserved for men, started a munitions and aircraft department in July 1915, and arranged the first training classes in oxy-acetylene welding. The pupils were the first women welders to enter the engineering trade, and after two years the Ministry of Munitions assumed financial responsibility for the school. Messrs. Beardmore in Glasgow and Messrs. Vickers, at Barrow-in-Furness and at Erith employed women on shell-making in the spring of 1915.

Enrolled and Non-enrolled Women.—The women's services were of two types. First came those composed of enrolled women in the legal sense, who were in the direct employment of the war departments, and whose contracts brought them within the regulations of the Defence of the Realm Act. The women could be enrolled as mobile workers for home service only, or for service at home and abroad; or as immobile workers, recruited for local employment, who could not be required to move away from the district. Secondly came those composed of non-enrolled women in the legal sense, who did not render themselves liable to penalties under the Defence of the Realm Act and might be engaged on an annual or weekly contract. Some services enrolled their women for a year only; others for the duration of the war.

The enrolled women consisted of the various army nursing services; the Military Massage Service, which started its career in Aug. 1914, under the name of the Almeric Paget Massage Corps; the Women's Forage Corps; Queen Mary's Army Auxiliary Corps; the Women's Royal Naval Service, commonly known as the "Wrens"; and the Women's Royal Air Force. (*See* NURSING.)

In Queen Mary's Army Auxiliary Corps which was at first the Women's Army Auxiliary Corps or familiarly the Waacs, the women were enrolled as mobiles for home service only, or for home or foreign service, and for the duration of the war; they received a special rate of pay, not civilian or military, and were

not enlisted under the Army Act. At first substitution overseas only had been contemplated, but by March the number of women recruited by the Department of National Service was so great that home commands were included in the scheme. Recruiting was afterwards carried on through the employment department of the Ministry of Labour. In Dec. 1917, owing to the shrinkage of available woman power, an immobile branch was formed. Women employed in the Ordnance Army Pay Department and Record offices at home were not made to join the Corps. In all there were 1,200 officials and 56,000 women, of whom 9,500 were the outside number employed in France at any one time.

As regards the Women's Royal Air Force, 566 officers and 31,764 other ranks passed through the service, the strength at the time of the Armistice being rather over 25,000. The service consisted of mobiles and immobiles in approximately equal proportions.

Non-enrolled women included the Anti-Gas Department, the Army Pay Corps, the Army Remount Department and the Navy and Army Canteen Board. Practically the whole of the work on gas-mask manufacture was performed by women. There were 34 factories employing 12,000 under the immediate control of the Anti-Gas Department, and 160 contractors employed a further 90,000 on work for the department.

Army Pay Corps.—The Army Pay department was one of the earliest in the army to substitute female clerks. In July 1915, 479 were working and by Jan. 1, 1916, there were 4,556 female clerks and 13 lady superintendents. The engagement was a weekly one and there was no form of contract till Aug. 1917.

Navy and Army Canteen Board.—When the Navy and Army Canteen Board (then called the Army Canteen Committee) started operations in April 1916, only 20 women clerks were employed. During 1917 the Board's activities were enormously expanded to include catering for the Imperial Overseas forces and for the American and Allied troops. It was decided in March 1917 to institute a N.A.C.B. Women's Corps in mobile and immobile sections, and by the date of the Armistice the women employed in connection with canteen organization in the mobile corps numbered 10,000 and the clerical staff in the immobile corps, 2,000.

II. IN THE UNITED STATES

When the United States entered the World War in April 1917, but one organization depending mainly on the efforts of women was officially recognized by the Government, the Red Cross. Its upwards of 8,000,000 regular volunteer women workers in 3,500 chapters produced in 20 months over 371,000,000 relief articles, including surgical dressings, garments for the wounded and the refugees, and a variety of comforts and conveniences for soldiers and sailors. The value of their output was about $94,000,000. The Red Cross enrolled during the war 23,822 women as nurses. They served in the military and naval hospitals in the United States, Europe and the Near East, as well as in convalescent homes for soldiers and sailors and in relief work for adults and children both in the United States and overseas. They worked in 700 Red Cross canteens in the United States and 130 in France, serving refreshments to moving troops, giving them medical care and transferring them when sick.

When war was declared many large national organizations of women applied to the Government for instructions. The Council of National Defense appointed, at the end of April 1917, a committee of nine women (afterwards increased to eleven), to form a plan by which the women of the country could be utilized. This committee selected a woman in each State as a temporary chairman. She called together the heads of all national organizations of women in her territory to elect permanent officers for a State division. In turn the State division organized county committees and each county was to form a division in each city and town. By December 1917 the county organization was complete in 23 States, and a year later more than 80% of all the counties in the country had county chairmen.

The Women's Committee through ten national departments penetrated by means of this network throughout the country. It registered women for service in key industries to replace men, Michigan enrolling 98% of its women; it conserved food, 5,223,850 pledge cards being signed in 39 States in the first few weeks of the campaign; it helped to safeguard the health of the children; it assisted in keeping up the morale of the country by distributing news letters, 40,000 pamphlets and bulletins and sending out speakers to counteract rumours; it helped with the Liberty Loan campaigns; it inspired its volunteers to home and foreign relief.

The War Department asked the Y.M.C.A. in August, 1917, to organize a group of women for welfare work with the American Army somewhat similar to that of the Women's Auxiliary Army Corps for the British troops. The American "Y" women served in the United States, France, Belgium, Italy, Germany, Constantinople and Siberia, 1,665 enrolled in the home camps and 3,480 going overseas, 561 of the latter entertainers. A special unit of coloured women was sent for work with the negro troops. The "Y" women remained on after the armistice, serving with the Army of Occupation from December 1918 until it was withdrawn and afterwards with the American Forces in Germany. The Y.W.C.A. organized in June 1917 a war council, under which it developed a variety of clubs, both in the United States and overseas, particularly France, behind the lines. The hostess houses of the association at the home camps of both white and coloured soldiers looked after women visitors, a service which proved of such value that the War Department at the close of the war took the work under its educational and recreational branch. Some 50 buildings were turned over to the Government by the war work council of the Y.W.C.A. Overseas the association conducted clubs which served Red Cross nurses and other women workers.

WOMEN'S CLUBS, THE GENERAL FEDERATION OF, a federation of approximately 15,000 clubs in the United States, 32 U.S. Territories and foreign countries. It was organized and a constitution adopted on April 24, 1890 after a preliminary meeting of women's clubs held in New York in 1889. It was incorporated under the laws of New Jersey in 1895, and a charter was granted by Congress in 1901. Membership in the federation is open to any women's club or organization which requires no sectarian or political test for membership, is not a secret society, does not tolerate violation of national or State laws, and agrees to the constitution and by-laws of the General Federation. While the membership of the organization extends into millions, no exact figure can be given owing to overlapping memberships.

While the first clubs existed largely for self-culture, there was unquestionably in the inner consciousness of the founders a realization that, since the great economic changes of the world were removing many tasks from the home, women must prepare to play a new part in the affairs of their community, State and country. That they looked forward to a programme of practical, civic, educational and welfare work is plainly recorded in their early writings.

The officers are elected by delegates from the member clubs at a triennial convention. At this meeting and at the two intervening councils, the members express themselves nationally in their endorsement of such movements or legislation as they consider important to the national welfare. The individual clubs and State federations plan and carry on their own activities. Some of the causes which the General Federation has supported are: greater educational opportunities, scholarship loan funds for girls, home economics teaching, home demonstration agents, public libraries, travelling libraries, greater appreciation of music, painting and sculpture, the eradication of illiteracy, training in citizenship, Americanization of aliens, better working conditions for women and children, the abolition of child labour, prison reform, adequate pure food laws, recognition by the U.S. Census of homemaking as an occupation, the raising of the standard of home equipment, conservation of our natural resources, the creation of national parks, prohibition, peace, and a better understanding of international relations. (S. O. D.)

WOMEN'S SUFFRAGE. The Women's Suffrage Movement dates, for all practical purposes from the middle of the 19th century. The systems of government of the ancient world were all based upon the theory that women could take no part in political matters, except when they became reigning queens.

In Great Britain.—In spite of Plato and a few other political theorists, it was not until the French Revolution that the idea that women might share in political power gained any support. Then, however, Condorcet upheld it, and Mary Wollstonecraft wrote her great book *A Vindication of the Rights of Women* in 1792. The French Revolution speedily became unpopular in England, however, and although in the next 40 years a few isolated advocates appeared, it was not until the Chartist Movement began that it again attracted attention. The first draft of the "Charter of Rights and Liberties" was composed in 1838, and is stated to have included Women's Suffrage; but it was not allowed to remain, as it was thought likely to bring ridicule upon the agitation.

Between 1840 and 1850 a certain number of politicians mentioned the subject in their speeches, in particular Richard Cobden, who strongly supported it, and Disraeli, who spoke in its favour when a resolution was introduced into the House of Commons by Joseph Hume. The election of John Stuart Mill to parliament in 1865 marked its real beginning.

Mill was a convinced believer in the importance of this reform, and it occupied a foremost place in his election address. His return to parliament therefore encouraged those women who were thinking about the subject, and in 1866, when it was found that almost all the 50 members of the Kensington Ladies' Discussion Society were its supporters, a group of them, led by Barbara Leigh Smith (Mme. Bodichon), Elizabeth Garrett (Mrs. Garrett Anderson), Emily Davies and Bessie Rayner Parkes (Mme. Belloc) decided to form a provisional women's suffrage committee. Its first work was to collect a petition to parliament, and 1,499 names were secured. This petition, the first of a long series, was presented by Mill in 1867, and in the same year he moved an amendment to the Reform bill by which women were to be enfranchised.

A number of suffrage societies came into existence about this time in London, Manchester, Bristol, Edinburgh and Birmingham, and a real effort at propaganda was undertaken. Mill published *The Subjection of Women,* which he had written seven years earlier, and serious organization was begun. The leader in the north of England was Miss Lydia Becker, a woman of unusual political insight; and her first care was to make certain that women were not already enfranchised under the existing law. Over 4,000 claims to be put on the parliamentary register were sent in by women ratepayers in Manchester, and the same thing was done in other parts of the country. The test case (Chorlton *v.* Lings) was tried before the court of common pleas in 1868, and the decision was that women were disqualified, and attention was thereafter directed to promoting a bill in parliament. In 1869 the municipal franchise was extended to women ratepayers, and in the following year, when the school boards were created, women were made eligible and were actually elected to them.

In 1870 Jacob Bright brought forward a bill for extending the parliamentary franchise to women, and it passed its second reading, but was not allowed time to proceed further. The suffragists then began to hold meetings in various parts of the country.

In 1880 the vote was given to women owners in the Isle of Man, and it was subsequently extended to occupiers also.

During the years before the introduction of the Reform bill of 1884 the suffragists were very active. The political parties seemed to be favourable, and a majority of the members of the House of Commons was individually pledged, but W. E. Gladstone killed their chances of securing the amendment they hoped for. He announced that women would "overweight the Bill" and must be "thrown overboard," and accordingly 104 Liberal members broke their pledges, and the thing was done. The women at last realized the difficulty of trying to secure reform while they were themselves without political power. In 1888, when the county councils were created, women were included among the electorate. Two women were elected to the first London County Council, but their eligibility was challenged, and rejected by the courts, and it was not until 1907 that an act was passed making them eligible to serve on these bodies, and also to hold the office of mayor. The first woman mayor in Great Britain was Mrs. Garrett Anderson, mayor of Aldburgh in 1908.

The suffrage movement passed through a period of comparative discouragement after 1884, and though propaganda continued, and huge petitions were yearly sent in, no fresh developments took place. In the '90s a successful effort was made to interest the working women of the north, and although no progress was apparent in parliament the volume of support for the movement steadily grew. In 1897 the scattered societies united in a National Union, under the presidency of Mrs. Henry Fawcett, and their efficiency greatly increased.

In 1903 an event occurred which was both a symptom of renewed interest and a cause of further progress, namely the formation of the Women's Social and Political Union. Before many years were over this society, led by Mrs. Pankhurst, had developed "militant tactics."

The real development of this policy began in 1906, when the Liberal Party came into power. The older societies were asking for pledges from individual candidates, but the new society believed that the only hope lay in the action of the Government. At a meeting in the Free Trade hall, Manchester, Christabel Pankhurst and Annie Kenney asked what the attitude of the new Government would be. Instead of an answer to their perfectly legitimate question, however, the two girls were seized by the stewards and thrown roughly into the street; and when they held an indignation meeting they were arrested for obstruction, and sentenced to fine or imprisonment. Both chose to go to prison; and the sensation caused by these events was an enormous advertisement to the cause. Thereafter the "militants" adopted the policy of heckling cabinet ministers, of marching with petitions to parliament, and of sending deputations to Downing street. Disturbances and arrests followed, and with every such demonstration the strength of their society grew.

From 1906 the movement entered upon its stage of greatest effort. Organised societies expanded with great rapidity, and the agitation they carried on became incessant. The meetings which multiplied in halls and drawing rooms, in schools and chapels, at street corners and on village greens were missionary meetings, and new converts flocked into the ranks. In 1907 the first public demonstration in the streets was organized, and on a wet afternoon 3,000 women took part in the "mud march" through London. Nothing dreadful happened to them, and the demonstration was repeated in other places. As time went on the scale increased, and vast crowds gathered again and again in the Albert hall, in Hyde park and in other open spaces, and processions, miles long, marched with bands and banners through the streets. Both suffragists and suffragettes developed great ingenuity in propaganda. They turned everything to their uses, and their war-cry, "votes for women," cropped up in the most unexpected places. They chalked the pavements, paraded in sandwich boards, sold their newspapers in the streets, picketed the House of Commons and flooded the streets with leaflets and handbills.

All this commotion put the Government into a very uncomfortable position, since H. H. Asquith, the prime minister, was a violent opponent of the cause. He was determined not to yield; and yet nothing but the granting of the vote seemed likely to stop the agitation. The militants courted arrest, and continued their protests in prison. They adopted the method of hunger striking, and after painful attempts at forcible feeding, which they invariably resisted, the authorities were obliged to release them. While the propaganda of both sections of suffragists developed, the political situation remained unaltered. Private members' bills were introduced, but owing to the opposition of the Government they were either defeated or blocked. In 1910 a serious effort was made to find a solution of the problem, and a conciliation committee of M.P.s with Lord Lytton as its chairman and H. N. Brailsford as its secretary was set up. This committee drafted a bill acceptable to all sections of suffragist opinion, and the second reading was carried in the same year by 110 votes. Asquith refused further facilities, but after the second general election of 1910 the same bill was brought forward again, and was again carried by an increased majority. But still the Liberal Government would not grant facilities, and in the autumn of 1911 Asquith announced that he proposed to introduce a franchise bill "for male persons only." This naturally enraged the suffragists,

and the militants began a campaign of greater violence, destroying property and breaking windows to mark their protest. Early in 1912 the conciliation bill again came forward, but this time, owing to the prospect of the franchise bill and the known wishes of the prime minister, it was defeated by 14 votes—and that in the same parliament as had carried the same bill by 167 votes not a year before. This treatment of their cause still further angered and stiffened the suffragists, but they fixed their hopes upon the coming reform bill, which Asquith had promised would be open to amendments including women.

In Jan. 1913 the committee stage of the reform bill was reached, and the women's suffrage amendments were tabled. Then followed a parliamentary surprise; for, by the Speaker's ruling these amendments were declared so to alter the bill as to make it a different one from that which had already passed its second reading. The consequence was that the whole bill had to be withdrawn, and the chances of women's suffrage seemed to be hopeless.

The militant outbreak which followed was met by the Government with severely repressive measures. An act was passed, officially known as the Prisoners (Temporary Discharge for Ill Health) Act, but commonly known as the Cat and Mouse Act, whereby released hunger strikers could be re-arrested and sent back to prison when their health was restored. Many prisoners were recaptured under this act, and Mrs. Pankhurst, who was sentenced to three years in 1913 was re-imprisoned eight times; yet even so she only served 30 days in the first year.

After the fiasco of the reform bill the National Union adopted the election policy of supporting the party which officially advocated their cause and at that time the only party to do so was the Labour Party. In 1913 the National Union organised a pilgrimage of women, which marched upon London from all over the country, and culminated in a monster meeting in Hyde park. The reception of the pilgrims all along the route was so friendly, and the meetings they held in the towns and villages they passed through were so enthusiastic that they began to feel sure that public opinion was won, and that success was near at hand.

The course of the movement was interrupted in August 1914 by the outbreak of the European war, and the members of the suffrage societies at once turned their energies to helping the country through the economic difficulties of the time. "Let us prove ourselves worthy of citizenship" said Mrs. Fawcett in a message to her followers, "whether our claim be recognised or not." The suffragette prisoners were pardoned and the Women's Social and Political Union ceased to exist, but the National Union remained as an organised body and undertook relief work of many kinds.

For a time it seemed as if the suffrage question was lost to sight; but the war work which women were able to do was of such value, and they revealed such unsuspected powers and abilities that public opinion became very favourable to them. In 1916 the question of a new registration bill arose owing to the impossibility of re-registering the men who were absent on war service under the old act; and when the suffragists pointed out that any change in the basis of registration would be a change in the franchise, and that if it were made the women's question ought at the same time to be considered, they found not only the Coalition Government, but the whole press and people of the country in agreement with them. After several unsuccessful efforts to settle the matter without raising the whole franchise issue, H. H. Asquith invited the Speaker to call a conference representative of all the parties. The conference reported in Jan. 1917 in favour of a limited form of women's suffrage to householders and the wives of householders provided they had reached the age of 30 or 35 years; and this proposal, with the lower of the age limits, was inserted into the bill which D. Lloyd George's Government introduced. In June 1917 the clause enfranchising women was carried in the House of Commons by a majority of 7 to 1, with the general approval of the whole country. Early in the following year it passed the House of Lords, and received the royal assent.

The reason for the insertion of the age limit and the other differences between the franchises of men and women was to reduce the numbers of women voters, so that they should not be in a majority; and the suffrage societies, although continuing to work for equality, accepted this as a first step. In Nov. 1918 the act making women eligible for election to Parliament was passed, and at the election of that year women not only voted for the first time, but stood as candidates. The only one elected was the Countess Markievicz, who, being a Sinn Feiner did not take her seat; but in 1919 the Viscountess Astor was elected.

It immediately became evident that there was no danger of the formation of a "Woman's Party," and the extension of the franchise worked so smoothly that within a year or two all three political parties declared themselves in favour of extending the vote to women upon equal terms. In March 1928 the Conservative Government brought forward a new Representation of the People bill for this purpose. This was carried with only ten dissentients in the House of Commons, by 387 to 10. The bill passed the House of Lords in May with a majority of 79, and received the royal assent on July 2, 1928. With its passage into law complete political equality was granted to women, and the Women's Suffrage Movement in Great Britain came to an end.

In the British Dominions.—In all the British Dominions except South Africa some form of women's suffrage is in force. New Zealand enfranchised its women in 1893, and the commonwealth of Australia in 1902, South Australia having previously granted state suffrage in 1894, and West Australia in 1899. New South Wales granted it in the same year as the commonwealth, Tasmania followed in 1903 and Queensland and Victoria in 1905 and 1908. Canada acted in the matter almost at the same time as Great Britain. All the provinces except Quebec adopted it in 1916, and the Dominion followed in 1917. In Newfoundland women vote at municipal elections on the same terms as men, but at the age of 25 instead of 21 at parliamentary elections. In the Irish Free State equal franchise and eligibility are in force. In India the Government of India Act specifically left the question to be decided province by province by the elected legislatures. Cochin, Travancore and Jehalwar adopted it in 1921, Mysore in 1923, Assam in 1924, Bengal in 1925 and the Central Provinces in 1927. Burmah also adopted women's suffrage in 1922 when it became a province of India. Jamaica, South Rhodesia and British East Africa gave votes to women in 1919 and 1920. At Trinidad, Tobago and the Windward islands women vote at 30 and men at 21, and women are not eligible for election, and in the Channel islands they vote on equal terms, but are eligible only in Guernsey.

In Other Countries.—Before the World War there were only four countries where women exercised the franchise. In 1928 it is the practice in the great majority of the countries of the world, the principal exceptions being France, Italy and Spain. The position in 1928, in countries other than Great Britain and the Dominions, is as follows: Equal suffrage and eligibility for all elected bodies prevail in Austria, Czechoslovakia, Denmark, Esthonia, Finland, Germany, Iceland, Lettonia, Lithuania, Luxemburg, the Netherlands, Norway, Poland, Russia and Sweden. In Hungary women have the municipal franchise and the parliamentary franchise at the age of 30 with eligibility. Municipal suffrage is granted in Spain, in the Argentine (province of San Juan), in Brazil (province of Rio Grande do Norte) and in Belgium, where women are also eligible for Parliament, but without the right to vote (except in the case of a limited class of war sufferers). In Greece limited municipal suffrage without eligibility was passed to come into force in 1927, but the necessary decree has not been issued. In Italy a limited measure of municipal suffrage has been granted, but is inoperative. In Palestine women have equal suffrage and eligibility for the Jewish National Assembly, but have no voting rights under the constitution.

BIBLIOGRAPHY.—*Women's Suffrage* (1912) and *The Women's Victory and After* (1920) by Dame Millicent Fawcett describe the progress of the Suffrage campaigns. Sylvia Pankhurst, *The Suffragette* (1911) and Mrs. Emmeline Pankhurst, *My Own Story* (1914) deal with the militant movement, as does also *Prisons and Prisoners* (1914) by Lady Constance Lytton. Ray Strachey, *The Cause: A Short History of the Women's Movement in Great Britain* (1928) covers the whole field, and contains a bibliography. (M. G. F.; R. St.)

THE UNITED STATES

As the first experiment in a so-called democracy was made in the new Government known as the United States, it seemed most

fitting that there it should reach its full fruition in complete and universal suffrage. The earliest colonists recognized the value of a vote for the law-makers and the laws, but in the beginning it was very closely restricted to the members of certain specified churches and to those whose names were on the tax list, while in some cases a slight educational requirement was made. Women, even though qualified, were almost universally excluded.

After the Revolutionary War when the convention met in Philadelphia to organize the States no question aroused such vehement discussion as that of the suffrage. It was so long continued that finally the only solution possible was to omit the subject from the National Constitution and leave each State free to make its own qualifications for voting.

Meanwhile women were receiving the rudiments of an education and slowly acquiring a voice. By 1832 the anti-slavery question was becoming acute. Women were intensely interested and were developing so much power as public speakers that the question of allowing them on its platform had divided the Anti-Slavery Association, the Garrison-Phillips branch standing by Lucretia Mott and her contemporaries. Among these were the "Quakers" who always had recognized the equal rights of women. In later years Elizabeth Cady Stanton, of Revolutionary ancestry, had joined the anti-slavery forces and she and Lucretia Mott decided that the rights of women as well as those of the negro slave needed redressing. In July 1848, at a Friends' Yearly Meeting in Western New York, they issued a call for the first Woman's Rights Convention in all history. It met in Seneca Falls, Mrs. Stanton's home, on July 19, and after a two days' session adjourned to Rochester.

This may be regarded as the beginning of the movement for woman suffrage not only in the United States but in the world. It received the wide publicity of the New York *Tribune* under Horace Greeley and was followed in 1850 by a convention in Worcester, Mass., under the auspices of Lucy Stone and a distinguished group of Eastern suffragists. The movement, however, still lacked the dynamic force which was to put it into effective action and this was soon supplied by Susan B. Anthony. In 1851 she first met Mrs. Stanton and the friendship began which remained unbroken for over 50 years. Each was the needed complement of the other. Miss Anthony attended her first woman's rights convention in Syracuse in 1852, her last in Baltimore in 1906, one month before her death.

At first no way of extending suffrage was known except through amendments to State constitutions, which required the consent of a majority of the male voters. The first attempt was made in Kansas in 1867, immediately after the close of the Civil War, in which for four years women had borne an heroic part. An amendment was submitted at the same time to enfranchise the newly-liberated male slaves, who had flocked into that State. Both were defeated but the latter received a much larger vote in its favour. The women then had their first lesson in what was before them. All the States had the word "white" in the suffrage clause of their Constitutions, and legislatures in a number of them submitted amendments to the voters to take it out. In every instance they were defeated and it was evident that some other method must be found if the negro men were to vote, which the Republican Party was very desirous that they should do. This Party was in power in all the States and a measure was decided on that had not been attempted since early days, which was for the Congress to submit an amendment to the National Constitution.

As soon as this intention was announced Miss Anthony and some of the woman suffrage leaders rose up in arms and demanded that this proposed amendment should not enfranchise only coloured men but all women. Most of the men who had been the strongest advocates of woman suffrage opposed this demand and they were supported by some of the women, all of whom feared that it would imperil the success of the amendment. Women were not included in this 14th amendment, and later, when a 15th was found necessary to strengthen it, they were also excluded.

The woman suffrage leaders, however, perceived a new method, which did not seem so utterly hopeless as amending the Constitution of every State by consent of a majority of the voters. In New York city in 1869, at the close of the May anniversary of the Equal Rights association, which had been formed soon after the war to protect the negro men, they formed a National Woman Suffrage association. Representatives from 19 States were present and its object was declared by resolution to be to secure the ballot for women by a 16th amendment to the Federal Constitution. Mrs. Stanton was elected president and Miss Anthony chairman of the executive committee. This organization held a national convention every year thereafter for 50 years and went before committees of every Congress asking for this amendment. Its leaders soon learned that pressure from the States on their representatives in the Congress would be absolutely necessary and so they began to organize the States to work on the legislatures until every State was organized. In the autumn of 1869 another distinguished group, headed by Lucy Stone, organized a national association called the American, solely for this purpose. In 1890 the two organizations united under the name of National American, which worked for both objects for almost 30 years.

Mrs. Stanton, Miss Anthony and their heroic contemporaries passed away, leaving the work to be finished by their successors in office, Dr. Anna Howard Shaw and Mrs. Carrie Chapman Catt, who now headed a determined army of women eventually increased to many thousands. Individual States began to yield and enfranchise their women and each one increased the members of Congress elected partly by women, who were thus obliged to vote for an amendment to the National Constitution. The revenues increased annually, $120,000 being subscribed in 1919 to the work of the National Association, exclusive of the amounts raised by the various States for their own work.

It was found that legislatures could give women the vote for presidential electors and in some States the municipal and various forms of local franchise. Those of Arkansas and Texas gave the primary suffrage, equivalent to a full vote. Meanwhile campaigns were being vigorously conducted to persuade the legislatures to submit to the voters amendments to the State Constitutions conferring the full suffrage in State affairs. This was accomplished in New York in 1917 and was the greatest victory yet achieved. By 1918 women had thus acquired equal suffrage with men in 15 States, offering the only instance in the world where the voters themselves gave the franchise to women.

Meanwhile other associations national in character had been formed. The Federal Association was organized in 1892, of which the Rev. Olympia Brown was president for 17 years and many prominent men and women were members. Its object was the passage of a law by the Congress authorizing women to vote for members of the lower house, which would have been constitutional. The College Equal Suffrage League was organized in 1908 with Dr. M. Cary Thomas, president of Bryn Mawr college, at its head during the nine years of its existence, and it co-operated with the National American Association. This was true also of the Friends' (Quakers') Association. Mississippi Valley Conferences were organized in 1912 and Southern Women's Conferences the following year, which did effective work in their sections as auxiliaries of the National American as long as it was needed. A Congressional Union was formed in Washington in the spring of 1913 to support the work of the association's Congressional Committee, but in December it became an independent organization with headquarters in Washington and Miss Alice Paul as its head. Its object was a Federal amendment, which it attempted to secure by aggressive and militant methods never before employed in the United States. At the time of the National Republican Convention in Chicago in 1916 it adopted the name National Woman's Party. Later it established permanent headquarters in Washington through a gift of Mrs. Oliver H. P. Belmont, who became its president. In 1911 a National Men's League for Woman Suffrage was organized in New York and soon had many State branches officered by prominent men.

By 1918 the United States had entered the World War, and the nation-wide response of the women to every demand made on them and their valuable work broke down the barriers of the opposition. All the political parties were committed to their enfranchisement, but there was still enough opposition in the

Congress to delay the final vote of both Houses to submit the amendment to the legislatures until June 1919. The tremendous struggle was then ahead of securing the ratification of three-fourths of the legislatures in time for the women to vote at the presidential election of Nov. 1920. Most of them had adjourned and this would have to be done by special sessions. It was accomplished and the last certificate, that of Tennessee, was delivered to Secretary of State Bainbridge Colby at 4 o'clock in the morning of Aug. 26, 1920. At 9 o'clock he issued the official proclamation that the 19th amendment having been duly ratified by 36 State legislatures "has become valid to all intents and purposes as a part of the Constitution of the United States." It reads as follows: "The right of citizens of the United States to vote shall not be denied or abridged by the United States or by any State on account of sex." From that hour complete and universal woman suffrage was the law of the land.

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WONOSOBO, a town in Central Java, residency Kedu, the "capital" of Java's beautiful highland district known as the Dieng Plateau, is 7,000 ft. high and surrounded by mountains. Wonosobo is 3,400 ft. high and is connected by steam tramway with the main railways of Java. Pop. (1930) 10,701. A delightful climate makes Wonosobo a fine starting-point for excursions to the plateau. A motor road runs from Wonosobo to Garung, five miles distant, and from there to the plateau a rough road, traversed on foot, or by sedan chair, leads, by way of the charming lake of Mendjer, to Kejajar. A climb from here leads past the native villages of Tieng, Lowang, Wadasputi and Parikesit, on to the plateau. The plateau has a cold and bracing climate, almost Alpine scenery, small lakes, several Arjuna temples of Hindu construction. Wonosobo was occupied by Japan in March 1942, during the invasion of Java.

WOOD, ANTHONY À[1] (1632–1695), English antiquary, was the fourth son of Thomas Wood (1580–1643), B.C.L. of Oxford, where Anthony was born on Dec. 17, 1632. He was sent to New College school in 1641, and at the age of twelve was removed to the free grammar school at Thame, where his studies were interrupted by civil war skirmishes. He was then placed under the tuition of his brother Edward (1627–1655), of Trinity college. He was entered at Merton college in 1647, and made postmaster. In 1652 he amused himself with ploughing and bell-ringing, and "having had from his most tender years an extraordinary ravishing delight in music," began to teach himself the violin, and was examined for the degree of B.A. He engaged a music-master, and obtained permission to use the Bodleian, "which he took to be the happiness of his life." He was admitted M.A. in 1655, and in the following year published a volume of sermons by his late brother Edward. He began systematically to copy monumental inscriptions and to search for antiquities in the city and neighbourhood. He went through the Christ Church registers, "at this time being resolved to set himself to the study of antiquities." Dr. John Wallis, the keeper, allowed him free access to the university registers in 1660; "here he layd the foundation of that book which was fourteen years afterwards published, viz., *Hist. et Antiq. Univ. Oxon.*" He also came to know the Oxford collections of Brian Twyne to which he was greatly indebted. He steadily investigated the muniments of all the colleges, and in 1667 made his first journey to London, where he visited Dugdale, who introduced him into the Cottonian library, and Prynne showed him the same civility for the Tower records. On Oct. 22, 1669, he was sent for by the delegates of the press, who arranged to publish his work. In 1674 appeared *Historia et antiquitates Universitatis Oxoniensis,* handsomely reprinted "e Theatro Sheldoniano," in two folio volumes, the first devoted to the university in general and the second to the colleges. His great work was produced by a London publisher in 1691–1692, 2 vols. folio, *Athenae Oxonienses: an Exact History of all the Writers and Bishops who have had their Education in the University of Oxford from 1500 to 1690, to which are added the Fasti, or Annals for the said time.* On July 29, 1693 he was condemned in the vice-chancellor's court for certain libels against the late earl of Clarendon, fined, banished from the university until he recanted, and the offending pages burnt. Wood died on Nov. 28, 1695, and was buried in the outer chapel of St. John Baptist (Merton college), in Oxford, where he superintended the digging of his own grave but a few days before.

Wood's original manuscript (purchased by the Bodleian in 1846) was first published by John Gutch as *The History and Antiquities of the Colleges and Halls in the University of Oxford, with a continuation* (1786–90, 2 vols. 4to), and *The History and Antiquities of the University of Oxford* (1792–96, 3 vols. 4to), with portrait of Wood. To these should be added *The Antient and Present State of the City of Oxford, chiefly collected by A. à Wood, with additions by the Rev. Sir J. Peshall* (1773, 4to; the text is garbled and the editing very imperfect). An admirable edition of the *Survey of the Antiquities of the City of Oxford, composed in 1661–66 by Anthony Wood,* edited by Andrew Clark, was issued by the Oxford Historical Society (1889–99, 3 vols. 8vo.). Wood bequeathed his library (127 MSS. and 970 printed books) to the Ashmolean Museum, and the keeper, William Huddesford, printed a catalogue of the MSS. in 1761. In 1858 the whole collection was transferred to the Bodleian, where 25 volumes of Wood's MSS. had been since 1690.

We are intimately acquainted with the most minute particulars of Wood's life from his *Diaries* (1657–95) and autobiography; all earlier editions are now superseded by the elaborate work of Andrew Clark, *The Life and Times of Anthony Wood, Antiquary, of Oxford, 1632–1695, described by himself* (Oxford Historical Society, 1891–1900, 5 vols. 8vo). *See* also *Reliquiae Hearnianae,* ed. Bliss (2nd ed., 1869, 3 vols. 12mo.); Hearne's *Remarks and Collections* (Oxford Historical Society, 1885–1907), vols. i.–viii.; Macray's *Annals of the Bodleian Library* (2nd ed., 1890); Nichols's *Literary Anecdotes* (9 vols., 1812–15), i. iv. v. viii.; T. Granger's *Biogr. History of England* (3 vols., 1806, ed. by Noble), i.

WOOD, MRS. HENRY [ELLEN] (1814–1887), English novelist, was born at Worcester on Jan. 17, 1814. Her maiden name was Price; her father was a glove manufacturer in Worcester. She married Henry Wood in 1836, and after her marriage lived for the most part in France, her husband, who died in 1866, being at the head of a large shipping and banking firm. In 1860 she wrote a temperance tale, *Danesbury House.* Her first great success was made with *East Lynne* (1861) which was translated into several languages, and was dramatized with great success. Other novels followed. She became proprietor and editor of the *Argosy* magazine in 1867. She died on Feb. 20, 1887.

Memorials of Mrs. Henry Wood, by her son, were published in 1894.

WOOD, SIR HENRY EVELYN (1838–1919), British field marshal, was born at Braintree, Essex, on Feb. 9, 1838, the youngest son of Sir John Page Wood, Bart. Educated at Marlborough, he entered the Royal Navy in 1852, and served as a midshipman in the Crimean War. He then transferred into the army. Wood served in the Indian mutiny, and returned from India with a V.C. and a growing reputation. In 1878 he became regimental lieutenant-colonel of the 90th, which he immediately joined in South Africa. In January 1879 he was in command of the left column of the army that crossed the Zulu frontier. At the close of the war Sir Evelyn Wood was appointed to command the Chatham district. But in January 1881 he was again in South Africa with the local rank of major-general, and after Sir G. P. Colley's death at Majuba he negotiated the armistice with General Joubert. He returned to the Chatham command in 1882, having meantime been promoted substantive major-general. In 1882 he commanded a brigade in the Egyptian expedition. Wood remained in Egypt for six years. From 1883 to 1885 he was Sirdar of the Egyptian army, which he reorganized and in fact created. During the Nile operations of 1884–85 he commanded the forces on the line of communication of Lord

[1] In the *Life* he speaks of himself and his family as Wood or à Wood, the last form being a pedantic return to old usage adopted by himself. A pedigree is given in Clark's edition.

Wolseley's army. In 1886 he returned to an English command, and in January 1889, he was appointed to the Aldershot command. In 1891 he went to the War Office as quartermaster-general. Four years afterwards he became adjutant-general. He was promoted full general in 1895. He commanded the II. Army Corps and Southern Command from 1901 to 1904, being promoted field marshal on April 8, 1903. In 1907 he became colonel of the Royal Horse Guards. After retiring from active service he took a leading part, as chairman of the Association for the City of London, in the organization of the Territorial Force. He died on Dec. 2, 1919. Sir Evelyn Wood published several works, perhaps the best known of which to the soldier are *Achievements of Cavalry* (1897) and *Cavalry in the Waterloo Campaign* (1896). He also wrote *The Crimea in 1854 and in 1894;* an autobiography, *From Midshipman to Field Marshal;* and *The Revolt in Hindostan.* In 1917 he published a volume of reminiscences entitled *Winnowed Memories.*

WOOD, SIR HENRY JOSEPH (1869–1944), English conductor and musician, was born in London on March 3, 1869. His musical education was largely received at the Royal Academy of Music, and at the age of ten he became deputy organist at St. Mary's Aldermanbury. As a conductor he first appeared in 1889 with Rousbey opera company, and for some years he toured with various companies, including the Carl Rosa (1891). His name was closely bound up with the musical life of London from 1895, when the Queen's Hall Promenade concerts were started under a system of guarantees, with himself as conductor and Robert Newman as manager. These increasingly popular concerts, held nightly during August and part of September, were conducted by Sir Henry Wood throughout, although the management thrice changed hands and the concerts, after 1927, were under the direction of the British Broadcasting Corporation. The educative results of Sir Henry's liberal program policy were very remarkable. As conductor of the Queen's Hall Symphony concerts, established in 1897, he made for himself a high international reputation and greatly raised the standard of orchestral playing in England. He was knighted in 1911. He died Aug. 19, 1944 in London.

WOOD, JOHN (*c.* 1705–1754), British architect, was born about 1705, probably in Yorkshire. He settled in Bath in 1727, and is known as "Wood of Bath." He paid several earlier visits to Bath for the purpose of constructing roads. As an architect he was particularly successful in his designs for streets or groups of houses, and became well known as a follower of the Palladian school. His designs in Bath include Queen's square; Prior park, built for Ralph Allen; and the Royal crescent, designed by himself, but built under the direction of his son. The Bristol (1740–43) and Liverpool (1748–55) exchanges were also designed by Wood, and he restored Llandaff cathedral. His best work is, however, to be seen in Bath, where his classical style harmonized with the spirit of the town as he found it. He died on May 23, 1754. Many of his designs were carried out after his death by his son John (d. 1782), who also, in addition to many groups of houses, built the Hot bath and the Royal Private baths.

The elder Wood wrote *Choir Ganre* (Stonehenge, 1747); *Essay Towards a Description of Bath* (2 vols., 1742; reprinted, 1749 and 1765); and several other works on architecture.

WOOD, LEONARD (1860–1927), American soldier, was born at Winchester, N.H., Oct. 9, 1860. He graduated from the Harvard medical school in 1884, was appointed acting assistant surgeon, U.S. army, in 1885, becoming assistant surgeon with the rank of first-lieutenant in 1886, when he was assigned to Capt. Lawton's expedition against the Apaches in the South-west, resulting in the capture of Geronimo. For distinguished services he was awarded the Congressional Medal of Honour. In 1891 he was promoted captain and full surgeon, and later, while stationed in Washington, D.C., became the close friend of Theodore Roosevelt, then Assistant-Secretary of the Navy. On the outbreak of the Spanish-American War in 1898 Wood was commissioned colonel 1st U.S. Volunteer Cavalry (the famous Rough Riders) with Roosevelt as lieutenant-colonel. For conduct at Las Guasimas and San Juan Hill, Wood was promoted brigadier-general, July 1898, and in Dec. major-general of volunteers. He was military governor of Cuba from 1899 to 1902, when the Cuban Republic was established. He was appointed brigadier-general U.S.A. Feb. 1901. In 1903 he was sent to the Philippines and appointed governor of the Moro province, being promoted major-general in that year. In 1908 he returned to America as commander of the Eastern Department. In 1910 he was appointed chief of staff, U.S. Army, serving until 1914, when he was again given command of the Eastern Department. Gen. Wood as early as 1908 had urged preparedness. He was largely responsible for the establishment of a summer camp at Plattsburg for training civilian officers, which was taken as a model for other camps of the kind after the entrance of the U.S. into World War I. Just before the entrance of the U.S. into the World War in 1917 Gen. Wood was assigned to the southeastern division but was later transferred to Camp Funston, where he trained the 89th Div., N.A., the 10th Div. of the regular army and other troops. In 1919 he was put in command of the Central Department, with headquarters at Chicago. In 1920 he was a prominent candidate for the presidential nomination at the Republican National convention. Harding, a "dark horse," was nominated on the 10th ballot, with 692½ votes to 156 for Gen. Wood. In 1921 Gen. Wood was sent at the head of the Wood-Forbes mission to the Philippine Islands. Prior to leaving he was appointed head of the University of Pennsylvania, but did not assume charge because of the president's desire that he remain in the Philippines as governor-general, a position which he held from Oct. 1921 until his death which occurred in Boston, Mass., on Aug. 7, 1927. Wood was the author of *The Military Obligation of Citizenship,* lectures at Princeton and elsewhere (1915); etc.

See I. F. Marcosson, *Leonard Wood, Prophet of Preparedness* (1917); Joseph H. Sears, *The Career of Leonard Wood* (1919); Herman Hagedorn, *That Human Being, Leonard Wood* (1920); Walter Robb, *The Khaki Cabinet and Old Manila* (1926).

WOOD, ROBERT WILLIAMS (1868–), U.S. physicist, born in Concord, Mass., May 2, 1868. He graduated at Harvard in 1891, studied a year at Johns Hopkins university and two years at the University of Berlin (1892–94). He was assistant professor in physics at the University of Wisconsin, 1897–1901, and then became professor of experimental physics at Johns Hopkins. In 1938 he was retired as professor emeritus and reappointed research professor the following week. A method which he originated in 1898 of thawing frozen water mains and service pipes by passing an electric current through them was widely adopted. He was made a foreign member of the Royal Society in 1919. Dr. Wood has also conducted researches in optics, spectroscopy, atomic, and molecular radiation, the biological and physical effect of high frequency sound waves, and diffraction gratings for astrophysics. More than 200 of his papers appeared in the scientific journals; a bibliography of most of these is to be found appended to William Seabrook's *Dr. Wood* (1941). He is the author of *Physical Optics* (1905, rev. eds. 1911, 1934) and *Researches in Physical Optics* (2 vols., 1913–19).

WOOD. In all classes of plants, including for instance ferns, more highly organized than mosses, wood occurs in all members of the plant and is continuous from the finest rootlets up the root and stem, into the leaves and flowers or the equivalents of these. Wood performs two functions in the plant's life: first, it serves for the transport of water and contained salts, absorbed by the roots, to parts where this "raw sap" is needed and especially to the leaves; secondly it gives mechanical strength to the plant.

In palms and bamboos the wood of the leaves is string-like in form and is confined to the nerves or veins; from these the strings extend into the trunk or stem, where they descend but join one another at intervals thus producing a more or less basket-like or loose loofah-like complex, which is embedded in the general mass of tissue composing the rest of the trunk. Thus it is this linked net-like complex of woody strings that corresponds to the solid mass of wood of a pine or oak.

Wood that has attained only slight thickness and accordingly cannot be termed timber, is nevertheless utilized, for instance in the form of thin branches and twigs to make besoms and baskets. Even when wood attains greater thickness it is not always timber,

since there are some woods so soft, light in weight, and weak that they have little or no value as structural material upon which there is a demand for strength: such wood supplies means of flotation for fishing-nets and buoys, and insulation, while the lightest of all are pith-like and are the materials of which sun-helmets are composed.

(*See* also TIMBER.) (P. GM.)

WOOD ALCOHOL: *see* METHYL ALCOHOL.

WOODBINE, a plant name, applied in England to the honeysuckle (*q.v.*) and in America to the Virginia creeper (*q.v.*).

WOODBRIDGE, a market town in Suffolk, England; 79 mi. N.E. by E. from London by the L.N.E.R.

Pop. (1938) 4,959.

Woodbridge Abbey occupies the site of an Augustinian foundation of the 12th century.

There is a large agricultural trade.

WOODBURY, LEVI (1789–1851), American political leader, was born at Francestown, N.H., on Dec. 22, 1789. He was a judge of the superior court from 1816 to 1823. In 1823–24 he was governor, in 1825 a member and speaker of the State house of representatives, and in 1825–31 and again in 1841–45 a member of the U. S. Senate.

He was secretary of the Navy in 1831–34, secretary of the Treasury in 1834–41, and associate justice of the U.S. Supreme Court from 1846 until his death, Sept. 4, 1851.

WOOD-CARVING, the process whereby wood is ornamented with design by means of sharp cutting tools held in the hand.

The term includes anything from sculpture in the round up to hand-worked mouldings to help to compose the tracery of screens, etc.

(For technique, *see* SCULPTURE TECHNIQUE: *Wood-Carving.*) (X.)

AFRICAN

In dealing with African woodwork, a distinction must be drawn between the Mohammedan and the fetishistic countries.

Mohammedan Art.—In the Mohammedan countries, which are mainly in the north, the art has remained decorative, and statuary has been excluded; this is due partly to the natural bent of the Semitic race, which, coming from Arabia, has dominated these regions since the time of Mohammed, and partly to specific commandments in the Koran. Objects in daily use, furniture, and semi-architectural work are consequently almost the only forms of art for which the natives have used wood in Egypt, Tripoli, Tunis, Algeria, and Morocco, and among the scattered tribes north of Lake Chad and the Niger. Among objects in daily use, mention may be made of the powder-flasks of the Berber tribes of northern Morocco, carved with geometrical designs, and in some cases ornamented with copper studs and filigree-work; rifle-stocks inlaid with silver, ivory, and mother-of-pearl; mirrors, small chests, and boxes, similarly inlaid, particularly among the peoples more directly influenced by Egypt and the East.

Special attention has been paid by the Egyptians to furniture, and they have always excelled in inlaying, marquetry, and turned-wood work. There are but few types, however. Some are of a liturgical character, like the *kursi,* or Koran reading-desk, and the *minbar,* or pulpit, while others are for household purposes, like the *sanduq* or clothes-chest and the *marfoa* or dresser. These have often, particularly in Morocco, been carved with palm-leaves or conches and painted in gay colours. The Moors had also bed-ends, small cupboards, and large armchairs used at marriage-feasts, of chased wood, painted with delicate floral and geometrical designs. But it is in large-scale architectural decoration that the African Muslims have displayed the highest degree of skill.

The *mqarbe* or bees'-nest process consists in constructing arches, niches, or cupolas by placing together a large number of small wooden pales, all capable of reduction to seven fundamental forms, and each projecting corbel-wise in the manner of a trumpet. A series of these little trumpets is formed into vaults or portions of vaults hollowed out into hundreds of cells and bristling with stalactites, producing the most opulent effect.

Another process is the large-scale mosaic in wood, used mainly for ceilings and doors in magnificent buildings. For ceilings it is used in two ways: (1) The beams being left visible and assembled in lines agreeable to the eye, panels of various shapes being interposed between them at intervals to produce a large mosaic presenting various combinations and geometrical flourishes. (2) A rough framework, which is not visible, having inlaid upon it panels of wood on which baguettes and leaves of wood are applied so as to form a mosaic in relief. In the case of doors the processes are much the same, except that uprights and lintels take the place of beams and joists. This art of wood mosaic has been practised with great success, especially in Morocco and Egypt. In Morocco it has almost always been embellished with very delicate arabesques, painted with size, varnished, and gilded. In Egypt, in the best periods, it was adorned with elements in ivory, ebony, or even precious metal, with thin sheets of wood here and there.

Turned woodwork has been used mainly for balustrades and partitions. The native method is to fit little twirls between turned baguettes. Both twirls and baguettes are made on primitive lines, with a wire saw wielded in one hand, the other hand holding a chisel which is guided with the foot. The method is still in use among the Spaniards in certain Andalusian towns. Partitions of turned wood have been used chiefly by the Egyptians, for the kind of loggia called *musharrabieh* which gives so picturesque an appearance to the streets of old Cairo.

The Muslims have produced some most beautiful interior decoration in the form of wood-carving. In Morocco more especially, the inner courtyards of the houses in the 14th, 15th and 16th centuries were ornamented throughout with corbelled penthouses, friezes, lintels, and mural facings in carved wood. The carving is not very deep; it is a bas-relief, with sometimes an intermediate plane between the foundation and the most salient parts. The decorative motifs are floral twines composed of two-branched palm-leaves, interspersed with conches and pineapples. There are also inscriptions in Arabic characters artistically intertwined with the floral elements. The depth of the hollows is from 3 to 4 centimetres. Very often, however, especially in more modern buildings, the wood has been simply engraved on the surface, so as to accentuate the painting a little more heavily.

In practice these different methods of decoration are often combined. So in doors or very elaborate ceilings in wood mosaic, the boards may be carved with interlaced palm-leaves. The panels of which inlaid ceilings are composed are not always ornamented with mosaic; many of them are merely engraved with rectilinear geometrical designs. Again, partitions of turned wood are frequently embellished with baguettes forming combinations or even inscriptions in stylized Cufic characters.

It should be added that all these methods of woodworking have also been applied to objects not directly concerned with architecture, such as *mihrabs* (niches indicating the direction of Mecca in mosques), and in particular to some *minbars* (pulpits).

At the present day the native woodwork is not so excellent as it used to be; but highly-skilled joiners, carpenters, and wood-carvers are still to be met with in Morocco. Marshal Lyautey, while he was administrator attached to Sultan Mulay Yussef, helped to preserve these traditions of craftsmanship. Among the best-known examples are: At Cairo, the rich collections of the museum of Arab art, several doors and minbars of mosques, lids of tombs, etc.; at Kairuan (Tunis), the minbar (9th century) and the maqsura (11th century) of the Sidi-Okba mosque; at Algiers, the minbar of the chief mosque (11th century); at Fez, the splendid decorations in the inner courtyards of the Medersas of Buanania, El Attarin, El Mesbahiya, Es Sahrij (14th century), and Esh Sharrabin (16th century); at Marrakesh, the minbar of the mosque of El Kutubia, the wall-facings and friezes of the Ben-Yussef Medersa (16th century), and the stalactite vault of the mausoleum of the Saadian princes (16th century).

Fetishistic Art.—In the Fetishistic countries, peopled by black races, the development of art has been entirely opposite to that in the Mohammedan countries; it has been concerned mainly with the representation of living beings. This art is essentially religious. The carved wooden images are mostly

statuettes of gods and goddesses and masks for ritual dances. Drinking-cups, seats, head-rests, etc., are also met with. Though long regarded as purely barbarous, in recent years negro art has attracted the attention of a large number of enthusiastic collectors, who recognize in it not merely an unusual and individual character, but qualities of construction, synthesis, and even frequently expression, together with a striking decorative power and delicacy of ornament in objects of daily use. Few of the examples that have reached us are of any great age, the oldest dating back only some two or three centuries. According to the closest students, however, they follow for the most part traditional types the canons of which were established in very remote times. One of the features of the human effigies is the intentional smallness of the lower limbs. Some say that this deformity is intended to represent the primitive inhabitants of Africa, the Pygmies or Negrillos, who are supposed to have been deified by the negroes.

Roughly, the chief centres of negro art are: Benin, where local traditions have mingled with Portuguese influences dating from the 14th and 15th centuries, with engaging results; the Ogowé, in the north of Gaboon, where wooden fetishes sheathed in copper plating are the chief feature, the human form being completely conventionalized into a geometrical figure; Dahomey, where the human figures are much more realistic; the Congo, where there are statuettes covering a fairly wide range of types, and also, in the Kasai basin, objects of daily use which are remarkable both in form and in ornamentation—goblets, drinking-cups, musical instruments, chairs, etc.

Guinea, the Oil rivers, the Sudan, the Ivory coast, the Gold coast, Dahomey, Liberia, the Cameroons, Gaboon, etc., have produced statues and masks displaying the most painstaking workmanship. Wood-carving is also found in Loango and Angola. The finest collections of negro art are in the British museum, the Trocadéro museum at Paris, the Tervueren museum near Brussels, and various museums in Germany. (J. GAL.)

Muslim Art: *See* S. Lane-Poole, *The Art of the Saracens in Egypt* (1886); M. Herz, *Catalogue of the National Museum at Cairo* (1896); H. Saladin, *Manuel d'Art Musulman; vol. 1; L'Architecture* (1907); G. Migeon, *Manuel d'Art Musulman; vol. II.; Les Arts Plastiques et Industriels* (1907); G. Marçais, *La Chaire de la Grande Mosqueé d'Alger* (1921) and *Manuel d'Art Musulman* (2 vols., 1926); J. Gallotti, *Le Jardin et la Maison Arabes au Maroc* (1926).

Negro Art: *See* C. H. Read and O. M. Dalton, *Antiquities from the City of Bénin* (1899); A. H. L. Fox-Pitt-Rivers, *Antique Works of Art from Bénin* (1900); M. de Zayas, *African Negro Art* (1916); C. Einstein, *Negerplastik* (Munich, 1916) and *Africanische Plastik* (1921); H. Clouzot and A. Level, *L'Art Nègre et l'Art Océanien* (1919) and *Sculptures Africaines et Océaniennes* (1924); E. von Sydow, *Kunst der Naturvölker* (1923); *Handbook to the Ethnographical Collection at the British Museum* (2nd ed. 1925); G. Hardy, *L'Art nègre* (1927).

FAR EASTERN

Splendid examples of Japanese 8th century wood-carving may be found in the phoenix and musical angels adorning the canopy hung in the Kondō of Hōryuji and in the *gigaku* masks carved in paulownia wood and preserved in the Imperial treasure-house Shōsōin, the Hōryuji monastery and other ancient temples in Japan. The *gigaku* masks in the Shōsōin, numbering 164, the majority of which are in wood, the most of which are in paulownia, if not all, the rest being in dry-lacquer, are believed to have been used in connection with religious services observed at Tōdaiji, especially at the inauguration ceremony of the Great Buddha which took place on April 9, 752. The belief is substantiated by the carvers' signatures and dates written on the inside of the masks, and also on the original bags which contained them. Inscriptions on some of the masks indicate the number of days spent in carving the mask, some being 5 and 7 and others 9 days. The wooden masks used in *bugaku*, the music of which is still preserved and occasionally performed in the Palace, are smaller and less grotesque in appearance, as may be seen from the old masks scheduled as "national treasures" and preserved in some temples. The *no* masks, all carved in wood, which came into existence in the 16th century, taxed the resources of the talented carvers, and a large number of masterpieces are now in possession of the head families of the different schools of *no* drama.

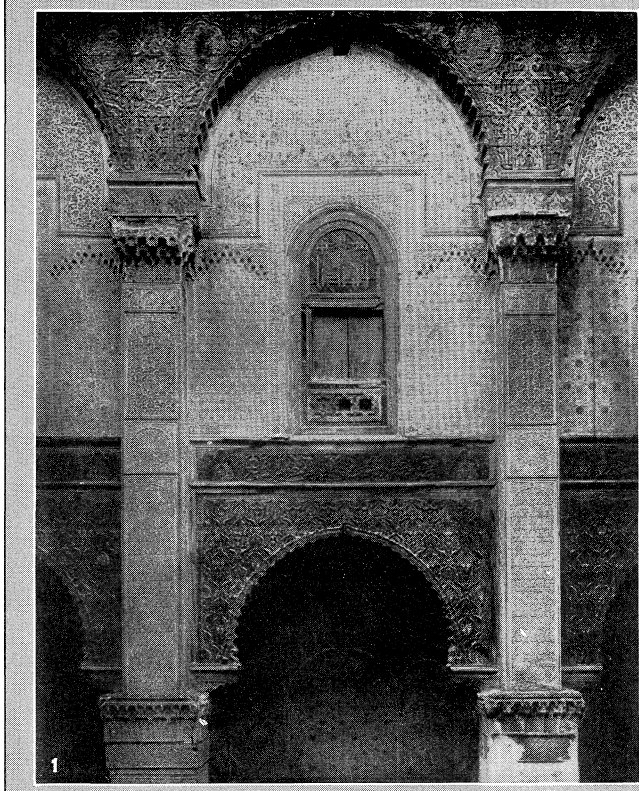
Up to the 15th century, the work of the wood-carver was confined to the embellishment of the temples: carvings on the pedestals, nimbus, and baldachins of Buddhist figures, and some slight ornamentations on the building itself, such as the carving of the beam-ends into animal heads and the use of the *kaeru-mata*, a simple decoration between the beams. But in the second half of the 16th century, the decorative wood-carving came to assume an importance in palatial mansions of the shōguns and in shrines where wood carvings were inserted into the *kaeru-mata* between the beams, attached under the rafters, used as the panels of the gate, etc., a large number of which may still be seen at Kitano Jinsha and Nishi Hongwanji of Kyoto, Chikubushima Jinsha in Lake Biwa, etc. The predominance of wood-carving as an architectural decoration in the 17th century may be seen at the mausoleums of the Tokugawa shōguns at Shiba, Tokyo, and at Nikko, where both the interior and exterior of the buildings are profusely covered with wood-carvings ranging over a wide variety of subjects faithfully executed and realistically coloured.

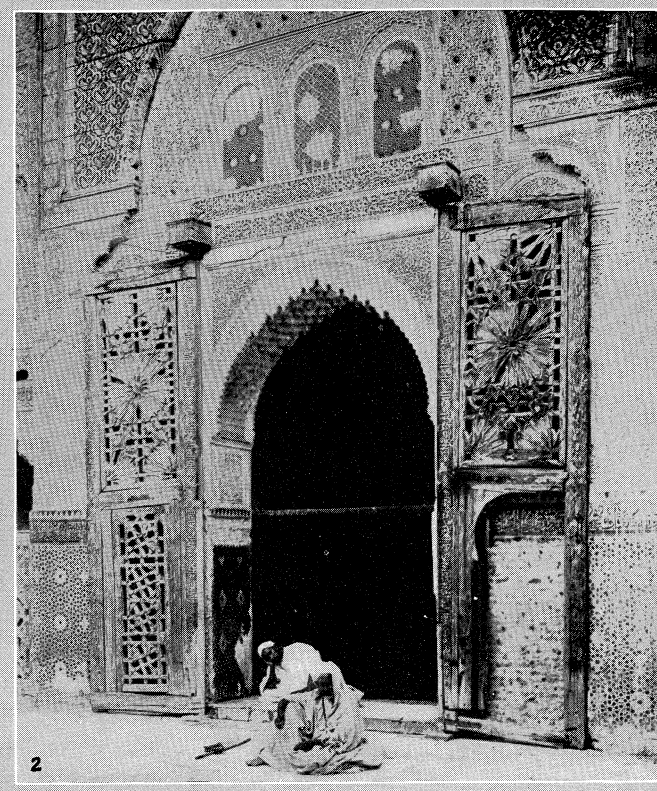
The taste for simplicity has not tolerated wood-carving in the architecture of dwelling houses. The only place the carver could display his art was in *ramma*, the ventilating panel in the narrow partition wall over the sliding screens that separate one room from another. The *ramma* carving has made a special development of its own, all sorts of subjects being treated: flowers and birds, animals and insects, figures in history and romance, landscapes and mists, clouds and waves, etc., carved on board to give, together with the decoration on the sliding screens, a character to the room.

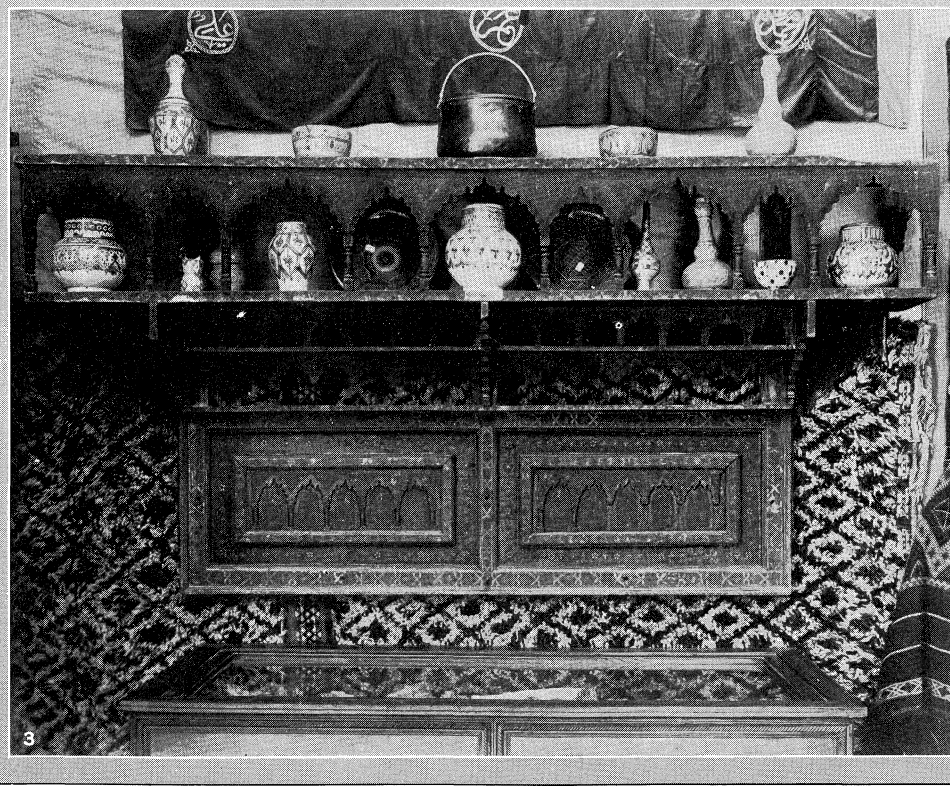
Some fine carving in wood, the temple decoration in miniature scale, may be seen in the family shrine (*butsu-dan*) where the ancestral tablets are kept, generally fitted into a recess in the room. In their profuse and minute decoration some of the portable shrines (*mikoshi*), used in the procession at the festival, are also beautiful examples of the art of wood-carving. So also are the small ornaments for cabinet decoration or for the *tokonoma*, the recess in the guest room for objects of art. Some wonderful workmanship in wood has been produced by the *netsuke* (ornamental button for suspending a pouch or medicine case) carvers when many of the talented sculptors in wood turned their attention from carving Buddhist figures to the production of smaller objects in greater demand.

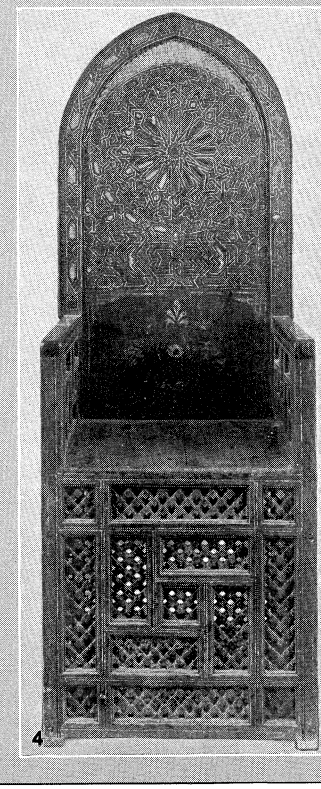
The Chinese have utilized the wood-carving more lavishly than the Japanese in their home architecture. They have carved their heavy beams on the ceiling and the massive pillars as well with delicate tracery. The simplest of their chairs and tables are invariably carved in the "key"-pattern, some simpler than others, and the doors are in delicate trelliswork design or ornamented with carvings in low relief. Lanterns with diapers or some other interesting designs in pierced work are held by brackets or arms carved in forms of dragon heads. Although rich in variety, the designs used in the wood-carving, show a fondness for geometric patterns that is distinctly Chinese. The following are some of the other motives resorted to by the wood-carvers: emblems of richness and happiness, clouds and thunder patterns, the curious mask of a creature "TaoTieh," "The Eight Trigrams" or "Pa Kwa," "The Four Quadrants," "The Five Elements," etc. Sacred scenes and figures incised in floral scrolls, intermingled with series of conventional emblems of one religion or another form subjects for wood-carvers in decorating the Buddhist, Taoist and Confucian temples. Sacred to Buddhism are the eight symbols, the chief among which is the lotus, an emblem of purity, chosen because the lotus lifts out of the mud its rosy or white blossoms unsullied, forming a fitting resting place for the Buddha. Taoists have their symbols of eight immortals and derive many floral emblems of longevity from sacred plants, the most prominent among which is the peach, the tree of life of their paradise, bearing fruits ripening but once in 3,000 years which confer immortality to those who partake of it. While Confucianism has no distinct emblem of its own, the symbol of culture and examples of filial piety, such as the well known 24 examples of filial piety, are sometimes attributed to it.

Artistic vitality characterizes even the highly conventionalized designs of the Japanese wood-carvers, but the bulk of the Chinese work reveals a sense of laborious and mechanical execution. On





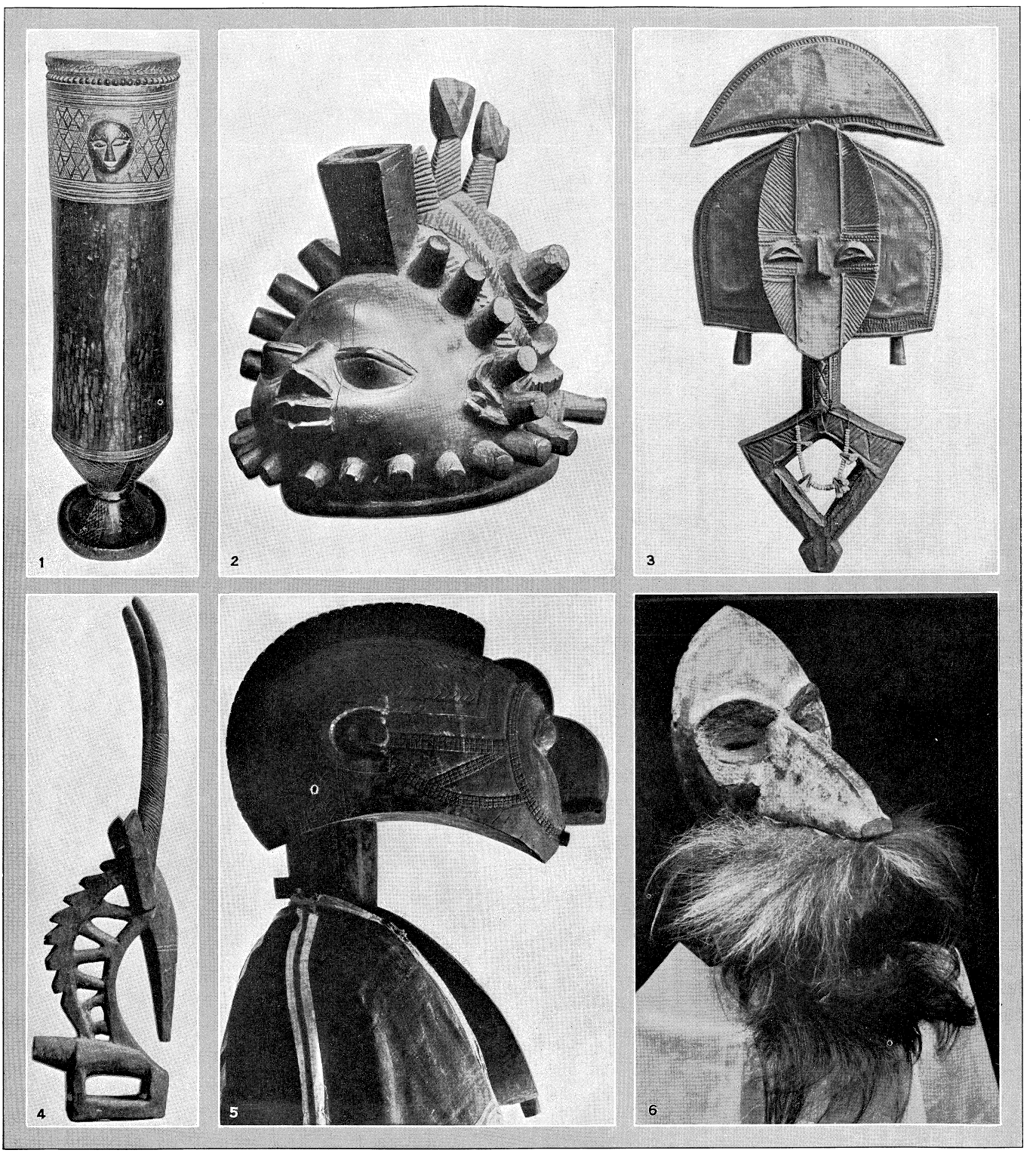




DECORATIVE WOODWORK OF MOHAMMEDAN AFRICA

1. Part of a series of wooden arcades in a medresseh of Fez, Morocco. 2. Mosaic doorway of wood in the Medresseh Bou-Anania, Fez. 3. Painted wooden table and pottery, Fez. 4. Marriage throne of carved and painted work

WOOD-CARVING



PHOTOGRAPH, (1) LIBRAIRIE DE FRANCE

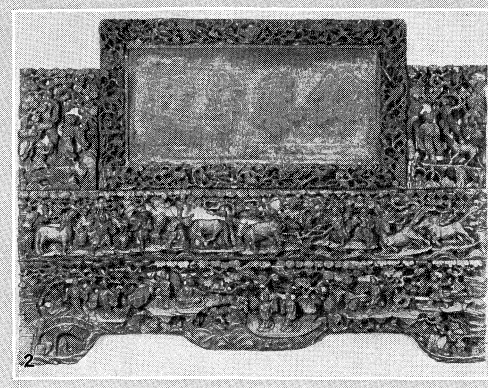
WOOD-CARVING OF AFRICAN NEGROES

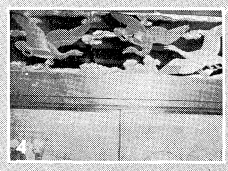
1. Wooden drum carved with geometrical designs and a human face in relief, Belgian Congo
2. Mask for ceremonial dance
3. Wooden fetish copper covered in the form of a conventional human figure (bakota)
4. Head of an antelope from the Sudan, where the sculpture bears a resemblance to that of the primitive Egyptians
5. Part of a figure representing the goddess of maternity
6. Mask with beard of animal hair worn in a ceremonial dance

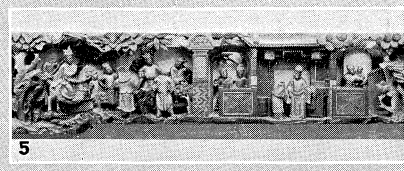
FETISHES, GOBLETS AND A MASK CARVED IN WOOD BY AFRICAN NEGROES

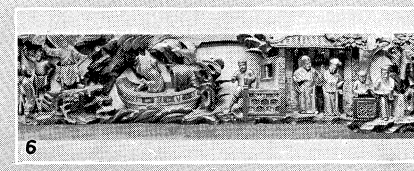
1. Statuette fetish from Gaboon
2. Statuette fetish from Dahomey
3. Statuette fetish from the Congo with a cavity in the abdomen to receive a special charm
4. Goblets ornamented with the geometrical designs characteristic of African negro art (Kagaï)
5. Mask from the Ivory Coast worn in a ceremonial dance

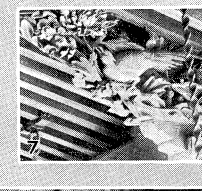
WOOD-CARVING

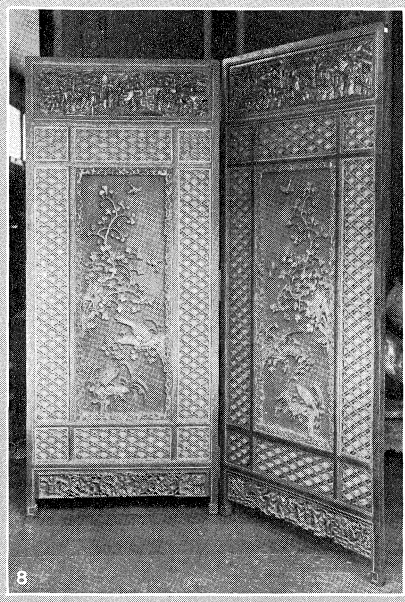


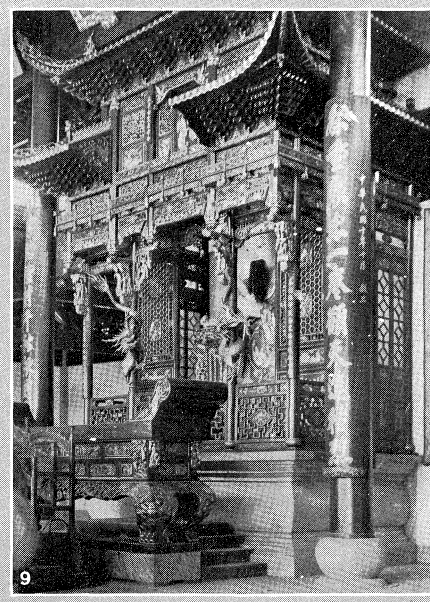


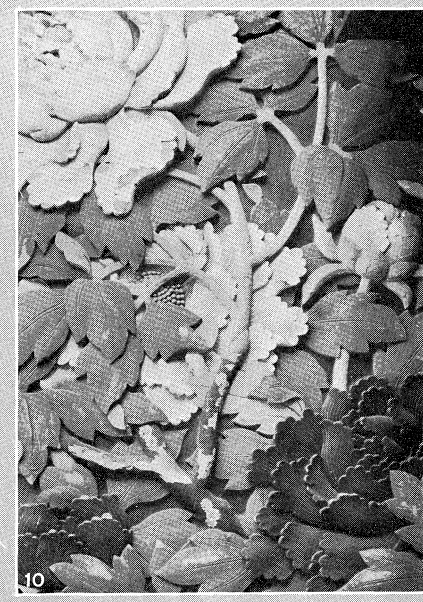


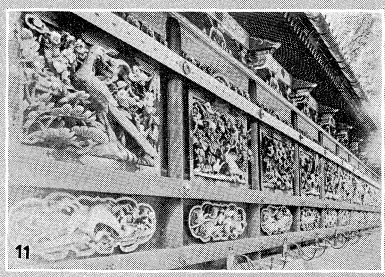


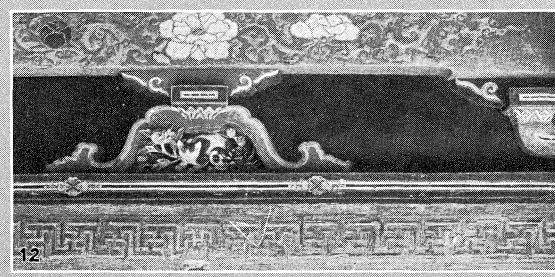


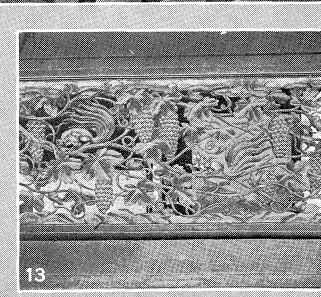












BY COURTESY OF (1, 2, 3, 5, 6) THE DIRECTOR OF THE VICTORIA AND ALBERT MUSEUM

EXAMPLES OF FAR EASTERN WOOD-CARVING

1, 2, 3. Chinese shop front

4. Carved ramma in the crane room of the Nishi Hongwanji, Kyoto

5, 6. Carved beam from a Chinese house

7. Wood-carving under the eave of Kitano Jinsha, Kyoto

8. Chinese screen with carving

9. A Chinese temple

10. Wood-carving on the famous gateway (Yōmeimon) of the Nikko Shrine, Japan

11. Wood-carving on the wall of the Nikko Shrine

12. Sleeping cat at the Nikko Shrine carved by the left-handed Jingoro

13. Carved ramma in the wave room of the Nishi Hongwanji, Kyoto

the whole, the Chinese wood-carvings are more effective as a design and ornament compared with the Japanese work, which, while the thing carved on is well decorated, carry a far less decorative value. The former aims more for the effect, while the latter pays much greater attention to the mode of execution and technical skill. The former covers the carving with paint or lacquer, while the latter delights in appreciating, whenever possible, the clear cut chisel marks in natural wood. Even the decorative panels in the temples and shrines which are coloured, show traces of the Japanese wood-carver's pleasure and satisfaction derived from the clear cuts of his chisel. There is a tendency in both for an effort to surmount formidable difficulties in design and execution, defying time and labour, with little regard for the artistic merit in the result achieved. (*See* INDIAN AND SINHALESE ART; INDONESIAN AND FURTHER INDIAN ART.)

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GOTHIC

Such meagre fragments of woodwork as have come down to us from the 11th and 12th centuries, tend to show that the woodworker was following the stoneworker in every particular, and that where he failed to be constructive, he had to call in the help of the metalworker to make his ware hold together. The stoneworker was paramount until about the 15th century. From that time onward it was the woodworker who became predominant. By that time he had found that wood should be treated in quite a different manner from stone, and, inspired by new ideas and new motives, he invented new methods for the construction and embellishment of his work. The wood-carver, then, no longer followed the patterns and designs of the stone-carver, but he made them for himself in a manner to suit the material and tools he worked with, in fact he began to influence the stoneworkers in such a way as sometimes to divert them from their intrinsic principles.

Early Period.—The earliest examples of wood-carving are some remnants of Scandinavian carving dating from the ninth and tenth centuries. They are carved framings of doorways made of thick planks of pinewood. They follow the same form of designs as are found on Celtic stone crosses, or in the elaborate initial letters of early illuminated manuscripts. This carving is in low relief, and it is always kept up to the surface of the material out of which it is made. The designs are of interlacing stems sometimes foliated, and often terminating in a monster's head. Occasionally the stem is doubled and criss-crossed, and invariably the space which is decorated is so much filled with pattern as to leave scarcely any ground showing. An example of this kind of carving is shown in the reproduction of a Norwegian chair of the 9th or 10th century. (Pl. V., fig. 1.)

Of the Norman period in England only a few isolated pieces remain, and these are only enriched with a row of moulded arches, as in the railing at Compton church, Surrey, or the desks at Rochester, or the tomb at Pitchford church, Shropshire, which has also a shield carved in oak in each arch of the arcaded side of the tomb, supporting the carved wood effigy of Sir John Pitchford, which was made at the very end of the Norman period. It may be conjectured that the characteristic feature of Norman wood-carving is the rounded surface of most of the foliated forms, which appear to have avoided hollows. The leaves were often a series of lobes with a V-shaped sinking round the edge. Even in the mouldings, beads or rounds preponderated over hollows, and in the grotesque beaked heads carved on the arches to many a doorway the surface treatment is generally a series of ribs or small rolls, rather than a succession of hollows or V cuts as was the case in Byzantine ornament. Sometimes the stems of the foliage were enriched by a small bead carved on either side of a rounded stem, as may be seen on the Prior's doorway at Ely cathedral.

Of the early English period which lasted roughly from 1190 to 1310—a little over 100 years,—there is not a great deal of wood-carving remaining, though there is sufficient to tell us what it was like, even in elaborate work, as in the stalls at Winchester cathedral. These however were executed at the very end of the 13th century. They are carved with the utmost care and skilfulness but the work follows the idiosyncrasies of the stonemason and carver, inasmuch as it is cut out of solid blocks of oak and the forms and designs are identical with that of stonework. Some of the designs for foliage follow the typical early English forms, whilst others might be taken for the work of the next great divisional period of architecture which followed. The miserere seat from the Priory church at Christchurch, Hampshire is a good example of early English carving. (Pl. V., fig. 2.) Others may be found in Henry VII.'s Chapel at Westminster, and at Exeter.

In the traditional carvings of the 13th century the curves of the foliage are very simple. The leaves start from a fairly thick stem which is generally cut very square in section. Sometimes the curve of the stem is reversed as it nears the end of the spray, but more often than not it is one simple curve which quickens as it reaches the end of the leaf, and finally buries itself in a deep pocket in the centre lobe. The variations of this form of foliage are wonderful and beautiful in the extreme. The building where this form of carving may best be studied in England is Wells cathedral. Towards the end of the 13th century the wood workers were coming into greater prominence. There is an example of a groined roof with carved bosses at the junction of the ribs at Warmington, Northamptonshire, and of carved roof beams at Bradfield, Berkshire; and Rochester cathedral has a lean-to roof with moulded beams.

Decorated Style.—The next phase of Gothic work, which began about 1300, is known in England as the Decorated style. It lasted for the comparatively short time of 70 years, before it gave place to another type. Even during these 70 years carving had more than one character. At first there was a tendency to follow more closely naturalistic forms, though treating them conventionally, but this is rather more apparent in the stone-carver's work than in the wood-carver's. This faithful portraying of natural forms does not appear to have lasted for more than 10 to 20 years. What succeeded was a very conventional and exaggerated treatment of the surface of foliage applied indiscriminately to leaves of every description. It consisted of a large bump in the middle of the leaf, a smaller one in the centre of each lobe and a still smaller one on every serration. The effect of this arrangement was a deep hollow round each protuberance in the centre of the leaf, partly broken by the lip or raised edge to the circular eyes which divide the main lobes of the leaf.

The Fifteenth Century.—The 15th century was productive of the finest quality and of the largest amount of decorative Gothic woodwork that the world has even seen. Although there was a distinct style pervading the whole period, there was more variety in expressing it than had been the case in any of the previous developments in architecture. This period of work which is known as the Perpendicular style began about the year 1390 and continued until about 1550; after that date it was practised in a debased form for another 100 years.

It was a time of prosperity. Spacious and noble churches were built and sumptuously furnished and decorated. Not only did one parish vie with another in erecting churches with costly and elaborate fittings richly painted and gilded, but the merchants also built noble houses for themselves. There was no difference in the style of building between domestic and ecclesiastical edifices, save that many houses were constructed of timber. Screens, pulpits and font covers were invariably prepared with gesso and sometimes minute decoration added to the faces of the buttresses, as at Southwold, and then gilded, and sprays of flowers painted on the broad hollows. The beadings were picked out with a chevron, or a twist of two or more colours like a barber's pole. The corner posts generally received a greater or less degree of carved ornamentation such as is here shown from a house in Suffolk (Pl. V., fig. 4).

The most noticeable features of the work of this period are that carving became flatter, tracery was built up of several boards as one order was superimposed upon another and not cut out of one thick piece of oak as had formerly been done. It will be seen that in the emblems of S.S. John and Matthew (Pl. V.,

fig. 3), the work is applied and that a broad simple treatment is the outstanding characteristic of these vigorous carvings. Whereas in Decorated carving the prominent projections on the surface of leaves were made into round bumps, in Perpendicular carving these projections were made to take a rectangular form. Above all the carver worked in a manner that suited his tools and material. In the latter half of the 15th century some of the carved foliage is composed almost entirely of hollows divided by a V cut to represent the stem of the leaf, or by a softly carved raised stem. The edges of the leaves are kept up and the serrations are produced by a vertical cut with a gouge at right angles to the edge of the leaf and a hollow cut with the same tool on the edge of the leaf, getting deeper until the chip falls out as the cut meets the first incision. The inner edge of these gouge cuts form the centre stems of the serrations. The Poppy-head from Walpole St. Peter (Pl. V., fig. 5) partly illustrates this. It will be seen from this how very different is the carver's expression to what it was when every serration was elaborately carved with a swelling in the middle and a hollow round it. One type of leaf which was invented, for there is nothing in nature like it, was that in which the corners of the leaf ended in a tightly rolled ball, as may be seen in the left hand leaf on the miserere seat from Ripon cathedral, on which Samson is shown carrying away the gates of Gaza (Pl. V., fig. 6).

The wealth of pattern and fanciful design in crestings, strings, bosses, tracery, poppy-heads, bench ends, etc., is wonderful, and the rendering of fables and biblical stories in the miserere seats inimitable. The repeating patterns in carved tracery and cresting, etc., are always interesting, because although there is a sameness, there is never an exactitude. The curves of tracery are never mechanical but are drawn freely, and great care was taken to get a breadth of effect. The hollows of the tracery are very flat, and not like the cast iron effect produced by some revivalists who make the section of the hollow almost a quarter of a circle. In a few of the East Anglican churches an effect of great richness is produced by carving the back of the top rail of each bench with a simple band of ornament, as in Dennington church, Suffolk (Pl. V., fig. 8). As band beyond band is seen when viewed from the west end the impression it gives is quite startling.

An extraordinary development took place at this period in the erection of timber roofs. The skill and imagination of the carpenter together with the conception of the figure and foliage carvers produced a wealth of grand architectural effects that has never been surpassed. The roof of Westminster Hall will for ever be a wonder for its construction and magnitude.

In England the type of work differs considerably in different parts of the country. There is a great deal of beautiful oak carving of this period to be seen in France, Germany and Flanders. In St. Paul's church at Abbeville, there is a beautiful reredos (Pl. V., fig. 10) which is Flemish in character, illustrating the lace-like effect so often found in French carvings. Perhaps the most striking piece of work on account of its vast amount, its completeness, and its elaboration is the stalls at Amiens cathedral, which were begun in 1508 and completed in 1522. One characteristic feature of French Gothic tracery carving is that the section is often but little more than a chamfer and when there is a double order it is often made by dividing the chamfer by a square incision. Most of the foliage carving is expressed by the use of the gouge, that is to say it is composed of broad hollows. In German work the tendency is for the designs to be more intricate and to contain less breadth and freedom in the carving. Most of this work is very much undercut and the chief aim appears to have been definition of outline and strong shadows.

At the end of the 15th century Renaissance influence begins to make its appearance, and although the structural parts of woodwork remain purely Gothic in design, it is in the carvings that the innovation first makes its presence known. The four oak panels (Pl. VI.) are dated 1540 and indicate the effect the new style is beginning to have on the carver. The suggestion is that carvers were introduced from Flanders with which there was constant intercourse in connection with the trade in wool, and it is from this source that the splendid traditions of the Gothic period were undermined. When the fashion for this new form of art took hold of the popular imagination, the end of Gothic was not far off; although tradition born of centuries is hard to kill; for it was not quite dead until the middle of the sixteenth century. (*See* also SCULPTURE TECHNIQUE: *Wood-carving;* GOTHIC ART.)

(L. A. T.)

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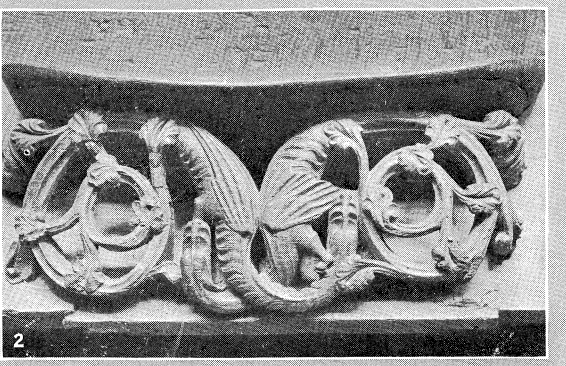
MODERN

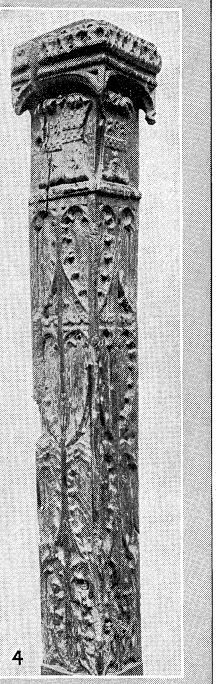
With the passing of the Gothic the symbolism that inspired the wood-carver gave place to ornament almost devoid of ideas. Under the influence of the builders it functioned to give expression to proportion and structural design, and to convey something of the joy of life in those effects with which man delights to surround himself. When symbolism or aesthetic understanding is not guiding the decorative instinct, manipulative skill becomes easily a snare, hence, the styles of decoration which have arisen throughout Europe since the Renaissance have provoked a constant struggle between sincerity and technical dexterity. Especially has this been the case with wood-carving. Wood is an intractable material to carve but, in skilful hands, lends itself to the production of *tours de force.* The wood-carver's method of cutting with gouges leaves the trace of the tool on modelled surfaces to a greater or lesser degree, according to the vigour and spontaneity of his work.

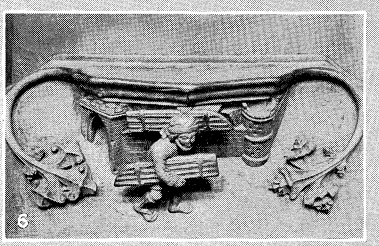
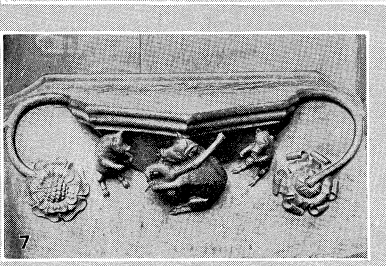
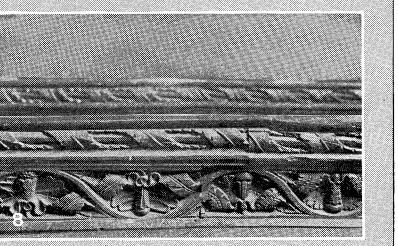
The Renaissance.—The wood-carving of the Renaissance was chiefly in walnut, and is best understood if it be realized that the structural design of the woodwork was reminiscent of building and that structural features such as pilasters, capitals, etc., were employed decoratively. Further, the Renaissance being in essence the revival of classic *motifs,* familiarized by ancient examples in marble, which material was especially understood in Italy, it is not surprising that much of the work lacks a distinctive wood-like effect. Nevertheless the release from the domination of the middle ages with their limited symbolism brought a freedom and vitality into design that made the Italian carving the inspiration of the greater part of Europe for many centuries, and the inventiveness and opulence displayed have never been excelled or rarely equalled elsewhere. Its *motifs* taken freely from nature and treated naturalistically to an extent unknown in the classic prototypes on which the Renaissance was founded, were combined with arabesques, woven into designs by means of sinuous and scroll movements, and modelled to produce to the utmost a play of light and shade.

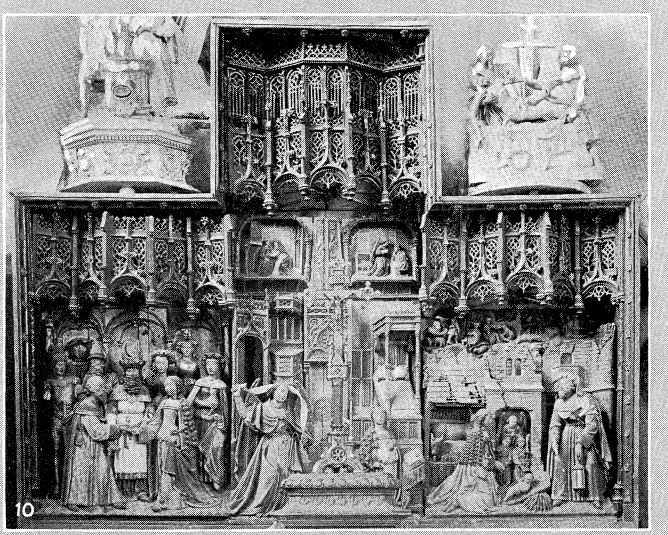
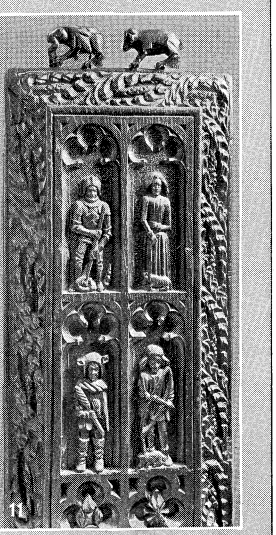
Towards the end of the 15th century, France felt the inspiration of the Renaissance. It was there welcomed avidly by the carvers, who had the Gothic insight to a degree never attained by the Italians. Perhaps the highest beauty achieved by the Renaissance was in the admixture of the new details and Gothic structure, so common in France, suggesting that it is during transitional periods in art that man is most vital and creative. The French understood the treatment of wood and, although sometimes over-lavish and small in detail, their technique was easy and unsophisticated, and in the designs of the best examples provision was made freely for surfaces broad enough to display the grain and beauty of the wood. A characteristic example of the period are the doors of St. Maclou, Rouen, which are attributed to Jean Gougon and if this work be compared with much of the stonework of the time it would appear that stone was influenced by wood.

The work of nearly the whole of Europe was gradually influenced by Italy either directly or through an intervening country. The influence was too vital to incite mere reproduction, even had the means existed to make this possible, so that, except where the craftsman was imported, the expression of Renaissance ideas in each country had its distinctive idiom. The Plateresque of Spain is noteworthy for the exceptional profusion





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GOTHIC WOOD-CARVING

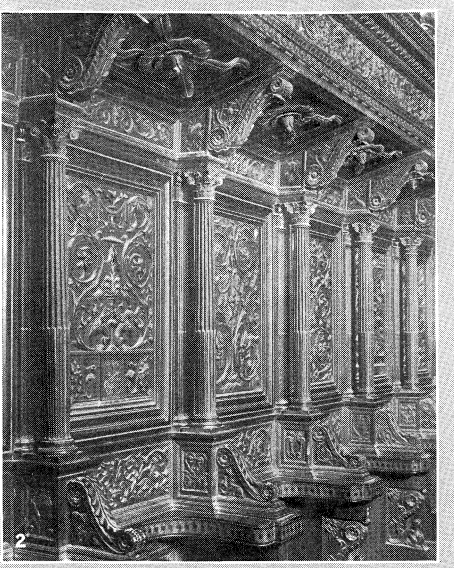
1. Chair of the 9th or 10th century, from Tydalen, Norway, an example of the earliest type of extant wood-carving
2. Miserere seat of conventionalized foliage with writhing dragons, from the Priory church of Christ Church, Hampshire, early 13th century. The miserere or misericord, a projection on the under side of a hinged stall seat for giving support to a standing person, afforded a rich field to the ingenuity of the Gothic carver
3. Emblems of St. John and St. Matthew, 15th century applied carving
4. Corner post from a house in Bury St. Edmunds, ornamented with tracery and the family arms; 2nd quarter of the 16th century
5. Fleur-de-lis poppy-head, or finial of a bench end, Walpole St. Peter, Norfolk, 15th century
6. Miserere seat in Ripon cathedral, Yorkshire, 1490, showing Samson carrying away the gates of Gaza. As in the case with most Old Testament subjects employed by the mediaeval wood-carver, the story is symbolical of events in the New Testament, Samson representing Christ rising from the tomb
7. Pigs and bagpipes, a miserere seat in Ripon cathedral, 1490, one of many satires in wood directed against minstrelsy
8. Pew railing from Dennington church, Suffolk, late 15th century
9. Square "ship" bench end, church of East Budleigh, Devonshire, 1537
10. Reredos in St. Paul's church at Abbeville, France, showing the lace-like effect characteristic of French carving
11. Square bench end from the church of Combe-in-Teignhead, Devonshire, carved with niched figures representing Sts. George, Agnes, Genest (in fool's cap and bells) and Hubert, 15th or 16th century

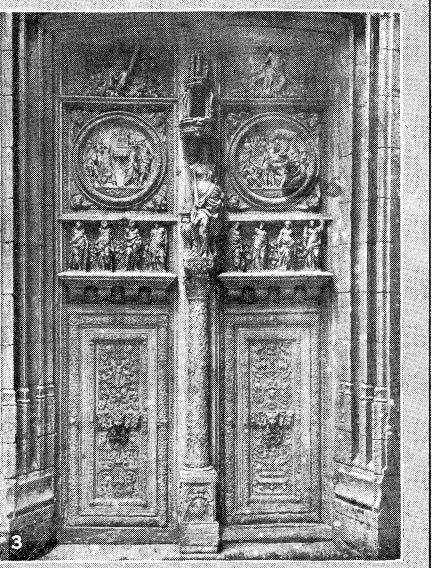
WOOD-CARVING

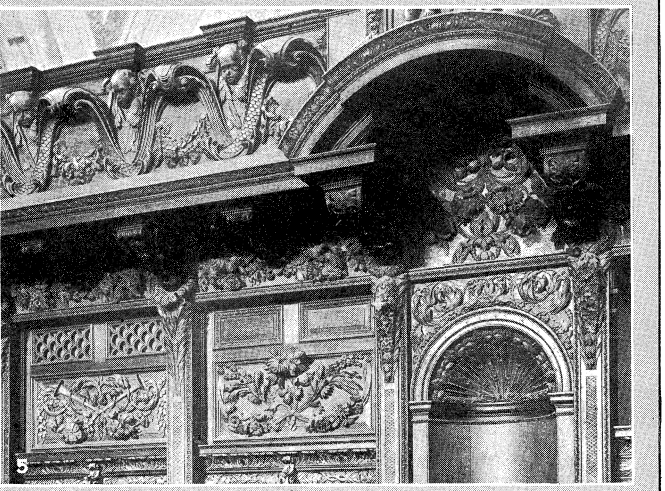
PHOTOGRAPHS, COLLECTION ARCHIVES PHOTOGRAPHIQUES

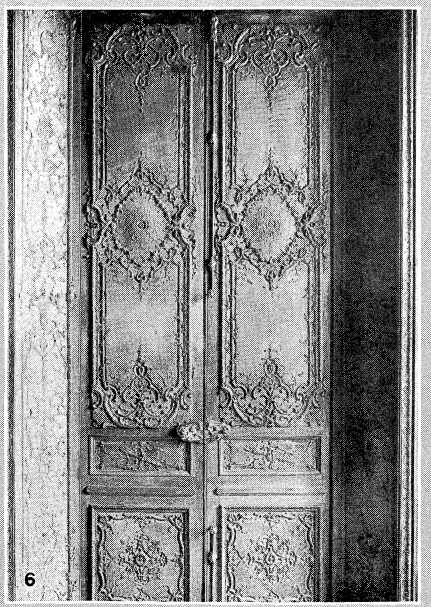
EXAMPLES OF GOTHIC CARVING

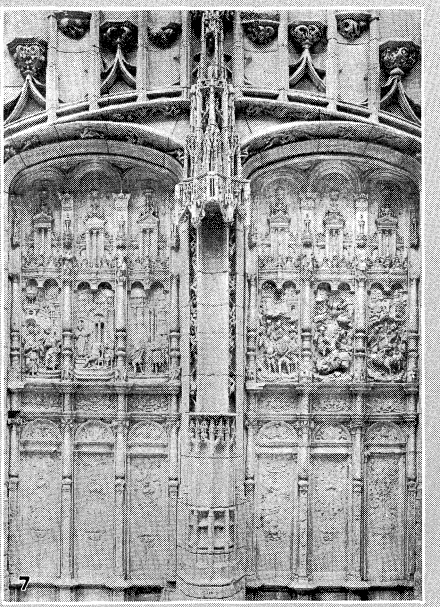
Carved wood portal of Beauvais Cathedral, Beauvais, France. Most of the foliage carving is expressed by use of the gouge (composed of broad hollows). Photograph shows the delicate lace-like effect often found in French carving

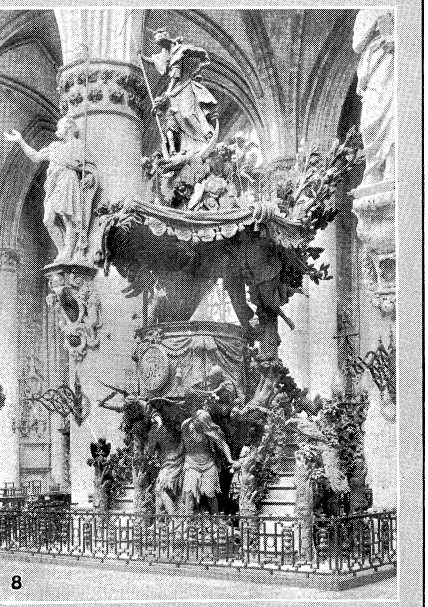












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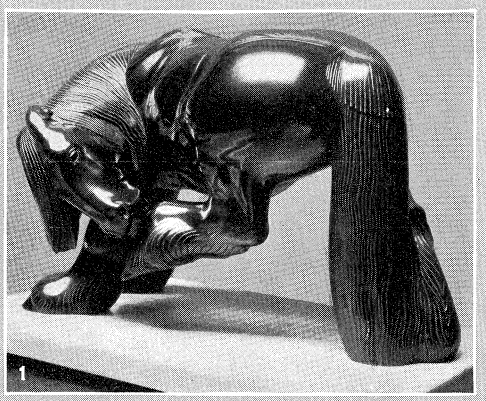
EXAMPLES OF EUROPEAN WOOD-CARVING

1. Choir stalls (1499), Church of Sta Maria in Organo, Verona. 2. Choir stalls (1535), Church of S. Pietro dei Cassinensi, Perugia. 3, 4. North transept door, Church of St. Maclou, Rouen. 5. Stalls north side, Mayor's seat (1697), by Grinling Gibbons (1648–1720). In St. Paul's cathedral, London. 6. Door of the boudoir of Marie Antoinette, Château de Rambouillet. 7. Sixteenth century panels in Beauvais cathedral. 8. Pulpit by Fredrik F. Verbruggen (1655–1724), Church of Ste Gudule, Brussels

WOOD-CARVING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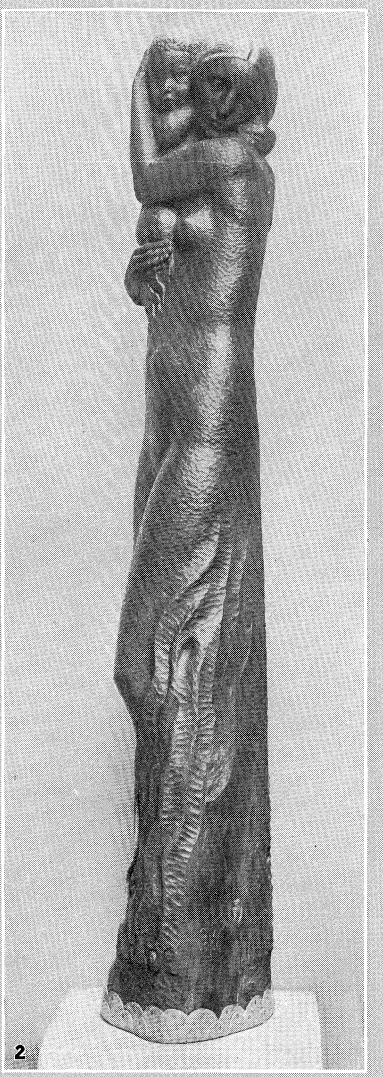
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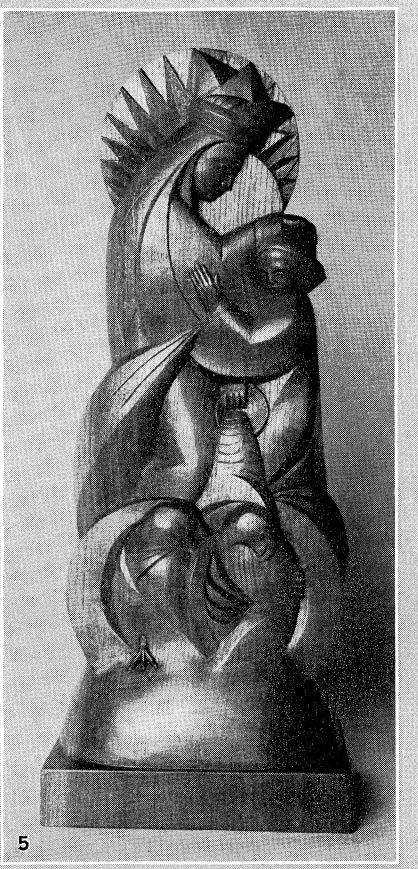
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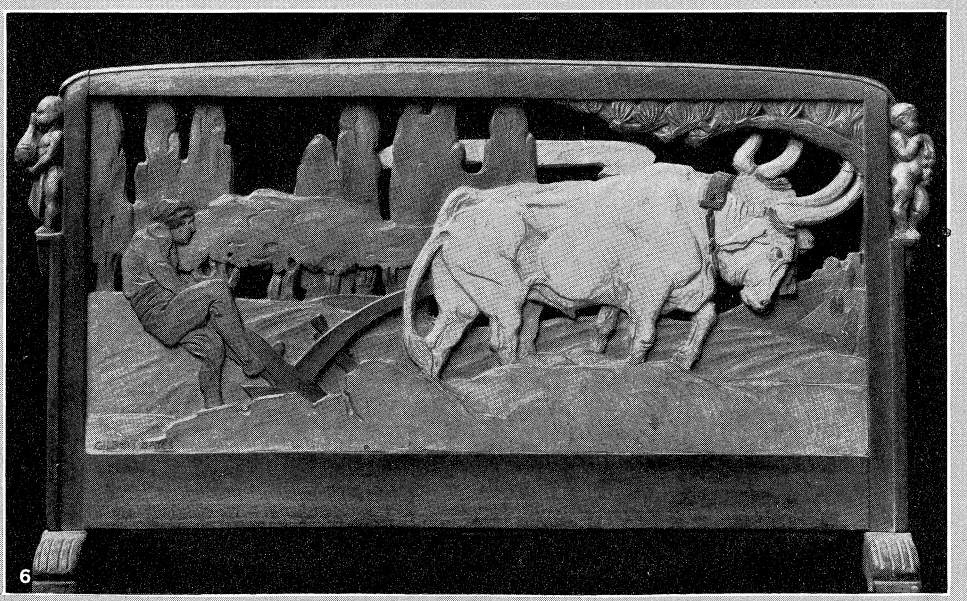
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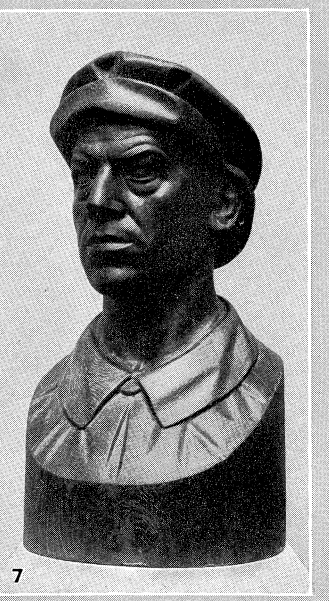
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EXAMPLES OF MODERN WOOD-CARVING

1. "Black Mare," carved in mahogany and lacquered black by William G. Simmonds. 2. "Mother and Child," carved in limewood by Charles Wheeler. 3. "Panther" by Eugene Borga. Illustrates modern trend in one type of wood-carving. 4. "Albigensian Woman Resting," by Jean Tirefort. 5. "Madonna" by a pupil of Professor Brzega, a typical example of modern semi-geometric wood carving. 6. "Oxen of Siena," a carved wood panel pierced, painted and gilded by Gilbert Bayes. 7. "Self-portrait" by Jens Lund, an example of the Danish style of wood carving

of small surface detail, sometimes of great refinement. In Germany, the Netherlands and England the Renaissance carving is associated with the development of strapwork, in some examples of which it scrolls vigorously while in others groups of fruit, grotesque masks and figures sculptured in high relief, enrich it. At a later date the Baroque carving of large figures was in Germany more remarkable for skill than taste and in Italy for wildness in its application to its architectural setting. Of great interest to the wood-carver as further examples of his art when uncontrolled by architectural considerations are a number of the pulpits of Belgium. That by Verbruggen, 1699, in St. Gudule, Brussels, is the most extravagant of the school and it was not improved by the addition of the elaborate railing in 1780.

The Eighteenth Century.—The most radical change in style after the Renaissance was the so-called Rococo (*q.v.*) of the reigns of Louis XIV. and XV. It reflects the artificiality and extravagance of its time and is distinguished by its arrangements of "C" scrolls and attenuated foliage for structural as well as decorative purposes, and for the substitution of richly ornamented broken curved movements for straight horizontal lines. Its draftsmanship is superb, and for effect it relies upon the perfect technique of its somewhat fantastic designs.

The inception of the 18th century in England, which is singularly remarkable for the fertility of its designers and carvers, witnessed the development of the art of Grinling Gibbons who fashioned wood with a freedom and delicacy unprecedented. His work has provoked controversy as to the suitability of wood for masses of fruit and flowers in such high relief and so freely undercut. The preservation of his work, in spite of the ravages of the wood-worm justifies the apparent liberties he took with his material and his freedom from the shackles of tradition; the variety of his designs and his sense of decoration proclaim him a great artist and craftsman. His most restrained work and probably his best, was done in association with Sir Christopher Wren for the choir of St. Paul's cathedral, London.

The effects of the French Rococo were disastrous everywhere. In Italy and Germany the character of the style was interpreted with a crudeness that almost amounted to a burlesque; and only in England, notably in the hands of Chippendale, were its suggestions controlled by refinement and discretion. The swing of the pendulum led to the production of the ornament of Louis XVI. in France, Biedermeyer in Germany, and the Adams brothers in England. These styles were a return to more severe classic ideals, and the enrichments involved the repetition of small patterns and *motifs* that had been exhausted in the past.

Decline of Wood-carving.—Since the end of the 18th century, wood-carving all over Europe and America has been almost confined to the reproduction of the styles of the past without any regard for nationality or the expression of individuality. *L'art nouveau* of France towards the close of the 19th century had its repercussions elsewhere but passed away rapidly because its tones were untrue to material; its wood-carving conveying the impression of metal or modelled clay. The carver works with the architect and furniture designer, and the tendencies of modern Europe influencing these in the direction of simplicity of structure and effect, his art has languished. In Scandinavia, where modern architecture is achieving triumphs, it is exceptional for carved wood to be employed as decoration.

In America the wood-carver has not produced anything national but there, as in Europe, are signs of activity and impending fruition. He is producing *objets d'art* and entering the domain of sculpture, hitherto almost monopolized by bronze and marble; and in harmony with the modern spirit in decoration which is rediscovering the nature of materials that may be fashioned artistically, he is using woods which have been carved rarely in the past, because of their grains and markings, and carving them with the partial object of bringing out these peculiar features. The general tendency is towards severe conventions, economy of method and occasional colouring, but is otherwise too individual to be categoried. The greatest encouragement is being given to this work in Germany and Czecho-Slovakia but there the animating motive is derived from a revolt against pre-war ideals and consequently, being largely a negative impulse, it would be devoid of promise but for the stimulating and modifying influences which in modern times circulate internationally.

(H. H. G.)

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WOODCHUCK (*Marmota monax*), a North American rodent, called also ground-hog or American marmot, found from Nova Scotia to British Columbia and Alaska and in the United States from North Dakota south to Oklahoma and eastward to the Atlantic. It is usually about 20 in. long, brownish or reddish gray in colour, with a heavy-set body, short tail, and strong claws adapted for digging. The woodchuck lives in burrows in the ground or in piles of rock, feeding upon grass and other vegetation.

(*See* GROUND-HOG DAY; MARMOT.)

WOODCOCK, a succulent game bird, in the family Scolopacidae, highly prized by sportsmen and epicures, famous for its erratic, whistling flight. It is chunky, short in neck and leg, and lives in wooded bottomlands and wet uplands. The sensitive, movable tip of the long bill is used to punch "borings" and probe for earthworms in moist earth. One American bird, weighing six ounces, ate half a pound of worms in 24 hours.

Large eyes are set high forward in the large head, and the bird is usually crepuscular or nocturnal. During bright daylight it sits close in brush, where its mottled brown plumage conceals it against dead leaves or nest. Three blackish bands across the pale buff rear-crown distinguish woodcocks from snipe.

The sky dance is a remarkable courtship flight. With loud cries, usually at dawn, the male spirals over a wide area, high into the air, and zigzags back to earth. Four buff eggs, blotched with brown, are laid—February to May in America, March to August in Europe—in a slight hollow in the ground, and incubated for 21 days. Downy young are carried in flight to the feeding ground, or removed from danger, between the mother's thighs. Reluctant to leave the nest, the mother feigns injury to mislead intruders.

The American woodcock (*Philohela minor*), 11 in. long, breeds from Nova Scotia to Florida, and Manitoba to Louisiana and Colorado, wintering in the southern half of its range. The European species (*Scolopax rusticola*), 14 in. long, breeds from Ireland to Japan, from the Arctic circle to the Azores and Canaries, Pyrenees, Alps and Himalayas; it winters to North Africa, Ceylon and southern China, and occurs occasionally from Labrador to Virginia. A smaller, darker species (*S. saturata*) is found in the mountains of Sumatra, Java and New Guinea, while local species occur in the Celebes (*S. celebensis*) and on Obi in the Moluccas (*S. rochussenii*).

(G. F. Ss.)

WOODCRAFT. Woodcraft is the knowledge of the wilderness conditions which enables one to enjoy and supply oneself with the crude necessities and comforts of life in unsettled and uninhabited areas, be it forest or prairie, mountain or swamp, lakeland or desert.

Primitive man has always had to deal with nature in order to exist. However, it took centuries to bring knowledge of woodcraft to a point where it embraced comforts as well as necessities. The particulars of woodcraft vary with each country and area, but the requisites are always the same, good eyesight and hearing, good judgment and patience.

The first white settlers of North America learned much from the Indians who were masters of woodcraft. Life itself was a matter of woodcraft to the Indian, as it still is to many savage and semisavage people in Africa, South America, and the South Pacific islands.

One versed in woodcraft will have sufficient knowledge of mechanics and craftsmanship to enable him to improvise tools, weapons, shelters and clothing; to make rafts and to construct canoes of birch bark or skins. He will know the value of fire, and what can be done with it. For the dry wood or bark which is needed for his fire he will break dry branches from trees rather than use those found on the ground, or he will look for it in hollow logs or trees. He knows that resinous woods produce smoke while dry, non-resinous woods usually do not. For a quick fire the woodsman will use soft woods such as poplar or pine; for a hot fire such hard woods as oak, hickory or maple; and on his night fire he will use green logs since they will burn slower and keep a fire longer than dry logs. In rainy weather he often carries enough dry wood or birch bark in his pack to start a fire, and he dries out wood at each fire to carry with him to his next stopping place and he always carries extra matches in a waterproof match box. The woodsman never builds a fire without first clearing away all brush and inflammable matter to prevent a forest or grass fire and he always kills his fire before leaving it.

Woodcraft is the knowledge of where to find water fit to drink. The old timer knows that springs can often be found in low places or at the bases of hills and that they are as a rule safe to drink from, as are also swift-flowing streams away from human habitation. Many a woodsman in swampy country quenches his thirst by cutting off grapevines and drinking the sap as it drips from the ends. The desert prospector, on the other hand, will when necessary drink the water that is found in certain cactus: he will never drink alkali water or salty water, and when in doubt he knows that 10 or 15 minutes of boiling will make any but salt or alkali water fit for drinking or cooking.

The woodsman knows which berries and wild fruits are edible and will not eat those he knows nothing about. He knows that fresh greens are a necessary addition to a meat diet, and that he can eat young stalks of milkweed, burdock and Solomon's-seal when they are boiled. He will eat roots of bulrushes also, when boiled, and young shoots of dandelion, dock, sorrel, wild mustard and watercress without cooking. He knows how to build caches of stone or poles to keep his food and belongings out of the reach of wild animals. The expert in woodcraft knows how to read signs—that is, he can tell by telltale marks what animals have passed along a trail. He knows the marks left on trees by bear claws, raccoon or squirrel claws, and deer horns. He knows the footprints of animals and birds, and he can tell that a bit of fur on the bark of a tree or twig has come from a bear or a deer, or a feather from a partridge or a blue jay.

He knows how to make cord and rope of basswood, elm, or cedar bark, strong enough to lash things together when nails are lacking. He is able to build a rainproof lean-to shelter with a few poles and a blanket or some brush. Here, in the reflected heat of a fire built a few feet from its open side, he can be comfortably warm in cold weather. The woodsman knows too that it is warmer sleeping on fir branches or dry grass on the ground than a raised platform or cot under which cold draughts circulate.

The true woodsman is seldom lost. If he hasn't the faculty of knowing directions at all times, he does know that moss usually grows thicker on the north side of a tree, providing the tree is not in a damp shady spot or in a densely wooded place. He can also, by chopping into the sides of a tree, find by careful observation which side has the thickest bark; this side, he knows, is north, but he will understand that he must check his observations on several trees. He also knows that the two stars at the end of the bowl farthest away from the handle in the Great Dipper point upward to the north star.

Woodcraft then, may be said to be a match of wits with nature, an attempt to be one jump ahead of it or at least to meet it on even terms. Today, with many, woodcraft is a hobby. The study of nature is interesting and instructive. Woodcraft is taught in camps and schools to enable children better to enjoy the wonders and beauties of nature. It is taught in both scientific and practical form to men and boys entering the forestry service, so that they can help in the preservation of forests and wild life. The knowledge of woodcraft can take one back 100 years, to enjoy simple life in the open; to see and learn the beauties and mysteries of nature and to make use of the materials nature has so graciously furnished. To know how to live close to nature, in friendship and understanding with it—that is woodcraft.

(W. B. Ht.)

WOODCUTS AND WOOD-ENGRAVING. To-day the woodcut is used as a direct expression of artists who themselves cut and print the block. During the greater part of its history the medium has been used quite differently. It has been a reproductive process; a craft rather than an art. Craftsmen have cut out of the block drawings made for the purpose by artists and then passed the block to other craftsmen for printing. This is comparable to our photo-engraving reproductive process—the difference being that the older method was done by hand whereas the present one is mechanical. In both cases the method was merely a means to an end and quite detached from the original conceptions of the artists involved. In making drawings for reproduction, either by woodcut or photo-engraving, artists are thinking in terms of ink or pencil lines on paper—not of lines which their hands are carving out of wood. A work so detached from its medium does not exploit the peculiar quality of that medium. It lacks unity and completeness. It loses force. For some ten centuries of its known history the woodcut, as a process, has been so handicapped. Only during the last thirty or forty years has it arrived at what might be called its full functioning maturity.

TECHNICAL PROCESSES

Technically speaking the woodcut is pictorial type. It prints pictures as type prints letters of the alphabet, by raised lines or areas that catch ink from a roller and deposit it on paper under moderate and more or less even pressure. This analogy roots in history as well as fact. The first printed letters were woodcut type carved into pictorial woodcut blocks in explanation of the picture. The first movable type was a cutting up of this block type in order to save labour by rearrangement and re-using. The woodcut raised line is the opposite of the intaglio, or sunken line, which is etched or engraved on copper. (*See* INTAGLIO.) In the print etched or engraved lines catch the light and cast minute shadows, thus giving a life or sparkle to the work that is impossible with any other mediums. The woodcut gives a flat surface print, with an interplay of solid black and white, and a slightly varying texture and intensity that is quite unique.

The raised line of the woodcut is simply a part of the original untouched surface of a block or plank of wood; if no cutting away were done the print from this block would be solid black. Each stroke of the tool removes a section of the ink-holding surface, thus preventing its printing and letting the white of the unprinted paper into the black of the printed. Like the world at dawn, the woodcut-picture actually emerges from blackness into light.

There are two kinds of woodcuts, the black line and the white line. The black line, or woodcut proper, is one for which a drawing is made on the block and all spaces between lines gouged out or cut away. In other words a black line drawing is reproduced in approximate (but never complete) facsimile. The black lines are conscious lines. The white lines or spaces are left-overs which receive either secondary or no consideration *per se*. In the white line cut, or engraving, the reverse holds; the white line that is gouged out will receive first attention, the black lines and spaces between, second. In the first case the artist conceives his drawing as starting with white paper and growing towards black; in the second as emerging from black into light, as in actual fact it does. Both systems have their advantages but the second, or white line, being the natural method, because it makes a positive instead of a negative use of each gouge or cut, would seem to be the most logical.

Cutting the Block.—The black line cut is ordinarily made on a plank or block of soft wood like beech, apple, pear, cherry, sycamore or whitewood cut parallel to the grain as in ordinary lumber. Preferably it is of type height (about $\frac{7}{8}$ in. as shown in fig. 2), planed and sanded to a perfectly smooth and level surface, and cut with a sharp knife. An ordinary pen knife will serve as a makeshift, but the carver (fig. 1) set in a cord-wrapped handle

is better. The knife makes a sloping cut which tapers upward along each side of each line, thus supporting the line on a widened base (as shown in fig. 2).

When two lines are close together and parallel the sloping cuts on adjacent sides of each would remove a V-section between them. This V-cut can be made with one stroke instead of two by using the "V" or parting tool shown in fig. 1. Larger areas are

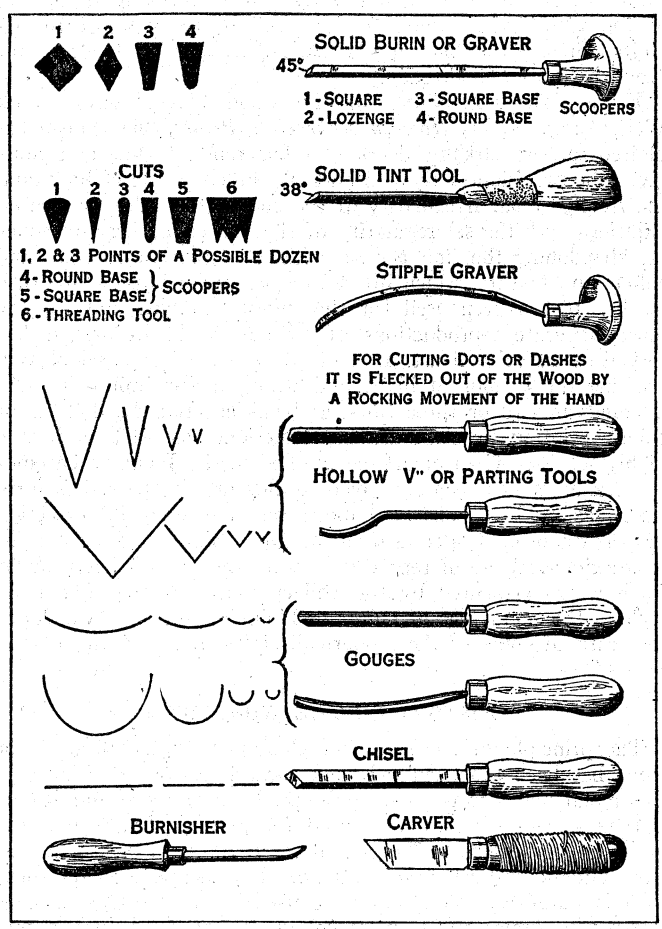


FIG. 1.—TYPES OF TOOLS USED IN WOOD ENGRAVING, AND SHAPES OF CUTS

removed with gouges of varying widths and depths (fig. 1). The method requires, as is readily seen, two or more cuts to release a single black line—two if the lines are in a parallel and close-together series, four if a line is segregated, and anywhere up to eight if the lines are cross-hatched. (*See* A, B, and C, respectively, fig. 2.) Laborious, round-about, forced—such is the reproductive black-line method.

The white line is engraved, rather than cut, into the end-grain of very fine hard wood, usually box-wood. The box-wood blocks are about $\frac{7}{8}$ in. high and across the grain. Into this hard fine grain lines are gouged out with hollow V- or U-shaped parting tools or gouges, or with solid metal burins or scoopers. All these tools are shown in their varying widths, depths and shapes in fig. 1. The burins, tint-tools and scoopers are held in the palm of the hand and pushed forward; the threading tool cuts several lines at once. The knife in cutting is pulled toward the body and may be held somewhat as a pencil is, or grasped as one would grasp a dagger. Chisels may be pushed by the hand or hit with a wooden mallet. In the process of cutting, the block is held on a leather bag filled with sand.

The left hand holds and turns the block easily against the pressure of the cutting tool in the right.

Fundamentally, the methods of the white and the black line woodcuts are the same in the actual technical process and the ultimate end achieved. In the black line cut the cutter is conscious only of the black lines he is reproducing; in the white line engraving he is exploiting the white lines, at the same time being fully conscious of the blacks by which he must obtain the whites. Xylography is a general title that covers both methods.

In etching and pencil drawing (*qq.v.*) the point glides easily over a smooth surface, flexibility and freedom being the consequent result. In copper-plate and wood-engraving there is resistance to a cutting tool which must be forced through resisting material. This tends to give a certain directness and rigidity to all lines, straight and curved. A slow uniformly changing curve would be more natural than a jerky, hectic, quickly curving one. The medium, therefore, lends itself to an abstract quality peculiarly adapted to contemporary creative expression. This adaptability, no doubt, explains the preponderance of woodcuts among the so-called "modern" works in prints.

Artists of Western civilization, it is interesting to note, have never made use of the potentially different characteristics inherent in lines of different types as have the artists of Japan and China. In Japanese art, for instance, there are the eighteen types of lines varying from stiff wiry ones expressing the starched garments of court nobles to the jagged ones expressing the rags of beggars. Among Western woodcutters, John J. A. Murphy has probably canvassed such possibilities more thoroughly than any other artist.

Drawing on Block.—There are a number of ways of drawing on the block. For a black line cut the drawing to be reproduced can be made with India ink, or Chinese black, with corrections in Chinese white. For a white line-cut the simplest and most flexible method, in that it allows erasing as easily as on paper, is with a lead pencil. The pencil drawing can be fully developed and then translated into white lines as the cutting proceeds. When mechanical exactness is required the subject can be photographed directly on a block prepared by the proper sensitizing of its surface. Photographs or wash drawings on the block have been commonly used during the latter part of the reproductive period—*i.e.*, up to the end of the last century. Timothy Cole, for instance, so photographed his subjects onto his block and then proceeded to interpret the photograph into white lines.

Printing.—Woodcut printing is of two kinds, black and colour, and may be done either by hand or on a regular type-printing press. For black printing the finest obtainable quality of proving ink ground in oil is used. The ink is spread on a glass or marble slab with a special composition hand-roller (of the same type as used in printing presses). After a thorough working onto the

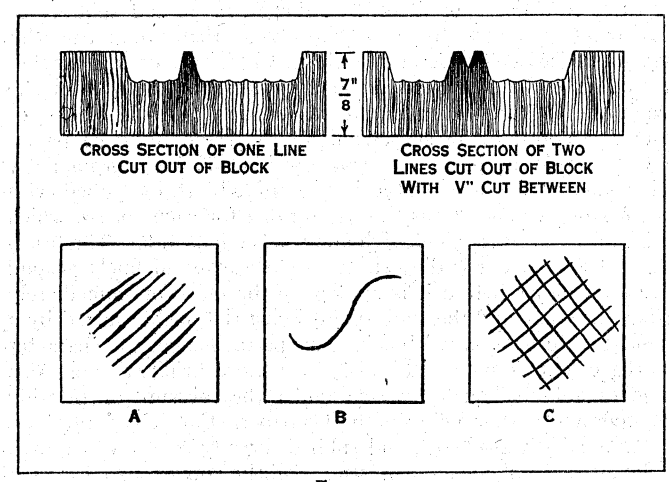


FIG. 2

roller in a uniform and exceedingly thin layer the ink is transferred to the surface of the block by several movements of the roller across the block in different directions. The paper may be India in several textures or soft hand-made Japanese such as the Gifu. Or it can be the less enduring machine-made domestic in many varieties. The India is adapted to the white line engraving, the harder textures to the finer lined blocks; the Japanese and domestic to the coarser lined blocks.

In the case of a hand print, the right sized sheet is laid over the inked block and pressed down with a sheet of cardboard. A second

cardboard coated with beeswax to make it slide easily, a steel burnisher, as in fig. 1, or a Japanese baren, is then rubbed over the first with considerable pressure which will vary in different sections of the block as the nature of the work demands. Less pressure means greyer and less even blacks, more means blacker blacks. This flexible control of pressure by the printer allows a quality of varied tone and texture in the hand-made print that can never be rivalled by any other method. In distinguished printing of this character a single print will take from 15 minutes to 3 hours of printing time. Corners of the print may be lifted to test results during this hand process.

In the case of a machine print the block is mounted in a printing press like any type form and the print made with uniform pressure. This pressure, however, can be varied artificially by the same overlay and underlay system used in type printing. When darker blacks are required thin sheets of paper are cut to proper size and pasted to the proper spot under the block itself or on the tympan against which the paper lies, in a registered position. The thicker these are the heavier the pressure in that spot, the darker the resulting black and the greyer the surrounding blacks.

Colour Printing.—Colour printing may be done from one block or a series of blocks. When printed from one block the colours are painted with a brush into the desired section of the uncut surface as in the case of a monotype. Each print thus becomes an original painting which is transferred by pressure to paper. If the colour is to be in spots no lines are necessary except guide lines. It facilitates the process of painting the block if these guide lines are white lines gouged out of the block around separate patches of colour. In the print the white unprinted line becomes part of the decorative pattern, giving a hint of mosaic effect. This process could never be used for a realistic picture. A regular line block could of course be printed in colour instead of black, thus getting a different effect. When many blocks are used for one print we have the Japanese colour printing process undoubtedly the highest developed art of colour printing the world has so far produced. (*See* JAPANESE PAINTING AND PRINTS.)

In this process there is a key line block to be printed in black or any desired colour. Each succeeding block, then, prints one, or sometimes two or three well-separated (so they do not overlap in painting on the black) colours onto the same key-block print. The number of blocks so printed may run all the way from two or three to a dozen or fifteen, gaining in range and subtlety as the number increases. The blocks are larger than the actual print thus including an unprinted margin in which two sunken notches are cut into the block to take one corner and one edge of the paper and thus provide accurate registration. All the blocks, of course, are printed in succession on the same piece of paper.

Colour printing ink is made of any kind of finely ground dry ink colour mixed with water instead of oil. It is applied with brushes of varying widths, a separate one for each colour, which paint over the entire block high and low sections alike. The brush charged with colour is dipped into a paste made of finely ground rice flour either before it is applied to the block or immediately after, the paste and the water-paint being thoroughly mixed by a sufficient brushing on the block. This paste changes the character of the colour from a mat finish to a more brilliant one. Also it gives adhesive quality which under the pressure of printing incorporates it thoroughly with the paper. Carefully dampened paper is laid on the block and rubbed directly on the paper with a Japanese bamboo-covered, stiff, slightly convex pad called a baren. The amount of pressure that is used determines the intensity of the colour of the print. (*See* JAPANESE PAINTING AND PRINTS.)

Chiaroscuro (clear-obscure).—In Europe during the 16th century another type of colour printing developed called chiaroscuro. The method comprised two prints from two blocks on one paper. One was a usual black line print, which as a line picture was complete in itself. The other was a tone block to be printed as one solid ground-colour in sepia, soft warm grey or other colours from which certain spots were gouged out to leave significant white highlights in the print. The final result resembled the wash-drawings of the masters and undoubtedly came into use as a means of approximating their effect.

The method is said to have been invented by Jobst de Negker at Augsburg. In Germany Hans Baldung Grien (1475–1552), Lucas Cranach (1472–1553) and Burgkmair (1473–1531) were among the first to practice it. In Italy Ugo da Carpi who worked in Venice and whose first print was dated 1518 was its foremost exponent. After dying out it was revived in Germany at the end of the 18th century and has persisted to the present. In the United States Rudolph Ruzicka, A. Allen Lewis and others are practising the method today.

Uses.—"The possibilities of the wood block," says Frank Weitenkampf in his *How to Appreciate Prints,* "have been exploited to a remarkable degree. It has rendered line and tone, given the precision of the pen and ink sketch or the etching, and the free, granular irregularity of the charcoal smudge, translated paintings with the set regularity of the line engraving on copper or, abandoning the line *per se,* with an attention to tone and colour and texture, which often gave even the illusion of brush marks. It has been used for the rudest handbills and for the most elaborate reproductions of famous works of art; it has served as an original art, as a direct means of expression, and, crossing the bounds of black and white, it has imitated wash-drawings in two or three tints, and has entered the domain of colour printing in elaborate reproductions, as well as in the highly sensitive form of art exemplified in the Japanese chromo-xylograph. It has been employed to illustrate in the rudest form the songs and ballads hawked about the streets, and in perfection of craftsmanship works such as the Doré Bible; it has been put to the practical use of reproducing wallpaper, and it has brought forth works treasured by the collector, though so different in style as the engravings of Dürer or Holbein, and those which are the work of some of the modern disciples of art in the United States."

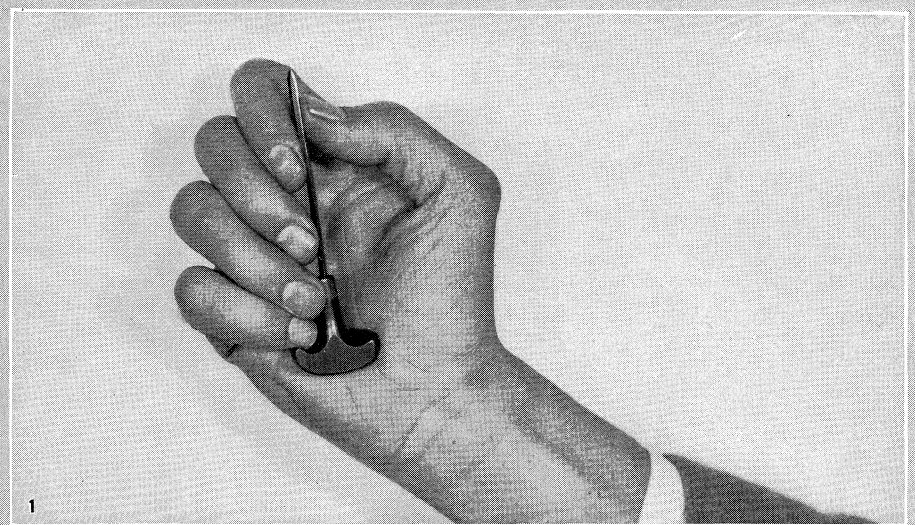
HISTORY OF THE WOODCUT

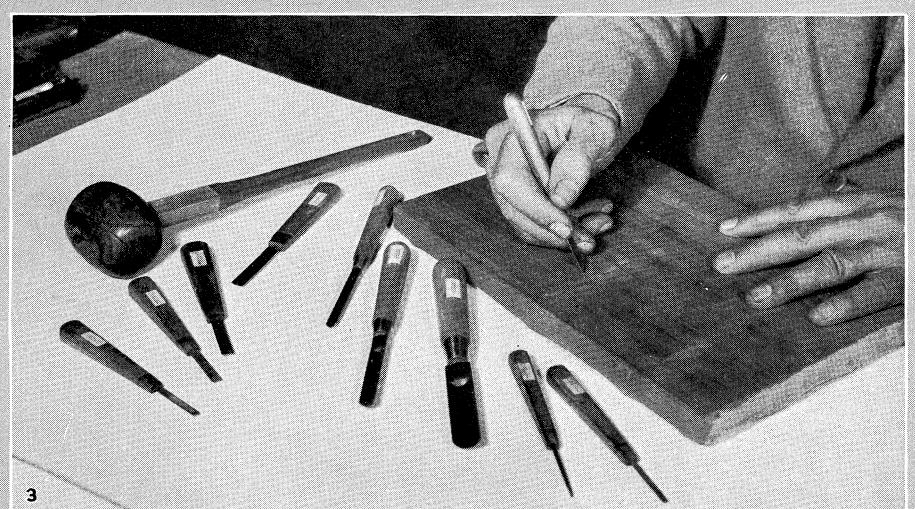
The principle of cutting relief characters in metal, wood or stone has been practised far back toward the dawn of history. Cut metal plates were used in Egypt, India, Greece and Rome. Carved stamps or dyes were used for pressing letters into the moist clay of bricks in Egypt and for branding slaves in Rome. Both intaglio and relief carvings were known and used for these various purposes. Woodcuts were used in the Middle Ages to stamp monograms and to print colour designs on textiles, a custom practised in the Orient from time immemorial.

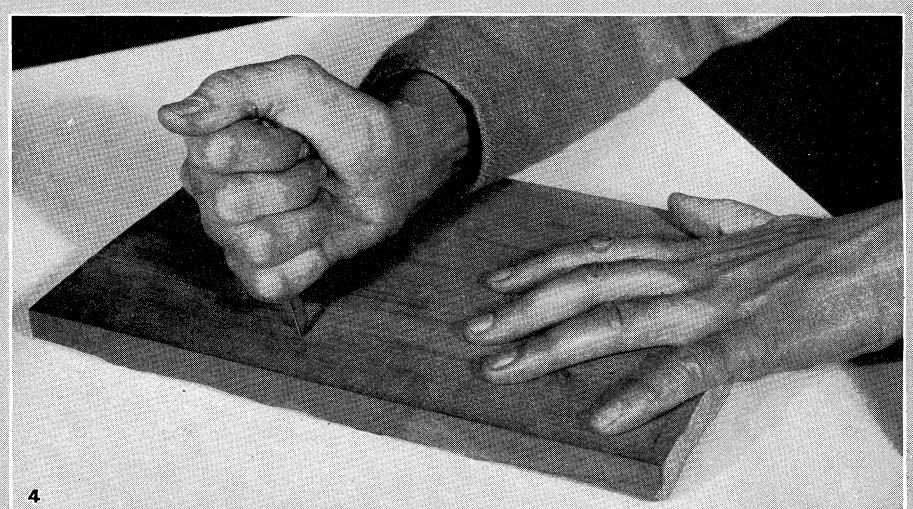
The earliest prints on paper so far found come from China of the T'ang dynasty (A.D. 618–905) when woodcuts in one colour were produced in great quantities as cheap substitutes for religious paintings. The oldest of such cuts now known is dated A.D. 868 and was found by Sir Aurel Stein in 1907 in the caves of a thousand Buddhas at Tun-huang in Chinese Turkistan. Throughout their history in China no artist of any note designed expressly for the woodcut. Even when the complex colour printing from many blocks came into use, beginning, so far as is known, about the time that colour printing began in the Chiaroscuro prints of Europe, *i.e.,* in the 17th century, this medium was used by craftsmen for the reproduction of paintings. The earliest known Chinese colour print is from a book called "Shih chu chai Shu hua p'u" and is dated 1625.

The method spread to Japan in the 8th century and for a long time was confined to reproducing popular religious figures. In Japan, however, there arose a whole school of artists who, though like the Chinese, still valuing painting as the supreme medium, did design expressly for the woodcut, thus conceiving their designs in terms of the carved line and colour block. The best of these were masters of the first rank.

For the greater part of their entire history, then, particularly as a reproductive process, woodcuts have been a widely used pictorial medium. Cheap in price, printed in quantity, close to the hearts and minds of common people in their choice of subject and story, they were used not as the collectors' items they have become today, but in every home as part of the furniture of actual life.







THE PROCESS OF WOOD-ENGRAVING

1. Correct position of the burin for engraving on wood. The knuckles of the hand should rest on the block. Tool should be pushed forward or backward by a contracting of the palm
2. Engraving into the hard end grain of a box-wood block with the burin. Various shaped burins and tools are on the table. Note leather cushion for holding block steady
3. Holding knife for cutting on the flat side of a plank block. On the table are various shaped gouges and flat chisels used for removing large or small areas of wood
4. Cutting a block of wood with the knife held in the sloping position. This gives a widened base to each black line left raised above the cut away portion

WOODCUTS AND WOOD-ENGRAVING

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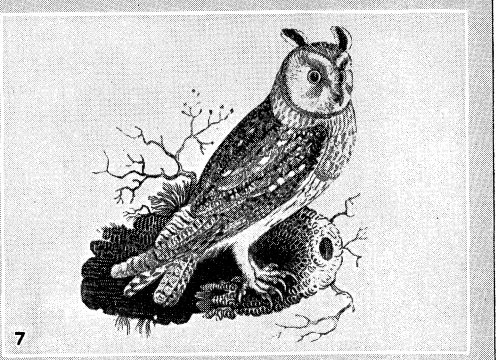

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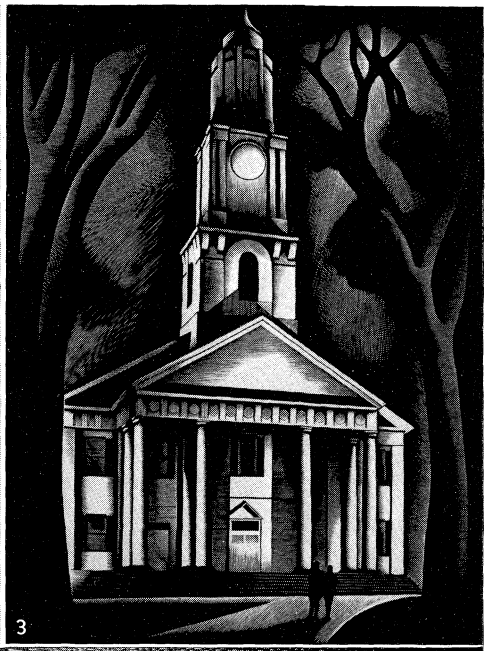
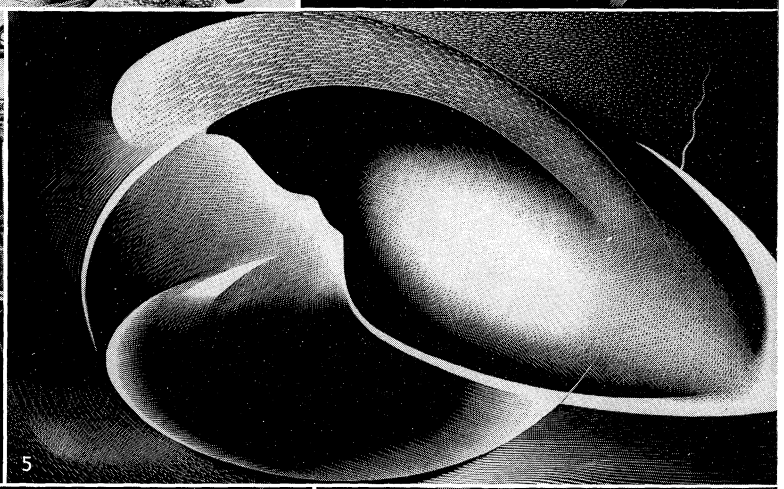
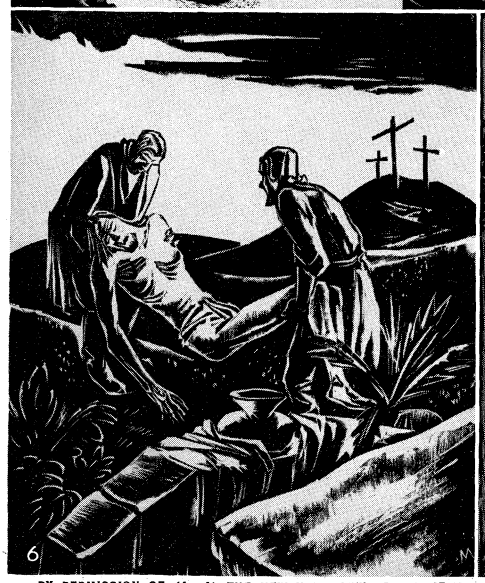
EARLY WOODCUTS

1. "The Buxheim St. Christopher," from a facsimile reproduced by the American Institute of Graphic Arts; earliest dated woodcut in Europe, made 1423. 2. Early Florentine woodcut. 3. Woodcut from Hans Holbein's "Dance of Death" series. 4. "Crucifixion" by Albrecht Dürer. 5. Frontispiece to Breydenbach's "Pilgrimage to Jerusalem," 1486. First known woodcut in which cross-hatching was used. 6. Print made about 1560, typical of the decorative Italian style. 7. A woodcut of an owl from an illustration in Thomas Bewick's "History of British Birds," published in 1825. 8. White line woodcut by William Blake, one of the first woodcuts to have the qualities of the modern art







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CONTEMPORARY WOODCUTS

1. "Drummer," by Fred Becker (1913–), American
2. From the book of wood-engravings, *Prelude to a Million Years,* by Lynd Ward (1905–), American
3. "New England Church," by Howard Cook (1901–), American
4. "Military Escort," by Fritz Eichenberg (1901–), German artist living in America
5. "Allegro," by Paul Landacre (1893–), American
6. "Grablegung Christi," by Hans Alexander Mueller (1888–), German artist living in America
7. "Emigrants," illustration by Allen Lewis (1873–), American, from *Calico Bush,* by Rachel Field
8. "Still Life with Flowers," by Emil Ganso (1895–), American

They were looked at, studied, talked about, absorbed. They took the part of picture books when books were still the hand-lettered creations of monks, chained to the "library" tables of churches and kings. They were books in embryo, in fact.

In the religious cuts (and in the beginning practically all were religious) the people could see the characters of the Christian drama intimately in a form different from but related to the great paintings in the churches. Brief printed captions began to appear beneath the pictures telling the story of their heroes. These cut into the block were the first type. Later, about 1436, when Gutenberg invented printing, cut into separate letters, they became the first movable type. When the printing of books began the woodcut inevitably became the means of illustration. Being pictorial type it went with letter-press type. In fact the harmony between text and illustration of the 15th and 16th centuries has never since been equalled in general practice. So right was the combination that even when, in the 18th century, taste ran to the greater elegance of copper plate engraving and the almost total abandonment of the woodcut, the latter still kept alive in incredibly rude form in chap books and other popular literature. It carried over in fact to the revival in the 19th century when again it became the main medium of illustration in press and books. Memory in this country can easily go back to its general use in magazines and elsewhere. The form was decadent as it gradually died out before the advance of the cheaper photo-engraving process, but it was still the medium of the people as it had always been. Taking its history as a whole through its great period in the 16th century, decline in the 17th, decay in the 18th and revival in the weakened form of the white line toned picture in the 19th, the woodcut is undoubtedly a close second to the book in the role of entertainer, instructor and guide to the human race in the last 500 years of its struggle toward its present civilization.

In Europe the earliest known woodcuts were playing-cards dating back to the beginning of the 15th century. Pictorial prints go back as far as 1410. The earliest dated pictorial print is generally (but not always) admitted to be the St. Christopher of 1423. It is simple, crude, and naïve. It was done with single lines, almost an outline drawing, for its full effect it, and practically all prints of its time, depended upon hand-colouring after the print was made.

From 1423 to 1490 the black line woodcut developed from a crude beginning through the block-books that immediately preceded type printing to a mastering of the medium that has not been surpassed in that department to this day. The block books originated in Germany and the Netherlands—the oldest ones being *Biblia Pauperum* (*c.* 1450) of German origin, and the *Apocalypse,* the *Canticum Canticorem* and *Biblia Pauperum* (*c.* 1470) of the Netherlands. Dürer's drawings on the block made from 1492 to 1526 and cut laboriously by craftsmen woodcarvers, were complex, sophisticated, varied in quality of line and texture, yet they attained this complexity with lines that were most natural to the medium, that avoided, except in the darkest shadows, the forced (in this medium) cross hatching of pen and ink drawings. Here, then, at the time that America was being discovered was a mature art in mediaeval Germany, which set the pace for other nations. The subjects were mostly religious.

Dürer (*q.v.*) was the first great master to use the woodcut extensively as a way of reproducing drawings made for it. Without attaining the unity of means and expression typical of today he refined and widened the process. He had many followers, among them the little masters Altdorfer, the Behams, Pencz and others who forgot the usual religious subjects to record, with a touch of un-German decorative quality learned from Italy, the labours, merriment or debauchery of the everyday life of their time. Influence flowed back and forth between Italy and Germany, Dürer influencing leading Italians like Marcantonio Raimondi (1480–1530), and vice versa. By 1490 in the north countries individual blocks were giving way to blocks cut for such newspapers of the day as the Nuremberg Chronicle of 1493 and for book illustrations. In Italy the art centred in book illustrations from the beginning. Lippmann, in his *Art of Wood Engraving in Italy in the Fifteenth Century,* notes this difference between the North and the South by saying, "In Germany the proper function of book illustration was instruction; in Italy, ornament." In thus stating the case he must have meant obvious ornament for there is a decorative design quality in the German work that goes far beyond "instruction."

Holbein (*q.v.*) was the next great artist to design particularly for the woodcut. Working through the woodcutter, Hans Lützelburger, the greatest master of the knife the craft has produced, he achieved what is probably as complete a synthesis between the means and the expression as is possible with the black line method. His *Dance of Death* series of blocks is one of the outstanding attainments of the medium.

In France the woodcut started in Paris with the cutting of blocks for the popular and frequently published *Books of the Hours.* Its chief masters in the 16th century were Jean Cousin and Bernard Salomon who worked around 1550. In the 17th and 18th it gradually declined. In 1766 Jean Michel Papillon wrote his famous *Treatise on Engraving* and showed in his work the minuteness of technique that was typical of the decline.

Thomas Bewick (1753–1828) did not invent the white line pictorial wood-engraving, there being evidence in his work that he was influenced by Croxall's cuts in his *Aesop* of 1722. He was, however, the first to give it popularity. The woodcut during the 18th and 19th century decline rivalled the camera as a recording instrument.

By adapting itself to the mirroring of a dozen mediums it had been forced into a sphere not its own. Bewick furnished the mechanism for this decline as well as that for the revival from it. His finest productions are the illustrations to *British Quadrupeds* (1790) and *British Birds* (1797).

William Blake (1757–1827) made only a few small woodcuts. He used the white line method. Technically they were not particularly skillful.

But pre-eminently they are *wood*-engravings. They emerge from blackness into light. They are plastic. They exploit the inherent quality of the medium. In doing these things they are the forerunners in character as well as technique of the significant work of today. (*See* BLAKE, WILLIAM.)

At the end of the century we find Felix Vallotton in Paris playing with solid areas of blacks and whites—one of the first to pick up the thread begun in Florence 500 years ago, the thread that in the 20th century is to develop into the dominant means of the modern expression.

MODERN TENDENCIES

The writer's contention that the present is the most fertile period in the history of the woodcut, in actual, contemporary achievement and in future possibilities is supported by two main reasons. The revolution in the mental approach to the making of pictures, which is the contribution of the first quarter of our 20th century to art history, and which involves a change from thinking of pictures as imitations or reports of nature to a conception of them as creatively reorganized interpretations, has brought the woodcut (which has been more sensitive to the new vitality than any other print medium) back into the fold of the *grand tradition.* Next in importance to this exceedingly significant event, the woodcut has found itself technically. That is, it has ceased forced service as proxy for another medium, the line drawing, and blossomed into a self-expression based on its inherent qualities. Its usefulness, however, has passed from the multitude who now find their pictorial entertainment in the photo and the pen and ink "funnies," to the few who care to seek out and pay the higher costs of what has become an aristocratic art—aristocratic, yet the lowest priced of all original pictorial works of art. (Prints made and signed by the artist are counted originals.)

This *grand tradition* includes work that is universal rather than particular in conception, creative rather than reportorial; it is older than the woodcut medium by many centuries. Work of today is rooted in fertile soil only when it belongs in both of these classifications. From the one it gains time*less*ness; from

the other time*li*ness. (*See* ENGRAVING; LINE ENGRAVING; PHOTO-ENGRAVING; PRINTING; ETCHING; LITHOGRAPHY.) (R. PN.)

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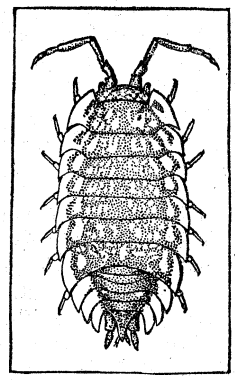
WOODFALL, HENRY SAMPSON (1739–1805), English printer and journalist, born in London on June 21, 1739. His father, Henry Woodfall, was the printer of the *Public Advertiser,* and the author of the ballad *Darby and Joan,* for which his son's employer, John Darby, and his wife, were the originals. From 1758–93 H. S. Woodfall controlled the *Public Advertiser* in which appeared the famous letters of "Junius." He died on Dec. 12, 1805. His younger brother, William Woodfall (1746–1803), also a journalist, established in 1789 a daily paper called the *Diary,* in which, for the first time, reports of the parliamentary debates were published on the morning after they had taken place.

WOODFORD: *see* WANSTEAD AND WOODFORD, England.

WOOD GREEN, a municipal borough in the Wood Green parliamentary division of Middlesex, England, 7 mi. N. of St. Paul's cathedral, London, on the L.N.E.R. and L.P.T.B. Pop. (1938) 53,190. Area, 2.5 sq.mi. The name covers a residential district lying N. of Hornsey and W. of Tottenham. Wood Green was incorporated in 1933. It contains the greater part of Alexandra park (173 ac.), with Alexandra palace, where the British Broadcasting corporation's television station was opened in 1936, the first transmission taking place on Aug. 26. However, the B.B.C. had been making television broadcasts since Aug. 22, 1932. Fuller's Almshouses, founded 1592 in Shoreditch, were removed there in 1933. The institutions for aged fishmongers and poulterers and printers are 19th century foundations.

WOOD LOUSE, a name commonly applied to certain terrestrial Isopoda (Crustacea) (*q.v.*), found in damp places, under stones or dead leaves, or among decaying wood. They form the tribe *Oniscoidea* and are distinguished from all other Isopoda by living on land and breathing air, and by the small size of the antennules and the absence of the mandibular palp. The head bears a pair of sessile compound eyes as well as the minute antennules and the longer antennae. Each of the seven thoracic segments carries a pair of walking legs. The appendages of the abdomen (except the last pair) are flat membranous plates and serve as organs of respiration. In many cases their outer branches have small cavities opening to the outside by slitlike apertures, and giving rise internally to a system of ramifying tubules filled with air somewhat similar to the air tubes or *tracheae* of insects and other air-breathing Arthropods.



FROM KUNKEL, "ARTHROSTRACA OF CONNECTICUT"

WOOD LOUSE OR PILL BUG (ONISCUS ASELLUS)

The female wood louse carries her eggs, after they are extruded from the body, in a pouch or "*marsupium*" which covers the under surface of the thorax and is formed by overlapping plates attached to the bases of the first five pairs of legs. The young on leaving this pouch are like miniature adults except that they are without the last pair of legs. Some common garden forms, such as *Armadillidium vulgare, Porcellio scaber, Porcellionides pruinosis,* are practically cosmopolitan, often being carried about on introduced plants. (*See* MALACOSTRACA.) (W. T. C.; X.)

WOODPECKER, the name applied to certain birds, forming together with the wrynecks (*q.v.*) the family *Picidae,* whose nearest allies are the toucans (*q.v.*). They generally have a bright particoloured plumage; the feet have two toes behind and two in front and the tail-quills are usually stiffened to form a prop on which the bird partially supports itself when climbing the trunks of trees.

The commonest species in Britain is the green woodpecker or yaffle (from its laughing cry), *Picus viridis.* It is about the size of a jay; the plumage is green, with a red crown and yellow rump. It obtains its food, consisting mainly of grubs, from the bark and rotten wood of trees; in search of these, it mounts trees in a spiral direction and bores holes in the decaying portions with its chisel-like beak. It also feeds much on the ground, being especially fond of ants. The nest consists of a hole drilled in the trunk of a tree, continued as a horizontal passage that reaches the core, whence it runs downwards for nearly a foot to expand into a chamber in which about six white eggs are laid on a bedding of chips. The two other British species, the greater and lesser spotted woodpeckers (*Dryobates major* and *D. minor*) are similar in habits, but have a plumage of black and white. They share with the red-headed woodpecker (*Melanerpes erythrocephalus*) of America, and other species, the habit of drumming with the beak on dead branches, etc., in lieu of a love-song. Inhabiting the pine forests of the Old World is the great black woodpecker (*P. martius*), larger than any of the previous species and with a black plumage and red crest. It is replaced in North America by the pileated woodpecker or log-cock, *Ceophloeus pileatus,* which is variegated with white.

BY COURTESY OF THE NATIONAL ASSOCIATION OF AUDUBON SOCIETIES

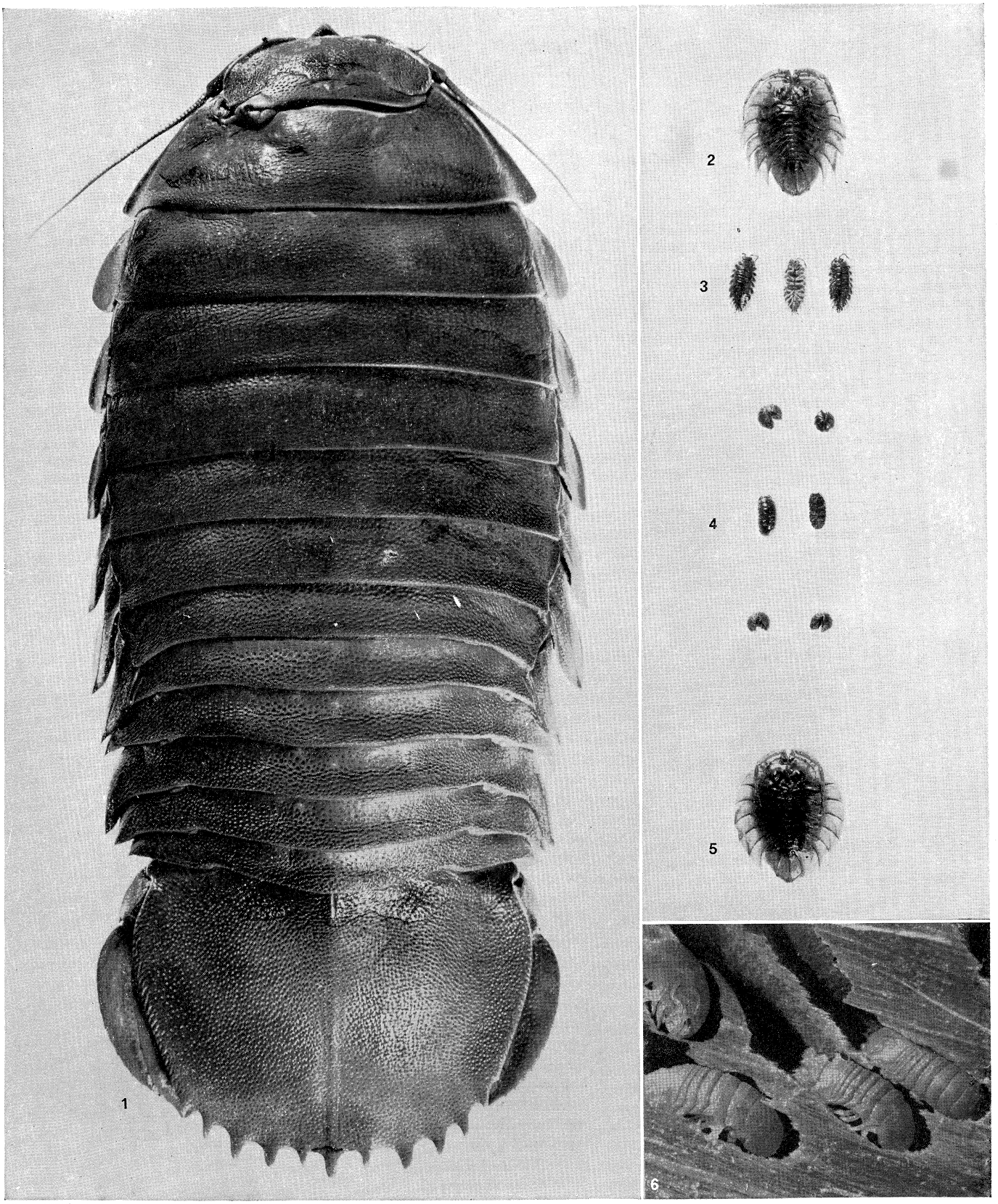
ABOVE; MALE AND FEMALE DOWNY WOODPECKERS (DRYOBATES PUBESCENS): BELOW; HAIRY WOODPECKER (DRYOBATES VILLOSUS), BOTH NORTH AMERICAN SPECIES

The Californian woodpecker, *Melanerpes formicivorus,* displays an amount of providence beyond almost any other bird in the number of acorns it fixes tightly in holes which it makes in the bark of trees, and thus a large pine forty or fifty feet high will present the appearance of being closely studded with brass nails, the heads only being visible. This is not done to furnish food in winter, for the species migrates, and only returns in spring to the forests where its supplies are laid up. The acorns thus stored are always those which contain a maggot, and, being fitted into the sockets prepared for them cup-end foremost, the enclosed insects are unable to escape, as they otherwise would, and are thus ready for consumption by the birds on their return from their winter migration to the south.

All woodpeckers are fond of ants, but one form, *Colaptes auratus,* the golden-winged woodpecker or flicker of North America, lives largely on grasshoppers and other ground insects and in this connection exhibits several interesting modifications, the bill being less sharp. The red is, in this species, reduced to a crescent on the neck. The red-shafted flicker (*C. cafer*) is a closely related species; the two interbreed where their ranges overlap, producing a variety of segregating types. Other common North American forms are the hairy woodpecker (*Dryobates villosus*) and the smaller downy woodpecker (*D. pubescens*), both black and white forms. The North American sapsuckers (*q.v.*) are also woodpeckers. Nearly one-half of the known species of woodpeckers occur in the New World. The remainder inhabit all parts of the Old World except Madagascar and the Australian region east of Celebes and Flores.

Some other woodpeckers deserve especial notice—the *Colaptes* or *Soroplex campestris,* which inhabits the treeless plains of Paraguay and La Plata; also the South-African woodpecker *Geocolaptes olivaceus,* which lives almost entirely on the ground or rocks, and picks a hole for its nest in the bank of a stream.

WOOD LOUSE



BY COURTESY OF (1-5) THE U.S. NATIONAL MUSEUM, (6) C. A. KOFOID

1. World's largest isopod, *Bathynomus giganteus* (Peracarida, order Isopoda), male specimen full 14 in. long, taken from a depth of 290 fm. in the Gulf of Mexico south of the Dry Tortugas, Florida
2. and 5. *Serolis paradoxus* (Peracarida, order Isopoda) from sand beaches at low tide, Straits of Magellan, superficially resembling a trilobite. Scale of reduction same as for *Bathynomus*
3. Three specimens of *Oniscus asellus* (Peracarida, order Isopoda), a widely distributed species of terrestrial isopod known as wood louse. The middle specimen shows the ventral side. Scale of reduction same as for *Bathynomus*
4. Six specimens of the pill bug, *Armadillidium vulgare* (Peracarida, order Isopoda), one of the cosmopolitan species of terrestrial isopods. The popular name is derived from its habit of rolling up like four of those illustrated. Of the two extended specimens the right one shows the ventral side. Scale of reduction same as for *Bathynomus*
6. *Limnoria lignorum* (Peracarida, order Isopoda), wood-boring isopod. Enlarged almost x 8

WOOD PULP: *see* PAPER MATERIALS.

WOODRUFF (*Asperula odorata*), a small herb of the madder family (Rubiaceae), found widely throughout Europe and northern Asia, native to Great Britain, and sparingly naturalized in the eastern United States. It has an erect stem, about 8 in. high, bearing lance-shaped leaves mostly in whorls of 8, and small white flowers in loose clusters. The dried leaves emit a hay-like fragrance.

WOODSTOCK, a city and port of entry of Oxford county, Ontario, Canada, 80 mi. S.W. of Toronto by rail, on Cedar creek, the Thames river and the Canadian National and Canadian Pacific railways. Pop. (1941) 12,461. It is one of the best agriculture sections of the province and has a large export trade in cheese, butter and farm produce. Organs, pianos and agricultural implements are manufactured.

WOODSTOCK, a municipal borough in Oxfordshire, England, 8 mi. N.W. of Oxford and the terminus of a branch of the G.W. railway. Pop. (1938) 1,598. Area 157 ac. The River Glyme divides the town into New and Old Woodstock. The church of St. Mary Magdalene, in New Woodstock, is Norman but has additions in later styles, and a west tower built in 1785.

After the battle of Blenheim the manor of Woodstock was bestowed in perpetuity on John, duke of Marlborough. In 1723 it was destroyed and the site levelled after the erection of Blenheim house, a mansion erected by parliament for the duke of Marlborough in consideration of his military services, and especially his decisive victory at Blenheim. The sum of £500,000 was voted for the purchase of the manor and the erection of the building, erected by Sir John Vanbrugh (*q.v.*), in a heavy Italo-Corinthian style. The magnificent park contains Fair Rosamond's well, near which stood her bower. On the hill stands a column commemorating the duke.

Domesday describes Woodstock as a royal forest; it was a royal seat from early times and Aethelred is said to have held a council there, and Henry I to have kept a menagerie in the park. Woodstock was the scene of Henry II's courtship of Rosamond Clifford ("Fair Rosamond"). It was a favourite royal residence until the Civil War, when the manor house was destroyed.

See Rev. E. Marshall, *Early History of Woodstock Manor* (Oxford, 1873); Adolphus Ballard, *Chronicles of Royal Borough of Woodstock; Victoria County History, Oxfordshire.*

WOOD-WORKING MACHINERY includes the various classes of tools for performing the operations on timber, from the rough log to the finished product. This group of machine-tools differs from those for metal-working in two important particulars. The speeds of cutting the material are relatively much greater, and the methods of holding or feeding it are usually quite different. These facts affect the design of the machines in numerous ways, while the saws, cutters, and knives possess much keener angles than those used on metal. Heavy pieces, such as logs, are held on a carriage or table which provides the means of movement in relation to a saw; in other cases ribbed rollers press against partly finished pieces and feed them along. There is also a good deal of direct hand feeding, with the assistance of fences or guides which keep the wood in a correct path, although much mechanically operated equipment is now in use.

Sawing Machines.—Taking the machines according to their class of operation, the saws comprise a wide range, from those dealing with big logs to the finest cutting necessary for cabinet work, and running blades of either circular, reciprocating, or band type. The first operation after tree-felling is to cross-cut the logs into suitable lengths for transport; for this purpose a stiff reciprocating blade, which cuts on the inward stroke, is driven by a steam or compressed air cylinder, the sole of the machine resting upon the ground. Or a crank-disc is driven by electric motor to reciprocate the blade, if current should be available. Tree-felling may be done by the same sort of machine differently mounted. Swing machines using a circular saw are likewise used for the cross-cutting of the smaller logs.

Several types of machines are employed for breaking down logs. A rapid-cutting machine which is much used, although it is rather wasteful of material, runs a big circular saw; past this the log is fed by a carriage on rollers, the log being held securely by a set of spiked dogs. A similar style of feed also occurs with the vertical band saws, with a blade thinner than that of the circular saw. The horizontal band-saw is a very fast-cutting and accurate machine, feeding the log by means of a carriage between two uprights up and down which the saw frame may be adjusted to cut successively the several boards or flitches from the log. The width of the saw blade reaches to a foot in the big machines, taking logs to 7 ft. diameter. Another manner of breaking down logs is with the log frame, with a feeding movement between uprights as with the horizontal band-saw; but the log is divided up by a number of reciprocating saws operated by a crank-shaft.

What are termed re-sawing machines do not deal with logs, but cut up the products from the latter, such as deals and flitches, into boards, etc. Such deal or flitch frames cut by a vertically reciprocating set of saws. For more varied cutting, a band re-saw is employed, this having the band-saw running vertically and the material fed over the table by ribbed feed rollers. A like class of feed apparatus is fitted to circular saw benches for re-sawing purposes. Saws for cross-cutting are used extensively, being of circular blade class, and with one saw, or two to cut to definite lengths. The pendulum saws are also utilized for this service, consisting of a frame pivoted from an overhead beam so that the circular saw at the bottom of the frame may be pulled by a hand motion through the wood. For general sawing the circular-saw bench is made in various styles, with a fence which guides the wood. The most complete types are the dimension saws which have a complete system of adjustments to angles and positions, with graduated scales for reading the amount that all sorts of cutting, as ripping, cross-cutting, bevelling, mitring, rebating, grooving, etc., require. Single machines carry one saw, double ones two, for ripping and cross-cutting respectively; either of these can be swung up through the table when required. By the use of a cutter-block on a saw spindle further operations beyond the capacity of a saw are practicable.

Band-sawing machines, and to a lesser degree fret-saws have to be utilized to cut straight and curved parts which cannot be dealt with by means of a circular saw. The table, through which the blade runs, may be used either in the horizontal attitude, or canted for bevel cutting. These saws need careful design in order to keep working well; the tension on the blade must be sensitive, and the latter has to run in anti-friction guides above and below the table so as to cut truly.

Planing Machines.—Those which finish sawn material on various faces vary greatly in design. The smallest are the hand-feed planers, along the surface of the table of which the operator slides the wood past the revolving cutter-block. For hand machines this has to be of the safety type, forming almost a cylinder so that the fingers cannot be drawn into the machine as with the older square cross-sectional shape. A vacuum effect is thus secured by the eccentric formation, leaving a space as marked. This both tends to draw the wood down on to the cutters and to suck away the chippings. The panel planers or thicknessing machines feed the wood along a table underneath the cutter cylinder, so that thick or thin pieces may be planed to uniform dimensions. With a second cutter-cylinder below the table each side of the wood is planed simultaneously. And with two extra vertical spindles, each carrying a short cutter-block, the edges of the timber may be treated as well, including tonguing, grooving, moulding, or rebating. Roller feed is applied to these panel machines. The most elaborate planing machines are those for flooring-boards, etc., the big ones having eight feed-rollers to propel the timber past the cutters and knives, the latter being of non-revolving class to impart a high finish after the revolving cutters have roughed off the surface. The rate of feed will sometimes exceed 400 ft. per minute. Machines for smaller dimensions of stuff are also made with four or five cutters, and either sort will do matching on the edges of the timber. The bottom cutter heads are constructed to draw out by means of a heavy slide, so that adjustments and settings may be effected and the head slid back into the working position.

Moulding machines produce shapes, planing all four sides at one

pass, and for mass production are built somewhat after the style of the large planing machines just mentioned. The vertical shaper or circular moulder has a cutter spindle standing up from a flat table, and the cutters may be of any desired profile, and will mould either straight, curved, or irregular mouldings. Fences of suitable shape guide the wood. Tenoning machines operate with cutters of appropriate shape, above and below the timber, which is fed along by a carriage. A grooving or drunken saw is often used: this is a circular saw set askew on its spindle, so that it wobbles and produces the groove. Dovetails are cut in machines of single- or multiple-spindle design. For the first, a pitching arrangement moves the wood into the successive positions for the high-speed cutter to pass through, and in the second all the dovetails are made at one feed, by the several cutters set at the correct distance apart.

Holes of round, square, or oblong shape are made in the boring and mortising machines. The first resemble drilling machines for metal in general form, but are of rather simpler construction. Mortising may be performed with a reciprocating chisel, which is pulled down by a slide and lever to penetrate the wood; but the hollow chisel is a faster-cutting tool. This is a hollow tool within which an auger revolves and removes the bulk of the stuff and as it is fed in the sharp corners at the end of the chisel square out the hole. Some machines, such as those for railway carriage and wagon work, have several boring spindles and a hollow auger spindle. Another fast-cutting machine is the chain mortiser. This has an endless steel chain the links of which are formed with chisel teeth, and it runs around a long guide bar that is fed into the wood, the teeth cutting the way before and producing the mortise.

Lathes.—Lathes produce all the numerous turned chisels, some of which are evolved with hand-controlled chisels and gouges supported on the hand-rest, others by means of a slide-rest having slides moved with handles and screws. When the contours of articles vary (*e.g.*, those of spokes, pick handles, cricket bats, or gun-stocks) a copying lathe is employed. This carries a model of the piece with one spindle and the roughly shaped wood with the other; the cutting is done by means of a revolving cutter block, and the frame holding this is moved in accordance with the copy, so that the shape of the latter becomes exactly reproduced on the wood.

Sandpapering machines finish wood of different shapes, some against a flat disc, others on an endless band. The drum machines are the largest kinds, for extensive output, and have three drums for successive action. The first has coarse paper, the second finer, and the third finer still with a soft cushion beneath to produce a high finish. A brush cleans off the dust.

Woodworking machines are extensively fitted with ball or roller bearings, to enable their high speeds to be maintained without heating and excess consumption of power. The mass of sawdust or chips, which is soon enormous with some machines, has to be taken away by a suction apparatus, as mentioned under FANS.

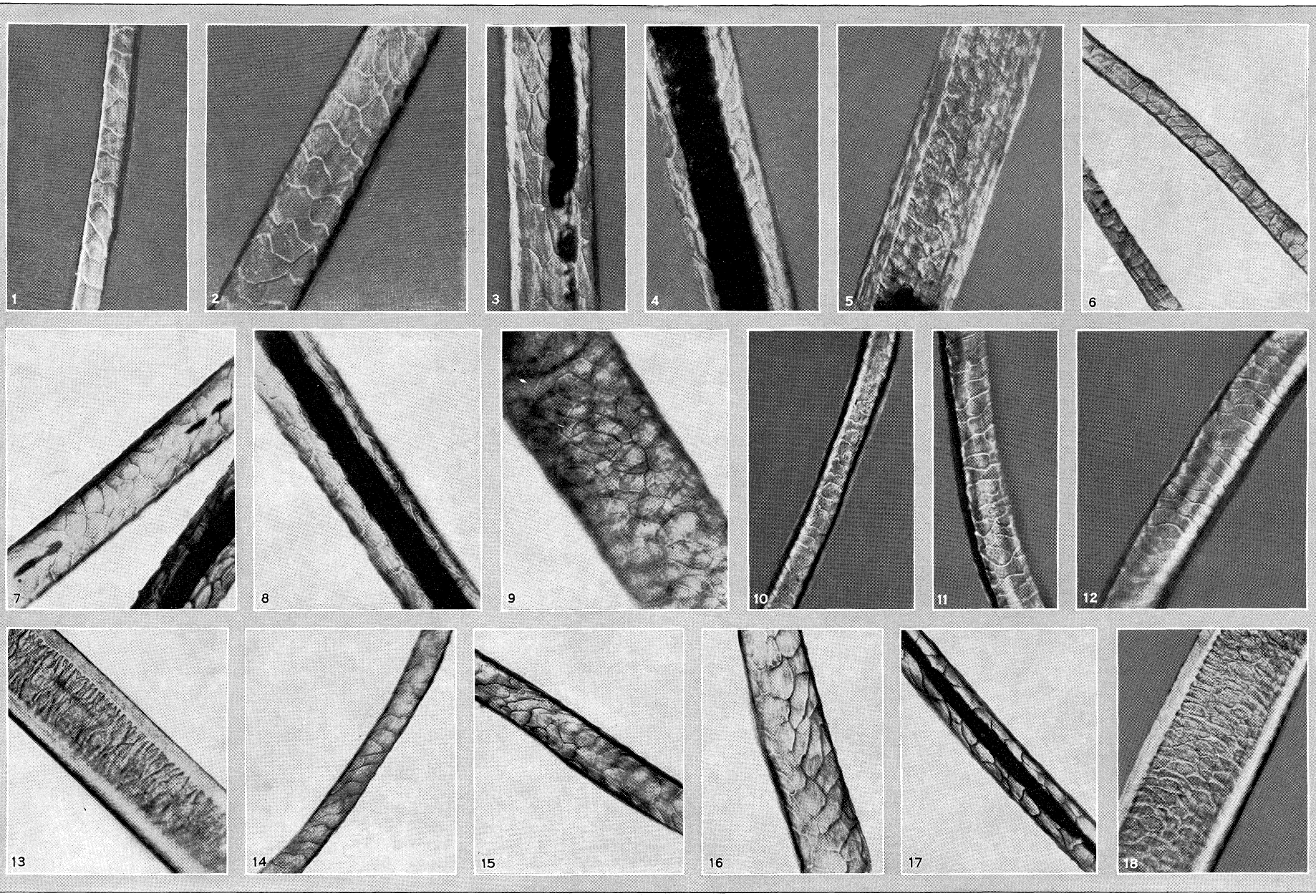
(F. H.)

WOOF. Another name for Weft: *see* WARP and WEFT.

WOOL. Animal fibres are usually spoken of as hair, with the exception of the coat of the sheep which is usually termed wool. Before the researches of Professor Cossar Ewart (Edinburgh) wool was looked upon as a modified form of hair. Now it is usual to look upon wool as the simpler structure and hair as a development from this structure. The difference between wool and hair is best realized by a study of the double coat of the primitive wild sheep. The under coat is fine wool—the fibre showing a twofold structure, inner or cortex and outer or cuticle. Microscopic examination of this fibre shows a highly imbricated or serrated surface. The outer coat is coarse hair—the fibre showing a threefold structure, medulla along with cortex and cuticle. The medulla is probably an air or gas-filled core of the fibre which markedly changes both the appearance and physical properties of the fibre. Certain animals are covered with wool only, others with hair only and others with both hair and wool. The sheep is possibly the only animal carrying a fleece of wool only and not every variety of sheep does this. Certain varieties of sheep are stated to carry hair only, but such animals as goats, cattle, horses, etc., are the chief hair-bearing animals. A few years ago the hair of the Angora goat (termed mohair) would have been classed as a hair but Duerdon (Grahamstown) has shown that it is the under-coat and therefore ought to be ranked as wool. That there may be gradations from wool to hair was shown by an analysis of the coat of the blackface sheep by Barker (Leeds) but further researches on this coat by Janet Blyth (Edinburgh) suggest rather modifications of the two extreme types of fibres towards a common type. The differentiation between the two types, however, is very difficult for both probably arise from the inturned epidermis; but as the sheep has two skins separated by a layer of fat it is suggested that the physiological process of bringing a fibre up from the lower skin produces hair and the process of bringing a fibre from the upper skin produces wool. This is borne out by the fact that if a small lock of wool is jerked from a fine merino sheep it brings the upper skin away with it. The camel produces two distinctive coats but perhaps the most interesting animal of this class is the "musk ox" or ovibos of the Arctic regions. This creature grows an under-coat of beautifully soft fibre, which perhaps should be regarded as wool, which it casts once a year; and an outer coat of strong hair of which presumably it distributes the casting throughout the entire year.

Wool in Britain.—Wool is one of the most important of the textile fibres. Owing to the ease with which it may be spun into thread, and the comfort derived from clothing made of wool, it would naturally be one of the first textiles used by mankind for clothing. Ancient records prove the high antiquity of wool textiles and the early importance of the sheep. The different kinds of wool and the cloth made from them in antiquity are described by Pliny and referred to by other writers. The sheep certainly was a domestic animal in Britain long before the period of the Roman occupation; and it is probable that some use was made of sheep skins and of wool. But the Romans established a wool factory whence the occupying army was supplied with clothing, and the value of the manufacture was soon recognized by the Britons, of whom Tacitus remarks, "*Inde etiam habitus nostri honor et frequens toga*" (*Agric.* c. 21). The product of the Winchester looms soon established a reputation abroad, it being remarked that "the wool of Britain is often spun so fine that it is in a manner comparable to the spider's thread." This reputation was maintained throughout the middle ages, and the fibre was in great demand in the Low Countries and other continental centres. There are many allusions to woollen manufactures in England in early times; but the native industry of the island could not rival the products of the continent.

In the time of William the Conqueror Flemish weavers settled under the protection of the queen at Carlisle, but later they were removed to Pembrokeshire. At various subsequent periods there were further immigrations of skilled Flemish weavers, who were planted at different places throughout the country. The cloth fair in the churchyard of the priory of St. Bartholomew was instituted by Henry II.; gilds of weavers were established; and the exclusive privilege of exporting woollen cloth was granted to the city of London. Edward III. made special efforts to encourage wool industries. He brought weavers, dyers and fullers from Flanders; he himself wore British cloth; but to stimulate native industry he prohibited, under pain of life and limb, the exportation of English wool. Previous to this time English wool had been in large demand on the continent, where it had a reputation exceeded only by the wool of Spain. The customs duties levied on the export of wool were an important source of the royal revenue. Edward III.'s prohibitory law was, however, found to be unworkable, and the utmost that both he and his successors were able to effect was to hamper the export trade by vexatious restrictions and to encourage much smuggling of wool. Thus while Edward III. limited the right of exporting to merchant strangers, Edward IV. decreed that no alien should export wool and that denizens should export it only to Calais. Legislation of this kind prevailed till the reign of Elizabeth, when the free exportation of English wool was permitted; and Smith, in his *Memoirs of Wool*, points out that it was during this reign that the manufacture made the most rapid progress. In 1660 the absolute prohibition of the



BY COURTESY OF JANET BLYTH

MAGNIFIED WOOLLEN FIBRES

Top panel (1–5): typical fibres taken from Lincoln sheep. Both continuous and intermittent medullated fibres are seen

Second panel (6–9): wool fibres from the Swaledale (improved Blackface Scotch sheep) showing external structure of the kemp. Actual scale structure approaches Merino fibre

Third panel (10–13): there are no medullated fibres in this wool from a Southdown sheep, the best of the fine British breeds. Merino origin is shown by both thin and thick fibres

Bottom panel (14–18): demi-lustre class fibres taken from a Romney Marsh sheep, the wool of which makes good felting. Clearly defined external structure is probably dominant factor with reference to this quality

export of wool was again decreed, and it was not till 1825 that this law was finally repealed. The results of the prohibitory law were exceedingly detrimental; the production of wool far exceeded the consumption; the price of the raw material fell; wool-"running" or smuggling became an organized traffic; and the whole industry became disorganized. Extraordinary expedients were resorted to for stimulating the demand for woollen manufactures, among which was an act passed in the reign of Charles II. decreeing that all dead bodies should be buried in woollen shrouds—an enactment which remained in the Statute Book, if not in force, for a period of 120 years. On the opening up of the colonies, every effort was made to encourage the use of English cloth, and the manufacture was discouraged and even prohibited in Ireland.

Wool was "the flower and strength and revenue and blood of England," and till the development of the cotton trade, towards the end of the 18th century, the wool industries were, beyond comparison, the most important sources of wealth in the country. Towards the close of the 17th century the wool produced in England was estimated to be worth £2,000,000 yearly, furnishing £8,000,000 worth of manufactured goods, of which there was exported about £2,000,000 in value. In 1700 the official value of woollen goods exported was about £3,000,000, and in the third quarter of the century the exports had increased in value by about £500,000 only. In 1774 Dr. Campbell (*Political Survey of Great Britain*) estimated the number of sheep in England at 10,000,000 or 12,000,000, the value of the wool produced yearly at £3,000,000 (or about 5s. per lb.), the manufactured products at £12,000,000, and the exports at £3,000,000 to £4,000,000. He also reckoned that the industry then gave employment to 1,000,000 persons. In 1800 the native crop of wool was estimated to amount to 96,000,000 lb; and, import duty not being imposed till 1802, the quantity brought from abroad was 8,600,000 lb., 6,000,000 lb. of which came from Spain. In 1825 the importation of colonial wool became free, the duty leviable having been for several previous years as high as 6d. per lb, and in 1844 the duty was finally remitted on foreign wool also.

British Wools.—English wool, known the world over as being of a long and lustrous type was doubtless the kind so much in demand in the middle ages. That it was as long and lustrous as the typical Leicester or Lincoln of to-day is doubtful, as the new Leicester breed of sheep was only fully developed by Bakewell after the year 1747, and the latter day Lincoln is even a later development of a similar kind. As already remarked, the long and lustrous wools are the typical English, being grown in Lincolnshire, Yorkshire, Nottinghamshire, Devonshire, etc., in fact in all those districts where the pasturage is rich and specially fitted for carrying a heavy sheep. It is claimed that the lustre upon the wool is a direct result of the environment, and that to take a Lincoln sheep into Norfolk means the loss of the lustre. Attempts were made in the 18th century to develop a fine wool breed in England, George IV. importing a number of merino sheep from Spain. The discovery was soon made that it was difficult to maintain a breed of pure merinos in Great Britain, but the final outcome was by no means unsatisfactory. By crossing with the indigenous sheep a race of fairly fine woolled sheep was developed, of which the present day representative is the Southdown—a sheep which feeds naturally on the downs of Sussex, etc., forming a marked contrast to the artificially turnip-fed Lincoln, Leicester, etc., sheep. Following the short, crimpy Southdown, but rather longer, come the Hampshire and Oxford down sheep; these are followed by Suffolk, Shropshire, Kent and Romney Marsh (Demi-lustre), until at last the chain from the Southdown to the Lincoln (lustre) is completed. Of course there are several British wools not included in this chain. Scotch or black-face wool is long and rough, but well adapted for being spun into carpet yarns. Welsh wool has the peculiarity of early attaining its limit of shrinkage when washed, and hence is specially chosen for flannels. Shetland wool is of a soft nature specially suited for knitting yarns, while Cheviot wool—said to be a cross between merino sheep saved from the wreck of the Great Armada and the native Cheviot sheep—has made the reputation of the Scottish manufacturers for tweeds. North wool—wool from an animal of the Border Leicester and Cheviot breed—Wensleydale, Masham and Ripon wools are also specially noted as lustre wools.

Merino.—For centuries the finer wools used for cloth-making throughout Europe had been obtained from Spain—the home of the famous merino breed developed from races of sheep originally introduced into the peninsula by the Moors. Till early in the 19th century the superiority of Spanish merinos remained unchallenged, but the Peninsular War and its attendant evils produced a depreciation of quality concurrently with the introduction of Saxon and Silesian wools, which suddenly supplanted the product of Spain. The Spanish merino sheep had been introduced into Saxony by the elector in 1765, and by judicious crossing with the best native race developed the famous electoral breed. Merinos were carried to Hungary in 1775, and to France in 1776, and in 1786 Daubenton brought them to Rambouillet, whence a famous race developed. In 1802 the first merinos known to have left pure descendants were taken to the United States, and in 1809–1810 an importation (4,000) of merino sheep was made.

Wool in Australasia.—The introduction of the merino sheep into Australasia about the end of the 18th century and later into South America was an important move. It is probable that the marked improvement in the appearance of the first sheep taken out by the early colonists suggested the possibilities of Australia as a wool-growing country. As has been noted above, marked endeavours were being made at this time to extend the merino breed of sheep, so that it was but natural that this breed should be given the first chance. It should here be noted that the Australian fine wools were first shipped from Botany bay (near Sydney), hence the now universal term "botany" for fine wools. The colonists were not to be repressed, however, and eventually, through the endeavours of Captain MacArthur, the Rev. Samuel Marsden and others, notwithstanding the opposition of Sir Joseph Banks, the president of the Royal Society, the merino breed became established on a firm basis, and in a comparatively short time Australian wools were no longer a drug on the market. In the 19th century the possibilities of raising larger sheep on the better coastal pasturage was naturally suggested. Until about 1885 this tendency was largely repressed owing to the demand for merino as distinct from cross-bred wool. In other words wool was the dominating factor. But with the possibilities and the development of the frozen meat trade from 1880 to 1890 this condition was changed, and the tendency to breed a large sheep of an early maturing type, with a valuable carcass and mediocre wool grew apace. New Zealand was specially adapted for this development; thus New Zealand frozen mutton completely dominated New Zealand wool. In this manner it came about that cross-bred wool supplanted merino wool to a very considerable extent throughout Australasia.

The final results of these crossings are somewhat peculiar. The Lincoln crossed on to the Merino and in-bred for at least ten generations has produced the world renowned "Corriedale" sheep which on a large body carries a heavy fleece of 48's/56's quality of wool. The half-bred Down cross Merino produces an early fattening lamb with a wool between the Down and the Merino. The Romney Marsh sheep has proved a wonderful sheep for New Zealand especially from the frozen mutton trade point of view. Its wool may be a useful demi-lustre but unfortunately has been allowed to deteriorate. This deterioration, however, is now being suppressed and wools at present being tested in the University of Leeds (1928) show a return to a useful quality. Any cross between an English breed and a Merino which has been crossed towards the Merino again produces the fine "cross-bred" or "Comeback" wools for which Australia is specially noted. The Corriedale sheep crossed on to the Merino and in-bred for many generations form the Polworth sheep and wool.

A somewhat different evolution has taken place in later years with reference to the interior sheep stations. The merino sheep will thrive where a larger sheep would starve, hence its value for the stations where salt-bush and blue-bush dominate all vegetation. But the merino sheep is a "wool" sheep, not a "frozen mutton" sheep, hence all crossing here was carried out with the idea of simply developing the weight of fleece and if possible retaining the merino wool characteristics.

South American Wool.—Hardly second in importance to Australia as a wool-growing country comes South America. In most years Australia has produced the greater bulk, but until recently occasionally S. America has come out top. To-day, however, although Patagonia and Chile have shown remarkable sheep developments, South America as a whole has relatively declined as a wool-growing continent. Cattle and cereals prove the better paying products. The history of the introduction of merino sheep into S. America may be briefly summed up as follows. In 1842 Henri Solanet, a Frenchman, began to shear the comparatively few sheep round Buenos Aires. His example was soon followed by Edouardo Olivera and José Planer. The idea almost at once came to these pioneers of importing well-bred rams, and as S. America is essentially a Latin country it was but natural that the French flocks of Rambouillet should be first drawn upon. With the development of the meat trade—just as in the case of Australia and New Zealand—a larger carcass was then sought after. This led to the introduction of the Lincoln ram and the development of cross-bred flocks about the year 1885. Perhaps this cross was favoured owing to the skill of the Bradford spinners, who made excellent use of the cross-bred wool produced. Flocks of sheep were first introduced into the Falkland islands in 1867. The pasturage here being limited, the flocks have probably attained their limit, but from the Falkland islands flocks have been passed on to Punta Arenas, where there is practically unlimited pasturage. The chief centres from which wool from S. America comes to Europe are Buenos Aires, which exports chiefly long and cross-bred wools, Montevideo, which exports chiefly merino wools, and the Falkland islands and Punta Arenas, which export mostly wools of the finer Cheviot type. The industry is largely in the hands of Englishmen. In Peru the weight of fleece carried and the number of sheep are being so increased that Peru may soon be exporting over 100,000,000 lb. of wool annually in addition to its export of vicuna, alpaca, and llama markets.

South African Wool.—Prior to the introduction of the merino sheep into Australia it had been introduced into S. Africa by the Dutch. There the climate was not so helpful as was that of Australia. The newly acclimatized sheep appears to have cast its wool at about the fifth generation and to have generally deteriorated, necessitating the reintroduction of fresh blood from Europe. In this manner have been developed the Cape flocks and the considerable Cape wool trade—largely centred at Port Elizabeth, East London, Cape Town, Mossel Bay and Port Natal. The country is evidently specially adapted for the rearing of the merino type of sheep, as cross-bred Cape wool is almost unknown. In 1907 some thousands of Australian merino sheep were introduced, and this has been followed up by more recent importations. Thus to-day Cape merinos rival those of Australia.

Such remarkable advances have been made in the weights of fleeces carried by sheep of particular breeds that it is difficult to say if finality has been reached. The following list gives average weights:

Breed	Weight of average fleece	Breed	Weight of average fleece
Merino (Australian)	8 to 10 lb.	Southdown	6 lb.
Merino (South American)	4 to 6½ lb.	Lincoln	12 lb.
Corriedale	8 to 10 lb.	Shetland	4 lb.
		Cashmere	4 oz.

In 1885 the average weight of wool per sheep per year was about 5 lb., while 7 to 8 lb. is now the average weight. The weights of Australian fleeces are to-day about double as compared with 1885.

The Colour of Wool.—The prevailing colour of sheep's wool is white, but there are races with black, brown, fawn, yellow and grey shades of wool. For manufacturing purposes generally white wool is, of course, most valuable, but for the homespuns, which in earlier times absorbed the bulk of wool, natural colours were in many cases used with good effect. In domestic spinning, knitting, and weaving, natural colours are still largely taken advantage of, as in the cases of rough yarns, Shetland knitted shawls, Highland tweeds, etc.

TABLE I.—*The World's Sheep (millions)**

Country	Average 1926–30	Average 1931–35	1933	1934	1935	1936	1937
Russia	122.7	52.9	45.7	46.8	54.2	66.7	..
Australia	103.3	111.4	112.9	109.9	113	108.8	..
United States	45.5	53.2	53	53.7	52.2	52	52.5
Argentina	44.4	40.5	..	39.3	37.9	40.3	43.7
Union S. Africa	43.1	44	47.3	35.1	35.9	39.8	..
New Zealand	27.5	28.7	27.7	28.6	29.	30.1	31.2
United Kingdom	24.6	26	26.6	24.9	25.	25	25.5
China	24	24	..	19.	28.	..	..
Uruguay	20.5	17.9	..	..	..	..	17.9
Spain	19.9	17.9	16.4	..	17.3	..	..
Rumania	12.9	12.1	12.2	..	11.8	..	..
Turkey	11.8	11.5	11.	10.7	12.4	14.8	16.4
Italy	11.3	9.5	..	..	..	8.8	9
France	10.5	9.8	9.7	9.7	9.5	9.5	9.7

*"Agricultural Statistics, 1938," United States Department of Agriculture, from which Table I and Table II herewith are compiled, estimates the world's census of sheep at an annual average of 734,100,000 for the years 1926–30 and 684,200,000 for the years 1931–35.

TABLE II.—*The World's Wool (millions of lb.)*

Country	Average 1926–30	Average 1931–35	1933	1934	1935	1936	1937
Australia	926.4	1,010.5	995.9	1,015.4	971.1	975	1,014
United States	364.3	432.1	438.4	430.8	430.7	426.5	432.5
Russia	362.9	159.4	141	135	167	200	259
Argentina	327	360.8	364	348	364	373	375
Union S. Africa	294.1	269.5	272.2	210	237	264	230
New Zealand	258.2	281.1	289.6	265	304.3	302.9	314
Uruguay	140.1	110.6	104.7	119	113	116.2	128
United Kingdom	112.4	114.4	119.9	112.3	108.6	107.7	105.7
China	78	78	78	78	78	78	..
Rumania	66.9	63.5	61.5	68	60.1	60.1	..
Spain	73.7	68.5	67.6	68	71	71	..
Italy	53.3	40.5	39	38.1	37.5	36.3	37.4
Germany	34.8	30.4	30	29.8	30.7	34.5	38.1
Asia Minor†	62.5	58.7	59.9	58.4	60.6	71.8	73.7
World	3,230.2	3,382.7	3,392.4	3,317	3,352.5	3,414.2	..

†Turkey, Iraq and Syria.

Tables I. and II. give useful particulars of the World's sheep and wool and also illustrate recent developments in wool-growing.

The Physical Characteristics of Wool.—The most important physical characteristics of the wool fibre are the cell structure, the fibre diameter and the fibre length. Researches into the external structures of ranges of British and Merino wools reveal interesting differences which largely explain the felting qualities observable in the respective wools. It is usual to consider British wools under the headings—*mountain wools, lustre wools, demi-lustre wools* and *down wools.*

Fig. 1 illustrates typical fibres taken from the Swaledale (an improved Blackface Scotch sheep) showing in *K* the external structure of the kemp, in *I.* medullated and non-delullated coarse fibres and in *II.* the finest fibre, which in this case approaches the merino fibre in actual scale structure.

Fig. 2 illustrates typical fibres taken from the Lincoln sheep, typical of the lustre wool class; in this case in *I.* there are continuous and intermittent medullated fibres.

Fig. 3 illustrates typical fibres taken from the Romney Marsh sheep, typical of the demi-lustre class. This is a remarkably good felting wool and the very clearly defined external scale structure is probably a dominant factor with reference to this quality.

Fig. 4 illustrates fibres taken from Southdown sheep—the best of the fine British breeds—which are particularly interesting in that there are no medullated fibres, while both thick and thin fibres clearly show a merino origin. This is not a milling wool.

In fig. 5 a photo-micrograph of a typical merino fibre is shown, from which it will be gathered that the typical merino structure is of the coronal pattern in which each scale tends to encircle the shaft of the fibre and rests in the cup formed by the scale beneath it.

In fig. 6 a photo-micrograph of a New Zealand cross-bred fibre (Lincoln×merino) is given, this presenting a curious blend of the British and merino wools external fibre structures.

Wool fibres vary in diameter from more than $\frac{1}{400}$″ to less than $\frac{1}{2,000}$″. In the best bred merino wools, say a 70's quality,

shoulder staples or locks of wool will snow a useful uniformity varying only from about $\frac{1}{1,000}$″ to $\frac{1}{4,000}$″, whereas in the typical mountain wools variations from $\frac{1}{400}$″ to $\frac{1}{900}$″ are quite usual. The explanation is that the well-bred merino wool is entirely the under coat of the wild sheep, while the mountain wool appears to be composed of fibres from both the under and outer coats of the wild sheep with modified fibres coming in between the two types.

Just as the life history of a fish may be recorded in its scales so the life history of a sheep is recorded in its wool fibres. The single factor—fibre diameter—usually reveals important facts with reference to both "race" and "environment."

Wool fibres vary in length from under one inch to more than 18 inches, in fact, on several occasions when sheep have accidentally missed shearing for two or three years a wool growth, in the case of crossbreds, has been recorded to more than 40 inches. The yearly growth of wool, however, is within the limits indicated. The following are the average yearly growths of the most important breeds of sheep.

Blackface	18″ to 10″	Southdown	3 ″ to 4″
Lincoln	12″ to 18″	Clothing Merino	1½″ to 3″
Romney	6″ to 8″	Combing Merino	2½″ to 5″
Shropshire	4″ to 6″		

It should be noted that the first year's growths of wool, sheared from what are termed "hogg" or "teg" sheep, are usually rather longer than the above owing to the lambs being dropped from February to April and the shearing not taking place until the following May or June. Hogg wool also reveals itself in its pointed fibre tips.

The dominant physical characteristics of the four classes of wool referred to are:—For mountain wools, strength of fibre and in some cases a free intermixture of coarse and fine fibres; for lustre wools, that lustre which the manufacturer can develop in his lustre fabrics; for demi-lustre wools, either an approach to a lustre type or more frequently a loftiness in handle well suiting the type of wool for the coarser hosiery fabrics. For down wools, a fineness combined with loftiness which specially fits these wools for the finer hosiery styles; and for merino wools, a special fibre fineness with plasticity of handle which enables the spinner to produce the finest possible wool yarns and the manufacturer to obtain a superb "handle" in his fabrics.

The other distinguishing qualities of good wool are uniformity and strength of fibre with freedom from tender or weak portions in its length, a condition which not unfrequently arises from ill health in the sheep, or is due to violent climatic changes. In ill-bred wool there may also be found intermingled "kemps" or dead hairs—straight, coarse, dull fibres which show conspicuously among the wool, and become even more prominent in the manufactured and dyed goods, as they will not take dye.

The Chemical Characteristics of Wool.—Wool as it comes from the sheep's back is in anything but a pure form. The following analyses carried out at Leeds university (Barker and Wilson) give an idea of the problem facing the wool-scourer who, receiving wool "in the grease," is expected to turn it out clean with a moisture content of about 16% in the weight of the clean dried wool.

Type of wool	Clean wool	Water	Soil	Fat	Potash salts	Organic matter burnt off	Per cent
	%	%	%	%	%	%	%
Lincoln (washed)	73·3	13·4	5·32	3·77	2·06	1·63	99·48
Merino	45·0	9·0	13·0	24·0	4·0	6·0	101·0
Corriedale	54·0	13·0	10·0	12·0	5·9	6·0	100·9
Southdown	50·0	11·0	16·0	10·0	5·2	8·0	100·2
Burry	62·0	12·8	9·3	10·0	4·5	4·6	102·9

A careful analysis of typical wools (Speakman) usefully indicates the percentages on the weights of the clean dry wool of "wool fat" and "suint" usually present.

Type of wool	Wool fat	Suint
	%	%
Australian wools		
Geelong, 80's quality	35·3	14·2
Merino, 64's quality	41·9	17·1
Corriedale, 56's quality	45·8	23·5
African wools		
Eastern state, 70's quality	27·9	26·0
Swagershock, 64's quality	29·6	21·4
Grootfontein, 70's quality	41·4	12·0
Peruvian		
Ordinary, 56's quality	9·4	29·2
Improved, 60/64's quality	14·0	35·0
English		
Wensleydale, 46's quality	9·3	27·3

The variations here in evidence are remarkable and well illustrate the difficulties with which the wool-scourer has to contend. It is usual now to recover the wool fat which is placed on the market as "lanoline," but it is not usual to attempt to recover the potash salts.

Chemical Composition.—According to Dr. Bowman, the chemical composition of the cell structure of the average wool-fibre is:—

Carbon	50·8
Hydrogen	7·2
Nitrogen	18·5
Oxygen	21·2
Sulphur	2·3
	100·0

It is said to be a most complex body of which the probable formula is $C_{42}H_{157}N_5SO_{15}$.

If wool is burnt, it largely resolves itself into ammonia gas—whence it derives its characteristic odour—and carbon "beads" or "remains," which serve to distinguish wool from cotton, which, upon being burnt, does not smoulder but burns with a flash and leaves no beads. For further particulars on the organic nature of the wool-fibre *see* FIBRES.

Lamb, Hogg and Wether Wool.—The bulk of the wool of commerce comes into the market in the form of fleece wool, the product of a single year's growth, cut from the body of the living animal. The first and finest clip, called lambs' wool, may be taken from the young sheep at about the age of eight months. When the animal is not shorn till it attains the age of twelve or fourteen months the wool is known as hogg or hogget, and, like lambs' wool, is fine and tapers to a point. All subsequently cut fleeces are known as wether wool, and usually possess relatively somewhat less value than the first clip. Fleece wool as it comes into the market is "in the grease," that is, unwashed, and with all the dirt, etc., present; or it is received as "washed" wool, the washing being done as a preliminary to the sheep-shearing; or, in some few cases, it is scoured and is consequently stated as "scoured." Skin wool is that which is obtained from sheep which have either died or have been killed. Typical skin wool is that which has been removed by a sweating process or by painting with sulphide.

Sheep Washing.—Where there is abundance of water and other conveniences it is the practice to wash sheep previous to shearing, and such wool comes onto the market as washed. Where running streams exist, the sheep are penned by the side of the water, and taken one by one and held in the stream while they are washed, one man holding and the other washing. Sheep washing appliances are now largely employed, the arrangement consisting of a pen into which the sheep are driven and subjected to a strong spray of water either hot or cold, which soaks the fleece and softens the dirt. This done, they are caused to swim along a tank which narrows towards the exit, and just as they pass out of the pen they are caught and subjected to a strong douche of pure water. They should then be kept on grass land free from straw, sand, etc., so that the wool may be sheared free from vegetable matter, etc. After a few days the wool of a washed sheep is sufficiently dry for shearing or clipping.

Sheep Shearing.—A skilful shearer will clip the fleece from a sheep in one unbroken continuous sheet, retaining the form and relative positions of the mass almost as if the creature had been

skinned. In this unbroken condition each fleece is rolled up by itself and tied with its own wool, which greatly facilitates the sorting or stapling which all wool undergoes for the separation of the several qualities which make up the fleece. Mechanical shears have almost revolutionized the shearing industry, a good shearer shearing from 100 to 200 sheep per day.

Wool Classing.—On the great Australian sheep stations wool classing is one of the most important operations, largely taking the place of sorting in the English wool trade. This is no doubt due to the wonderful success which has attended the efforts of the Australian sheep breeders to breed a sheep of uniform staple throughout. Thus the fleeces as taken from the sheep are skirted and trimmed on one table and then passed on to the classer, who places them in the 56's, 60's, 64's, 70's, 80's or 90's class according to their fineness, these numbers approximately indicating the worsted counts to which it is supposed they will spin. The shorter Australian wools not coming under any of these heads are classed as super-clothing, ordinary clothing, etc., being more suitable for the woollen industry.

The technique of sheep shearing, skirting, classing, packing and transporting has been brought up to a wonderful state of perfection in Australia, and the "get up" of the wool is usually much superior to the "get up" of the "home-clip."

Wool Sorting.—Sorting or stapling was formerly a distinct industry, and to some extent it is so still, though frequently the work is done on the premises of the comber or spinner. Clothing wools are separated and classed differently from combing wools, and in dealing with fleeces from different breeds, the classification of the sorter varies. In the woollen trade short-staple wool is separated into qualities, known, in descending series from the finest to the most worthless, as picklock, prime, choice, super, head, seconds, abb and breech, and the proportions in which the higher and lower qualities are present are determined by the "class" of the fleece. In the worsted trade the classification goes, also in descending series, from fine, blue, neat, brown, breech, downright, seconds, to abb for English wools. The last three are short and not commonly used in the worsted trade. The greater proportion of good English long wool will be classified as blue, neat and brown; it is only in exceptional cases that more than from 5 to 8% is "fine" on the one hand, or of lower quality than breech on the other. Generally speaking, the best portion of a fleece is from the shoulders and side of the animal. The quality decreases towards the tail end of the sheep, the "britch" being frequently long, strong and irregular. The belly wool is short, worn and dirty, as is also the front of the throat, while on the head and shins the product is short, stiff and straight, more like hair than wool and is liable to contain grey hairs. The colonial wools come "classed," and consequently are only as a rule sorted into three or four qualities. Thus a 60's fleece may be sorted into 56's, ordinary 60's, super 60's and skirtings.

The sorter works at a table or frame covered with wire netting through which dust and dirt fall as he handles the wool. Fleeces which have been hard packed in bales, especially if unwashed, go into dense hard masses, which may be heated till the softening of the yolk and the swelling of the fibres make them pliable and easily opened up. When the fleece is spread out the stapler first divides it into two equal sides; then he picks away all straws, large burrs, and tarry fragments which are visible; and then with marvellous precision and certainty he picks out his separate qualities, throwing each lot into its allotted receptacle. Sorting is very far removed from being a mere mechanical process of selecting and separating the wool from certain parts of the fleece, because in each individual fleece qualities and proportions differ, and it is only by long experience that a stapler is enabled, almost as it were by instinct, rightly to divide up his fleeces, so as to produce even qualities of raw material. Cleanliness is most essential if the wool sorter is to keep his health and not succumb to the dread disease known as "anthrax" or "wool-sorters' disease." Certain wools such as Persian, Van mohair, etc., are known to be very liable to carry the anthrax bacilli, and must be sorted under the conditions imposed by government for "dangerous wools." Fortunately wools can now be readily disinfected at the Government's station at Liverpool. Ordinary or non-dangerous wools are perfectly harmless from this point of view.

Scouring.—The washing which a fleece may have received on the live sheep is usually not sufficient for the ordinary purposes of the manufacturer. On the careful and complete manner in which scouring is effected much depends. The qualities of the fibre may be seriously injured by injudicious treatment, while, if the wool is imperfectly cleansed, it will dye unevenly, and the manufacturing operations will be more or less unsatisfactory. The water used for scouring should be soft and pure, both to save soap and still more because the insoluble lime soap formed in dissolving soap in hard water is deposited on the wool fibres and becomes so fixed that its removal is a matter of extreme difficulty. In former times stale urine was a favourite medium in which to scour wool; but that is now a thing of the past, and a specially prepared potash soap is the detergent principally relied on. Excess of uncombined alkali has to be guarded against, since uncombined caustic acts energetically on the wool fibre—especially in the presence of heat—and is indeed a solvent of it. A soap solution of too great strength leaves the wool harsh and brittle, and the same bad result arises if the soapy solution is applied too hot.

The scouring of wool has passed through many changes during the past fifty years, but to-day the principle upon which all scouring machines are based is that wool naturally opens out in water. The mechanical arrangements of the machines are such as to ensure the passage of the wool without undue lifting and "stringing"; to obviate the mixing of wool grease, sand, dirt, etc., once taken out of the wool with that wool again; to give time for the thorough action of the scouring agents, so that neither too strong a solution nor too great a heat be employed; and to allow of the ready cleansing of the machines so that there is no unnecessary waste of time. In England the recognized type of merino wool-washing machine is the fork-frame bowl. Three to five of these machines are employed. The "scour" is strongest and hottest in the first bowl (unless this is used as a "steeper") as the wool at first is protected from the caustic by the wool-fat, etc., present. The last bowl is simply a rinsing bowl. With modern "nip rollers" botany wool is sufficiently dry to be passed on directly—say by pneumatic conveyers—to the carding. This the worsted spinner does, thereby saving time and money. The woollen spinner, however, may require the wool for blending, and so may require it dry and in a fit state for oiling. He, therefore, will employ one or other of the drying processes to be immediately described. For English and cross-bred wools more agitation in the scouring bath may be desirable. If so, the eccentric fork action machine is employed, in which the agitation of the bath is satisfactorily controlled by the setting of the forks which propel the wool forward. An average wool will be in the scouring liquor about eight minutes, the temperature will vary from 120° F to 110° F, and the length of bath through which it will have passed will be from 48 to 60 ft.

It is interesting to note that the "emulsion" method of wool scouring as described above is practically universal in England. In the United States of America the "solvent" method is largely in use. The agent employed—say benzene—is recovered by volatilizing and condensing, thus being used over and over again.

Wool Drying.—The more gently and uniformly the drying can be effected the better is the result attained; over-drying of wool has to be specially guarded against. By some manufacturers the wool from the squeezing rollers is whizzed in a hydro-extractor, which drives out so much of the moisture that the further drying is easily effected. The commonest way, however, of drying is to spread the wool as uniformly as possible over a framework of wire netting, under or over which is a range of steam-heated pipes. A fan blast blows air over these hot pipes, and the heated air passes up and is forced upwards through the layer of wool which rests on the netting, or downwards, as the case may be. In either case, unless the wool is spread with great evenness, it gets unequally dried, and at points where the hot air escapes freely it may be much over-dried. A more rapid and uniform result may be obtained by the use of the mechanical wool drier, a close chamber divided into horizontal compartments, the floors of which have alternate fixed and movable bars. Under the chamber is a tubular

heating apparatus, and a fan by which a powerful current of heated air is blown up the side of the chamber, and through all the shelves or compartments successively, either following or opposing the wool in its passage through the machine. The wool is introduced by a continuous feed at one end of the chamber; the strength of the blast carries it up and deposits it on the upper shelf, and by the action of the movable bars, which are worked by cranks, it is carried forward to the opposite end, whence it drops to the next lower shelf, and so on it travels till at the extremity of the lower shelf it passes out by the delivery lattice well and equally dried. Another drying machine in extensive use is what is known as the "Jumbo dryer." This consists of a large revolving cylinder or churn which turns over the wool—as a churn turns butter—and owing to its inclination passes it from one end to the other. A hot air blast follows the wool through the machine.

Teasing.—The dried wool may be in a partially matted condition. If so, it must be opened out and the whole material brought into a uniformly free and loose condition. This is effected in the Willey, which consists of a large drum and three small cylinders mounted in an enclosed frame. The drum is armed with ranges of powerful hooked teeth or spikes, and is geared to rotate with great rapidity, making about 500 revolutions per minute. The smaller cylinders, called workers, are also provided with strong spikes; they are mounted over the drum and revolve more slowly in a direction contrary to the drum, the spikes of which just clear those of the workers. The wool is fed into the drum, which carries it round with great velocity; but, as it passes on, the locks are caught by the spikes of the workers, and in the contest for possessing the wool the matted locks are torn asunder till the whole wool is delivered in a light, free and disentangled condition. It is a debatable point as to whether willowing should precede scouring.

Burring.—For certain classes of wool, notably Buenos Aires, still another preparing operation is essential at this stage—that is, the removal of burrs or small persistently adherent seeds and other fragments of vegetable matter which remain in the wool. Two methods of effecting this—one chemical, the other mechanical—may be pursued. The chemical treatment consists in steeping the wool in a dilute solution of sulphuric acid (or other carbonizing agent), draining off the dilute acid by means of the hydro extractor, and then heat-drying in a temperature of about 250° F. The acid leaves the wool practically uninjured, but is concentrated on the more absorbent vegetable matter, and the high heat causes it to act so that the vegetable matter becomes completely carbonized. The burrs are then crushed and the wool washed in water rendered sufficiently alkaline to neutralize any free acid which may remain, and dried. The same burr-removing effect is obtained by the use of a solution of chloride of aluminium, a method said to be safer for the wool and less hurtful to the attendant workmen than is the sulphuric acid process. For mechanical removing of burrs, a machine something like the Willey in appearance is employed. The main feature of this apparatus is a large drum or swift armed with fine short spikes curved slightly in the direction in which it rotates. By a series of beaters and circular brushes the wool is carried to and fed on these short spikes, and in its rotation the burrs, owing to their weight, hang out from the swift. The swift as it travels round is met by a series of three burring rollers rotating in an opposite direction, the projecting tails of which knock the burrs off the wool. The burrs fall on a grating and are ejected, with a certain amount of wool adhering to them, by another rotating cylinder. With wools not too burry the worsted spinner largely depends upon burring rollers placed upon the first cylinder of the "carder," and possibly to one or other of the patent pulverizing processes applied further on in the card. In the latter process a complete pulverizing of the burrs is aimed at, this being effected by the introduction of specially constructed pulverizing rollers between the first doffer and the last swift of the carding engine. Wooled skins are now successfully deburred by a new machine—an Australian invention. (A. F. B.)

Wool in the United States.—The three types of wool produced in the United States are usually classed as fine, medium, and low. Fine wools come from the Merino and Rambouillet breeds of sheep or crossbreds which show a preponderance of Rambouillet or Merino blood. They vary from 1 to 4 in. in length. The United States Department of Agriculture estimated 48,414,000 sheep shorn in 1940, producing 388,692,000lb. of wool, 65% being of the fine-woolled type, called fine and half-blood or 64s/70s and 60s, English designation.

The fineness, crimp, elasticity and good felting properties make the longer-stapled fibres, $1\frac{1}{4}$ in. and over, most suitable for the finest worsted fabrics and the shorter-stapled for the choicest woollens and felts.

Medium wools, which are coarser and longer-stapled than the fine wools, come from the Down breeds of sheep: *i.e.*, Dorset, Southdown, Shropshire, Hampshire, Cheviot, and Oxford. These wools grade and are classed three-eighths blood and quarter-blood, the fleeces of the Cheviot and Oxford sheep usually being graded as low quarter-blood. These grades in the English count system are called 56s, 50s and 46s/48s.

The length of medium wool varies from 2 to 5 inches. This type of wool does not usually possess the elasticity and such well-defined crimp as the fine wools, but due to length and diameter of staple are adapted for the heavier worsted suitings and knitting yarns; the shorter-stapled wools being used in blankets, tweeds, overcoatings and other woollens.

The low wools, or "coarse wools" come from the Lincoln type of sheep, which would include the Cotswold and Leicester. The wool is graded as common and braid, the equivalent English terms being 40s/44s and 36s/40s. These fleeces are much coarser than medium wools, are very lustrous with the length of staple varying from 5 to 15 inches. The wools are adaptable for heavy, lustrous worsted yarns for linings and braids and are also used in the manufacture of paper makers' felts.

Wools grown in the United States are usually classed as territory and domestic. The territory wools are grown in the States of Montana, Wyoming, Idaho, Nevada, Utah, Arizona, New Mexico, Colorado, the Dakotas, Nebraska, and Western Kansas. Those grown in Texas, California, Oregon, and Washington are designated by the name of the State. Domestic wools are grown east of the States mentioned; these wools are also called fleece wools or fleeces.

Fine woolled breeds of sheep, having a natural tendency to herd and being hardy, are more suitable for western ranges than the medium and coarse woolled types. Some medium wool is grown on the farms bordering rivers and on small ranches. Texas and California wools, though grown far apart, have characteristic elasticity, strength, and fineness which distinguish them from the western-grown wools. Double shearing, spring and fall, in Southwest Texas and Southern California, results in a large production of quite short, though very desirable wools. Texas is the largest producing State, growing in 1940, 83,648,000lb. of wool, Wyoming second with 32,456,000lb., and Montana third with 28,384,000 pounds. Eastern Oregon wools, grown east of the Cascade mountains, are nearer to the Merino type and are noted for their fair length and strong staple. Washington wools are heavy in shrinkage, some clips containing 75% of dirt and grease.

New England, up to 1840, was the largest wool producing area, but with the opening up of new lands in the Middle West, with better systems of transportation, the sheep-growing industry centred in the States bordering the Ohio, Mississippi, and Missouri rivers. Ohio is the largest sheep-growing State in the Middle West, raising in 1940 18,200,000lb. of wool. Both Ohio and Michigan raise a large quantity of fine wool from Merino and Rambouillet sheep. The bulk of the wool grown in the so-called fleece wool States is of the medium order, grown principally from Shropshires, Hampshires, and other Down breeds. There are some purebred fine-woolled flocks in Western Pennsylvania and in West Virginia. (C. M. AL.)

WOOL, WAR CONTROL OF. Wool is an indispensable article in war. No fibre has yet been discovered, the properties of which can equal, for the clothing of armies, its hygienic and durable qualities; whilst for munition purposes, such as felt washers, for shells, guns, submarine and aeroplane engines, torpedoes, tanks, etc. and other equipment such as water bottle covers, wool is essential. A soldier's clothing and equipment con-

sumes on a war basis from four to ten times the average wool consumption of a civilian in times of peace.

The question of wool supplies during the World War was in part met by each country from its domestic production, and by the utilisation of old woollens in the manufacture of new goods. By this latter method and by substitution by inferior materials, the German armies, in fact, maintained their military clothing supplies throughout the war on a level of efficiency adequate for their purpose, in spite of the Allied blockade which effectually prevented supplies of overseas wool from reaching Germany and her Allies. Germany achieved this, however, at the expense of her non-combatants, who had to rely largely upon inferior substitutes for all their textile requirements.

From the point of view of the Allies the importance of conserving supplies could not be minimised. It was true that 85% of the wool production of Australia consisted of the finer merino quality not specially required for military purposes. After some discussion, however, the British Government agreed in the autumn of 1916 to purchase the whole wool production, excluding local manufacturing requirements, of Australia and New Zealand on a f.o.b. basis of 55% over average pre war prices (1913–14) with the stipulation that this price should be maintained for all military and other Government requirements both of Great Britain and of her Allies, but that in respect of civil consumption the fullest possible price should be obtained, and any net profit resulting be divided equally between the Treasuries of the imperial Government and the Governments of the commonwealth and the dominion. The purchase was repeated in practically the same terms for the 1917–18 and 1918–19 seasons.

In 1915 the French Government had requisitioned its domestic wool clip on a price basis 25% over pre war, in 1916 the British Government requisitioned the British domestic clip on a level of 35% over pre war prices. The latter was a gesture rather than a necessity. In 1917 the price paid for the British clip was raised to 50% over pre war prices and in 1918 to 60%.

Institution of Control.—Owing mainly to factors external to its own peculiar difficulties the War Office in the autumn of 1916 found itself launched on a huge wool purchase scheme and had immediately to devise ways and means of dealing with the raw wool which it now owned. In the first place, arrangements were made with the shipping authorities by which the wool was brought from Australasia by requisitioned shipping at Blue Book rates. Special storage and transport arrangements had to be improvised both in Australia and at British ports. In the previous spring an organisation had been set up by the War Office for the valuation, collection, and distribution of the British domestic clip, a relatively small matter of 120,000,000 lb. The Australian and New Zealand clips, amounting to about 1,000,000,000 lb., were valued, collected, and brought to Australasian ports by a machinery set up by the selling brokers and other trade organisations under the supervision of their Governments, which worked amazingly well within a very short time. When it is realised that whilst the average price of Australian wool was 15½d. there were almost a thousand different prices in the schedules prepared, the detailed work of valuation alone will be appreciated.

The War Office then expanded its British wool purchase executive under a wool controller to deal with the supplies of colonial wool now coming forward. The distribution of wool and tops to manufacturers at fixed prices made it possible to fix also the prices at which the finished cloth was to be delivered. In making purchases of cloth and other textiles, the War Office contracts department up to the end of 1916 endeavoured to purchase within fixed prices, but owing to rising prices of raw material this method in practice broke down. Not only was wool now issued for military but also for civilian purposes, whilst control of the raw material gave automatically the opportunity of controlling the use to which machinery should be put and ensured the supply of finished war material at fixed prices. To cope with these difficult problems a department of wool textile production was set up. The shipping and political factors involved were not known by and could not, therefore, be justly appreciated by the trade. It seemed, indeed, to a vast majority of those in the wool textile industry that an unnecessary degree of State control and interference had been instituted and this was vigorously opposed. As a method of understanding, a board of control of the wool textile industries was set up consisting of Government officials, mainly brought in from the trade, employers' and also trade union representatives. This board in practice represented a buffer between the War Office and the trade, and under its auspices problems concerning the rationing and control of civilian trade were decentralised. The responsibility, however, for meeting the increasingly growing demands not only of the British military, naval, and air forces, but of the armies of Russia, Belgium, Serbia and to a certain extent of Italy and France, and later the entire equipment in Europe of the American troops, remained with the responsible officials. In addition they were responsible for supplies of essential public services, both voluntary and Government, throughout the empire, including the Red Cross and prisoners of war organisations, post office, police and municipal requirements at home and abroad, women's organisations, as well as such services as the Indian and Egyptian Government services, together with the initiation and control of standard clothing schemes for the civil population and for the needs of demobilisation after the war.

In March 1918, when the British armies lost large reserves of stores in France, and the demands of the Allies and America were rapidly increasing, the department had to extend its production by over one million yards of material per week. It did this without apparent difficulty. A costings department was set up to investigate and fix conversion costs at each stage of production, but owing to technical complications the fixing of these rates was a most difficult business. The practical workings of a central statistical and costings staff necessarily lacked the flexibility of the normal play of individual units in competition. The system inevitably tended to fix the recognised conversion rate in excess of average efficiency, for otherwise output suffered.

Success of the Scheme.—Viewed broadly the scheme achieved its object. It produced necessary supplies at a calculable price. To produce the varied and changing demands of peace at competitive prices, the system must have broken down, but to meet a fairly standardised demand, in which finance as the governing factor was absent, the system was satisfactory, and inevitable in the circumstances of war.

The wool purchase scheme was of special benefit to Australia and New Zealand. During the first year of the purchase the imperial Government paid to the commonwealth and dominion Governments £25,000,000 and received for sales £330,000. By June 1918, it had paid out over £100,000,000 and received not much more than £50,000,000 by the end of 1919. A year after the war the imperial Government had expended many millions sterling in the purchase of wool more than it had received and at the conclusion of hostilities it was responsible for about £75,000,000 of wool accumulated in Australasian ports owing to lack of shipping to transport it. In addition, an arrangement was entered into by the surveyor-general of supply, who had been appointed in 1917 to control all War Office supply services, by which one clear season's (1919–20) wool clip after the war was purchased by the imperial Government. During the war a large part of the South African clip was also purchased, on optional terms to growers, as well as that of the Falkland islands and of Iceland (from which country wool cargoes had been running the North sea blockade). East Indian wool was marketed at fixed levels of prices under a special scheme. Numerous proposals were from time to time put forward for the purchase of the wool clips of South America but were in turn all vetoed by the Treasury owing mainly to exchange difficulties.

In all 9,895,000 bales (approximately 3,250,000,000 lb. of wool) were purchased, for which approximately £300,000,000 was paid and a net profit of £70,000,000 was divided equally between the British and colonial Governments. The aggregate sales of British wool amounted to £40,000,000 on which a profit of £5,000,000 was made. Within one year of the war the whole organisation of the department of wool textile production was liquidated, but owing to the new arrangement made with regard

to the further purchase, wool control was maintained, and a wool control board set up to advise the War Office and the liquidation commission concerning the various post-war questions which arose.

Government wool control continued until 1921, when its functions were taken over by a company, called the British Australian Wool Realisation Association, referred to as B.A.W.R.A. This rearrangement was made in order to avoid the restrictions and international complications which direct Government trading involved, and, incidentally, to minimise domestic political interference. During the post-war period the policy was followed of establishing price by the release of wool at auction at calculated quantities and at reserve prices based upon estimates prepared from centralised Government and other statistics, and this for a short time appeared very successful. The basing of potential consumption figures upon such estimates proved, however, within a short time unreliable. In spite of having at its command the fullest possible information, and in addition, being in the enormously strong position of the largest holder of wool stocks, the wool control was unable to make any estimate of a useful nature of future wool consumption, or to control the market, and as a result its predictions on price did not eventuate, and sudden and severe slumps overwhelmed the world wool trade both in 1920 and 1924. Apart, however, from this post-war experiment, which endeavoured somewhat unsuccessfully to control prices, it is generally conceded that the wool control exercised during the war was justified in the circumstances and by its results. (E. F. H.)

WOOL COMBING: *see* COMBING.

WOOLF, VIRGINIA (?–1941), English writer, daughter of Sir Leslie Stephen, married in 1912 Leonard Woolf. They controlled the Hogarth Press, which published most of her books. Her first novel, *The Voyage Out* (1915), was realized to be a remarkable book, and its success was followed up with *Night and Day* (1919) and *Jacob's Room* (1922). Meanwhile, Mrs. Woolf had published several shorter experiments in a new method, which were collected in *Monday or Tuesday* (1921). In this new style were written her next novels, *Mrs. Dalloway* (1925), *To the Lighthouse* (1927), and, to a lesser extent, *Orlando*, a "biography" (1928). Among her later novels, *The Years* (1937) was especially acclaimed by critics (with whom, incidentally, she was in constant argument). Instead of writing novels in which the thoughts of the characters are to be deduced from what they say and do, or in which the thoughts of individuals are recorded to show to what sort of person they belong, Mrs. Woolf chose to write novels in which thought is so minutely revealed that words and actions lose much of their importance. The merit of her books lies partly in her understanding of those about whom she wrote, partly in the felicity with which she used words. These gifts placed her among the best literary critics of her time; she published critical essays, *The Common Reader* (1925) and *The Common Reader, Second Series* (1932).

Mrs. Woolf was drowned near Lewes, Sussex, March 28, 1941, and the coroner returned a verdict of suicide.

WOOLLEN MANUFACTURE. The processes described in the article WOOL are common to English, cross-bred and botany wools, whether intended for woollen or for worsted yarns. From this point, however, differentiation starts. Wool may be manipulated with the idea of converting it into felt (*q.v.*), "woollen" fabrics or "worsted" fabrics.

Woollen and Worsted.—In a general way it may be said that *woollen* yarns are those made from short wools usually possessed of high felting qualities. These are prepared for spinning by the process of *carding*, a process which so thoroughly blends or mixes the fibres—long and short, black and white or coloured, or even of different materials—that a homogeneous fibrous mass in broad film form is obtained, which is then divided up longitudinally, as it emerges from the carder, into a number of pith-like filaments. These filaments are then extended into finer filaments and twisted to form the woollen thread upon the mule or mule-frame.

On the other hand *worsted* yarns are generally made from the long lustrous varieties of wool; the fibres are so combed as to bring them as far as possible parallel to each other; the spinning is usually effected on the frame, and the yarn is spun into a compact, smooth and level thread, which, when woven into cloth, is not necessarily milled or felted. At all points, however, woollen and worsted yarns and cloths as thus defined overlap each other, some woollens being made from longer wool than certain worsteds, and some worsteds made from short staple wool, carded as well as combed. The most fundamental distinction between the two rests in the crossing and intercrossing of the fibres in preparing woollen yarn, while for worsted yarn the fibres are treated by processes designed to bring them into a smooth parallel relationship to each other.

Woollen Yarn Manufacture.—To obtain a sliver which can be satisfactorily spun into a typical woollen thread the following operations are necessary: willowing, oiling and blending, teasing, carding (two or three operations), condensing and possibly roving. Spinning upon the woollen mule or frame completes the series of operations all of which are designed to lead up to the desired result. Of the foregoing operations the carding is perhaps the most important as it is certainly one of the most interesting. At the same time it must be fully realized that deficiencies in any one of these operations will result in bad work at every subsequent process. For example, let an unsatisfactory combination of materials be blended together and there will be trouble in both carding and spinning. The roving operation included above is not always necessary. In the old days, if a really fine thread were required, roving was absolutely necessary, as the carder could not turn off a sliver fine enough to be spun at one operation. To-day, however, with the "tape" condensers, such fine slivers can be turned off the condenser that it is easy to spin directly to the required count.

Blending and Oiling.—At the beginning of the 19th century woollen cloths were made of wool—some of them of the very finest wool obtainable. To-day woollen cloths are made from any and every kind of material, of which the following are the most important: noils (botany, cross-bred, English, alpaca and mohair), mungo, shoddy, extract, flocks, fud (short mill waste), cotton sweeping, silk waste, etc.; in fact it is said that anything which has two ends to it can be incorporated into a woollen thread and cloth. It does not follow, however, that all woollen cloth is cheap and nasty. On the contrary the west of England still produces the finest woollen fabrics of really marvellous texture and beauty, and Batley, Dewsbury, etc., produce many fabrics which are certainly cheap and yet not cheap appearing. The first essential for blending is that the materials to be blended should be fairly opened out. This is effected by passing each material, if necessary, through the willow or through the "fearnaught"—a machine coming between the willow and card—prior to beginning the "blend-stack." Sometimes it may be that a blending of different colours of wools to obtain a definite "colour mixture" is necessary, more often it will be a blending of various materials, such as noils, mungo, cotton, etc., to obtain a cheap blend which may be spun into a satisfactory warp or weft yarn. The blender proceeds as follows: first a layer of No. 1 material—say wool—is spread over the required area on the floor; it is then lightly oiled. A layer of No. 2 material—say noils—is now added to the first layer; then another layer of wool with rather more oiling; then No. 2, then No. 1 with still more oil until all the material is built up into layers in the stack. The stack is now beaten down sideways with sticks or pulled, and then the more or less mixed mass is passed through the willow and fearnaught still further to mix it prior to carding, where the true and really fine mixing takes place. After passing through the fearnaught the material is sheeted and left to "mellow," this no doubt consisting in the oil applied distributing itself throughout the material. If wool and cotton are blended together the wool must be oiled first, or the blend will not work to the greatest advantage. The oil may be best Gallipoli olive oil—which should not turn rancid—but there are many good oils—and unfortunately many bad oils—placed on the market at a reasonable rate which the really skilled judge may use to advantage. The percentage of oil varies from 2% to 12%—this remark applies both to the woollen and worsted trades—and there is no guide as to the amount required, saving and excepting experience, observation and common sense. Automatic oiling arrangements have now been applied in the woollen trade with a considerable amount of success, the sprink-

ling of the oil by means of a watering-can on the stack, made as described above, still being much in favour. The oil serves to lubricate the fibres, and to render them more plastic and consequently more workable, and to hold the fibrous mass together and thus prevent "fly" during the passage through the cards.

Carding.—Carding was originally effected by hand, two flat boards with convenient handles, covered with teeth or card cloth-

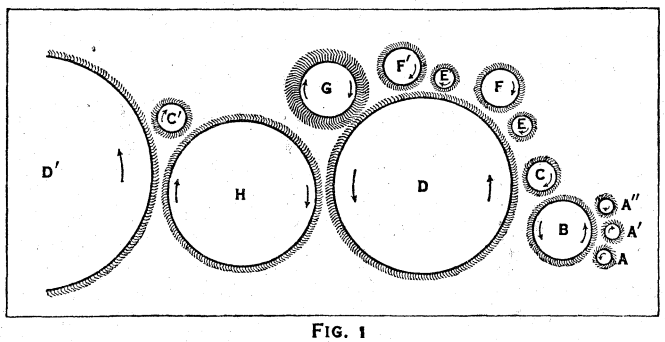


FIG. 1

ing, serving as a means of teasing out lock by lock, fibre by fibre, reversing root to tip and tip to root, so that a perfect mixing of the fibres resulted. It was but natural that, when an attempt was made to render the carding operation more mechanical, the operation should be converted into a continuous one through the adoption of rollers in place of flats. Flats combined with rollers still maintain their position in cotton carding, but in wool carding the pure roller card is employed. The factors of carding are size of rollers, speeds of rollers, inclination and shape of teeth and density of card clothing. Probably no operation in the textile industries is so little understood as carding. Thus the long wool carder would think a man an idiot who suggested the running of the teeth of the various cylinders actually into one another, while the short mungo carder regularly carries out this idea, and so on. The underlying principle of carding, however, is shown in fig. 1, in which a sectional drawing of part of a card is given. The wool is carried into the machine on a travelling lattice and delivered to the feed rollers A, A′, A″ of which A and A″ in turn are stripped by the licker-in B working at a greater speed point to smooth side. This in turn is stripped by the angle stripper C again working at a greater speed point to smooth side, which in its turn is stripped by the breast D —the "carrying-forward" and swiftest carding cylinder in the machine. The swift carries the wool forward past the stripper E—which as a matter of fact is stripped by the swift still working point to smooth side—into the slowly retreating teeth of the first worker F, which, being set a fair distance from the swift, just allows well laid-down wool to pass, but catches any projecting and uncarded staples. The worker in its turn is stripped by the stripper E, which in turn is stripped by the swift as already described. The passage of the wool forward through the machine depends upon its being carried past each worker in turn. Thus from beginning to end of a machine the workers are set closer and closer to the swift, so that the last worker only allows completely carded wool to pass it. Immediately on passing the last worker F′ the wool is brushed up on the surface of the swift by the "fancy" G—as a rule the only cylinder whose teeth actually work into the teeth of the swift and the only cylinder with a greater surface speed than the swift. The swift then throws its brushed-up coating of wool into the slowly retreating teeth of the doffer H, which carries it forward until angle stripper C′ strips the doffer, to be in its turn stripped by swift D′ and so on. The speeds of the cylinders are in the first place obviously dependent upon the principle of carding adopted, the greater speed always stripping (save in the case of the fancy). As to whether the speed shall be obtained by actual revolutions or by a larger diameter of cylinder depends upon the nature of the wool to be carded (long or short), the part which each cylinder has to play in the card, and upon the question of wear of clothing and power consumed. As a rule the strippers are all driven from a smaller circumference of the swift to obtain conveniently the necessary reduction in speed, and the slowly revolving workers are chain driven from the doffer, which indirectly receives its motion from the swift. The principles involved in the relative inclinations of teeth are very apparent, but the principles involved in the relative densities of teeth on the respective cylinders are again much involved and little understood.

A complete scribbler or first card engine consists of a breast, or small swift, and two swifts with the accompanying workers, strippers, fancies, doffers, etc. The wool is stripped from this card as a thin film by means of the doffing comb. This film is sometimes weighed on to the next machine—whether intermediate or condenser—a given weight giving a definite count of condensed sliver. Should an intermediate carder be employed, there must be an automatic feed, taking the wool, as stripped from the last doffer of the intermediate, and cross-feeding it evenly on to the feed sheet of the condenser. It is now more usual to automatically weigh into the scribbler and automatically feed the condenser or, if an intermediate is employed, both the intermediate and condenser. The condenser is a one-swifted or two-swifted card, the only difference in principle being that, whereas the sliver comes out of the scribbler or intermediate in one broad film, it is broken up into a number of small continuous slivers or films as it issues from the condenser, each one of which will ultimately be drafted or drawn out and twisted into a more or less perfect thread. These slivers—which are delicate and pith-like in substance—are wound on to light bobbins, and these bobbins are placed on the mule for the roving, or final spinning operations. There are many forms of condensing mechanisms such as the single-doffer, the double-doffer and the tape-condensers, which cannot be described here.

Mule Spinning.—The principles involved in mule spinning are comparatively simple, but the necessary machinery is very complex; indeed it is questionable if a more ingenious machine than the mule exists. The pith-like slivers received from the card must be attenuated until the correct count of yarn is obtained; they must be twisted while this attenuation or drafting is in process, otherwise they would at once break; and after being attenuated to the required fineness the requisite number of turns must be inserted. Great stress must be laid on the effects of what is termed the "drafting-twist" noted above; it is probably this simultaneous drafting and twisting which develops the most pronounced characteristics of the woollen yarn and cloth, and differentiates it entirely from the worsted yarn and cloth. The mule (*see* fig. 2) consists fundamentally of the delivery cylinders A, upon which the sliver bobbins B from the condenser are placed, which deliver the slivers as required to the front delivery rollers C (these rollers controlling perfectly the delivery of sliver for each stretch of the carriage), and the carriage EE carrying the spindles which may be

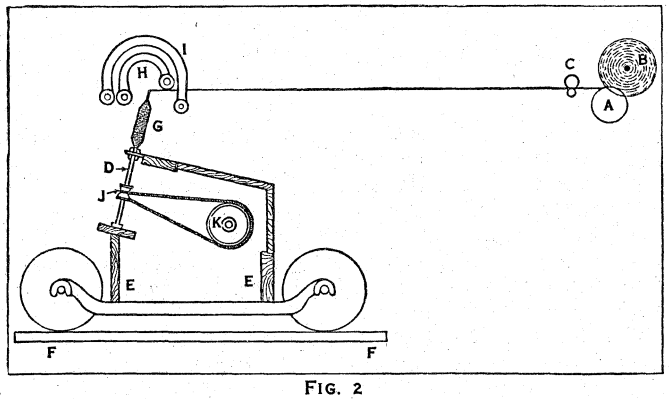


FIG. 2

run close up to the front delivery rollers and about two yards away from them to effect the "spin," which is of an intermittent character. The spindles D are turned by bands passing round a tin drum K in the carriage, but this motion, and every other motion in the mule, is controlled perfectly from the headstock. In brief, the operation of spinning is as follows: as the carriage begins to recede from the delivery rollers these rollers deliver condensed sliver at about the same rate as the carriage with its spindles moves out, the spindles putting in a little twist. When the carriage has perhaps completed half its traverse (say 36″) away

from the front rollers these suddenly stop delivering the condensed sliver, the carriage travelling more and more slowly outwards until it completes its traverse, drafting the sliver out to perhaps double the length. This drafting could not be effected but for the "drafting-twist," which, running into the thin parts of the yarn during drafting, strengthens them and thus from beginning to end equalizes the thread. Upon the completion of drafting the spindles are thrown on to "double speed" to complete the twisting of the 72″ of yarn just spun as rapidly as possible, the carriage being allowed to run inwards for a few inches, to allow for the take-up due to twisting. The mule now stops dead, backs-off the turns of yarn from the top of the spindle to the bottom, the faller H wire falls into position to guide the thread on to the spindle to form the required cop G, and the counter-faller I wire rises to maintain a nice tension on the yarn. The carriage now runs in, the spindles being revolved to wind up the yarn, and, in conjunction with the guiding on of the faller wire, builds up a firm cop or spool.

Woollen mules are made with several hundred spindles and of varying pitch to suit particular requirements. Thus if the mules are to follow a set of say three machines with a tape condenser, and are required to spin fine counts, the pitch of the spindles may be much finer than ordinarily, but a greater number will be required to work up the sliver delivered by the set of machines. There are many other details which require careful consideration; the inclination of the spindles, for example, must be suited to the material to be spun.

The mule-frame to which reference has been made is a ring-spinning frame arranged to spin condensed woollen slivers continuously, thus producing about double the weight per spindle as compared with the intermittent mule. Drafting-twist is introduced in this case between two pairs of drafting rollers by a "twizzler" which, however, only inserts false twist. The true twist is inserted later by the spindle and traveller. This method of spinning necessitates more twist than that necessary in mule spinning so that "frame" woollen yarn is most suitable for warp and is usually not soft enough for weft yarn.

The yarn as delivered by the mule is "single" and will serve as warp or weft for the great bulk of woollen cloths, warp being as a rule twisted harder than weft. Sometimes for strength, sometimes for colour, however, it will be necessary to twist two or more of these single strands together. This is best effected on a twisting frame of the ring type, which consists of delivery rollers, to deliver a specified length of yarn in relationship to the turns of the spindles, and the spindles, which serve to put in twist and to wind the yarn upon the bobbin or tube, which they effect by reason of the retarding action of the traveller. Fancy twists such as knops, loops, slubs, etc., may also be produced if the frame is fitted up with two pairs of delivery rollers and two or three special but simple appliances.

For woollen and worsted weaving, *see* WORSTED MANUFACTURE.

(A. F. B.)

WOOLLEY, MARY EMMA (1863–), American educationist was born at South Norwalk (Conn.), on July 13, 1863. She was instructor at Wheaton college, Norton (Mass.), 1886–91, before going to Brown university, where she graduated in 1894. She was a teacher of biblical history in Wellesley college, 1895–98, becoming in the latter year professor and head of the department of biblical history and literature. From 1900 to 1937 she was president of Mount Holyoke college and became one of the most influential women educators in the United States.

WOOLLY APPLE APHID, an American aphid (*Eriosoma lanigera*), sometimes called the woolly root-louse of the apple. Although of American origin, this insect has become a cosmopolitan pest of the apple and pear. Making its appearance in England toward the close of the 18th century, it became known as the American blight; and either from England or from America it has been carried to many different parts of the world, probably on nursery stock. It is likely to have been an indigenous pest of Crataegus and to have established at a very early date an alternate food plant in the American elm.

In the northern part of the United States and in general throughout its whole northern range, the insect lives almost entirely upon the roots of its host plants, causing swellings and other deformations and interfering seriously with the sap flow. In the southern part of its range it lives for the most part above ground, preferably upon suckers from the trunks but also upon normal twigs and even upon leaves. In south England and most parts of Europe, the aerial form predominates. This form is concentrated upon the tender growth and is conspicuous, the colonies appearing as whitish cottony masses beneath which are the reddish insects themselves. The winter eggs are laid in crevices of the bark on elm and occasionally on apple, and hatch in the spring. They develop parthenogenetically, winged forms appearing occasionally, by means of which the insect spreads. In the United States, the fourth generation is winged and migrates from elm to apple. There are usually seven generations each summer.

At present the insect is known in nearly all the European countries, in a number of South American countries, and also in Japan, Australia and New Zealand. It has many natural enemies among the insects, just as all plant lice have, and it has one specific parasite—*Aphelinus mali*—which since 1920 has been carried from America to many countries and has been acclimatized in France, Italy, Uruguay, South Africa, Australia and New Zealand.

(L. O. H.)

WOOLMAN, JOHN (1720–1772), U.S. Quaker preacher, was born in Northampton township, Burlington county (N.J.), Oct. 19, 1720, the son, according to himself, "of religious parents," for whom "he wrought on the plantation." Although he chronicles some small faults in his youth, the majority of his life was one of the most unaffected piety, humility, and devotion to the cause of mankind. In 1772 he sailed for London to visit Friends in the north of England, especially Yorkshire, and died in York of smallpox, Oct. 7. He spoke and wrote against slavery, refused to draw up wills transferring slaves, induced many of the Friends to set their Negroes free, and during the yearly meeting in 1760 at Newport (R.I.), urged the submission to the legislature of a petition he had prepared forbidding the slave trade. In 1763, in spite of the dangers, he "felt inward drawings" to preach to the Indians at Wehaloosing (now Wyalusing), on the Susquehanna. For the fate of the red man his heart yearned, as it did for the Negro and the poor white. He was particularly concerned about the sale of rum to the Indians, and about the loss of their lands through the superior cunning and force of civilized man. Nevertheless remembering "that the people on the frontiers, among whom this evil is too common, are often poor," he was "renewedly confirmed in a belief that, if all inhabitants lived according to sound wisdom, labouring to promote universal love and righteousness, and ceased from every inordinate desire after wealth, and from all customs which are tinctured with luxury, the way would be easy to live comfortably on honest employments," without temptation to unjust dealing.

Woolman's writings include *Some Considerations on the Keeping of Negroes* (1854; part ii., 1862); *Considerations on Pure Wisdom and Human Policy, on Labour, on Schools, on the Right Use of the Lord's Outward Gifts* (1758); *Considerations on the True Harmony of Mankind, and How it is to be Maintained* (1770); *A Word of Remembrance and Caution to the Rich* (1793); and the most important of his works, the *Journal* (1774), which was begun in his 36th year and was continued until the year of his death.

The works of John Woolman appeared in two parts in 1774 and have been frequently reprinted. The best-known edition of the *Journal* is that prepared, with an introduction, by John G. Whittier in 1871; it was translated into French and German; and it is in Everyman's Library. The most recent and scholarly edition is *The Journal and Essays of John Woolman*, edited from the original manuscripts with a biographical introduction by Amelia M. Gummere (1922). *See* also W. T. Shore, *John Woolman: His Life and Our Times* (1913); Janet Whitney, *John Woolman, American Quaker* (1942).

WOOLSACK, a sack stuffed with wool and covered with red cloth upon which the lord chancellor sits in the House of Lords. Originally there were four woolsacks in the parliament chamber, upon which were seated the judges, barons of the exchequer, serjeants-at-law and masters in chancery. The uppermost woolsack now alone survives, but it is regarded as technically outside the precincts of the House.

WOOLSEY, THEODORE DWIGHT (1801–1889), American educationalist, born in New York city Oct. 31, 1801. He was the son of a New York merchant, a nephew of Timothy Dwight, president of Yale, and a descendant of Jonathan Edwards. He graduated at Yale at the head of his class in 1820: became a tutor there after studying theology and law at Princeton, in 1823–25; studied Greek at Leipzig, Berlin and Bonn in 1827–30; became professor of Greek language and literature at Yale in 1831; and was elected president of the college and entered the Congregational ministry in 1846. He resigned the presidency in 1871, and died July 1, 1889, in New Haven. During his administration the college grew rapidly, the scientific school and the school of fine arts were established, and the scholarly tone of the college was greatly improved. Much of his attention in his last years was devoted to the American commission for the revision of the authorized version of the New Testament, of which he was chairman (1871–81). He prepared excellent editions of *Alcestis* (1834), *Antigone* (1835), *Prometheus* (1837) and *Gorgias* (1843). He published several volumes of sermons and wrote for various periodicals. His *Introduction to the Study of International Law* (1860) and his *Essay on Divorce and Divorce Legislation* (1869) went through many editions. He also wrote *Political Science* (1877), and *Communism and Socialism* (1880).

See the memorial address by President Timothy Dwight (1890), and *Theodore Dwight Woolsey—A Biographical Sketch* by his son T. S. Woolsey (1912), also in the *Yale Review* (new ser., vol. 1).

WOOLSTON, THOMAS (1669–1731), English deist, born at Northampton in 1669, entered Sidney college, Cambridge, in 1685, and was made a fellow. After studying Origen, he devoted himself to the allegorical interpretation of Scripture, and advocated its use in his first book, *The Old Apology for the Truth of the Christian Religion against the Jews and Gentiles Revived* (1705). In 1720–21 his open challenges to the clergy brought him into trouble. It was reported that his mind was disordered, and he lost his fellowship. From 1721 he lived in London, on an allowance of £30 a year from his brother, and other presents. His influence on the deistical controversy began with his book, *The Moderator between an Infidel and an Apostate* (1725, 3rd ed. 1729). The "infidel" was Anthony Collins (*q.v.*). Woolston denied the proof from miracles, called in question the resurrection of Christ and other miracles of the New Testament, and maintained that they must be interpreted as types of spiritual things. Two years later in a series of *Discourses,* he applied his principles to the miracles in detail. The *Discourses,* 30,000 copies of which were apparently sold, were six in number, the first appearing in 1727, the next five 1728–1729, with two *Defences* in 1729–1730. For these publications he was tried before Chief Justice Raymond in 1729 and sentenced (November 28) to pay a fine of £25 for each of the first four *Discourses,* with imprisonment till paid, and also to a year's imprisonment and to give security for his good behaviour during life. He failed to find this security, and remained in confinement until his death on Jan. 21, 1731.

See *Life* of Woolston prefixed to his *Works* in five volumes (London, 1733); *Memoirs of Life and Writings of William Whiston* (London, 1749, pp. 231–235); Appendix to *A Vindication of the Miracles of our Saviour, etc.,* by J. Ray (2nd ed., 1731); J. Cairns, *Unbelief in the Eighteenth Century* (1880); Sayous, *Les Déistes anglais* (1882); and the article DEISM, with its bibliography.

WOOLWICH, a metropolitan borough of London, England. Pop. (est. 1938) 150,900, area 14.04 sq.mi. It lies mainly north of the river Thames. The most populous part is situated between Shooter's Hill road and the river, the site falling from an elevation of 418 ft. to the river level. To the east lie the Plumstead marshes and to the south in the borough is Eltham. The three parishes of Woolwich, Plumstead and Eltham were combined in 1930.

Woolwich (Wulewich) is mentioned in a grant of land by King Edward in 964 to the abbey of St. Peter at Ghent. In Domesday the manor is mentioned as consisting of 63 ac. of land. The Roman Watling street crossed Shooter's hill. Numerous Roman urns and fragments of pottery have been dug up. Early in the 16th century Woolwich rose into prominence as a dockyard and naval station. Ships were built there in the reign of Henry VII but it was with the purchase by Henry VIII of two parcels of land in the manor, called Boughton's Docks, that the foundation of the town's prosperity was laid, the launching of the "Harry Grâce de Dieu," of 1,000 tons burden, marking an epoch in its history. Woolwich remained the chief dockyard of the English navy until the introduction of iron ship building, but the dockyard was closed in 1869. The town became the headquarters of the royal artillery on the establishment of a special branch of the service in 1806. In 1664, land was acquired for storehouses and sheds for repairing ship's carriages. In 1667, batteries were erected against the invading Dutch fleet. In 1668 guns, carriages and stores were concentrated at Woolwich, and in 1695 the laboratory was moved thither from Greenwich. Before 1716 ordnance was obtained from private manufacturers and proved by the board of ordnance. In 1741 a school of instruction was established. It was not until 1805, however, that the establishments at Woolwich became the royal arsenal.

By the London Government act 1899 Woolwich was brought into line with other London districts. Woolwich returns two members to parliament. (X.)

Royal Military Academy.—The Academy, on Woolwich common and familiarly known as "the shop," dates from 1741. It was composed not only of cadets but also of young and untrained officers. Intended for the artillery and engineers, the curriculum also included a general education. The ages of the students varied from 10 to 30. Cadets were admitted on the nomination of the master-general of the ordnance without examination, but as many possessed no education whatever, an entrance examination of an easy character was introduced in 1774. This system has remained in force. In the early days discipline was of a low standard, and was enforced by corporal punishment or confinement to a dark cell on bread and water diet. The number of cadets in 1782 was 30, rising to 90 in 1812. By 1870 the strength had increased to about 150. From 1900 onwards the strength has varied between 200 and 250, except during World War I, when as many as 500 cadets were in residence. Between 1905 and 1911, owing to lack of accommodation at Sandhurst, cadets destined for infantry and cavalry were trained at Woolwich.

In 1806 buildings were erected on the present site and the academy was confined to cadets. Age limits for admission were fixed a few years later at 14 to 16, and in 1820 cadets were obliged to leave at the age of 20 or after having spent five years at the academy. In 1815 the rank of under officer (selected from cadets of the senior term) was instituted. In 1859 the east and west wings, gymnasium and racket courts were built.

The honour roll of the cadets includes Gen. Gordon (1852), the duke of Connaught (1867), Lord Kitchener (1868), and the prince imperial (1872). At the R.M.A. cadets are trained for commissions in the royal artillery, royal engineers, royal corps of signals and also for the Indian army (unattached list). A few vacancies are reserved for specially selected n.c.o.'s recommended for commissions, for nominations by the New Zealand government and for candidates recommended, among others, by the secretary of state for the colonies, governors-general of the dominions and the governors of Newfoundland, Northern Ireland and Southern Rhodesia. The course consists of three terms, of which there are two per year (Feb. 1 to mid-July, and from Sept. 1 to Christmas). Cadets enter each term at the age of 18 to 19. During World War II, a special course was given at certain universities to train candidates for emergency commissions.

The army entrance examination is conducted by the civil service commission. With the exception of certain candidates nominated by the army council, candidates are required to possess a school certificate before being permitted to sit for the examination. The cadets are organized in four half companies on the lines of an infantry battalion, and cadets of the senior term act as non-commissioned officers. The staff of the academy consists of a commandant, chief instructors and company officers for each half company (four), and a number of civilian instructors. These latter are especially responsible for instruction in non-military subjects, viz., imperial and foreign affairs, mathematics, science, languages. The military part of the course includes con-

duct of war, strategy, tactics and organization—illustrated from military history—map reading, military law, drill, riding and physical training. At the end of the course commissions are allotted in the three branches of the service according to existing vacancies—choice of corps being given to those high up in the order of passing out. The sons of officers of H.M. forces are, subject to certain conditions, admitted at a reduced rate and a limited number of cadets are admitted at still further reduced rates on account of pecuniary need at the discretion of the army council. A certain number of scholarships are available for cadets on entering the academy (awarded on results of army entrance examination) and other scholarships are available for cadets during their course, and for young officers during the first five years of their service. The conditions of admission, fees and the syllabus of the army entrance examination are subject to alteration at any time by the war office. (J. V. D.)

WOOLWORTH, FRANK WINFIELD (1852–1919), American merchant, was born near Rodman (N.Y.), April 13, 1852. In 1879 he opened in Utica (N.Y.) his first "five cent" store, which was a failure. Later in the same year he established a "five and ten cent" store in Lancaster (Pa.), followed by another in Harrisburg. When the F. W. Woolworth Co. was incorporated in New York in Dec. 1911 he became president. In 1912 the Woolworth building in New York city was completed from the designs of Cass Gilbert. It is 792ft. high, has 57 stories, and, excepting the Eiffel Tower in Paris, was the tallest building in the world at the time. He died at Glen Cove (L.I.), April 8, 1919, leaving an estate appraised at $27,000,000.

WOOLWORTH CO., F. W., an American chain store system, was started in Feb. 1879, in Utica, N.Y., by F. W. Woolworth (*q.v.*). Woolworth's brother, C. S. Woolworth, his cousin Seymour H. Knox and his close friends F. M. Kirby and E. P. Charlton, as well as his old mentor W. H. Moore, all started stores of their own after F. W. Woolworth.

All of these parties operated independent units until 1912 when they were merged into the present F. W. Woolworth Co. There were 598 stores in the combined organization on Jan. 1, 1912. By the year 1940 the American chain had grown to 2,021 stores, and the total sales had grown from $60,557,767 for the year 1912 to $318,839,663 for the year 1939 in the United States, Canada and Cuba. The stores of the F. W. Woolworth Co. are located in every State of the Union. In addition to the Canadian and Cuban stores, the F. W. Woolworth and Co., Ltd. of England, which started in 1910, operates 759 stores; and the F. W. Woolworth Co. of Germany, which started in 1927, operates 82 stores. The F. W. Woolworth Co. of New York holds the controlling interest in both the British and German companies.

WOONSOCKET, a city of Rhode Island, U.S.A., on the Blackstone river. Pop. (1920) 43,496 (37% foreign-born white, of whom over half were French Canadians); 1940 federal census 49,303. The river with its tributaries, the Mill and the Peters, provides abundant water power. The city manufactures woollen, worsted and rayon yarns; worsted and pile fabrics; machinery, tools and gauges and rubber products. The value of products in 1937 was $47,821,500. Assessed valuation for 1940 was $73,181,500. Settlement began about 1666, when Richard Arnold built a sawmill on the Blackstone. Woonsocket was separated from Cumberland and incorporated in 1867 and was chartered in 1888.

WOOSTER, a city of Ohio, U.S.A., the county seat of Wayne county; on the Lincoln highway. Population (1920) 8,204 (92% native white); 1940 by federal census, 11,543. It is the seat of the College of Wooster (Presbyterian; 1866), occupying a beautiful site of 100 ac. on a hill 1,100 ft. above sea level; and of the Ohio agricultural experiment station, which operates 3,300 ac. of farmlands and 100,000 ac. of forests and state parks. The city has the largest paint-brush factory in the United States and is headquarters of the oil and gas industry of the county, whose farms are nearly all under lease for drilling. Wooster was laid out in 1808, incorporated in 1817 and as a city in 1869. It was named in honour of Gen. David Wooster (1710–77).

WOOTTON BASSETT, a market town in Wiltshire, England, $5\frac{3}{4}$ mi. W. from Swindon on the G.W.R. Pop. (1931) 2,419. It is the junction of the railway between London and the Severn tunnel with the main line of the Great Western. Wootton Bassett received its first charter from Henry VI, and returned members to parliament from 1446–1447 until the Reform Act of 1832.

WORCESTER, EARLS AND MARQUESSES OF. Urso de Abitot, constable of Worcester castle and sheriff of Worcestershire, is erroneously said to have been created earl of Worcester in 1076. Waleran de Beaumont (1104–1166), count of Meulan in France, a partisan of King Stephen in his war with the empress Matilda, was probably earl of Worcester from 1136 to 1145. He was deprived of his earldom, became a crusader and died a monk. From 1397 to 1403 the earldom was held by Sir Thomas Percy (c. 1343–1403), who in 1403 joined the other Percies in their revolt; he was taken prisoner at Shrewsbury, and subsequently beheaded, the earldom becoming extinct. The title of earl of Worcester was revived in 1421 in favour of Richard Beauchamp, Lord Abergavenny, but lapsed on his death in 1422. The next earl was John Tiptoft, or Tibetot, a noted Yorkist leader during the wars of the Roses, who was executed in 1470. On the death of his son, Edward, in 1485 the earldom reverted to the crown.

In February 1514 the earldom was bestowed by Henry VIII. on CHARLES SOMERSET (*c.* 1460–1520), a bastard son of Henry Beaufort, duke of Somerset. Having married Elizabeth, daughter of William Herbert, earl of Huntingdon, he was styled Baron Herbert in right of his wife, and in 1506 he was created Baron Herbert of Ragland, Chepstow and Gower. He was chamberlain of the household to Henry VIII. His son Henry, 2nd earl (*c.* 1495–1548), obtained Tintern Abbey after the dissolution of the monasteries. The title descended in direct line to Henry, the 5th earl (1577–1646), who advanced large sums of money to Charles I. at the outbreak of the Great Rebellion, and was created marquess of Worcester in 1643.

EDWARD SOMERSET, 2nd marquess of Worcester (1601–1667), is better known by the title of earl of Glamorgan, this earldom having been conferred upon him, although somewhat irregularly, by Charles I. in 1644. Under the Commonwealth he was formally banished from England and his estates were seized. At the Restoration his estates were restored, and he claimed the dukedom of Somerset promised to him by Charles I., but he did not obtain this, nor was his earldom of Glamorgan recognized.

See Henry Dircks, *Life, Times and Scientific Labours of the 2nd Marquess of Worcester* (1865); Sir J. T. Gilbert, *History of the Irish Confederation and the War in Ireland* (Dubin, 1882–1891).

His only son HENRY (1629–1700), the 3rd marquess, abandoned the Roman Catholic religion and was a member of one of Cromwell's parliaments. But he was quietly loyal to Charles II., who in 1682 created him duke of Beaufort. As the defender of Bristol, the duke took a considerable part in checking the progress of the duke of Monmouth in 1685, but in 1688 he surrendered the city to William of Orange. He inherited Badminton, still the residence of the dukes of Beaufort, and died there on the 21st of January 1700. The Worcester title was henceforth merged in that of Beaufort (*q.v.*). Henry, the 7th duke (1792–1853), was one of the greatest sportsmen of his day, and the Badminton hunt owed much to him and his successors, the 8th duke (1824–1899) and 9th duke (1847–1924).

WORCESTER, WILLIAM (*c.* 1415–*c.* 1482), English chronicler, was a son of William of Worcester, a Bristol citizen, and is sometimes called William Botoner, his mother being a daughter of Thomas Botoner. He was educated at Oxford and became secretary to Sir John Fastolf. When the knight died in 1459, Worcester, although an executor, found that nothing had been bequeathed to him, and with a colleague, Sir William Yelverton, he disputed the will, obtaining some lands near Norwich and in Southwark. He died about 1482. His *Itinerarium* of England is of great value. Portions were printed by James Nasmith in 1778, and the part relating to Bristol is in James Dallaway's *Antiquities of Bristowe* (Bristol, 1834).

Worcester also wrote *Annales rerum Anglicarum*, a work of some value for the history of England under Henry VI. This was published by T. Hearne in 1728, and by Joseph Stevenson for the "Rolls" series

with his *Letters and Papers illustrative of the Wars of the English in France during the Reign of Henry VI* (1864). Stevenson also printed here collections of papers made by Worcester respecting the wars of the English in France and Normandy. Worcester's other writings include the last *Acta domini Johannis Fastolf. See* the *Paston Letters* edited by J. Gairdner (1904); and F. A. Gasquet, *An Old English Bible and other Essays* (1897).

WORCESTER, episcopal city, county and parliamentary borough and the county town of Worcestershire, England, 120½ mi. N.W. from London by the G.W.R., but served also by the L.M.S.R. Pop. (1938) 53,290. Area, 8.4 sq.mi.

The city is situated on a ridge parallel with the left bank of the river Severn, which is navigable here.

The cathedral church of Our Lord and the Blessed Virgin Mary is beautifully placed close to the river. The see was founded about 679, though owing to the opposition of the bishop of Lichfield it was not established till 780. (*See* WORCESTERSHIRE.) The bishop's church of St. Peter's, with its secular canons, was absorbed by Bishop Oswald into the monastery of St. Mary. The canons became monks, and in 983 Oswald finished the building of a new monastic cathedral. After the Norman Conquest the bishop of Worcester, Wulfstan, the only English prelate left in possession of his see, undertook the building of a Norman church. Of his work much remains, including (1084) one of the four apsidal crypts in England. The Norman cathedral was dedicated in 1218, and then the monks built a lady chapel and extended the building by 50 ft. In 1224 was begun the present splendid Early English choir. The nave was remodelled in the 14th century, and is principally Decorated early Perpendicular work. A Jesus chapel (an uncommon feature) is separated from the north aisle by a beautiful modern screen in the Perpendicular style. The exterior is plain, save the ornate tower, which dates from 1374, and is 196 ft. in height. The dimensions of the cathedral are—length 425 ft. (nave 170 ft., choir 180 ft.), width 145 ft. (choir 78 ft.), height of nave 68 ft. The cloisters are Perpendicular engrafted upon Norman walls. A Norman chapter house adjoins them, its Perpendicular roof supported on a central column, while on the south lies the Refectory, a fine Decorated room (1372) now the King's (or cathedral) school. There are also picturesque ruins of the guest hall (1320), which was still standing in 1860. A restoration was begun in 1857, considerably more than £100,000 being spent before the reopening in 1874.

Of the 11 parish churches, St. Alban's has considerable Norman remains, St. Peter's contains portions of all Gothic styles, St. Helen's has Gothic portions. The Commandery, founded in 1085, was a hospital. It was rebuilt in Tudor times, and there remains a beautiful hall, with music gallery, canopied dais, and a fine bay window, together with other parts. There are many old half-timbered houses. The guild-hall (1723) is an admirable building in the Italian style. The Festival of the Three Choirs is maintained here alternately with Gloucester and Hereford.

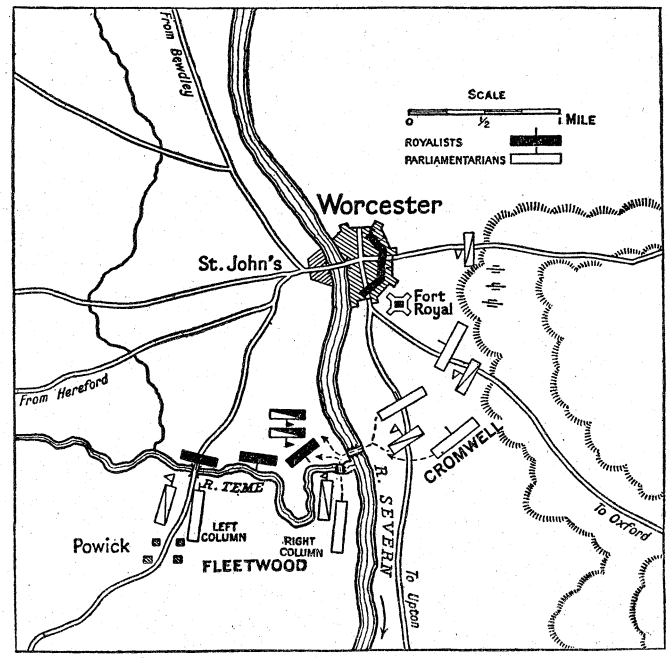
Public buildings include the shire-hall (1835), Corn Exchange and market house. Fairs are held thrice annually. The King's school was founded in 1541; the Royal Grammar school (Queen Elizabeth's), in a modern building, in 1563; there are also a choir school, a school for the blind, and municipal art, science and technical schools.

In the vicinity there is a Benedictine convent, at Stanbrook hall, with a beautiful modern chapel.

Traces of British and Roman occupation have been discovered at Worcester (*Wigeran Ceaster, Wigornia*), but its history begins with the foundation of the episcopal see. Being the chief city on the borders of Wales, Worcester was frequently visited by the kings of England. In 1139 it was taken by the Empress Maud and retaken and burned by Stephen in 1149. It surrendered to Simon de Montfort in 1263. In 1642, during the Great Rebellion, a handful of cavaliers was besieged here, and in spite of an attempted relief by Prince Rupert, the city was pillaged, as it was again in 1646. In 1651 Charles II with the Scottish army was defeated here by Cromwell and Lambert.

During the reign of King Alfred, Aethelred and Aethelflead, ealdorman and lady of the Mercians, deferring to the request of the bishop, "built a burgh at Worcester." King Richard I in 1189 granted the town to the burgesses, and Henry III in 1227 granted a gild merchant. The first incorporation charter was granted by Philip and Mary in 1554, but James I in 1622 made the city a separate county. By the Municipal Reform act of 1835 the government was again altered. The burgesses returned two members to parliament from 1295 to 1885, when the number was reduced to one. As early as 1203, the manufacture of cloth is mentioned, the weavers, walkers and clothiers receiving an incorporation charter in 1590, but by 1789 had ceased to exist. Its place was taken by the manufacture of porcelain, famous as Royal Worcester, introduced in 1751 by Dr. John Wall, and by the increasing manufacture of gloves, which is one of Worcester's oldest trades, dating from the 15th century. The Glover's company apparently existed in 1561; it is said to have been incorporated in 1497 or 1661, but satisfactory evidence for either date is lacking. The city also makes wine and vinegar, besides Worcestershire sauce. There are many smaller industries; there is a considerable traffic in agricultural produce on the Severn.

Battle of Worcester, 1651.—Early in Aug. 1651 (*see* GREAT REBELLION) Charles II crossed the Scottish border with 16,000 men, nearly all Scots, in a last attempt to regain the English throne by invasion. His first intention was to march on London, hoping that recruits would flock to his standard; on the contrary, the local militia everywhere took arms to oppose him, Cromwell's cavalry clung to his flank and heels, and Cromwell himself followed a few days' march behind. In despair Charles turned westward, still hoping for a rising in his favour, and on Aug. 22 reached Worcester, where he was brought to bay. Worcester lies on the left bank of the Severn, with a small suburb, St. John's, on the right bank, a bridge connecting the two. The city was fortified, but its walls had been demolished in 1646 and, though partially restored, presented in 1651 no formidable obstacle. Fort Royal, outside the southeastern gate, was still of some strength, and this and the rest of the fortifications were now strengthened



PLAN OF THE BATTLE OF WORCESTER, SEPTEMBER 3, 1651

by Charles to the best of his limited means. The nearest bridges to Worcester were at Upton, 6 mi. down stream, and Bewdley, 15 mi. north. Bewdley bridge was already in the hands of the Parliamentarians, but Upton bridge the Royalists destroyed; on Aug. 28, however, it was seized by Lambert and repaired, Charles' last hope of commanding a considerable stretch of west country being thus snatched from him. None the less, his position was a strong one. About a mile below Worcester the river Teme joins the Severn, making a formidable obstacle to an advance up the right bank of the Severn from the south, while a smaller stream, running into the Teme from the north, formed some defense for

the western approach to St. John's. If only the walls of the city itself on the left bank had been in their proper condition Charles might well have held out for a considerable time. The king posted the main body of his army between the Severn and the Teme, using the city and its walls as a bridgehead. Cromwell himself reached Worcester on the 28th, and found himself in command of about 30,000 men, with many thousands more, chiefly militia, within a few days' march. He at once reconnoitred the Royalist position and decided Fleetwood was to advance up the right bank of the Severn, force the passage of the Teme, and destroy the Scottish forces between that river and Worcester; he himself would attack Fort Royal and the city. To connect the two operations a bridge of boats was to be laid across the Severn just above its junction with the Teme, and a similar bridge across the Teme close to its junction with the Severn. A force of cavalry was sent to Bewdley to cut off the Royalists' line of retreat to the north. The preparation of the bridges took a few days, but the time was well employed by Cromwell's guns on the high ground east of the city, which pounded the fortifications mercilessly and reduced the already exhausted defenders to a state of despair. Sept. 3, the anniversary of his great victory at Dunbar, was chosen by Cromwell for the day of his attack, and its watchword, "The Lord of Hosts," repeated. Fleetwood advanced in two columns, that on the right being directed upon the junction of the Teme and Severn, where the bridges were to be laid, that on the left against Powick, just north of which a bridge crossed the Teme. Little opposition was met with till the Teme was reached, but here the Scots were found to be in great strength, while the road bridges over this river, both at Powick and further west, had been destroyed. The left column's attempt to cross the Teme was repulsed with some loss, but in the meantime the bridge of boats had been successfully thrown across the Severn and Cromwell himself led a brigade of horse across on to the right bank. The second bridge over the Teme was quickly laid, and Fleetwood's right column joined Cromwell's horse, which had been already reinforced by foot. For a time the Scots fought fiercely to recover their river defenses, but they fell slowly back toward St. John's. Fleetwood's left column now crossed near Powick and it looked as if the battle would soon be over. But Charles, seeing that Cromwell had transferred a considerable part of his own force to the right bank to join Fleetwood's attack, decided to make a sortie from his bridgehead on the left bank and strike the remainder of the Parliamentary forces still lying on that side of the river. Issuing from the walls under cover of Fort Royal, Charles' cavalry, supported by such infantry as he could collect, made a furious attack upon the troops opposing them. The militia wavered, but they were stiffened by two regiments of regulars, and before long cavalry joined in the fight. For an hour or more the issue was in doubt, but Cromwell, warned of the danger, recrossed the Severn with reinforcements and gradually forced the exhausted Scotsmen back within the walls. Following close upon their heels, Cromwell's men burst into the city and put the Scotsmen to the sword. Panic spread like wildfire and the Royalist army dissolved into a rabble of fugitives. Fleetwood blocked the line of retreat to the west but some of the cavalry, including Charles himself, escaped northwards, though most of them were cut down or captured in the relentless pursuit. Charles himself got away to France, but his army was completely destroyed—3,000 of his men were dead, more than 10,000 prisoners—while the Parliamentarians admitted a loss of but 200 men. The "Crowning Mercy" was complete.

WORCESTER, town of South Africa, near the Hex River mountains, is the centre of a fruit growing area. The annual rainfall is under 12 in., but irrigation is obtained from the Hex river. It is also intended to irrigate 8,000 ac. from the Breede river. Much wine and brandy is produced, and fresh and dried fruit is exported. Many of the South African raisins come from this district. Population (1936) 12,486 (5,631 white).

WORCESTER, a city of Massachusetts, U.S.A., 40 mi. W. of Boston, on the Blackstone river. Population (1920) 179,754 (30% foreign-born white, representing most of the countries of Europe); 1940, 193,694.

The city occupies 37.1 sq.mi., at an altitude of 480 feet. On its eastern border is Lake Quinsigamond (4 mi. long), spanned by a reinforced concrete bridge. Worcester is an important educational centre, the seat of Clark university (1887); Worcester academy (1832); the Worcester Polytechnic institute (1865), one of the oldest and best equipped schools of engineering in the country; the Jesuit College of the Holy Cross (founded in 1843 by the second bishop of Boston); Assumption college (1903); and a State normal school (1874). The public school system includes 81 grammar, a junior high, 4 high schools, a boys' trade school (1909) and a girls' trade school (1911). There are 17 parochial schools, five of which have high-school departments. The public library (founded 1859) was one of the first in America to admit readers on Sunday. In the library and museum of the American Antiquarian society (established 1812) are many valuable early portraits, books and pamphlets. The art museum (founded in 1896 by Stephen Salisbury) contains, among other important collections, the Bancroft collection of Japanese art. The Worcester Natural History society (1829) and the Worcester Historical society (1875) both maintain museums. An annual music festival is held. There are four daily newspapers, including one in French and one in Finnish. The city has more than 100 churches, and a boys' club of 5,500 members.

Worcester is a large producer of machine tools and of wire and wire products and mill machinery. In 1937 there were 516 factories, employing an average of 31,134 wage earners and with an output of $182,777,047. The city's trade area embraces a population of 450,000, and retail sales aggregate $100,000,000 annually.

Six insurance companies, with combined assets of $192,000,000, have their home offices there. Bank resources amount to over $200,000,000, and Worcester boasts never to have had a bank failure.

The first grant of land was made in 1657, and in 1668 the plantation of Quinsigamond was laid out, a committee of the general court expecting it to support from 30 to 60 families. In 1675, on the outbreak of King Philip's War, the settlement was abandoned. It was revived in 1684, and was named after the English home of several of the settlers. In 1702 it was abandoned owing to attacks by Indians. In 1713 a tavern and a mill were built, and a turnpike was constructed to Boston. Worcester became a town in 1722, and in 1780 was incorporated. Until the Revolution it remained an isolated frontier settlement and as late as 1783 its population was not over 2,000. During the Shays Rebellion it was taken by the insurgents and the courts were closed.

Utilization of waterpower and establishment of industries began about 1800, and by 1825 the town was manufacturing hats, clocks, chairs, paper, cards, carpets, corduroy, fustians, textile machinery and many other articles. In 1828 the Blackstone canal was opened from Worcester to Providence. The railroad to Boston was completed in 1835; to Norwich in 1840; to Providence in 1847; and to Springfield in 1849. In 1848 the town was incorporated as a city. Strong anti-slavery sentiment led to a serious riot in 1854, owing to an apparent attempt to enforce the Fugitive Slave law. By 1860 the population had grown to 24,960, and there has been a steady increase ever since. Many famous men and women of America have lived for longer or shorter periods in or near Worcester, including the inventors Elias Howe, Eli Whitney, Erastus Bigelow, Russell L. Hawes, Thomas Blanchard, William and George Crompton, L. J. Knowles, Draper Ruggles, Joel Nourse and J. C. Mason; and Gen. Artemas Ward, Gen. Rufus Putnam, Col. Timothy Bigelow, Isaiah Thomas, Dr. William T. G. Morton, Eli Thayer, Gen. Charles Devens, George Frisbie Hoar, George Bancroft, Dorothea Lynde Dix, Clara Barton, Edward Everett Hale and John B. Gough.

WORCESTERSHIRE, a midland county of England. Area 699 sq.mi. It covers a portion of the rich valleys of the Severn and Avon with their tributaries, the Stour and the Teme. The Avon valley, known as the vale of Evesham, lies on the Lias clays, and provides an excellent soil for orchards and market gardening. The Jurassic escarpment of the Cotswold

hills rises sharply from it in the south-east, the outlier of Bredon hill being a conspicuous spur. Salmon and lampreys are taken in the Severn; trout and grayling in the Teme and its feeders. The Malverns rise from the flat vale of Worcester and reach a height of 1,395 and 1,114 ft. in the Worcester and Hereford beacons.

The ridge is continued in the Abberley Hills to the north. The Lickey Hills (900 ft.) in which there are Silurian, Cambrian and Pre-Cambrian rocks, cross the north-east corner of the county. Their northern parts, the Clent Hills (1,028 ft.), are formed of Permian breccias. Partly within the county are the sites of two ancient forests. That of the Wyre on the northern boundary, retains some of its ancient character; but Malvern Chase is hardly recognizable. Road metal is extensively quarried in the Malvern hills (Pre-Cambrian and Cambrian) and in the Lickey hills (Cambrian); lime is obtained from the Silurian limestones; coal is mined in portions of the Forest of Wyre, and the South Staffordshire coal-fields which come within the county.

History and Early Settlement.—Worcestershire was largely wooded in early times and is consequently not rich in prehistoric remains but some stone implements have been found on the surrounding hills and some bronze implements along the Severn, pointing perhaps to river communications or perhaps to occupation of the river banks. The great earthwork on the Malvern hills of Romano-British or late pre-Roman date should be specially mentioned, and there are others at Berrow Hill above the Teme west of Worcester and at Round Hill by Spetchley.

The earliest English settlers were a tribe of the Hwiccas of Gloucestershire, who spread along the Severn and Avon valleys in the 6th century. By 679 the Hwiccan kingdom was formed into a separate diocese with its see at Worcester, and the Hwiccas had made themselves masters of nearly the whole of the modern county. From this date the town of Worcester became not only a religious centre, but the chief point of trading and military communication between England and Wales. The shire originated as an administrative area after the recovery of Mercia from the Danes. Worcester was destroyed by Hardicanute in 1041.

In no county has the monastic movement played a more important part. Foundations existed at Worcester, Evesham, Pershore and Fladbury in the 8th century; at Great Malvern in the 11th century, and in the 12th and 13th centuries at Little Malvern, Westwood, Bordesley, Whistones, Cookhill, Dudley, Halesowen and Astley. At the time of the Domesday Survey more than half Worcestershire was in the hands of the church. This prevented the rise of a local aristocracy, and Dudley castle was the sole residence of a feudal baron. Worcester Castle passed in the 12th century to the Beauchamps, who owned Elmley and Hanley castles. The possessions of William Fitz Osbern in Doddingtree hundred and the Teme valley fell to the crown in 1074 and passed to the Mortimers. Hanley Castle and Malvern Chase were granted by Henry III. to Gilbert de Clare. The early political history focusses on the city of Worcester. In the Civil War of the 17th century Worcestershire was conspicuously loyal.

The Droitwich salt-industry was very important at the time of the Domesday Survey. In the 13th and 14th centuries Bordesley monastery and the abbeys of Evesham and Pershore exported wool, and in the 16th century the Worcestershire clothing industry gave employment to 8,000; fruit-culture with the manufacture of cider and perry, nail-making and glass-making also flourished. The clothing industry declined in the 17th century, but the silk-manufacture replaced it at Kidderminster and Blockley. Coal and iron were mined at Dudley in the 13th century.

Architecture.—There are remains of the great abbeys at Evesham and Pershore, and the priory church at Malvern, besides the cathedral at Worcester. There are further monastic remains at Halesowen and at Bordesley, and there was a Benedictine priory at Astley. Good Norman work remains in the churches of Martley, Astley, Rous Lench, Bredon and Bockleton; while the Early English churches of Kempsey and Ripple are noteworthy. Half-timbered buildings add to the picturesqueness of many towns and villages; and among country houses this style is well exemplified in Birts Morton Court, Eastington Hall, Elmley Lovett Manor, and in Pirton Court. Westwood Park is a mansion of the 16th and 17th centuries; the site was formerly occupied by a Benedictine nunnery. Madresfield Court embodies remains of a fine Elizabethan moated mansion.

Agriculture.—The climate is equable and healthy, and is very favourable to the cultivation of fruit, vegetables and hops, the red marls and the rich loams being good both for market gardens and tillage. About 78½% of the land was under cultivation in 1939; of this 71% was in permanent pasture. Orchards of apples, pears and plums are extensive, the county being, after Kent, the greatest fruit producer in the country. In 1939 there were 23,242 ac. of orchards. There are large tracts of woodland. Wheat and oats are the principal grain crops. Peas, beans, potatoes, mangolds and turnips are important crops covering 17,480 ac. Near Worcester there are large nurseries. The National Trust owned 688 ac. in the county in 1942.

Industries.—In the north Worcester includes a portion of the Black Country. Dudley, Netherton and Brierley Hill, Stourbridge, Halesowen, Oldbury and the south and west suburbs of Birmingham, have a vast population engaged in ironworking, in chemical and glass works, and motor engineering. Worcester is famous for porcelain, Kidderminster for carpets and Redditch for needles, fishhooks, etc. Salt is produced from brine at Droitwich and Stoke Prior. The fire clays and limestone of the north unite with the coal measures to form a basis of the industries in the Black Country. Railway signals, made at Worcester, clothing, leather and buttons are important trades.

Communications.—The county is served by the G.W.R. main lines connecting Worcester with Birmingham, Oxford, Gloucester, Hereford and Shrewsbury, the L.M.S.R. serves the north, and the Birmingham-Bristol line passes through the county. The Severn is an important highway; the Avon, though locked up to Evesham, is little used. Canals follow the courses of the Stour and the Salwarpe, and serve the towns of the Black Country. There are 511 mi. of roads in the administrative county.

Administration and Population.—The area of the geographical county is 699 sq.mi., pop. (1938) 449,670. Wartime population movements raised the county's population by 7% between Sept. 1939 and Feb. 1941. Worcestershire has detached portions enclaved in Herefordshire, Staffordshire, Warwickshire and Gloucestershire. It comprises five hundreds, each divided into upper and lower sections. Oswaldslow having a middle section in addition. There are two county boroughs, seven municipal boroughs and four urban districts. The county is in the Oxford circuit, and assizes are held at Worcester. It has one court of quarter sessions, and is divided into 15 petty sessional divisions. Worcestershire returns four members to parliament, and the county boroughs of Dudley and Worcester return one member each.

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WORDSWORTH, CHARLES (1806–1892), Scottish bishop, son of Christopher Wordsworth, Master of Trinity, was born in London on Aug. 22, 1806, and educated at Harrow and Christ Church, Oxford. He was a brilliant classical scholar, and a famous cricketer and athlete. He was tutor at Christ Church (1834–35) and then second master at Winchester. In 1839 he brought out his *Greek Grammar,* which had a great success. In 1847, he became warden of Trinity College, Glenalmond, the new Scottish Episcopal public school and divinity college, where his views on Scottish Church questions brought him into opposition at some important points to W. E. Gladstone. In 1853 he was consecrated bishop of St. Andrews, Dunkeld and Dunblane. Wordsworth was a strong supporter of the establishment, but conciliatory towards the Free churches. He was a voluminous writer, and one of the company of revisers of the New Testament (1870–1881), among whom he displayed a conservative tendency. He died at St. Andrews on Dec. 5, 1892.

See his *Annals of my Early Life* (1891), and *Annals of My Life,* edited by W. Earl Hodgson (1893); also *The Episcopate of Charles Wordsworth,* by his nephew John, bishop of Salisbury (1899).

WORDSWORTH, CHRISTOPHER (1774–1846), youngest brother of the poet, was born on June 9, 1774, and became a fellow of Trinity College, Cambridge, in 1798. He obtained preferments through the patronage of Manners Sutton, bishop of Norwich, afterwards (1805) archbishop of Canterbury. In 1810 he published an *Ecclesiastical Biography* in 6 volumes. On the death of Bishop Mansel, in 1820, he was elected Master of Trinity, and retained that position till 1841. His proposal as vice chancellor

(1821) for a Classical Tripos, though then rejected, was adopted in 1822. He died on Feb. 2, 1846, at Buxted. In his *Who wrote Ikon Basilike?* (1824), he advocated the authorship of Charles I.; and in 1836 he published, in 4 volumes, a work of *Christian Institutes,* selected from English divines. He married in 1804 Miss Priscilla Lloyd (d. 1815), a sister of Charles Lamb's friend Charles Lloyd; and he had three sons, John W. (1805–1839), Charles (*q.v.*) and Christopher (*q.v.*); the two latter both became bishops, and John, who became a classical lecturer at Trinity College, Cambridge, was an erudite scholar.

WORDSWORTH, CHRISTOPHER (1807–1885), English bishop and man of letters, was born in London on Oct. 30, 1807, and was educated at Winchester and Trinity, Cambridge. He, like his brother Charles, was distinguished as an athlete as well as for scholarship. He was public orator at Cambridge, Headmaster of Harrow from 1836–44, and bishop of Lincoln in 1869. He died on March 20, 1885. He married in 1838 Susanna Hartley; his eldest son was John, bishop of Salisbury, and author of *Fragments of Early Latin* (1874), and his daughter Elizabeth was first principal of Lady Margaret Hall, Oxford. As a scholar he is best known for his edition of the *Greek New Testament* (1856–60), and the *Old Testament* (1864–70), with commentaries; and for his *Inscriptiones Pompeianae* (1837).

His *Life,* by J. H. Overton and Elizabeth Wordsworth, was published in 1888.

WORDSWORTH, DOROTHY (1771–1855), English writer and diarist, the third child and only daughter of John Wordsworth, of Cockermouth, and his wife, Anne Cookson-Crackanthorpe, was born on Dec. 25, 1771, and, after her mother's death in 1778, lived chiefly at Halifax with a Mrs. Threlkeld, her mother's cousin. In 1787 she went to live with her maternal grand-parents in Penrith, where she was not very happy. From 1788–93 she stayed with an uncle at Forncett, in Norfolk. She and her brother William, the poet, who was a year older than Dorothy, were early drawn to one another; in 1794 they visited the Lakes together, and in the autumn of the following year they combined their small capitals and set up house at Racedown, in Dorsetshire, where they lived a frugal but ideally happy life. In 1797 they made the acquaintance of Coleridge, and in the same year moved to Alfoxden, on the northern slope of the Quantock hills, Coleridge about the same time settling near by in the town of Nether Stowey. On Jan. 20, 1798, Dorothy Wordsworth began her invaluable *Journal,* used by successive biographers of her brother, but first printed in its quasi-entirety by Prof. W. Knight in 1897. The Wordsworths, Coleridge and Chester, left England for Germany on Sept. 14, 1798; and of this journey also Dorothy Wordsworth preserved an account, portions of which were published in 1897. On May 14, 1800, she started another *Journal* at Dove cottage, Grasmere, which she kept very fully until Dec. 31 of the same year. She resumed it on Jan. 1, 1802, for another 12 months, closing on Jan. 11, 1803. These were printed first in 1889. She composed *Recollections of a Tour in Scotland,* in 1803, with her brother and Coleridge; this was first published in 1874. Her next contribution to the family history was her *Journal of a Mountain Ramble,* in Nov. 1805, an account of a walking tour in the Lake District with her brother. In July 1820 the Wordsworths made a tour on the Continent, of which Dorothy preserved a very careful record, portions of which were given to the world in 1884, the writer having refused to publish it in 1824 on the ground that her "object was not to make a book, but to leave to her niece a neatly-penned memorial of those few interesting months of our lives." Meanwhile, without her brother, but in the company of Joanna Hutchinson, Dorothy Wordsworth had travelled over Scotland in 1822, and had composed a *Journal* of that tour. In 1829 she had a serious nervous breakdown, from which she never recovered. For the last 26 years of her life her mind and body seemed broken; she died on Jan. 25, 1855, five years after William's death in 1850.

Dorothy Wordsworth claims a distinct place in the history of English prose as one of the very earliest writers who noted, in language delicately chosen, and with no other object than to preserve their fugitive beauty, the little picturesque phenomena of homely country life amid simple scenes and quiet people.

A *Life,* by E. Lee, was published in 1886; but it is only since 1897, when Prof. Knight collected and edited her scattered mss., that Dorothy Wordsworth has taken her independent place in literary history. The *Journals of Dorothy Wordsworth,* edit. by W. Knight, were republished in 1924; *see* also C. M. Maclean, *Dorothy and William Wordsworth* (Cambridge, 1927).

WORDSWORTH, WILLIAM (1770–1850), English poet, was born at Cockermouth, Cumberland, on April 7, 1770, the second son of John Wordsworth, attorney-at-law and agent to Sir James Lowther (afterwards first earl of Lonsdale). His mother was Anne, daughter of William Cookson, a Penrith mercer, and Dorothy, born Crackanthorp, "of the ancient family of that name, who from the time of Edward the Third had lived in Newbiggen Hall, Westmorland" (*Autobiographical Memoranda*). The Wordsworths were a Yorkshire family "settled at Peniston . . . probably before the Norman Conquest" (*ib.*); the first of the family to settle in the Lake District was the poet's grandfather.

Wordsworth's mother died in 1778; and in that year he was sent to the ancient grammar school of Hawkshead, boarding in the village with Anne Tyson, at the cottage still known as "Wordsworth's cottage." His father died five years later—Wordsworth speaks of him as having "never recovered his usual cheerfulness" after the loss of his wife. The family were placed under the guardianship of two uncles, Richard Wordsworth and Christopher Crackanthorp. Beyond the claims which he had against the Lowther family (amounting to well over £4,000), claims which were the subject of protracted dispute, until they were acknowledged and discharged, in 1802, by the second earl of Lonsdale, the father had left small provision for his children. Wordsworth, however, was sent in 1787 to St. John's, Cambridge, of which college his uncle, William Cookson, had been a fellow. Already he had contracted both the habit of verse and the temperament of poetry. Among his published works are included two sets of verses written as early as 1786; and "I wrote," he says, "while yet a schoolboy, a long poem running upon my own adventures and the scenery of the country in which I was brought up": a poem containing "thoughts and images" most of which were used later in the poet's "other writings." He had been sufficiently well taught at Hawkshead, at least in mathematics, to have "a full twelve months' start" of the freshmen of his year at St. John's; and to this circumstance he attributes it that he "got into rather an idle way," "reading nothing but classic authors according to my fancy, and Italian poetry" (*Autobiogr. Mem.*). His Italian master was a man who had "been well acquainted with the poet Gray." During his freshman year he composed a large part of the *Evening Walk,* finishing it in 1789. Of his Cambridge friends the chief was Robert Jones, who subsequently took orders, with whom, in 1790, Wordsworth undertook the walking tour in France and Switzerland which is commemorated in *Descriptive Sketches.* Forty years later, Jones, "fat and roundabout and rosy, and puffing and panting" up very moderate hills, "looked back to that journey as the golden and sunny spot in his life" (Dorothy Wordsworth: *Letters* ii., 497).

In Jan. 1791 Wordsworth took his B.A. degree. It is clear from Books iii.–vi. of the *Prelude* that he conceived himself to have derived from his three years residence in Cambridge little intellectual profit; and "the manners of the young men," he wrote later, "were very frantic and dissolute at that time" (*Letters,* i., 162). His guardians had destined him for the Church. But the thought of "vegetating on a paltry curacy" made no strong appeal to him (*ib.* i., 33); and it is probable that already before he had taken his degree he had experienced some unsettlement both of religious and of moral belief. He pleaded for delay; and he seems to have persuaded his guardians that the best preparation for the study of oriental languages (pressed upon him as a likely means of advancement) would be a year spent in learning French. He went to France at the end of Nov. 1791, and he remained there till the end of 1792, for the most part in Orleans and Blois. He took to France a keen sympathy with the principles of the revolution; and his faith in the revolutionary idea was deepened and intensified by the intimate friendship which he formed in Blois with Michel de Beaupuy, a captain (later general) in the republican

army. The ninth book of the *Prelude* bears witness to the profound influence exercised upon his political thinking by Beaupuy. In Orleans he formed an attachment to Marie-Anne Vallon ("Annette"), a girl of royalist family, by whom he had a daughter, Anne-Caroline (baptised Dec. 15, 1792); and by whose marriage in 1816 with Jean Baptiste Martin Baudouin he has a number of French descendants. Of "Annette" the *Prelude* tells us nothing. Yet, as first sketched, it contained the story of *Vaudracour and Julia,* of which the earlier sections, at least, were not written without some thought of her. The amatory colouring of the second paragraph of the poem is unlike the Wordsworth whom we know best; and the third paragraph attempts (we must suppose) such justification of the "Annette" episode as Wordsworth felt to be possible. He felt himself to have been betrayed by a false philosophy, by his creed of nature and freedom:

> tempted to decline
> To perilous weakness, and entrust the cause
> To nature, for a happy end of all.

During his sojourn in France he wrote the greater part of *Descriptive Sketches.* Isolated passages crudely expressed his revolutionary sympathies, his deep moral dejection; and even a mood of religious unbelief. Yet as late as May 1792, "it is at present my intention," he writes, "to take orders in the approaching winter or spring. My uncle the clergyman will furnish me with a title" (*Letters,* i., 42). "I should certainly have wished to defer the moment" (*Letters,* i., 42). The failure here, at once of religious and moral conviction, seems complete.

In Feb. 1793 Wordsworth published both *Descriptive Sketches* and *An Evening Walk.* Of both poems perhaps the principal interest resides in the conflict between style and substance: things freshly and romantically observed fight for expression within the limits of a diction which has all the faults of the worst 18th-century work. In the same month England declared war upon France —the first real shock, Wordsworth tells us, which his moral nature had received (*Prelude* x., 268 *et seq.*). At once he ranged himself on the side of his country's enemies. February 1793 was further notable in that it saw the publication of Godwin's *Political Justice.* Hitherto, Wordsworth had been content to take his philosophy from Rousseau, in ethics deifying "nature," and in politics making a gospel of "the general will." Under the influence of Godwin, he began now to deify Reason, the individual reason—collective reason being only another name for the general will, that is, for a tyranny.

The period 1793–96 is, in respect both of the external and of the internal biography of Wordsworth, still involved in considerable obscurity; an obscurity not much illumined by the rather confused account of his own development which he himself furnishes to us in Books xi.–xii. of the *Prelude.* Early in 1793 he wrote the "Letter to the Bishop of Llandaff . . . by a Republican," in which he is still the champion of the general will. The Letter attacks monarchy, the clergy and (here under Godwinian influence) the state penal code. For the bishop, a renegade liberal, Wordsworth entertains some such sentiments as, later, were felt for himself by Hazlitt and others. The Letter was not published until 1876. If its self-conscious loftiness of style and sentiment does not altogether lift it out of the commonplace, it is yet a composition which may be accounted, for the years from which it proceeded, remarkable. In the autumn of 1793, he began upon *Guilt and Sorrow,* his first considerable poem, in many parts of it distinctively "Godwinian." It was finished in 1794, and a portion of it, under the title of *The Female Vagrant* was printed in the *Lyrical Ballads* (1798); the whole saw the light (a good deal revised) in 1842. In 1795 he began, and in 1796 finished, *The Borderers: A Tragedy,* of which the gloomy perversities show him struggling out of the Godwinism in which he had been for two painful years involved. Sometime in 1795 he wrote his first truly characteristic piece, "Nay, Traveller, rest . . .", in which the victory over Godwinism is already complete.

For two years since his return from France Wordsworth had led a wandering life, making no attempt to find for himself a profession. In the early part of 1795 occurred the death of his friend Raisley Calvert, who left him a bequest of £900. He used the independence afforded to him to settle with his sister Dorothy at Racedown, Crewkerne. It was here that *The Borderers* was finished; and here (more important) *Margaret, or The Ruined Cottage* (incorporated, later, in Book i. of *The Excursion*) was begun. The poem was finished at Alfoxden, whither, in the summer of 1797, the Wordsworths moved, in order to be near Coleridge at Nether Stowey. In the *Prelude* Wordsworth traces the recovery of his moral, and poetical, health to the influence, first of his sister, and secondly of Coleridge. It was while these "three persons and one soul" were living in close conjunction in Somerset that the *Lyrical Ballads* were conceived and written.

The publication (September 1798) of the *Lyrical Ballads* constitutes the most important event in the history of English poetry after Milton. Of the genesis of the book Coleridge has given, in the first section of chap. xiv. of the *Biographia Literaria,* an account which may be summarised by saying that, while his own share in the work was directed towards illustrating (in *The Ancient Mariner*) the naturalness of the supernatural, Wordsworth's task was to point the supernatural meanings, the inner spirituality of actions and incidents the most natural conceivable. We are concerned here only with Wordsworth; and it is notable that the *Advertisement* to the *Lyrical Ballads* is concerned only with him (save for the excuses made, in its last section, for the diction of *The Ancient Mariner*). "It is the honourable characteristic of poetry"—says the opening sentence of the *Advertisement*—"that its materials are to be found in every subject which can interest the human mind." That is only to say that the natural, the ordinary, the obvious, has its poetry, its supernaturalness. It states the theme which, in Coleridge's account, it was Wordsworth's task to illustrate. But if poetry can draw its supernatural effects from natural objects and happenings, to what extent can it employ (its primary means being language) merely natural language? The *Ballads,* says the *Advertisement,* are an "experiment" to discover "how far the language of conversation . . . is adapted for the purposes of poetic pleasure." Perhaps the principal result of it was the discovery of a new blank verse—that of what Coleridge christened the "Conversation Poem." If we leave aside *The Ancient Mariner,* the best of the *Lyrical Ballads* of 1798 is that part for which blank verse is used; a blank verse neither Shakespearian nor Miltonic; domestic, but with a telling quality wanting to the domestic blank verse of Cowper; individual without eccentricity; attaining its perfection in *Tintern Abbey.* The same conversational triumph meets us in the second volume of the *Lyrical Ballads* (1800) in "There was a Boy . . .", *Michael* and *The Brothers;* and indeed, wherever in the two volumes blank verse is used, it is used to fine effect.

In the purely lyrical species Wordsworth is, in the 1798 volume, less successful. Perhaps, in this kind, only "It is the first mild day of March . . ." and "I heard a thousand blended notes . . ." have the perfect lyric quality which, two years later, he was to show in the Lucy Poems, *The Fountain, The Two April Mornings,* the *Poet's Epitaph.* Several of the lyrical experiments fail badly; e.g., *Goody Blake,* to which the *Advertisement* unhappily directed special attention. But the volumes of 1798 and 1800 contained, together, a sufficient number of lyrical successes to afford an overwhelming demonstration of the power of poetry to use natural language, even the "language of conversation." But Wordsworth had an affection for his failures; and in the preface of 1800 he threw after them many paradoxes of theory and much false history.

It is, however, neither a theory of diction nor the successful practice of a new diction which gives to the *Lyrical Ballads* the importance which they have in literary history. The greatness of the book may more truly be conceived to lie in the metaphysic of the imagination from which it proceeds (and from which, indeed, the theory of diction itself proceeds). The outlines of this metaphysic are hinted in Wordsworth's Prefaces and Notes, and in passages of the poems themselves (the *Prelude* being, in this connection, particularly valuable). The *Lyrical Ballads* owe their greatness to the power with which they revindicate for poetry the life of the senses. We are only poets in so far as we confide ourselves to the senses. We see into the life of things only when

we receive the impressions of sense in a "wise passiveness," disconnecting ourselves from the tie of reason and custom, from "the meddling intellect"—the operation of which is only one of the effects of custom. The source of truth—poetic truth—is not reason, but the eyes and ears. What is the matter with the poetry of the Age of Reason is that it had lost the art of seeing and hearing, or of performing these acts *purely,* in a fashion, that is to say, not vitiated by custom or theory. It had lost, at the same time, the gift of pure expression, using a mere customary or conventional diction. It is the supreme achievement of the *Lyrical Ballads* to have brought back the glory and the freshness of the senses. The work is done with the greater power and convincingness from the circumstance that Wordsworth had won his way back to nature and the senses through the valley of the shadow, through the rationalism of Godwin. To say that he had come back from Godwin to Rousseau would be to misconceive him. Obviously he supposes his later naturalism to escape the perils of Rousseauism. Obviously also he believes his metaphysic of the imagination—which might easily be taken for a very bare philosophic "sensationalism"—to rise above the difficulties of the ordinary sensationalist creed. A logical demonstration of his metaphysic he nowhere essays. We may be content with that practical demonstration of it which his poetry furnishes.

The six months following the publication of the *Lyrical Ballads* Wordsworth spent in Germany. In Oct. 1799 he settled in Grasmere; and in that neighbourhood, save for occasional tours in Scotland and on the Continent, the rest of his life was spent. A new edition of the *Lyrical Ballads* was called for in 1800, and this edition Wordsworth enriched by the famous preface and by a second volume of poems—among them some of his best and most original pieces. A third edition appeared in 1802 (with the appendix on Poetic Diction), and a fourth in 1805. In 1804 he married Mary Hutchinson—in 1802 he had visited "Annette," and her story had been revealed to Mary.

In the year in which the first edition of the *Lyrical Ballads* appeared, Wordsworth had already begun upon the *Prelude* (de Selincourt, p. xxxi.); and in the year which saw the fourth edition of the Ballads he finished it. In this poem, "after *Paradise Lost* the greatest long poem in the language" (A. C. Bradley), he traces his spiritual autobiography, "the Growth of a Poet's Mind," from earliest childhood, from the first intimations which came to him of poetry and immortality, down to the date at which he took the resolution of devoting himself wholly to poetry. As a document of the romantic revival the book (not published until after his death) is of the first importance; and apart from this historical interest, it constitutes a handbook of the imaginative life unique in subtlety and power. It was intended to be a preparation for "a philosophical poem, containing views of Man, Nature and Society," of which the *Excursion* was a part (the only part finished). Of the same poem another part is the impressive fragment of *The Recluse,* written in 1800 but only published some years after in 1888.

In 1807 Wordsworth published the *Poems in Two Volumes.* These show a wide extension of his poetical power. New life is given to the sonnet—used with fine effect to express lofty patriotic sentiment—and to the ode—here were printed for the first time the *Ode to Duty* and the immortal *Ode on Intimations of Immortality.* The volumes of 1800 and 1807 establish Wordsworth as one of the great inventors of poetical forms. But, form apart, these volumes, taken together with the *Prelude,* the *Recluse* fragment, *Margaret, or the Ruined Cottage* (all written before 1807), constitute a body of poetical work of which the compass and original power are such as to place him among the greatest poets. By 1807, in fact, his best work was done; not all his good work, but his best work. The death, in 1805, of his brother John Wordsworth (of whom the *Happy Warrior* is, in part, a commemoration) had affected deeply a temperament to which melancholy was native, inducing in Wordsworth a regress upon religious orthodoxy, and upon orthodoxies less venial. By the end of the first decade of the nineteenth century his thinking, in religion and in politics, loses that speculative rebel quality from which it drew so much of its early strength; and his imagination, ever a miser of its memories, and now more so, tends to hoard barren incidents and trivial perceptions, to be the material of later poetry. It requires, henceforth, some cause in which his affections are passionately engaged to educe the old power. Perhaps he is, after 1808, most like himself, not in poetry, but in the noble prose of the tract upon the *Convention of Cintra* (1809). In 1814 appeared the *Excursion.* "This will never do," said Jeffrey. Yet Keats thought it "one of the three things to rejoice at in this age." Even outside the two first books, which belong to the Somerset period, the poem has lofty and noble reaches. The general decline of power, however (especially if it be compared with the *Prelude*), is marked. In 1815 was published the first collected edition of the poet's works (with the *Essay Supplementary to the Preface*); in the same year the *White Doe of Rylstone;* in 1819 *Peter Bell* (written in 1798) and the *Wagoner;* in 1820 *The River Duddon,* and *Miscellaneous Poems.* A further decline of power is witnessed, in 1822, by the *Ecclesiastical Sketches* and the *Memorials of a Tour on the Continent.* To the last, however, it is unsafe to regard Wordsworth as negligible; at any moment the old power is apt to reassert itself. It is to the period of his decline that we owe, in the *Prelude,* the magic of the famous description of Newton's statue—

> The marble index of a mind for ever
> Voyaging through strange seas of thought alone.

Many, again, of his best sonnets come from the late period. Here and there, from the *Evening Voluntaries* (1835) the old greatness flashes out. After 1835 Wordsworth published nothing new in poetry.

"Up to 1820 the name of Wordsworth," said De Quincey, "was trampled under foot; from 1820 to 1830 it was militant; from 1830 to 1835 it has been triumphant." In 1839 Wordsworth received the honorary degree of D.C.L. from the University of Oxford: he was presented by Keble, and the ceremony showed how deep was the hold that his poetry now had on young and old alike. In 1842 he was awarded a civil list pension of £300 a year (resigning the Distributorship of Stamps which he had held since 1813, a sinecure which had brought on him many reproaches). In 1843 he was appointed poet laureate, in succession to Southey. He died on April 23, 1850; and is buried in the churchyard of Grasmere. His wife survived him by nine years. Of his five children, two had died in 1812; his daughter, Dora, wife of Edward Quillinan, had died in 1847. Two surviving sons, John and William, left children. The present literary representative is the poet's grandson, Gordon Wordsworth of Ambleside.

BIBLIOGRAPHY.—The authorised edition of the Poetical Works is that published by Moxon in 1849–50 (6 vol.); which, however, does not contain *The Prelude* (first printed in 1850) or *The Recluse* (1888, Macmillan). Of subsequent texts the principal are: W. Knight, 1882–86, 8 vols.; E. Dowden, 1892–93, 7 vols.; Nowell Smith, 1908, 3 vols.; and in one volume, J. Morley, 1888; T. Hutchinson, 1895. In 1926 E. de Selincourt published, from the original mss., Wordsworth's first version of *The Prelude* (with the "authorised" text *vis-a-vis*). The Prose Works were collected by A. B. Grosart, 1876, 3 vols. (out of print), and are accessible in W. Knight's edition, 1896, 2 vols. *The Letters of the Wordsworth Family* were printed by W. Knight in 1907 (out of print); other letters of Wordsworth are in Edith Morley's *Correspondence of Crabb Robinson with the Wordsworth Circle* (1927). Wordsworth's *Tract on the Convention of Cintra* was edited separately by A. V. Dicey in 1915; the *Guide to the Lakes* by E. de Selincourt in 1906; the *Poems and Extracts from the Works of Anne, Countess of Winchelsea* by J. R. Rees in 1905. *A Concordance to the Poems of W. W.* by Lane Cooper was published in 1911.

For the life of Wordsworth chief authorities are: *Memoirs of W. W.,* by Christopher Wordsworth, 1851 (with the poet's "Autobiographical Memoranda"); *Life of William Wordsworth* by W. Knight, 1889; *William Wordsworth, his Life, Works and Influence,* by G. M. Harper (containing new material 1910); *The Early Life of Wordsworth* by E. Legouis, E.T., 1897. New facts about Wordsworth are to be found in G. M. Harper's *Wordsworth's French Daughter,* 1921, and in E. Legouis' *Wordsworth in a New Light,* 1923. Among general interpretative studies of Wordsworth may be mentioned those of F. W. H. Myers, W. Raleigh, H. W. Garrod, O. Elton; among special studies E. Barstow, *Wordsworth' Theory of Poetic Diction,* 1917; W. Beatty, *William Wordsworth: his Doctrine and Art in their Historical Relations,* 1927. Upon bibliographical questions *Two Lake Poets: a Catalogue,* etc., by T. J. Wise (1927) should be consulted. (H. W. GA.)

WORK: *see* LABOUR.

WORKERS, EDUCATION OF: *see* ADULT EDUCATION.

WORKHOUSE. The workhouse (in Scotland known as the poorhouse) is a British institution in which paupers are maintained. It is administered in England and Wales by the board of guardians (the parish council in Scotland), under regulations prescribed by a central authority, the Ministry of Health or the Scottish Board of Health. Destitute persons are admitted to the workhouse by a written order of the board of guardians or the relieving officer, or in exceptional cases by the master or matron without an order. All inmates are subject to strict discipline whilst remaining in the workhouse, and, under ordinary circumstances, may not leave the institution without first giving "reasonable notice," which is usually held to mean not less than 24 hours and in some situations it may be as long as three days.

Primitive workhouses were set up here and there in the 17th century under the Poor Relief Act of 1601, which directed the overseers of every parish, amongst other things, to raise funds "for providing a convenient stock of flax, hemp, wool, thread, iron and other ware and stuff to set the poor on work." But in this early period the authorities were for the most part content with "houses of correction" for the chastisement of the vagabond.

The 18th century saw the establishment of workhouses in towns and rural parishes. The administration was either brutally hard or incredibly lax; they ranged, it has been said, from "houses of terror" to "houses of debauchery." In 1834 the modern system was introduced. The 15,000 parishes of England and Wales were organized into a few hundred poor law "unions," each of which was required to set up a "well-regulated workhouse." Only in this institution could an able-bodied man and his family get relief, and in order to deter him from coming, the regimen was purposely made repugnant.

The Workhouse Condemned.—But in the course of the 19th century the strict principles of 1834 were generally relaxed, and in 1909 a royal commission found the state of the workhouses with few exceptions deplorable, and unanimously recommended their abolition. They were not abolished, but some improvement was effected under pressure from the central authority. In particular, a better "classification" of the inmates was enjoined. Married couples aged over 60 are now not to be separated if they wish to live together, and children between the ages of 3 and 16 may not be maintained in the workhouse. Some boards of guardians, however, have persisted in breaking this latter regulation, and in 1927 it was reported that in Somerset 15%, in Dorset 31% and in Cornwall 37% of the pauper children were in the workhouses. An effort was also made to render the workhouse less repellent to the poor by calling it "the institution," but there was no popular enthusiasm over this, and the old name continued in general use. After World War I, with the general relaxation of the restrictions on outdoor relief, the workhouse became less than ever a place for "testing" the able-bodied by disagreeable tasks of work. The inmates are chiefly aged and infirm. (*See* POOR LAW.)

(C. M. L.)

WORKING MEN'S CLUBS have existed for workmen in England and Wales (there are few in either Scotland or Northern Ireland) since the middle of the nineteenth century.

The majority are organized in the Working Men's Club and Institute Union, which owes its existence to the Rev. Henry Solly, a Unitarian minister, and was born at a meeting at which Lord Brougham presided, on June 14, 1862.

Many of the clubs were eleemosynary and scarcely one then founded is in existence today. It was intended that such clubs should be teetotal and apart from the abandonment of this policy their objects remain as in the beginning, and are as follows:

(1) That working men's clubs and institutes are calculated not only to diminish excessive use of intoxicating liquors, but also to promote self-culture and the growth of a healthy public spirit among the mass of people.

(2) That there are few social reforms of greater importance to this country than the substitution of clubs and institutes for public houses as places of resort for the recreation and business of the working classes.

Although the Union did not become entirely independent of outside support till 1890 it had, under the guidance of Hodgson Pratt, worked steadily to that end. In 1884 it became completely democratic in constitution. J. J. Dent became Secretary in 1883 and was largely responsible for the establishment of the Union on a firm and financially sound basis. In August, 1939, it included 2,854 clubs, with over 1,050,000 members, unequally distributed over the United Kingdom. The Union maintains four convalescent homes, accommodating 4,500 members yearly at a cost of over £18,000; and its expenditure during 1938 on the provision of educational and recreational facilities for its members amounted to £6,000. In addition to the Union clubs official returns show that there were on the register at the end of 1938 1,391 ex-Service men's clubs with a membership of 320,900, and 1,321 Conservative and 546 Liberal clubs (membership 363,000 and 147,500 respectively), the large majority of which were of this class. These figures do not include the many clubs established in the special areas and elsewhere for the unemployed.

WORKINGTON, a seaport and municipal borough in Cumberland, England, 34 mi. S.W. of Carlisle. Pop. (1938) 27,380. Area, 8.8 sq.mi. It stands on the river Derwent, and the Lonsdale dock is 4½ ac. in extent. Engineering is the main industry, but there are also collieries, with some workings beneath the sea. The town was incorporated in 1888 and is in the Workington parliamentary division. It suffered serious depression in the 1930s. Near by is the castellated Workington hall.

WORKMEN'S COMPENSATION. Until 1880 the only remedy which the law of Great Britain provided for a workman who had suffered physical injury in the course of his employment was a common law action in which the plaintiff had to establish that his injury was due to some personal fault in the employer, as that the employer had been guilty of personal negligence, or had knowingly employed an incompetent servant, or had committed a breach of some statutory duty. Even if the expense which had to be incurred was not an insurmountable obstacle, the cases where a workman would hope to recover damages for his injury by means of a common law action were comparatively rare. In an action for negligence formidable defences were available to the employer. Contributory negligence in the workman himself would be pleaded as a matter of course, and if it was established that the plaintiff could, by the exercise of ordinary care, have avoided the consequences of the defendant's negligence the action must fail. The doctrine of *volenti non fit injuria* might destroy the injured workman's right to damages on the ground that, knowing the risk he was running, he expressly or impliedly agreed to accept that risk. Then there was the defence of "common employment," which deprived the plaintiff of his right to damages when his injury was due to the negligence of a fellow workman. Moreover, the position of the dependants of a workman whose injuries had proved fatal was more desperate still, for the right of action was personal to the injured man and died with him. Lord Campbell's Act of 1846 created an exception to this rule in favour of a wife, husband, parent or child of the deceased, and enabled an action to be brought for the benefit of that limited class of persons in respect of the workman's death as a result of another's wrongful act or negligence. But the defences which were available in an action by the injured workman himself remained available as against the dependants of a workman whose injuries had proved fatal. So where a bricklayer was killed by the collapse of scaffolding which had been erected by men in the employment of the same employer who had not himself superintended the work, it was held that the master builder was under no liability (*Wigmore* v. *Jay* 5 Ex. 354).

Thereafter two different currents of opinion as to the manner in which the unsatisfactory state of the law should be remedied are observable. On the one hand, there was the view that any remedial measure should fit into the framework of the existing common law rules, and that all that was necessary was that those rules should be modified to remedy particular grievances. This school of thought found expression in the Employers' Liability Bill, introduced in 1893 by Asquith, who thus indicated its three vital principles: "The first is that it abolishes the doctrine of common employment; the second is that it prohibits contracts by

a workman renouncing his statutory rights; and thirdly, it simplifies the procedure by means of which the workman can seek his statutory remedy." The views of the opposing body of opinion were expressed in the amendment moved by Joseph Chamberlain when Asquith's bill was before the house of commons: "That no amendment of the law relating to employers' liability will be final or satisfactory which does not provide compensation to workmen for all injuries sustained in the ordinary course of their employment and not caused by their own acts or default." The House of Commons passed Asquith's bill, but abandoned it rather than accept an amendment of the House of Lords, the purpose of which was the preservation of the principle of contracting out, although subject to certain safeguards.

The British Workmen's Compensation Acts.—The Workmen's Compensation Act 1897 introduced a new principle into the law of the relationship between master and servant by imposing a liability on the employer to pay compensation to an injured workman, or if his injury proved fatal, to his dependants, although there had been no wrongful act or omission on the part of the employer or of anyone employed by him. Liability was imposed no less upon the employer who was blameless than upon him who had been guilty of negligence. Contracting-out was forbidden, save where an equally advantageous scheme, duly certified as such by the Registrar of Friendly Societies, was substituted for liability under the Act.

The Act of 1897 came up for review before a departmental committee appointed for the purpose in 1903. Many of the recommendations of that committee (*Report of Departmental Committee on Compensation for Injuries to Workmen,* 1904, Cmd. 2,208) were embodied in the Workmen's Compensation Act 1906, by which the Act of 1897 was repealed. In 1919 the departmental committee generally known as the Holman Gregory committee was appointed to report what alterations of the law were required "to remedy defects which experience has disclosed"; and "whether it would be desirable to establish a system of accident assurance under the control or supervision of the State." The committee reported in 1920 (*Report of Departmental Committee on Compensation for Injuries to Workmen,* 1920, Cmd. 816; *Minutes of Evidence,* Cmd. 908 and 909). Post-war conditions were not favourable to the achievement of the whole of the scheme of reform recommended by the committee, but a good deal of it was embodied in the amending Act of 1923. Finally, the consolidating Act of 1925 was passed and there the law must now be sought.

The Act of 1906 applied to the United Kingdom of Great Britain and Ireland. When the 1923 Act was passed the status of Ireland had changed. The present Act applies to England and Scotland only. It does not extend to Northern Ireland "except where otherwise expressly provided," and since the Irish Free State has dominion status it, of course, has its own legislation. Northern Ireland has passed an Act corresponding with the British Act.

From the first the remedy by way of the Workmen's Compensation Acts has, in Great Britain, been an alternative, and not an exclusive remedy. If circumstances are such that the Workmen's Compensation Act applies, the injured workman or his representatives are not barred from bringing an action at common law or under the Employers' Liability Act if the evidence necessary to support an action is forthcoming. The principle is laid down, however, that the employer is not to be liable to pay compensation twice over in respect of the same accident.

Employments to Which the Acts Apply.—The Workmen's Compensation Act of 1897 applied only to the more dangerous industries, and in effect to employers of the class best able to bear the liability. But the Workmen's Compensation Act 1900 applied the 1897 Act to "the employment of workmen in agriculture by any employer who habitually employs one or more workmen in such employment." Whereas the first Workmen's Compensation Act excluded from its scope all workmen not expressly included, the Act of 1906 included all "workmen" except the few classes expressly excluded, namely, non-manual workers whose remuneration exceeded £250 a year (the limit was raised to £350 by the 1923 Act); persons employed casually otherwise than for the purposes of the employer's trade or business; outworkers; members of the employer's family dwelling in his house; members of a police force, and persons in the army and navy. With the specific exceptions mentioned, the expression "workman" is defined to include "any person who has entered into or works under a contract of service or apprenticeship with an employer whether by way of manual labour, clerical work or otherwise." The sweep of the Act was thus widened in 1906 so as to include not only the coal miner and the engineer, but also the clerk in the counting-house, the shop assistant and the general servant.

Yet there were still workers excluded from the protection of the Act. These cases are a result of the general rule of law that, in the absence of an intention indicated in the Statute the presumption is that Parliament does not design its Acts to operate beyond the territorial limits of Great Britain. A seaman on a British ship meeting with an accident when abroad would be outside the Acts; so with the crews of British aircraft, when outside Great Britain. Again, if the legal relationship between, say, a cab proprietor and his driver is that of bailor and bailee, the relationship, the basis of which is a contract of service, which is the fundamental test for inclusion in the Acts, is absent. To bring such cases within the Workmen's Compensation Acts specific enactment has accordingly been necessary.

By Whom Compensation Is Paid.—The liability to pay compensation is imposed directly on the employer. It is not paid out of a fund to which the workman is himself a subscriber, as under national insurance. Nor does the employer's liability begin and end with the payment to a compensation fund, as in countries where there is a State scheme of workmen's compensation. Although in Great Britain insurance in respect of these risks is not compulsory, most employers do, in fact, transfer their liability to an insurance company.

What Injuries Are Within the Acts.—The law defining the liability of employers is as follows: If, in the employments to which the Act applies, "personal injury by accident arising out of and in the course of the employment is caused to a workman, his employer shall, subject as hereinafter mentioned, be liable to pay compensation." It is quite true that this form of words has given rise to an unprecedented crop of litigation. Nevertheless, a simpler and more satisfactory formula appears to be hard to find, for the formula has remained unaltered to the present day. Furthermore, the British form of words has been generally adopted in the Workmen's Compensation statutes of the British dominions and the United States, and in the Act recently passed by India the same formula appears.

On analysis it will be seen that the formula requires four conditions to be satisfied. (i) There must have been an "accident." This may include heat-stroke, murder and rupture of an aneurism by the strain of work. It does not include disease which, although traceable to the workman's employment, is gradual in its onset. (ii) The personal injury must have resulted from the accident. The incapacity or death must not be the consequence of some new intervening cause. So, if a workman dies from the effects of anaesthetics during an operation made necessary by an accident, the fact that the anaesthetic and not the accident was the immediate cause of death does not render the occurrence any the less a "personal injury by accident." Not so, however, if the fatal result was due to unskilful treatment of the injury. (iii) The accident must have arisen "in the course of" the employment. If it occurred before the employment began or after it had ended, compensation will not be payable. The beginning of employment is not the same thing as the beginning of work: the employment may begin when the workman reaches, say, a private road leading to the place of actual work: it may extend to attendance at the employers' premises for the purpose of drawing wages when not actually at work. (iv) The accident must have arisen "out of" the employment. The circumstances in which an accident may happen are infinite, and the meaning of the three words "arising out of" has to be gathered from literally hundreds of decisions in the Court of Appeal and the House of Lords. No universal test, whether an accident arose "out of" the employment, seems possible; but Lord Sumner in *L. & Y. Rly.* v. *Highley* [1917] A.C. 352 suggested a test which has been frequently ap-

plied, namely, "was it part of the injured person's employment to hazard, to suffer or to do that which caused his injury? If yea, the accident arose out of his employment. If nay, it did not."

Compensation is not necessarily payable because illness overtakes a workman while at work. For compensation to be payable for disablement or death due to disease, it must either be shown that the illness resulted from an accident, as where blood poisoning sets in as a consequence of a wound, however slight, received when at work; or the disease must be one of those to which the Workmen's Compensation Acts are specially applied, viz., anthrax, lead, phosphorus, mercury or arsenic poisoning and the miner's disease known as ankylostomiasis, together with the long list of other industrial diseases brought within the scope of the Acts by order of the home secretary in pursuance of his statutory powers.

Conditions Which Disqualify for Compensation.—In some of the dominions and the United States, it is provided that an injury which is self-inflicted, or was the result of intoxication, shall not be the subject of compensation. In Great Britain it has been left to the courts to rule out such cases, and only two disqualifications for compensation are the subject of specific enactment, namely, serious and wilful misconduct (but only in cases not resulting in death or serious and permanent disablement) and the fact that the incapacity did not extend beyond what is known as "the waiting period."

It is alleged in justification of this "waiting period" that it excludes a vast number of trivial claims, the cost of investigating and dealing with which would be disproportionate to the amount at stake. The British Act applies the simple plan by which compensation is payable after the first three days in all cases and from the date of the accident if the incapacity lasts four weeks or more. It is a condition to the granting of compensation that the accident has been brought to the knowledge of the employer as soon as possible and a claim for compensation made within six months from the occurrence of the accident, or, in fatal cases, within six months from the date of death, unless the absence of notice or failure to make the claim can be excused on one or other of the grounds indicated in the Statute, such as mistake, absence from Great Britain or "other reasonable cause."

Scale of Compensation.—In fatal cases compensation takes the form of a lump sum payment to or for the benefit of the deceased workman's dependants. Where the accident results in incapacity only, compensation is paid to the injured workman, and takes the form of a weekly payment during incapacity. The sum payable in fatal cases varies, in the first place according as the workman leaves total or partial dependants or no dependants at all and, in the second place, according as the dependants do or do not include children under the age of 15. If the deceased workman leaves any person entitled to rank as a dependant within the definition of the Act wholly dependent upon his earnings, the lump sum payable is £200 or a sum equal to the workman's earnings during the previous three years, whichever is the larger, but not exceeding £300. If the workman leaves only partial dependants, compensation is the sum which is "reasonable and proportionate to the injury" suffered by the dependants as a result of the workman's death, subject to the same maximum. If no dependants are left, only expenses of medical attendance and burial up to £15 are payable. Until 1923 no distinction was made between the case where the only dependant was, say, a young widow, and the case where a middle-aged widow and a family of small children were left to be provided for. The 1923 Act made provision for compensation additional to the above, where the workman leaves a widow or other member of his family dependant upon his earnings and in addition leaves one or more dependant children under the age of 15. This additional "children's allowance" is calculated according to the formula laid down in the Act and depends on the number of children and their respective ages. By way of illustration take the case of a workman earning 30s. a week, who leaves a widow and two children respectively seven and 14 years of age, all totally dependent upon his earnings. If the widow had been the only dependant the compensation payable would have been £234. But the "children's allowance" payable in addition is £105 6s., so that the total compensation payable amounts to £339 6s. The absolute maximum payable in a fatal case, including children's allowances, is £600. The lump sum payable in fatal cases is not paid direct to the dependants who, being generally persons unused to dealing with large sums, would possibly use it in an improvident manner, but is paid into the county court and by that court paid out to the dependants, according to their needs, in periodical instalments.

Where the workman is injured, but not killed, his weekly payment during total incapacity is a sum equal to 50% of his average weekly earnings but not exceeding 30s. So that compensation may not be wholly inadequate for the necessaries of life, provision is made by which workmen earning less than 50s. a week receive compensation in excess of 50% of earnings. Thus a workman whose earnings were 30s. a week would receive as compensation for total incapacity 20s. a week, and a workman earning only 20s. a week would get compensation amounting to as much as 75% of his weekly earnings. If the injury leaves him not totally but only partially incapacitated, so that a certain degree of working capacity exists, his compensation will be on a scale designed to give him one-half the difference between his earnings before and after the accident, special consideration being shown to workmen on the lower scales of wages.

Special provision is made for the case of minors who may meet with injury at their work when receiving only a low rate of wages, which rate, however, would normally be substantially increased when they become fully skilled workmen. Seeing that compensation is based on the wage rate during the time immediately preceding the accident, it would manifestly be unjust that compensation based on an apprentice's wages should continue without possibility of increase after the time when, but for the accident, he would be qualified for an adult workman's wages.

Compensation may be reviewed, and diminished or increased, according as the workman's condition gets better or worse. Most commonly such a review takes place when the workman, hitherto totally incapacitated, recovers part but not the whole of his earning capacity.

The authors of the original Act expected that disputed cases would in general be settled by private arbitration without resort to the courts. In fact, however, workmen's compensation cases are, with very few exceptions, dealt with by the county courts.

Systems Adopted in the Dominions and U.S.A.—In Great Britain, the employer is allowed to insure against his liability, or not, according to his discretion. But in certain of the States of the United States of America, and in a majority of the Canadian provinces, and in Queensland, the earlier Acts on the British model have been changed and the State, through the agency of a public department, levies upon employers compulsory contributions and itself assumes the liability to pay compensation. It is to the State fund and not to the individual employer that the injured workman or his dependants must look for compensation. The system, including the determination of disputes, is in reality a system of State insurance.

An intermediate position is occupied by the Australian States (with the exception of Queensland) and is common in the United States of America. There State intervention in workmen's compensation matters is directed to the compulsory insurance of workmen's compensation risk coupled, in the case of Victoria and New South Wales and sometimes in the United States, with the setting up of a State accident insurance office with which, however, private insurance enterprise is allowed to compete. In New Zealand, without the incentive of compulsory insurance, the accident branch of the Government insurance department provides an alternative to private insurance companies.

The German System.—In Germany, compensation for industrial accidents is one part of a code of social insurance of which sickness insurance, and invalidity, old age pensions, and widows' and orphans' pensions insurance are other branches. In Great Britain the latter forms of social insurance are contained in separate statutes and are administered by a distinct department.

The existing German law relating to accident insurance is contained in Part iii. of the Social Insurance Code of 1911 as revised in 1924, but its origin goes back to the period 1883 to 1889

when, by the triple scheme of social insurance then established in Germany, it became compulsory not only to insure, but to be a member of an association with liability to support a particular fund. Germany was indeed the first country to admit this liability.

Germany imposes the liability not on individual employers but on groups of employers organized in mutual trade associations. The industries broadly include the manufacturing and mining industries, the building trades, commercial undertakings and transport. Agriculture and navigation by sea constitute separate parts of the code. The financial liabilities of each association are determined annually and the levy on members necessary to cover compensation, reserves and administration expenses is based on the wage roll, modified by the risk as manifested by the accident rates for the particular industry or occupation. Compensation is paid through the post office. The workers contribute in some degree in that in respect of accidents causing temporary incapacity for work for a period not longer than 13 weeks, the case is dealt with by the sickness insurance organization and benefit paid by the sickness insurance fund to which employers and employed contribute in proportions of one-third and two-thirds. Only from the 14th week does the accident insurance organization take over the case. Compensation for industrial accidents provides an incentive to employers to avoid conditions likely to result in accidents and illness. The German code requires the employers' accident associations to issue regulations concerning the arrangements for the prevention of accidents and the rules of conduct to be observed by the workers. (C. M. KN.)

THE UNITED STATES

In comparison with Europe, workmen's compensation came late in the United States. To be sure, the common law rules of employers' liability had scarcely been laid down by the courts before attempts to modify them by legislation began in certain American States. The first such statute was passed in Georgia in 1855, and by 1910 practically every State had passed some sort of employers' liability statute. But these laws as interpreted by the courts merely mitigated the harshness of the common law rules, frequently in some rather minor respect. Moreover, many of them applied only to railway accidents in which the fellow servant rule operated with especial cruelty. In general the essential liability basis of the worker's right to recover remained unchanged. The first act substituting compensation for liability as its basic principle was enacted in Maryland in 1902; another (limited to coal mining) in Montana in 1909. Both these acts were held unconstitutional by State courts. The first permanent compensation law was passed by Congress in 1908, but it covered only certain classes of Government employees.

Commission Period.—The 20th century brought increasing public concern over industrial accidents and the plight of their victims. In State after State official commissions were set up to investigate and recommend legislation. Eight such commissions were appointed in 1910, twelve in 1911, and seven in 1913. Altogether there were 40 commissions between 1903 and 1919. These bodies were unanimous in their condemnation of the existing legal situation. Their investigations revealed that very few injured workers or their surviving dependents secured any compensation whatever from their employers, and then only after long delay. Moreover, a large proportion of any award of damages went to pay the lawyer's fee. Some of the commissions considered the possibility of strengthening existing employers' liability statutes, but concluded that this would prove an inadequate remedy, since the necessity for court action and proof of negligence by the employer would remain. With almost complete unanimity, the commissions recommended the adoption of the compensation principle and drafted bills along that line.

Period of Legislation.—New York passed the first comprehensive compensation law in 1910 and a wave of such laws followed. Ten States acted in 1911; eleven in 1912–14. Nine States and three territories were added to the compensation area in 1915–16, and eight states in 1917–19. After that the remaining States, mostly Southern, came in slowly; a law was passed for the Philippine islands, a Federal law for the District of Columbia, and another for the longshoremen and harbour workers who had been excluded from State legislation. In 1939 only two States, Arkansas and Mississippi, remained without workmen's compensation laws.

Constitutionality.—Like other kinds of American labour legislation, workmen's compensation had to run the gamut of the courts. Though eventually held constitutional, it bears the scars of that encounter in the "elective" feature which still remains in a majority of State compensation laws. It has been noted that the earliest attempts at compensation legislation in Maryland and Montana were invalidated by State courts. These laws were limited in scope and defective in plan. In 1910, however, the largest industrial State in the Union, New York, passed a compulsory compensation law for the industries which it designated as hazardous. This law was promptly invalidated by the highest court of the State in the famous case of *Ives* v. *So. Buffalo Ry. Co.*, 201 N.Y. 271 (1911). The statute was held to be in conflict with both the State and Federal constitutions. The court stated that it knew of "no principle on which one can be compelled to indemnify another for loss unless it is based upon contractual obligation or fault." Under the Federal Judiciary Act as it then stood, this case could not be appealed to the United States Supreme Court. New York at once amended its State constitution expressly to permit workmen's compensation legislation. But doubt as to the validity of such laws under the Federal Constitution obviously remained.

This doubt led to the use of the "election" device in two-thirds of the laws passed prior to 1917, the year in which the constitutionality of compulsory laws was finally established. By that time the elective pattern was so generally accepted that its use continued in many States. Under an elective law, the employer and the worker chose whether to come under compensation. The employer, however, was induced to come in by provisions which abrogated some or all of his common law defences (described above) if he remained outside. Most of these laws presumed his election to come in unless he took affirmative action to the contrary. It was generally believed that the absence of compulsion would make these elective laws easier to sustain.

However, in 1917, the United States Supreme Court finally upheld both compulsory and elective laws in three important decisions (*New York Central Rail. Co.* v. *White,* 243 U.S. 188; *Hawkins* v. *Bleakly,* 243 U.S. 210, and *Mountain Timber Co.* v. *Washington,* 243 U.S. 219). In the first case the court unanimously upheld New York's second compulsory law, passed in 1913 after the State constitution had been amended. The opinion emphasized that the compensation act did not merely destroy the body of common law rules relating to industrial accidents, but replaced them with another system. The court further declared that "liability without fault is not a novelty in the law." In the second case the court unanimously upheld Iowa's elective law. In the third case it sustained the compulsory law of the State of Washington which further required all covered employers to insure in a State insurance fund. This decision was reached by a five to four vote.

Comparison of American and British Systems.—American compensation laws differ from the British Act in several important respects. In the first place, they make compensation an exclusive remedy. In every State but one, the law denies the worker a choice *after the accident* between compensation and his right to sue for damages. Under compulsory laws he loses his right to sue entirely, except under certain special circumstances. Under elective laws he must choose between the two remedies prior to the accident; ordinarily he is presumed to accept compensation along with his employer. Again in contrast to the British system, employers are required under American acts to insure their compensation risk. In virtually all jurisdictions, all employers must carry insurance except those who can satisfy certain standards of financial responsibility and qualify as "self insurers." In seven States in 1939 employers were required to insure in the exclusive State fund; in 12 jurisdictions they had a choice between a State fund and private insurance; in the remaining States only private insurance carriers were available. Finally, unlike Great Britain, virtually every American State had by 1939 established some kind

of administrative agency for the decision of disputed compensation claims. Appeal to the courts from these quasi-judicial bodies could be made only on questions of law, not of fact. In addition these administrative agencies were charged with the affirmative responsibility to see that injured workers received the compensation due them. American compensation laws resemble the British Act in their benefit features. After a specified waiting period, compensation is paid covering medical care and a portion of wage loss measured as a percentage of average full time earnings. Various methods are used in different States in computing benefits due in case of death or one or another type of disability. The definition of injuries covered is typically the same as that used in Great Britain; namely, "injuries arising out of and in the course of employment." These terms have been interpreted in numerous court decisions. In addition to accidents, some kinds of occupational disease are included under more than half the American compensation laws. By 1939, 23 States and 6 other jurisdictions had amended their laws to this effect. However, only 14 of these acts provided complete coverage. The remainder compensated for certain listed diseases, or were more limited in scope. Though workmen's compensation had been generally accepted in the U.S. for about 20 years, it is important to note that in 1939, farm labourers, domestic servants, casual workers, and employees of small employers were still generally excluded from the scope of compensation laws. Interstate railway employees remained under a special employers' liability statute. The effect of these exclusions was to leave at least 20% of American workers outside the compensation system. Benefits are limited both in amount and duration so that they never equal the full wage loss.

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WORKS AND PUBLIC BUILDINGS, OFFICE OF: *see* GOVERNMENT DEPARTMENTS.

WORKS' COUNCILS: *see* INDUSTRIAL RELATIONS.

WORKSHOP LAW: *see* LABOUR LAW; HOURS OF LABOUR.

WORKSOP, a municipal borough in the Bassetlaw parliamentary division of Nottinghamshire, England, on the L.N.E.R. and the Chesterfield canal. Pop. (1938) 27,890. Area, 28 sq.mi. The civil parish is the largest in the county. The south door of the priory church of SS. Mary and Cuthbert possesses 12th or 13th century iron scroll work, the oldest in England. Of the priory, founded 1102–03, the gatehouse, containing the Early English shrine or chapel of St. Mary, remains. From 1894 to 1931, when it was incorporated, Worksop was governed by an urban district council. Coal mining is the chief industry, although there is also a large trade in timber.

WORLD COURT: *see* PERMANENT COURT OF INTERNATIONAL JUSTICE.

WORLD SOUL, in the history of philosophy, denotes the conception that there is in the world a universal spirit or soul which is related to the material world in a way that is similar or analogous to the relation of the human soul to the body. This view was taught by various Greek philosophers, notably by Plato and the Stoics. In modern times Schelling held a similar conception, and attributed to the world-soul the function of acting as an organizing principle of the material world, which is thereby made into a coherent system. *See* PLATO; STOICS; SCHELLING.

WORLD WAR I. The aim of this article is to trace the main strategic currents of World War I, and also the conditions and ideas which guided them. The causes of the war are not within its scope. (For the political and diplomatic history of the struggle *see* the article EUROPE.) A process of 50 years had gone to make Europe inflammable, and a few days were enough to detonate it. To study the causes of the conflict on the German side we should have to trace the influence of Prussia on the creation of the Reich, the political conceptions of Bismarck, the German philosophical tendencies, her economic situation—a medley of factors which transmuted Germany's natural desire for commercial outlets, unhappily difficult to obtain, into a vision of world-power. We should have to analyse that heterogeneous relic of the middle ages known as Austria-Hungary, appreciate her complex racial problems, the artificiality of her governing institutions, the superficial ambitions which overlay a haunting fear of internal disruption and frantically sought to postpone the inevitable end.

On the other side we should have to examine the strange mixture of ambition and idealism which swayed Russian policy; we should have to understand the constant and justifiable fear of fresh aggression which France had suffered since 1870, and follow the regrowth of confidence which fortified her to resist further threats; finally, we should have to trace Britain's gradual movement from a policy of isolation into membership of the European system and her slow awakening to the reality of German ambitions. Beside these fundamental causes the international "incidents" that took place between 1899 and 1914 are but symptoms.

I. INTRODUCTION

The Armed Forces.—World War I may be briefly epitomized as a progress from convention through chaos to co-operation. The nations entered upon the conflict with the conventional outlook and system of the 18th century merely modified by the events of the 19th century. Politically, they conceived of it as a struggle between rival coalitions based on the traditional system of diplomatic alliances, and militarily as between professional armies—swollen, it is true, owing to the continental system of conscription, yet essentially fought out by soldiers while the mass of the people watched, from seats in the amphitheatre, the efforts of their champions. The Germans alone had a glimpse of the truth, but—one or two prophetic minds apart—the "Nation in Arms" theory evolved by them during the 19th century visualized the nation rather as a reservoir to pour its reinforcements into the army than as a mighty river in which are merged many tributary forces, of which the army is but one. Their conception was the "Nation in Arms," hardly the "Nation at War." Even after the war this truth had still to be grasped in its entirety and its full implications understood. Progressively throughout the years 1914–18 the warring nations enlisted the research of the scientist, the inventive powers and technical skill of the engineer, the manual labour of industry and the pen of the propagandist. For long this fusion of many forces tended to a chaotic maelstrom of forces; the old order had broken down, the new had not yet evolved. Only gradually did a working co-operation emerge, and it is a moot point whether even in the last phase co-operation of forces had attained to the higher level of co-ordination—direction by unity of diversity.

The German army of 1914 was born in the Napoleonic wars, nursed in infancy by Gneisenau and Scharnhorst, and trained in adolescence by the elder Moltke and Roon. It reached maturity in the war of 1870, where it emerged triumphantly from a test against the long-service army of France. Every physically able citizen was liable to service, and the State took the number it desired, trained them to arms for a short period of full-time service, and then returned them to civil life. The feature, as also the object, of this system was the production of a huge reserve by which to expand the active army in war. A man served two or three years full-time, according to his branch of the service, followed by five or four years in the regular reserves. He then went into the Landwehr for 12 years, and finally passed into the Landsturm from 39 till 45. Further, an Ersatz reserve was formed of those who were not called on for service with the colours.

In this organization and the thoroughness of the training lay the secret of the first great surprise of the war, one which almost proved decisive. For instead of regarding their reservists as troops of doubtful quality, fit only for an auxiliary rôle or garrison duty, the Germans during mobilization were able to duplicate every first line army corps with a reserve corps—and had the courage, justified by events, to use them in the opening clash. This surprise upset the French calculations, as it dislocated their plan.

The Germans have been reproached for many miscalculations; less than justice has been done to the correctness of many of their intuitions. They alone realized what became an axiom—that, given a highly trained cadre of leaders, a military machine

can be rapidly manufactured from the levies of the led, like molten liquid poured into a mould. The German mould was a long-service body of officers and n.c.o.s who in their standard of technical knowledge and skill had no equal in the world. But if the machine was manufactured by training, it gained its solidity from another process. The psychological element plays an even greater part in a "national" than in a professional army. Esprit de corps is not enough; the stimulus of a great moral impulse to action is necessary, a deep-rooted belief in the policy for which citizens are called on to fight. The leaders of Germany had worked for generations to inspire their people with a patriotic conviction of the grandeur of their country's destiny. And if their opponents went forth to battle in 1914 with as intense a belief in their country's cause, this flaming patriotism had not the time to consolidate such a disciplined combination as years of steady heat had produced in Germany. The German people had an intimacy with and a pride in their army, notwithstanding its severity of discipline, that was unknown elsewhere.

This unique instrument was handled by a general staff which, by rigour of selection and training, was unmatched for professional knowledge and skill, if subject to the mental "grooves" which characterize all professions. Executive skill is the fruit of practice; and constant practice, or repetition, tends inevitably to deaden originality and elasticity of mind. In a professional body, also, promotion by seniority is a rule difficult to avoid. The Germans, it is true, tended towards a system of staff control, which in practice frequently left the real power in the hands of youthful general staff officers. As war memoirs and documents reveal, the chiefs of staff of the various armies and corps often took momentous decisions with hardly a pretence of consulting their commanders. But such a system had grave objections, for such a happy combination as that of a Hindenburg and Ludendorff is rarely found, and from it came the grit in the wheels which not infrequently marred the otherwise well-oiled working of the German war-machine.

Tactically, the Germans began with two important material advantages. They alone had gauged the potentialities of the heavy howitzer, and had provided adequate numbers of this weapon. And if no army had fully realized that machine-guns were "concentrated essence of infantry," nor fully developed this preponderant source of fire-power, the Germans had studied it more than other armies, and by their method of grouping the machine-guns under regimental control, instead of distributing them among battalions, were able to exploit its inherent battlefield-dominating power sooner than other armies. Strategically, also, the Germans had brought the study and development of railway communications to a higher pitch than any of their rivals.

The Austro-Hungarian army, if patterned on the German model, was a vastly inferior instrument. Not only had it a tradition of defeat rather than of victory, but its racial mixture prevented the moral homogeneity that distinguished its ally. This being so, the replacement of the old professional army by one based on universal service lowered rather than raised its standard of effectiveness. The troops within the borders of the empire were often racially akin to those beyond, and this compelled her to a politically instead of a militarily based distribution of forces, so that kinsmen should not fight each other. And her human handicap was increased by a geographical one—the vast extent of frontier to be defended. Nor were her leaders, with rare exceptions, the professional equals of the Germans, and if common action was better than with the Entente Powers, Austria did not accept German direction gladly.

Yet despite all its evident weaknesses this loosely knit conglomeration of races withstood the shock and strain of war for four years, in a way that surprised and dismayed her opponents. The explanation is that this complex racial fabric was woven on a stout Germanic and Magyar framework.

From the Central we turn to the Entente Powers. France possessed but 60% of the potential man-power of Germany, and this debit balance had forced her to call on the services of practically every able-bodied male. A man was called up at 20, did three years' full-time service, then 11 in the reserve and finally two periods of seven years each in the Territorial Army and Territorial Reserve. This system gave France an initial war strength of some 4,000,000 men, equal to her German rival, but, in contrast, she placed little reliance on the fighting values of reservists. The French command counted only on the semi-professional troops of the first line, about 1,500,000 men, for the short and decisive campaign which they expected and prepared for. Moreover, they assumed a similar attitude on the part of their enemy—with dire result. But this initial surprise apart, a more profound handicap was the lesser capacity of France for expansion, in case of a long war, due to her smaller population—under 40,000,000 compared with Germany's 65 millions. Col. Mangin, later to become famous, had advocated tapping the resources in Africa, the raising of a huge native army, but the Government had considered the dangers to outweigh the advantages of such a policy.

The French general staff, if less technically perfect than that of Germany, had produced some of the ablest military thinkers in Europe, and its level of intelligence could well bear comparison. Unfortunately, in recent years a sharp division of thought had arisen, which did not make for combined action. Worse still the new French philosophy of war in its abstraction with the moral element had become more and more separated from the inseparable material factors. Abundance of will cannot compensate a definite inferiority of weapons, and the second factor, once realised, inevitably reacts on the first. In *matériel,* the French had one great asset in their quick-firing 75 mm. field gun, the best in the world, but its very value had led them to undue confidence in a war of movement and a consequent neglect of equipment and training for the type of warfare which came to pass.

Russia's assets were in the physical sphere, her defects in the mental or moral. If her initial war strength was no greater than that of Germany, her man-power resources were immense and the courage and endurance of her troops were famous. But corruption and incompetence permeated her leadership, her rank and file lacked the intelligence and initiative for scientific warfare—they formed an instrument of great solidity but little flexibility—and her manufacturing resources for equipment and munitions were far below those of the great industrial Powers. This handicap was made worse by her geographical situation, cut off from her allies by ice- or enemy-bound seas, and with immense land frontiers. Another radical defect was the poverty of her rail communications, the more essential as she relied for success on bringing into play the weight of her numbers. In the moral sphere Russia's condition was less clear. Her internal troubles were notorious and must be a brake on her efforts unless the cause was such as to prove a crusade-like appeal to her primitive and incoherent masses.

Between the military systems of Germany, Austria, France and Russia there was a close relation, differences of detail rather than of fundamental, and this similarity threw into greater contrast the system of the other great European Power—Britain. Throughout modern times she had been essentially a sea-power, intervening on land through a traditional policy of diplomatic and financial support to Allies, whose military efforts she reinforced with a leaven from her own professional army. This regular army was primarily maintained for the protection and control of the overseas dependencies—India in particular—and had always been kept down to the minimum strength for this purpose. The reason for the curious contrast between Britain's determination to maintain a supreme navy and her consistent neglect, indeed starvation of the army, lay partly in her insular position, which caused her to regard the sea as her essential life-line and main defence, and partly in a constitutional distrust of the army, an illogical prejudice, which had its almost forgotten source in the military government of Cromwell. Small as to size, it enjoyed a practical and varied experience of war without parallel among the Continental armies. Compared with them, its professional handicap was that the leaders, however skilled in handling small columns in colonial expeditions, had never directed large formations in *la grande guerre.*

Further, the foundations of a general staff had only been laid since the bitter lessons of the South African War, and the interval

was too short, the distractions too great, for this to have been developed to the level of Germany and France. For the progress in organization in the years before 1914, the British army owed much to Lord Haldane, and to him also was due the creation of a second line of part-trained citizens—the Territorial Force. Lord Roberts had pleaded for compulsory military training, but the voluntary principle was too deeply embedded in the national mind for this course to be adopted, and Haldane wisely sought to develop Britain's military effectiveness within the bounds set by traditional policy. As a result, 1914 found England with an expeditionary force of some 160,000 men, the most highly trained striking force of any country—a rapier among scythes, and to maintain this at strength the old militia had been turned into a special reserve for drafting. Behind this first line stood the Territorial Force, which if only enlisted for home defence had a permanent fighting organization unlike the amorphous volunteer force which it superseded. The British army had no special outstanding asset in war armament, but it had developed a standard of rifle-shooting unique among the world's armies.

The reforms by which the army was brought into line with Continental models had one defect, which was accentuated by the close relations established between the British and French general staffs since the Entente. It induced a "Continental" habit of thought among the general staff, and predisposed them to the rôle, for which their slender strength was unsuited, of fighting alongside an Allied army. This obscured the British army's traditional employment in amphibious operations through which the mobility given by command of the sea was exploited. A small but highly trained force striking "out of the blue" at a vital spot could produce a strategical effect out of all proportion to its slight numbers.

The last argument brings us to a comparison of the naval situation, which turned on the balance between the fleets of Britain and Germany. Britain's sea supremacy, for long unquestioned, had in recent years been challenged by a Germany which had deduced that a powerful fleet was the key to that colonial empire which she desired as an outlet for her commerce and increasing population. To the spur of naval competition the British people eventually responded, determined at any cost to maintain their "two-power" standard. If this reaction was instinctive rather than reasoned, its subconscious wisdom had a better foundation than the catchwords with which it was justified, or even than the need of defence against invasion. The industrial development of the British Isles had left them dependent on overseas supplies for food, and on the secure flow of seaborne imports and exports for industrial existence. For the navy itself this competition was a refining agency, leading to a concentration on essentials. Gunnery was developed and less value attached to polished brasswork; warship design and armament were transformed—the "Dreadnought" ushering in a new era, of the all big-gun battleship. By 1914 Britain had 29 such capital ships and 13 building, to the 18 built and nine building, of Germany. Further, Britain's naval strength had been soundly distributed, the main concentration being in the North sea.

More open to criticism, in view of the forecasts of several naval authorities, was her comparative neglect of the potential menace of the submarine. Here German opinion was shown rather by the number building than those already in commission. It is to Germany's credit that though lacking a sea tradition, her fleet an artificial rather than a natural product, the technical skill of the German navy made it a formidable rival to the British ship for ship, and perhaps its superior in scientific gunnery.

But in the first stage of the struggle the balance of the naval forces would affect the issue far less than the balance on land. For a fleet suffers one inherent limitation—it is tied to the sea, and hence cannot strike direct at the hostile nation. The fundamental purpose of a navy is therefore to protect a nation's sea communications and sever those of the enemy, and, although victory in battle may be a necessary prelude, blockade is the ultimate purpose. And as blockade is a weapon slow to take effect, its influence could only be decisive if the armies failed to secure the speedy decision on land, upon which all counted.

The Economic Forces.—In this idea of a short war lay also the reason for the comparative disregard of economic forces. Few believed that a modern nation could endure for many months the strain of a large-scale conflict. The supply of food, of munitions and their manufacture, of funds, were problems only studied on brief estimates. Of belligerents, all could feed themselves save Britain and Germany, and Germany's deficit of home-grown supplies could only be serious in the event of a struggle of years. But Britain would starve in three months if her outside supplies were cut off.

In munitions and other war material Britain's industrial power was greatest of all, though conversion to war production was a necessary preliminary, and all, again, depended on the security of her sea communication. France was weak, and Russia weaker still, but the former, unlike the latter, could count on outside supplies so long as Britain held the seas. As Britain was the industrial pivot of the one alliance, so was Germany of the other. A great manufacturing nation, she had also a wealth of raw material, especially since the annexation of the Lorraine iron-fields after the 1870 war. But the stoppage of outside supplies must be a handicap in a long war, increasing with its duration, and serious from the outset in such tropical products as rubber. Moreover, Germany's main coal and iron fields lay dangerously close to her frontier, in Silesia on the east and in Westphalia and Lorraine on the west. Thus for the Central Alliance a quick decision and an offensive war were more vital than for the Entente.

Similarly, the financial resources were calculated on a short war basis, and all the Continental Powers relied mainly on large gold reserves accumulated specially for war purposes. Britain alone had no such war chest, but she was to prove that the strength of her banking system and the wealth distributed among a great commercial people furnished the "sinews of war," in a way that few pre-war economists had realized.

The Psychological Forces.—If the economic forces were neglected in the war calculations of the Powers, the psychological forces were an unexplored region, except in their purely military aspect. And even here little study had been devoted to the moral element compared with the physical element. Ardant du Picq, a soldier-philosopher who fell in the 1870 war, had stripped battle of its aura of heroic fictions, portraying the reaction of normal men in the presence of danger. Several German critics had described from experience the reality of battle *moral* as shown in 1870, and had deduced how tactics should be based on the ever-present and balancing elements of fear and courage. At the close of the century a French military thinker, Col. Foch, had demonstrated how great was the influence of the moral element in the higher sphere of command. But only the fringe of the subject had been penetrated. Its civil aspects were untouched, and in the opening weeks of the conflict the general misunderstanding of national psychology was to be shown in the undue muzzling of the Press, followed by the equally stupid practice of issuing communiqués which so veiled the truth that public opinion became distrustful of all official news and rumour was loosed on its infinitely more damaging course. The true value of wisely calculated publicity and the true application of the propaganda weapon was only to be learnt after many blunders.

The Rival Plans.—In this survey the German plan justly takes priority, for not only was it the mainspring which set in motion the hands of the war clock in 1914, but it may even be said to have governed the course of the war thereafter. It is true that outwardly this course from the autumn of 1914 onwards seemed to be of the nature of a stupendous "siege" of the Central Powers, an idea which is incompatible with the terms we have used. But the conception of the Germanic alliance as a besieged party, although true of the economic sphere, suggests a passivity which their strategy contradicts. Although the initial German plan miscarried, even in its failure it dictated the general trend of operations thereafter. Tactically, most of the fighting resembled siege operations, but the actual strategy on land for long erred rather by its disregard of these tactical conditions than by its conformity with them.

The Germans were faced with the problem that the combined

forces of themselves and Austria were decidedly inferior to those of France and Russia. To offset this adverse balance, however, they had a central position and the anticipation that Russia's mobilization would be too slow to allow her to exert serious pressure in the opening weeks. While this assumption might suggest a decisive blow at Russia before she was ready, it was equally probable that she would concentrate her main forces too far back for such a German blow to reach—and the experience of Napoleon was not an example to encourage an advance deep into the interior of Russia, with its vast distances and poor communications. The plan adopted by Germany was, therefore, a rapid offensive against France while holding the Russian advanced forces at bay, and later, when France was crushed, to deal with the Russian army.

But this plan, in turn, was complicated by the great natural and artificial barriers which the French frontier offered to an invader. It was narrow, only some 150 m. across, and so afforded little room for manoeuvre or even to deploy the masses that Germany planned to launch against her foe. At the south-eastern end it abutted on Switzerland, and after a short stretch of flat country known as the Gap of Belfort the frontier ran for 70 m. along the Vosges mountains. Thence the line was prolonged by an almost continuous fortress system, based on Epinal, Toul, Verdun and just beyond the last-named lay not only the frontiers of Luxembourg and Belgium but the difficult Ardennes country. Apart from the strongly defended avenues of advance by Belfort and Verdun, the only feasible gap in this barrier was the Trouée de Charmes between Epinal and Toul, left open originally as a strategic trap in which the Germans could be first caught and then crushed by a French counter-stroke.

Faced with such a mental and physical blank wall, the logical military course was to go round it—by a wide manoeuvre through Belgium. Graf von Schlieffen, chief of the German general staff from 1891 to 1906 conceived and developed from 1895 onwards the plan, by which the French armies were to be enveloped and a rapid decision gained, and as finally formulated it came into force in 1905. To attain its object Schlieffen's plan concentrated the mass of the German forces on the right wing for this gigantic wheel and designedly took risks by reducing the left wing, facing the French frontier, to the slenderest possible size. The swinging mass, pivoting on the fortified area Metz-Thionville, was to consist of 53 divisions, backed up as rapidly as possible by Landwehr and Ersatz formations, while the secondary army on the left wing comprised only nine divisions. Its very weakness promised to aid the main blow in a further way, for if a French offensive pressed them back towards the Rhine, the attack through Belgium on the French flank would be all the more difficult to parry. It would be like a revolving-door—if a man pressed heavily on one side the other side would swing round and strike him in the back. The German enveloping mass was to sweep round through Belgium and northern France and, continuing to traverse a vast arc, would wheel gradually east. With its extreme right passing south of Paris and crossing the Seine near Rouen it would then press the French back towards the Moselle, where they would be hammered in rear on the anvil formed by the Lorraine fortresses and the Swiss frontier.

Schlieffen's plan allowed ten divisions to hold the Russians in check while the French were being crushed. It is a testimony to the vision of this remarkable man that he counted on the intervention of Britain, and allowed for an expeditionary force of 100,000 "operating in conjunction with the French." To him also was due the scheme for using the Landwehr and Ersatz troops in active operations and fusing the resources of the nation into the army. His dying words are reported to have been, "It must come to a fight. Only make the right wing strong."

Unhappily for Germany, if happily for the world, the younger Moltke, who succeeded him, lacked his moral courage and clear grasp of the principle of concentration. Moltke retained Schlieffen's plan, but he whittled away the essential idea. Of the nine new divisions which became available between 1905 and 1914 Moltke allotted eight to the left wing and only one to the right. True, he added another from the Russian front, but this trivial increase was purchased at a heavy price, for the Russian army of 1914 was a far more formidable menace than when Schlieffen's plan came into force. In the outcome two army corps were taken from the French theatre at the crisis of the August campaign, in order to reinforce the Eastern front.

If the fault of the final German plan was a lack of courage, that of the French plan was due to an excess. In their case, also, a miasma of confused thought seemed to creep over the leadership in the years just before the war. Since the disasters of 1870 the French command had planned an initial defensive, based on the frontier fortresses, followed by a decisive counter-stroke. To this end the great fortress system had been created, and gaps like the Trouée de Charmes left to "canalize" the invasion ready for the counter. But in the decade before 1914 a new school of thought had arisen, who argued that the offensive was more in tune with French character and tradition, that the possession of the "75"—a field gun unique in mobility and rapidity of fire—made it tactically possible, and that the alliance with Russia and Britain made it strategically possible. Forgetful of the lessons of 1870 they imagined that *élan* was proof against bullets. Napoleon's much quoted saying that "the moral is to the physical as three to one" has much to answer for; it has led soldiers to think that a division exists between the two, whereas each is dependent on the other. Weapons without courage are ineffective, but so also are the bravest troops without efficient weapons to protect them and their *moral*.

The outcome was disastrous. The new school found in Gen. Joffre, appointed chief of the general staff in 1912, a lever for their designs. Under the cloak of his authority, the advocates of the *offensive à outrance* gained control of the French military machine, and, throwing aside the old doctrine, formulated the now famous, or notorious, Plan XVII. It was based on a negation of historical experience—indeed, of common sense—and on a double miscalculation—of force and place, the latter more serious than the former. Accepting the possibility that the Government might employ their reserve formations at the outset, the strength of the Germany army in the West was estimated at a possible maximum of 68 infantry divisions. The Germans actually deployed the equivalent of 83½, counting Landwehr and Ersatz divisions. But French opinion was and continued to be doubtful of this contingency, and during the crucial days when the rival armies were concentrating and moving forward the French Intelligence counted only the active divisions in its estimates of the enemy strength—a miscalculation by half! If the plan had been framed on a miscalculation less extreme, this recognition does not condone but rather increases its fundamental falsity, for history affords no vestige of justification for a plan by which a frontal offensive was to be launched with mere equality of force against an enemy who would have the support of his fortified frontier zone, while the attackers forswore any advantage from their own.

The second miscalculation, of place, was that although the possibility of a German move through Belgium was recognized, the wideness of its sweep was utterly misjudged. The Germans were expected complaisantly to take the difficult route through the Ardennes in order that the French might conveniently smite their communications! Based on the idea of an immediate and general offensive, the plan ordained a thrust by the 1st and 2nd Armies towards the Saar into Lorraine. On their left were the 3rd Army opposite Metz and the 5th Army facing the Ardennes, which were either to take up the offensive between Metz and Thionville, or, if the Germans came through Luxembourg and Belgium, to strike north at their flank. The 4th Army was held in strategic reserve near the centre and two groups of reserve divisions were disposed in rear of either flank—relegation to such a passive rôle expressing French opinion on the capacity of reserve formations.

Britain's share in this plan was settled less by calculation than by the "Europeanization" of her military organization during the previous decade. This Continental influence drew her insensibly into a tacit acceptance of the rôle of acting as an appendix to the French left wing, and away from her historic exploitation of the

mobility given by sea-power. At the council of war on the outbreak, Lord Roberts, summoned from retirement, advocated the dispatch of the expeditionary force to Belgium—where it would have stiffened the Belgian resistance and threatened the flank of the wheeling German mass. But his was a voice crying in the wilderness, and in any case the British general staff, through Gen. Wilson, had virtually pledged themselves to act in direct co-operation with the French. When the general staffs of the two countries conducted their informal negotiations between 1905 and 1914 they little realized that they were paving the way for a reversal of England's centuries-old policy, for a war effort such as no Englishman had ever conceived.

On the Eastern front, the plans of campaign were more fluid, less elaborately worked out and formulated—although they were to be as kaleidoscopic in their changes of fortune as in the Western theatre. The calculable condition was geographical; the main incalculable, Russia's rate of concentration. Russian Poland was a vast tongue of country projecting from Russia proper, and flanked on three sides by German or Austrian territory. On its northern flank lay East Prussia with the Baltic sea beyond. On its southern flank lay the Austrian province of Galicia with the Carpathian mountains beyond, guarding the approaches to the plain of Hungary. On the west lay Silesia. As the Germanic border provinces were provided with a network of strategic railways whilst Poland, as well as Russia itself, had only a sparse system of communications, the Germanic alliance had a vital advantage, in power of concentration, for countering a Russian advance. But if they took the offensive, the further they progressed into Poland or Russia proper the more would they lose this advantage. Hence their most profitable strategy was to lure the Russians on into position for a counter-stroke rather than to inaugurate an offensive themselves. The one drawback was that such a Punic strategy gave the Russians time to concentrate and set in motion their cumbrous and rusty machine.

From this arose an initial cleavage between German and Austrian opinion. Both agreed that the problem was to hold the Russians in check during the six weeks before the Germans, it was hoped, having crushed France, could switch their forces eastwards to join the Austrians in a decisive blow against the Russians. The difference of opinion was on the method. The Germans, intent on a decision against France, wished to leave a minimum force in the East, and only a political dislike of exposing national territory to invasion prevented them evacuating East Prussia and standing on the Vistula line. But the Austrians, under the influence of Conrad von Hötzendorf, chief of their general staff, were anxious to throw the Russian machine out of gear by an immediate offensive, and as this promised to keep the Russians fully occupied while the campaign in France was being decided Moltke fell in with this strategy. Conrad's plan was that of an offensive north-eastwards into Poland by two armies, protected by two more on their right, further east. Complementary to it, as originally designed, the Germans in East Prussia were to strike south-east, the two forces converging to cut off the Russian advanced forces in the Polish "tongue." But Conrad failed to induce Moltke to provide sufficient German troops for this offensive thrust.

On the opposing side, also, the desires of one ally vitally affected the strategy of the other. The Russian command, both for military and for racial motives, wished to concentrate first against Austria, while the latter was unsupported, and leave Germany alone until later, when the full strength of the Russian army would be mobilized. But the French, anxious to relieve the German pressure against themselves, urged the Russians to deliver a simultaneous attack against Germany, and got the Russians to consent to an extra offensive for which they were neither ready, in numbers, nor organized. On the south-western front two pairs of two armies each were to converge on the Austrian forces in Galicia; on the north-western front two armies were to converge on the German forces in East Prussia. Russia, whose proverbial slowness and crude organization dictated a cautious strategy, was about to break with tradition and launch out on a gamble that only an army of high mobility and organization could have hoped to bring off.

II. THE CLASH IN THE WEST

The Detonation.—On June 28, 1914, the murder of the Austrian Archduke Francis Ferdinand at Sarajevo set light to a powder trail which within a brief span exploded the European magazine in a series of detonations. Exactly one month later Austria-Hungary declared war against Serbia, whose appeal to her ally and protector led Russia to order a partial mobilization on her southern front. The same day, July 29, an Imperial council at Potsdam decided on war against Russia, and, as a corollary, against France, although hoping to bargain for Britain's neutrality. While the chancelleries of Europe argued at cross-purposes, the military tide swept them off their feet. On July 31 Russia ordered a general mobilization and Germany, taking equivalent steps, sent a 12 hours' ultimatum. Austria, seeking belatedly to temporize, was dragged in the train of her more determined ally. By noon on Aug. 1 a state of war existed between Russia and Germany and next day German troops entered French territory. At 7 P.M. came Germany's ultimatum to Belgium, demanding an unopposed passage. On Aug. 3 Germany's formal declaration of war on France followed, and on Aug. 4 her troops crossed the Belgian frontier, for the sanctity of which England stood guarantor. At midnight, in reply, England also entered the war—while the Belgian populace, rising to resist the German invaders, sounded the death-knell of gladiatorial wars and inaugurated the new warfare of peoples. And coincidently, by Italy's declaration of her neutrality, her refusal to fulfil the alliance with her hereditary enemy—Austria—the artificiality of the political alliance system broke down before the new wave of national feeling which was to characterize the World War.

Invasion of Belgium.—The German advance into France was designed as a methodical sweep, so that unexpected checks should not upset its time-table. Confronted with the fact that the Belgians would resist, a detachment was formed under Gen. von Emmich to clear a passage through the Belgian plain north of the Ardennes, ready for the ordered advance of the main armies concentrating behind the German frontier. The ring fortress of Liége (*q.v.*) commanded this channel of advance, but, after an initial check, a German brigade penetrated between the forts and occupied the town. The interest of this feat is that it was due to the initiative of an attached staff officer, Ludendorff, whose name ere long was to be world-famous. The forts themselves offered a stubborn resistance and forced the Germans to await the arrival of their heavy howitzers, whose destructive power was to be the first tactical surprise of the World War.

The very success of the Belgians' early resistance cloaked the weight of the main German columns and misled the Allies' intelligence. The Belgian field army lay behind the Gette covering Brussels, and even before the Liége forts fell the advanced guards of the German 1st and 2nd Armies were pressing against this line. The Belgians, deprived of support owing to the mistaken French plan and British conformity with it, decided to preserve their army by falling back on the entrenched camp of Antwerp—where its location would at least make it a latent menace to the German communications. The Germans, their passage now clear, entered Brussels on Aug. 20, and on the same day appeared before Namur, the last fortress barring the Meuse route into France. It must be noted that despite the Belgian resistance the German advance was slightly ahead of its time-table.

French Offensive in Lorraine.—Meanwhile, away on the other flank, the French offensive had opened on Aug. 8 with the advance of a force under Gen. Pau into upper Alsace, a move intended partly as a military distraction and partly for its political effect. Soon brought to a halt, it was renewed on the 19th, only to meet with a fresh check. Thereafter the pressure of disasters elsewhere compelled the abandonment of the enterprise and the dissolution of the force—its units being dispatched westward as reinforcements. Meantime the main thrust into Lorraine by the French 1st (Dubail) and 2nd (de Castelnau) Armies, totalling 19 divisions, had begun on Aug. 14 and been shattered in the battle of Morhange-Sarrebourg, Aug. 20 (*see* FRONTIERS, BATTLES OF THE) where the French discovered that the material could subdue the *moral*, and that in their enthusiasm for the offensive

they had blinded themselves to the defensive power of modern weapons, a condition which was to throw out of balance the whole mechanism of orthodox warfare. Yet it is but fair to add that this abortive French offensive had an indirect effect on the German plan, although this would hardly have been so if a Schlieffen or a Ludendorff had been in charge at German headquarters instead of the vacillating opportunist Moltke. The fact that Moltke had almost doubled the strength of his left, compared with Schlieffen's plan meant that it was unnecessarily strong for a yielding and "enticing" defensive such as Schlieffen had conceived, while lacking the superiority necessary for a crushing counter-offensive. But when the French attack in Lorraine developed and Moltke appreciated that the French were leaving their fortified barrier behind he was tempted momentarily to postpone the right wing sweep and instead seek a decision in Lorraine. This impulse led him to divert thither the six newly formed Ersatz divisions that should have been used to increase the weight of his right wing.

He had hardly conceived this new plan before he abandoned it and, on Aug. 16, reverted to Schlieffen's "swing-door" design. But the princely commanders in Lorraine were loath to forfeit this opportunity of personal glory. The Crown Prince Rupprecht of Bavaria, instead of continuing to fall back and draw the French on, halted his 6th Army on the 17th, ready to accept battle. Finding the French attack slow to develop, he planned to anticipate by one of his own. He struck on Aug. 20 in conjunction with the 7th Army on his left, but although the French were taken by surprise and rolled back from the line Morhange-Sarrebourg, the German counter-stroke had not the superiority of strength (the two armies now totalled 25 divisions) or of strategic position to make it decisive. Thus its strategic result was merely to throw back the French onto a fortified barrier which both restored and augmented their power of resistance. Thus they were enabled to despatch troops to reinforce their western flank—a redistribution of strength which was to have far-reaching results in the decisive battle, on the Marne.

With similar disregard of superior authority, the German Crown Prince, commanding the pivotal 5th Army between Metz and Thionville, attacked when he had been ordered to stand on the defensive. The lack of what Col. Foch had termed "intellectual discipline" was to be a grave factor in Germany's failure, and for this the ambitions of "court" generals were to be largely responsible.

The North-West Frontier.—While this "see-saw" campaign in Lorraine was taking place, more decisive events were occurring to the north-west. The attack on Liége awakened Joffre to the reality of a German advance through Belgium, but not to the wideness of sweep. And the sturdy resistance of Liége confirmed him in the opinion that the German right would pass south of it, between the Meuse and the Ardennes. Plan XVII. had visualized such a move, and prepared a counter. Grasping once more at phantoms, the French command embraced this idea so fervently that they transformed the counter into an imaginary *coup de grâce*. Their 3rd Army (Ruffey) and the reserve 4th Army (de Langle de Cary) were to strike north-east through the Ardennes against the rear flank of the Germans advancing through Belgium. The left wing (5th) Army, under Lanrezac, was moved further to the north-west into the angle formed by the Sambre and Meuse between Givet and Charleroi. With the British expeditionary force coming up on its left, it was to deal with the enemy's forces north of the Meuse and to converge on the supposed German main forces in conjunction with the attack through the Ardennes. Here was a pretty picture—of the Allied pincers closing on the unconscious Germans! Curiously, the Germans had the same idea of a pincer-like manoeuvre, with rôles reversed, and with better reason.

The fundamental flaw in the French plan was that the Germans had deployed half as many troops again as the French Intelligence estimated, and for a vaster enveloping movement. The French 3rd and 4th Armies (23 divisions) pushing blindly into the Ardennes against a German centre supposedly denuded of troops, blundered against the German 4th and 5th Armies (20 divisions) and were heavily thrown back in encounter-battles around Virton-Neufchateau. Fortunately the Germans were also too vague as to the situation to exploit their opportunity.

But to the north-west the French 5th Army (13 divisions) and the British (four divisions) had, under Joffre's orders, put their head almost into the German noose. The German masses of the 1st and 2nd Armies were closing on them from the north, and the 3rd Army from the east—a total of 30 divisions. Lanrezac alone had an inkling of the hidden menace. All along he had suspected the wideness of the German manoeuvre, and it was through his insistence that his army had been permitted to move so far north-west. It was due to his caution in hesitating to advance across the Sambre, to the arrival of the British on his left unknown to the German Intelligence, and to the premature attack of the German 2nd Army, that the Allied forces fell back in time and escaped from the trap.

Retreat to the Marne.—The British, after concentrating near Maubeuge, had moved up to Mons on Aug. 22, ready to advance further into Belgium as part of the offensive of the Allied left wing. On arrival, however, Sir John French heard that Lanrezac had been attacked on the 21st and deprived of the crossings of the Sambre. Although thus placed in an exposed forward position, he agreed to stand at Mons to cover Lanrezac's left. But next day Lanrezac had word of the fall of Namur and of the appearance of the German 3rd Army (Hausen) on his exposed right flank near Dinant, on the Meuse. In consequence, he gave orders for a retreat that night. The British, after resisting the attacks of six German divisions during the day, fell back on the 24th in conformity with their allies. Not a moment too soon in view of the fact that the rest of the German 1st Army was marching still further westward to envelop their open left flank.

At last Joffre realized the truth and the utter collapse of Plan XVII. Resolution was his greatest asset, and with imperturbable coolness he formed a new plan out of the wreckage. He decided to swing back his centre and left, with Verdun as the pivot, while drawing troops from the right and forming a fresh 6th Army on his left to enable the retiring armies to return to the offensive.

The German Breakdown.—His optimism might have been again misplaced but for German mistakes. The first was Moltke's folly in detaching seven divisions to invest Maubeuge and Givet and watch Antwerp, instead of using Landwehr and Ersatz troops as Schlieffen had intended. More ominous still was his decision on Aug. 25 to send four divisions to check the Russian advance in East Prussia. All these were taken from the right wing, and the excuse afterwards given for this violation of the principle of concentration was that the German command thought that the decisive victory had already been won! Further, the German command lost touch with the advancing armies and the movements of these became disjointed. The British stand at Le Cateau and Lanrezac's riposte at Guise (*see* FRONTIER, BATTLES OF THE: *Le Cateau; Guise*) were also factors in checking the German enveloping wing, and each had still greater indirect effects. For Le Cateau apparently convinced the German 1st Army commander, Kluck, that the British army could be wiped from the slate, and Guise led Bülow (2nd Army) to call on the 1st Army for support, whereupon Kluck wheeled inwards, thinking to roll up the French left. The idea of a Sedan was an obsession with the Germans, and led them to pluck the fruit before it was ripe. This premature wheel before Paris had been reached was an abandonment of the Schlieffen plan, and exposed the German right to a counter-envelopment. One further factor must be mentioned, perhaps the most significant of all: the Germans had advanced so rapidly, out-running their time-table, that their supplies failed to keep pace. Thus, in sum, so much grit had worked into the German machine that a slight jar would suffice to cause its breakdown. *This was delivered in the battle of the Marne (*q.v.*).

III. THE CRISIS OF THE MARNE

The Abandoned Plan.—Let us trace the sequence of events. The first, highly coloured, reports from the army commands in the battles of the Frontiers had given the German supreme command the impression of a decisive victory. Then the compara-

tively small totals of prisoners raised doubts in Moltke's mind and led him to a more sober estimate of the situation. The new pessimism of Moltke combined with the renewed optimism of his army commanders to produce a fresh change of plan, which contained the seeds of disaster. When, on Aug. 26, the British left wing fell back southwards badly mauled from Le Cateau, Kluck had turned south-westwards again. If this direction was partly due to a misconception of the line of retreat taken by the British, it was also in accordance with his original rôle of a wide circling sweep. And by carrying him into the Amiens-Peronne area, where the first elements of the newly formed French 6th Army were just detraining after their "switch" from Alsace, it had the effect of dislocating Joffre's design for an early return to the offensive—compelling the 6th Army to fall back hurriedly towards the shelter of the Paris defences.

But Kluck had hardly swung out to the south-west before he was induced to swing in again. For, in order to ease the pressure on the British, Joffre had ordered Lanrezac to halt and strike back against the pursuing Germans, and Bülow, shaken by the threat, called on Kluck for aid. Lanrezac's attack, on Aug. 29, was stopped before Bülow needed this, but he asked Kluck to wheel in nevertheless, in order to cut off Lanrezac's retreat. Before acceding Kluck referred to Moltke. The request came at a moment when Moltke was becoming perturbed in general over the way the French were slipping away from his embrace and, in particular, over a gap which had opened between his 2nd and 3rd Armies through the latter having already turned south, from south-west, to help the 4th Army, its neighbour on the other flank. Hence Moltke approved Kluck's change of direction—which meant the inevitable abandonment of the original wide sweep round the far side of Paris. Now the flank of the wheeling German line would pass the near side of Paris and across the face of the Paris defences. By this contraction of his frontage for the sake of security Moltke sacrificed the wider prospects inherent in the wide sweep of the Schlieffen plan. And, as it proved, instead of contracting the risk he contracted a fatal counterstroke.

The decision to abandon the original plan was definitely taken on Sept. 4, and in place of it Moltke substituted a narrower envelopment, of the French centre and right. The 4th and 5th Armies were to press south-east while the 6th and 7th Armies, striking south-westwards, sought to break through the fortified barrier between Toul and Epinal, the "jaws" thus closing inwards on either side of Verdun. Meantime the 1st and 2nd Armies were to turn outwards and, facing west, hold off any counter move which the French attempted from the neighbourhood of Paris.

The Allied Counter.—But such a counter move had begun before the new plan could take effect.

The opportunity was perceived, not by Joffre, who had ordered a continuance of the retreat, but by Galliéni, the military governor of Paris. On Sept. 3 Galliéni realized the meaning of Kluck's wheel inwards, directed Maunoury's 6th Army to be ready to strike at the exposed German right flank, and next day with some difficulty won Joffre's sanction. Once convinced, Joffre acted with decision. The whole left wing was ordered to turn about and return to a general offensive, beginning on Sept. 6. Maunoury was already off the mark on the 5th and as his pressure developed on the Germans' sensitive flank, Kluck was constrained to draw off first one part and then the remaining part of his army to support his threatened flank guard. Thereby a 30 m. gap was created between the 1st and 2nd German Armies, a gap covered only by a screen of cavalry. Kluck was emboldened to take the risk because of the rapid retreat of the British opposite, or rather with their backs, to this gaping sector. Even on the 5th, when the French on either flank were turning about, the British continued a further day's march to the south. But in this "disappearance" lay the unintentional cause of victory. For, when the British retraced their steps, it was the report of their columns advancing into the gap which, on Sept. 9, led Bülow to order the retreat of his 2nd Army. The temporary advantage which the 1st Army, already isolated by its own act, had gained over Maunoury was thereby nullified, and it fell back the same day. By the 11th the retreat had extended, independently or under orders from Moltke, to all the German armies. The attempt at a partial envelopment, pivotting on Verdun, had already failed, the jaw formed by the 6th and 7th Armies merely breaking its teeth on the defences of the French eastern frontier. The attack by Rupprecht's 6th Army on the Grand Couronné, covering Nancy, was a particularly costly failure. It is difficult to see how the German command could have reasonably pinned their faith on achieving as an improvised expedient the very task which in cool calculation before the war had appeared so hopeless as to lead them to take the momentous decision to advance through Belgium as the only feasible alternative.

Thus, in sum, the battle of the Marne was decided by a jar and a crack. The jar administered by Maunoury's attack on the German right flank causing a crack in a weak joint of the German line, and this physical crack in turn producing a moral crack in the German command.

The Pursuit Fails.—The result was a strategic but not a tactical defeat and the German right wing was able to re-knit and stand firmly on the line of the Aisne. That the Allies were not able to draw greater advantage from their victory was due in part to the comparative weakness of Maunoury's flank attack and in part to the failure of the British and the French 5th Army (now under Franchet d'Espérey) to drive rapidly through the gap while it was open. Their direction of advance was across a region intersected by frequent rivers, and this handicap was intensified by a want of impulsion on the part of their chiefs. It seems, too, that greater results might have come if more effort had been made as Galliéni urged, to strike at the German rear flank instead of the front, and to direct reinforcements to the north-west of Paris for this purpose. This view is strengthened by the sensitiveness shown by the German command to reports of landings on the Belgian coast, which might threaten their communications. The alarm caused by these reports had even led the German command to contemplate a withdrawal of their right wing before the battle of the Marne was launched. When the moral effect of these phantom forces is weighed with the material effect—the detention of German forces in Belgium—caused by fears of a Belgian sortie from Antwerp, the balance of judgment would seem to turn heavily in favour of the strategy which Lord Roberts had advocated in vain. By it the British expeditionary force might have had not merely an indirect but a direct influence on the struggle, and might have made the issue not merely negatively but positively decisive.

But, considering the battle of the Marne as it shaped, the fact that 27 Allied divisions were pitted against 13 German divisions on the decisive flank is evidence, first, of how completely Moltke had lapsed from Schlieffen's intention; second, of how well Joffre had re-concentrated his forces under severe pressure; third, of how such a large balance afforded scope for a wider envelopment than was actually attempted. The frontal pursuit was checked on the Aisne before Joffre, on Sept. 17, seeing that Maunoury's attempts to overlap the German flank were ineffectual, decided to form a fresh army under de Castelnau for a manoeuvre *round and behind* the German flank. By then the German armies had recovered cohesion and the German command was expecting and ready to meet such a manoeuvre, now the obvious course.

IV. THE SECOND CRISIS—STALEMATE

Centre of Gravity Shifts.—On the Aisne was re-emphasized the preponderant power of defence over attack, primitive as were the trench lines compared with those of later years. Then followed, as the only alternative, the successive attempts of either side to overlap and envelop the other's western flank, a phase known somewhat inaccurately as the "race to the sea." This common design brought out what was to be a new and dominating strategical feature—the lateral switching of reserves by railway from one part of the front to another. Before it could reach its logical and lateral conclusion, a new factor intervened. Antwerp, with the Belgian field army, was still a thorn in the German side, and Falkenhayn, who had succeeded Moltke, determined to reduce it while a German cavalry force swept across to the Belgian coast as an extension of the enveloping wing in France.

Belgian Operations.—We must pause here to pick up the thread of operations in Belgium from the moment when the Belgian field army fell back to Antwerp, divergently from the main line of operations. On Aug. 24 the Belgians began a sortie against the rear of the German right wing to ease the pressure on the British and French left wing, then engaged in the opening battle at Mons and along the Sambre. The sortie was broken off on the 26th when news came of the Franco-British retreat into France, but the pressure of the Belgian army (six divisions) led the Germans to detach four reserve divisions, besides three Landwehr brigades, to hold it in check. On Sept. 7 the Belgian command learnt that the Germans were despatching part of this force to the front in France; in consequence King Albert launched a fresh sortie on Sept. 9—the crucial day of the battle on the Marne. The action was taken, unsolicited by Joffre, who seems to have shown curiously little interest in possibilities outside his immediate battle zone. The sortie led the Germans to cancel the despatch of one division and to delay that of two others to France, but the Belgians were soon thrown back. Nevertheless the news of its seems to have had a distinct moral effect on the German command, coinciding as it did with the initiation of the retreat of their 1st and 2nd Armies from the Marne. And the unpleasant reminder that Antwerp lay menacingly close to their communications induced the Germans to undertake, preliminary to any fresh attempt at a decisive battle, the reduction of the fortress and the seizure of potential English landing places along the Belgian coast.

A Strategic Key.—The menace to Britain, if the Channel ports fell into German hands, was obvious. It is a strange reflection that the British command should have neglected to guard against the danger hitherto, although the first lord of the Admiralty, Winston Churchill, had urged the necessity even before the battle of the Marne. When the German guns began the bombardment of Antwerp on Sept. 28 England awakened, and gave belated recognition to Churchill's strategic insight. He was allowed to send a brigade of marines and two newly-formed brigades of naval volunteers to reinforce the defenders, while a regular division and cavalry division, under Rawlinson, were landed at Ostend and Zeebrugge for an overland move to raise the siege. Eleven Territorial divisions were available in England, but, in contrast to the German attitude, Kitchener considered them still unfitted for an active rôle. The meagre reinforcement delayed, but could not prevent, the capitulation of Antwerp, Oct. 10, and Rawlinson's relieving force was too late to do more than cover the escape of the Belgian field army down the Flanders coast.

Yet, viewed in the perspective of history, this first and last effort in the West to make use of Britain's amphibious power applied a brake to the German advance down the coast which just stopped their second attempt to gain a decision in the West. It gained time for the arrival of the main British force, transferred from the Aisne to the new left of the Allied line, and if their heroic defence at Ypres, aided by the French and Belgians along the Yser to the sea, was the human barrier to the Germans, it succeeded by so narrow a margin that the Antwerp expedition must be adjudged the saving factor.

Second German Bid for Victory.—In the French theatre of operations, the month following the battle of the Marne was marked by an extremely obvious series of attempts by each side to turn the opponent's western flank. On the German side this pursuit of an opening was soon replaced by a subtler plan, but the French persevered with a straight forward obstinacy curiously akin to that of their original plan. By Sept. 24, de Castelnau's outflanking attempt had come to a stop on the Somme. Next a newly formed 10th Army under de Maudhuy tried a little further north, beginning on Oct. 2, but instead of being able to pass round the German flank soon found itself struggling desperately to hold Arras. The British expeditionary force was then in course of transfer northwards from the Aisne, in order to shorten its communications with England, and Joffre determined to use it as part of a third effort to turn the German flank. To co-ordinate this new manoeuvre he appointed Gen. Foch as his deputy in the north. Foch sought to induce the Belgians to form the left of this wheeling mass, but King Albert, with more caution, or more realism, declined to abandon the coastal district for an advance inland that he considered rash. It was. For on Oct. 14, four days after the fall of Antwerp, Falkenhayn planned a strategic trap for the next Allied outflanking manoeuvre which he foresaw would follow. One army, composed of troops transferred from Lorraine, was to hold the expected Allied offensive while another, composed of troops released by the fall of Antwerp and of four newly-raised corps, was to sweep down the Belgian coast and crush in the flank of the attacking Allies. He even held back the troops pursuing the Belgians in order not to alarm the Allied command prematurely.

Meanwhile, the new Allied advance was developing piecemeal, as corps detrained from the south and swung eastwards to form a progressively extended "scythe." The British expeditionary force, now three corps strong, deployed in turn between La Bassée and Ypres, where it effected a junction with Rawlinson's force. Beyond it the embryo of a new French 8th Army was taking shape, and the Belgians continued the line along the Yser to the sea. Although the British right and centre had already been held up, Sir John French, discounting even the underestimate of the German strength furnished by his Intelligence, ordered his left to begin the offensive from Ypres towards Menin. The effort was still-born, for it coincided with the opening of the German offensive, on Oct. 20, but for a day or two Sir John French persisted in the belief that he was attacking while his troops were barely holding their ground. With Foch the delusion persisted still longer, and this failure to grasp the situation was partly responsible for the fact that Ypres was essentially, like Inkerman, a "soldiers' battle." Already, since the 18th, the Belgians on the Yser had suffered growing pressure which threatened a disaster that was ultimately saved by the end of the month through the opening of the sluices and the flooding of the coastal area. At Ypres the crisis came later and was repeated, Oct. 31 and Nov. 11 marking the turning points of the struggle. That the Allied line, though battered and terribly strained, was in the end unbroken was due to the dogged resistance of the British and the timely arrival of French reinforcements. (*See* YPRES, BATTLE OF, 1914.)

This defence of Ypres is in a dual sense the supreme memorial to the British regular army, for here they showed the inestimable value of the disciplined morale and unique standard of musketry which were the fruit of long training, and here was their tombstone. "From failing hands they threw the torch" to the new national armies rising in England to the call of patriotism. With the Continental Powers the merging of conventional armies into national armies was a hardly perceptible process, because of their system of universal service. But with Britain it was clearly stamped as revolution, not evolution. While the little professional army sacrificed itself as the advanced guard of the nation, the truth of the new warfare of peoples was beginning to come home to the civilian population. Lord Kitchener, a national symbol because of his imperial achievements, had been summoned to the post of war minister, and with a supreme flash of vision had grasped, in contrast to Governments and general staffs alike, the probable duration of the struggle. The people of Britain responded to his call to arms, and like an ever-rising flood the "New Armies" came into being. By the end of the year nearly 1,000,000 men had enlisted, and the British empire had altogether some 2,000,000 under arms. Perhaps Kitchener was wrong in not basing this expansion, from a professional to a national scale, on the existing Territorial foundation. It must be remembered, however, that the Territorial Force was enlisted for home defence and that initially its members' acceptance of a wider role was voluntary. Perhaps, also, he was tardy in recognizing their military value.

The duplication of forces and of organization was undoubtedly a source of delay and waste of effort. Kitchener has also been reproached for his reluctance to replace the voluntary system by conscription, but this criticism overlooks how deeply rooted was the voluntary system in British institutions, and the slowness with which lasting changes can be effected in them. If Kitchener's method was characteristic of the man, it was characteristic of England. If it was unmethodical, it was calculated to impress

most vividly on the British people the gulf between their "gladiatorial" wars of the past and the national war to which they were committed.

While a psychological landmark, the battle of Ypres is also a military landmark. For, with the repulse of the German attempt to break through, the trench barrier was consolidated from the Swiss frontier to the sea. The power of modern defence had triumphed over attack, and stalemate ensued. The military history of the Franco-British alliance during the next four years is a story of the attempts to upset this deadlock, either by forcing the barrier or by finding a way round.

On the Eastern front, however, the greater distances and the greater differences between the equipment of the armies ensured a fluidity which was lacking in the West. Trench lines might form, but they were no more than a hard crust covering a liquid expanse. To break the crust was not difficult, and once broken, mobile operations of the old style became possible. This freedom of action was denied to the Western Powers, but Germany, because of her central position, had an alternative choice, and from Nov. 1914 onwards her command adopted a defensive in France while seeking to cripple the power of Russia.

V. THE RUSSIAN FRONT

Invasion of East Prussia.—In the East the opening encounters had been marked by rapid changes of fortune rather than by any decisive advantage. The Austrian command, emulating their allies in violating the principle of concentration, detached part of their strength in an abortive attempt to crush Serbia. (*See* SERBIAN CAMPAIGNS.) And their plan for an initial offensive to cut off the Polish "tongue" was further crippled by the fact that the German part of the pincers did not operate. It was, indeed, being menaced by a Russian pair of pincers instead, for the Russian commander-in-chief, the Grand Duke Nicholas, had urged his 1st and 2nd Armies to invade East Prussia without waiting to complete their concentration, in order to ease the pressure on his French allies. As the Russians had more than a two-to-one superiority, a combined attack had every chance of crushing the Germans between the two armies. On Aug. 17, Rennenkampf's 1st Army (six and a half divisions and five cavalry divisions) crossed the East Prussian frontier, and on Aug. 19–20 met and threw back the bulk (seven divisions and one cavalry division) of Prittwitz's 8th Army at Gumbinnen. On Aug. 21 Prittwitz heard that the Russian 2nd Army (ten divisions and three cavalry divisions) under Samsonov had crossed the southern frontier of East Prussia in his rear, which was guarded by only three divisions. In panic Prittwitz momentarily spoke of falling back behind the Vistula, whereupon Moltke superseded him by a retired general, Hindenburg, to whom was appointed as chief of staff, Ludendorff, the hero of the Liège attack.

Developing a plan which, with the necessary movements, had been already initiated by Col. Hoffmann of the 8th Army staff, Ludendorff concentrated some six divisions against Samsonov's left wing. This force, inferior in strength to the Russians, could not have been decisive, but Ludendorff, finding that Rennenkampf was still near Gumbinnen, took the calculated risk of withdrawing the rest of the German troops, except the cavalry screen, from that front and rushing them back against Samsonov's right wing. This daring move was aided by the absence of communication between the two Russian commanders and the ease with which the Germans deciphered Samsonov's wireless orders to his corps. Under the converging blows Samsonov's flanks were crushed and his centre surrounded. The outcome of this military masterpiece, afterwards christened the battle of Tannenberg (*q.v.*), was the destruction of almost the whole of Samsonov's army. Then receiving two fresh army corps from the French front, the German commander turned on the slowly advancing Rennenkampf, whose lack of energy was partly due to his losses at Gumbinnen and subsequent lack of information, and drove him out of East Prussia. (*See* MASURIAN LAKES.) As a result of these battles Russia had lost a quarter of a million men and, what she could afford still less, much war material. But the invasion of East Prussia had at least, by causing the despatch of two corps from the West, helped to make possible the French "come-back" on the Marne.

Galician Battles.—Away on the southern front, moreover, the scales had tilted against the Central Powers. The offensive of the Austrian 1st and 4th Armies into Poland had at first made progress, but this was nullified by the onslaught of the Russian 3rd and 8th Armies upon the weaker 2nd and 3rd Armies which were guarding the Austrian right flank. These armies were heavily defeated (Aug. 26–30), and driven back through Lemberg. The advance of the Russian left wing thus threatened the rear of the victorious Austrian left wing. Conrad tried to swing part of his left round, in turn, against the Russian flank, but this blow was parried and then, caught with his forces disorganized by the renewed advance of the Russian right wing, he was forced on Sept. 11 to extricate himself by a general retreat, falling back almost to Cracow by the end of September. (*See* LEMBERG, BATTLES OF.) Austria's plight compelled the Germans to send aid, and the bulk of the force in East Prussia was formed into a new 9th Army and switched south to the south-west corner of Poland, whence it advanced on Warsaw in combination with a renewed Austrian offensive. (*See* VISTULA-SAN, BATTLES OF.) But the Russians were now approaching the full tide of their mobilized strength; regrouping their forces and counter-attacking, they drove back the advance and followed it up by a powerful effort to invade Silesia.

The Grand Duke Nicholas formed a huge phalanx of seven armies—three in the van and two protecting either flank. A further army, the 10th, had invaded the eastern corner of East Prussia and was engaging the weak German forces there. Allied hopes rose high as the much-heralded Russian "steam-roller" began its ponderous advance. To counter it the German eastern front was placed under Hindenburg and Ludendorff, who devised yet another master-stroke, based on the system of lateral railways inside the German frontier. The 9th Army, retreating before the advancing Russians, slowed them down by a systematic destruction of the scanty communications in Poland. On reaching its own frontier, unpressed, it was first switched northward to the Posen-Thorn area, and then thrust south-east on Nov. 11, with its left flank on the Vistula, against the joint between the two armies guarding the Russian right flank. The wedge, driven in by Ludendorff's mallet, sundered the two armies, forced the 1st back on Warsaw and almost effected another Tannenberg against the 2nd, which was nearly surrounded at Lodz (*q.v.*), when the 5th Army from the van turned back to its rescue. As a result, part of the German enveloping force almost suffered the fate planned for the Russians, but managed to cut its way through to the main body. If the Germans were baulked of decisive tactical success, this manoeuvre had been a classic example of how a relatively small force, by using its mobility to strike at a vital point, can paralyse the advance of an enemy several times its strength. The Russian "steam-roller" was thrown out of gear, and never again did it threaten German soil.

Within a week, four new German army corps arrived from the Western front, where the Ypres attack had now ended in failure, and although too late to clinch the missed chance of a decisive victory, Ludendorff was able to use them in pressing the Russians back by Dec. 15 to the Bzura-Ravka river line in front of Warsaw. This set-back and the drying up of his munition supplies decided the Grand Duke Nicholas to break off the see-saw fighting still in progress near Cracow and fall back on winter trench lines along the Nida and Dunajec rivers, leaving the end of the Polish "tongue" in the hands of the enemy. Thus, on the East as on the West, the trench stalemate had settled in, but the crust was less firm and the Russians had drained their stock of munitions to an extent that their poorly industrialized country could not make good.

The Beginning of Air Attack.—The same period witnessed the dawn of another new form of war which helped to drive home the new reality that the war of armies had become the war of peoples. From Jan. 1915, Zeppelin raids began on the English coast and reached their peak in the following winter, to be succeeded by aeroplane raids. The difficulty of distinguishing from the air between military and civil objectives, smoothed the path for a development which, beginning with excuses, ended in a frank

avowal that in a war for existence the will of the enemy nation, not merely the bodies of their soldiers, is the inevitable target.

The Psychological Situation.—The first psychological symptom of the World War, as it seemed to many, was an immeasurable sigh of relief. Had the peoples of Europe sat on the safety-valve too long? The war-weary mind of to-day cannot reconstruct the tension and anxiety, the strain and stress of hope and fear of the long years of the peace that was no peace and yet was not war. It may be read as a revolt of the spirit against the monotony and triviality of the everyday round, the completion of a psychological cycle when the memories of past war have faded, and paved the way for the emergence and revival of the primal "hunting" instinct in man.

This first phase of enthusiasm was succeeded by one of passion, the natural ferocity of war accentuated by a form of mob spirit which is developed by a "nation in arms." The British army was relatively immune because of its professional character, whereas in the German army, the most essentially "citizen," it gained scope because of the cold-blooded logic of the general staff theory of war. With the coming of autumn 1914, a third phase became manifest, more particularly among the combatants. This was a momentary growth of a spirit of tolerance, symbolized by the fraternization which took place on Christmas Day, but this in turn was to wane as the strain of the war became felt and the reality of the struggle for existence came home to the warring sides.

VI. THE EVENTS OF 1915

The Deadlock on Land.—Well before the end of 1914, the reality of the deadlock on the Western front was clear to the Governments and general staffs of the warring countries, and each was seeking a solution. The reaction varied in form and in nature according to the mental power and predisposition of the different authorities. With the Central Powers the opinion of Falkenhayn was the decisive factor, and the impression derived not merely from his critics but from his own account is that neither the opinion nor the direction was really clear as to its object. He was too obsessed with the principle of security at the expense of the principle of concentration, and in his failure to fulfil the second he undermined the foundations of the first.

On his appointment after the Marne reverse, he still adhered to the Schlieffen plan of seeking a decision in the West, but he did not follow the Schlieffen method of weakening his left wing in order to mass on the vital right wing. The October–November attack round Ypres was made largely with raw formations, while war-experienced troops lay almost idle between the Aisne and the Vosges. Col. Gröner, chief of the field railways, even went so far as to submit a detailed plan to Falkenhayn for transferring six army corps to the right wing, but it was rejected. When we remember how close to breaking point was the Allied line at Ypres, it can only be said that for a second time the German supreme command saved the Allies. At this juncture, too, Ludendorff was pleading for reinforcements to make his wedge-blow at the Russian flank near Lodz decisive, but Falkenhayn missed the chance by delaying until the Ypres failure had passed from assurance to fact.

Convinced at last of the strength of the Allied trench-barrier, Falkenhayn took the momentous decision to stand on the defensive in the West. But his object in so doing seems to have been vague. His feeling that the war must ultimately be decided in France led him to distrust the value, as he doubted the possibility, of a decision against Russia. Hence while he realized that the Eastern front was the only practicable theatre for operations in the near future, he withheld the necessary reinforcements until forced to do so by the threatening situation of the Austro-Hungarian front. And even then he doled out reserves reluctantly and meagrely, enough to secure success but never in the quantity and the time for decisive victory.

It is to his credit, however, that he realized a long war was now inevitable, and that he set to work to develop Germany's resources for such a warfare of attrition. The technique of field entrenchment was carried to a higher pitch than with any other country, the military railways were expanded for the lateral movement of reserves, the supply of munitions and of the raw material for their manufacture was tackled so energetically and comprehensively, that an ample flow was ensured from the spring of 1915 onwards—a time when the British were only awakening to the problem. Here were laid the foundations of that economic organization and utilization of resources which was to be the secret of Germany's resisting power to the pressure of the British blockade. For the scientific grasp of the economic sphere in war Germany owed much to Dr. Walther Rathenau, a brilliant captain of industry. Germany also pioneered in the psychological sphere, for as early as the autumn of 1914, she launched a vast scheme of propaganda in Asia, to undermine British prestige and the loyalty of Britain's Mohammedan subjects. The defect of her propaganda, its crudeness, was less apparent when directed to primitive people than when applied to the civilized peoples of Europe and America.

The same period witnessed also the one great success for German diplomacy, the entry of Turkey into the war, although this was fundamentally due to a combination of pre-war causes with military events. Since 1909 the country had been under the control of the Young Turk party, to whom traditions, including that of friendship with Britain, were abhorrent. Germany, filled with her own dream of a Germanic Middle East—of which the Baghdad railway was the symbol, had skilfully exploited the opportunity to gain a dominating influence over the new rulers of Turkey. Their leader, Enver Pasha, had been military attaché in Berlin, German instructors permeated the Turkish army, and a definite understanding existed between Germany and the Young Turk leaders as to common military action—urged by the common bond of necessary safeguard against danger from Russia. The arrival of the "Goeben" and "Breslau" reinforced the moral pressure of Wangenheim, the German ambassador, and eventually on Oct. 29 the Turks committed definite acts of war, at Odessa against Russia, and in Sinai against Britain.

Falkenhayn has shown "the decisive importance of Turkey joining in the struggle"—first as a barrier across the channel of munition supply to Russia, and secondly as a distraction to the military strength of Britain and Russia. Under German dictation, Turkey struck as early as mid-December against the Russians in the Caucasus (*q.v.*), but Enver's over-ambitious plan ended in disaster at the battle of Sarikamish. Turkey was no more fortunate in her next venture; to cut Britain's Suez canal artery with the East. The Sinai desert was a check on an invasion in strength, and the two small detachments which got across were easily repulsed, at Ismailia and El Kantara, although allowed to make good their retreat. But if both these offensives were tactical failures, they were of great strategic value to Germany by pinning down large Russian and British forces.

As an offset to Turkey joining the Central Powers, Italy definitely threw over the artificial ties of the old Triple Alliance and joined the Entente. On May 24 she declared war on Austria—her hereditary enemy—although avoiding an open breach with Germany. If her main object was to seize the chance of redeeming her kinsmen in Trieste and the Trentino from Austrian rule, there was also a spiritual desire to reassert her historic traditions. Militarily, however, her aid could not have an early or great effect on the situation, for her army was unready to deliver a prompt blow, and the Austrian frontier was a mountainous obstacle of great natural strength.

Franco-British Plans.—On the Entente side the reality of the trench deadlock produced different and diverse reactions. If the desire to hold on to her territorial gains swayed German strategy, the desire to recover her lost territory dominated French strategy. It is true that their mental and material concentration on the Western front, where lay the main armed force of the enemy, was justified by military tenets, but without any key to unlock the barrier they were merely knocking themselves to pieces. Winter attacks in Artois, on the Aisne, in Champagne and the Woevre afforded costly proof, and against the Germans' skill in trench-fighting Joffre's "nibbling" was usually attrition on the wrong side of the balance sheet. As for any new key, the French were singularly lacking in fertility of idea.

Britain's trouble was rather an excess of fertility, or rather an

absence of concentration in choosing and bringing to fruition these mental seeds. Yet in great measure this failing was due to the obscurantism of professional opinion, whose attitude was that of blank opposition rather than expert guidance.

British-inspired solutions to the deadlock crystallized into two main groups, one tactical, the other strategical. The first was to unlock the trench barrier by producing a machine invulnerable to machine-guns and capable of crossing trenches, which would restore the tactical balance upset by the new preponderance of defensive over offensive power. The idea of such a machine was conceived by Col. Swinton in October 1914, was nourished and tended in infancy by Winston Churchill, then first lord of the Admiralty, and ultimately, after months of experiment hampered by official opposition, came to maturity in the tank of 1916.

The strategical solution was to go round the trench barrier. Its advocates—who became known as the "Eastern" in contrast to the "Western" school—argued that the enemy alliance should be viewed as a whole, and that modern developments had so changed conceptions of distance and powers of mobility, that a blow in some other theatre of war would correspond to the historic attack on an enemy's strategic flank. Further, such an operation would be in accordance with the traditional amphibious strategy of Britain, and would enable it to exploit the advantage of sea-power which had hitherto been neglected. In October 1914, Lord Fisher, recalled to the office of first sea lord, had urged a plan for a landing on the German coast. In Jan. 1915, Lord Kitchener advocated another, for severing Turkey's main line of eastward communication by a landing in the Gulf of Alexandretta. The post-war comments of Hindenburg and Enver show how this would have paralysed Turkey. It could not, however, have exercised a wider influence, and it was anticipated by another project —partly the result of Churchill's strategic insight and partly due to the pressure of circumstances.

This was the Dardanelles expedition, about which controversy has raged so hotly that the term just applied to Churchill may be disputed by some critics. This is answered by the verdict of Falkenhayn himself: "If the straits between the Mediterranean and the Black sea were not permanently closed to Entente traffic, all hopes of a successful course of the war would be very considerably diminished. Russia would have been freed from her significant isolation . . . which offered a safer guarantee than military successes . . . that sooner or later a crippling of the forces of this Titan must take place . . . automatically." The fault was not in the conception, but in the execution. Had the British used at the outset even a fair proportion of the forces they ultimately expended in driblets, it is clear from Turkish accounts that victory would have crowned their undertaking.

The cause of this piecemeal application of force and dissipation of opportunity lay in the opposition of Joffre and the French general staff, supported by Sir John French. Despite the evidence of the sequel to the Marne, of the German failure at Ypres, and subsequently of his own still more ineffectual attacks in December, Joffre was still confident of his power to achieve an early and decisive victory in France. His plan was that of converging blows from Artois and Champagne upon the great salient formed by the entrenched German front, to be followed by an offensive in Lorraine against the rear of the enemy armies. The idea was similar to that of Foch in 1918 but the vital difference lay in the conditions existing and the methods employed. A study of the documents conveys the impression that there has rarely been such a trinity of optimists in whom faith was divorced from reason as Joffre, Foch, his deputy in Flanders, and French —albeit the latter's outlook oscillated violently. In contrast the British Government considered that the trench-front in France was impregnable to frontal attacks, had strong objection to wasting the man-power of the new armies in a vain effort, and at the same time felt increasing concern over the danger of a Russian collapse. These views were common alike to Churchill, Lloyd George and Lord Kitchener, who on Jan. 2, 1915, wrote to Sir John French: "The German lines in France may be looked upon as a fortress that cannot be carried by assault and also that cannot be completely invested, with the result that the lines may be held by an investing force while operations proceed elsewhere."

Lloyd George advocated the transfer of the bulk of the British forces to the Balkans both to succour Serbia and to develop an attack on the rear of the hostile alliance. This view was shared by a section of French opinion and, in particular, by Galliéni, who proposed a landing at Salonika as a starting point for a march on Constantinople with an army strong enough to encourage Greece and Bulgaria to combine with the Entente. The capture of Constantinople was to be followed by an advance up the Danube into Austria-Hungary in conjunction with the Rumanians. But the commanders on the Western front, obsessed with the dream of an early break-through, argued vehemently against any alternative strategy, stressing the difficulties of transport and supply and insisting on the ease with which Germany could switch troops to meet the threat. If there was force in their contention, it tended to ignore the experience of military history that "the longest way round is often the shortest way there," and that the acceptance of topographical difficulties has constantly proved preferable to that of a direct attack on an opponent firmly posted and prepared to meet it.

The weight of military opinion bore down counter-proposals and the Balkan projects were relinquished in favour of a concentration of effort on the Western front. But misgivings were not silenced and at this juncture a situation arose which revived the near Eastern scheme in a new if attenuated form.

The Dardanelles Expedition.—On Jan. 2, 1915, Kitchener received an appeal from the Grand Duke Nicholas for a diversion which would relieve the Turkish pressure on Russia's army in the Caucasus. Kitchener felt unable to provide troops and suggested a naval demonstration against the Dardanelles, which Churchill, appreciating the wider strategic and economic issues, proposed to convert into an attempt to force the passage. His naval advisers, if not enthusiastic, did not oppose the proposal and in response to a telegram the admiral on the spot, Carden, submitted a plan for a methodical reduction of the forts and clearance of the mine-fields. Fisher, while clinging to his own North sea project, strongly advocated a combined naval and military expedition. On Jan. 13, the War Council decided for a naval expedition to "take the Gallipoli peninsula, with Constantinople as its objective." A naval force, mainly of obsolete vessels was got together with French aid, and after preliminary bombardment, entered the straits on March 18. Drift mines, however, caused the sinking of several ships, and the attempt was abandoned.

It is a moot point whether a prompt renewal of the advances would not have succeeded, for the Turkish ammunition was exhausted, and in such conditions the mine obstacle might have been overcome. But the new naval commander, Admiral de Robeck decided against it, unless military aid was forthcoming. Already, a month before, the War Council had determined on a joint attack, and began the despatch of a military force under Sir Ian Hamilton. (*See* DARDANELLES CAMPAIGN.) But as the authorities had drifted into the new scheme, so were they tardy in releasing the necessary troops, and even when sent in inadequate numbers, several more weeks' delay had to be incurred—at Alexandria—in order to redistribute the force in its transports suitably for tactical action. Worst of all, this fumbling policy had thrown away the chance of surprise, which was vital for a landing on an almost impregnable shore. When the preliminary bombardment took place in February only two Turkish divisions were at the straits; this was increased to four by the date of the naval attack, to six when Hamilton was at last able to attempt his landing. For this he had only four British divisions and one French division—actually inferior in strength to the enemy in a situation where the inherent preponderance of defensive over offensive power was multiplied by the natural difficulties of the terrain. His weakness of numbers and his mission of aiding the passage of the fleet compelled him to choose a landing on the Gallipoli peninsula in preference to one on the mainland or on the Asiatic shore; and the rocky coastline limited his possible landing places.

On April 25, he made his spring, at the southern tip of the

peninsula near Cape Hellas and—with Australian and New Zealand troops—near Gaba Tepe, some 15 m. up the Aegean coast; the French, as a diversion, made a temporary landing at Kum Kale on the Asiatic shore. The troops effected the impossible and made good their lodgment on beaches strewn with barbed wire and swept by machine-guns. But the momentary asset of tactical surprise had passed, the difficulties of supply were immense, while the Turks held the commanding heights and were able to bring up their reserves. The invaders managed to hold on to their two precarious footholds, but they could not expand them appreciably, and the stagnation of trench warfare set in. They could not go on, and national prestige forbade them to go back.

Ultimately, in July, the British Government decided to send a further five divisions to reinforce the seven by now on the peninsula. By the time they arrived the Turkish strength in the region had also risen to 15 divisions. Hamilton decided on a double stroke—a reinforced blow from Gaba Tepe and a new landing at Suvla bay a few miles north—to sever the middle of the peninsula and secure the heights commanding the Narrows. He deceived the Turkish command and achieved surprise (Aug. 6), but the first blow failed and the second lost a splendid chance by the inexperience of the troops and still more the inertia and fumbling of the local commanders. For over 36 hours, before reserves arrived, only one and a half Turkish battalions barred the path. Energetic new commanders, for whom Hamilton had previously asked, were sent out when the opportunity had passed. The British were once more condemned to hang on to tenuous footholds, and with the autumn rains setting in their trials were increased. The Government had lost faith and were anxious to withdraw, but fear of the moral effect delayed their decision. Hamilton was asked for his opinion, however, and when he pronounced in favour of continuing—in which course he still had confidence—he was replaced by Sir Charles Monro, who immediately declared for evacuation. Kitchener was then sent out to investigate, and on his verdict a withdrawal was sanctioned and carried out from Suvla and Anzac on the night of Dec. 18–19 and from Hellas on that of Jan. 8–9. If the bloodless evacuation was an example of masterly organization and co-operation it was also a proof of the greater ease of such operations in modern warfare. Thus the curtain rang down on a sound and far-sighted conception marred by a chain of errors in execution almost unrivalled even in British history.

The Menace to Russia.—While the British were striving to unlock the back door to Russia, the Germanic Powers were hammering their Russian allies, whose resistance was collapsing in large measure from a lack of munitions which could only be made good by foreign supplies through that locked entrance, the Dardanelles. On the Eastern front, the campaign of 1914 had shown that a German force could count on defeating any larger Russian force, but that when Russians and Austrians met on an equality victory rested with the Russians. Falkenhayn was forced, reluctantly, to despatch German reinforcements as a stiffening to the Austrians, and thus was dragged into an offensive in the East rather than adopting it as a clearly defined plan. Ludendorff, in contrast, had his eyes firmly fixed on the ultimate object, and from now on advocated unceasingly a whole-hearted effort to break Russia. Ludendorff's was a strategy of decision, Falkenhayn's a strategy of attrition.

In the conflict of wills between these two men lies the clue to the resultant strategy of Germany—highly effective, yet not decisive. On the other side the fresh Russian plan embodied the lessons of experience and was soundly conceived, but the means were lacking and the instrument defective. The Grand Duke Nicholas aimed to secure both his flanks solidly before attempting a fresh blow towards Silesia. From January until April, under bitter winter conditions, the Russian forces on the southern flank of the Polish salient strove to gain possession of the Carpathians and the gateways into the Hungarian plain. But the Austrians, with a German infusion, parried their efforts, and the loss was disproportionate to the small gains. The long-besieged fortress of Przemysl (*q.v.*), however, at last fell into their hands on March 22. In northern Poland the Russians were preparing to strike upwards at East Prussia, when they were forestalled by a fresh Ludendorff stroke eastwards towards the frontier of Russia proper. The blow was launched on Feb. 7, over snow-buried roads and frozen swamps, and was distinguished by the envelopment of four Russian divisions in the Augustovo forests. (*See* MASURIAN LAKES.) Moreover, it extracted the sting from the Russian attack further west.

These moves were, however, merely a "curtain-raiser" to the real drama of 1915. But before turning to this it is necessary to glance at events on the Western front, the importance of which is partly as a signpost to the future and partly because of their reaction on the Eastern front.

The Western Front.—While a way round the trench barrier was being sought in Gallipoli and experiments with a novel key were being carried out in England, the Allied commands in France were trying more orthodox solutions. The most significant was the British attack at Neuve Chapelle (*q.v.*) on March 10. Save as a pure experiment the attempt stood self-condemned. For it was an isolated attempt on a small front with inadequate resources. The arrival in France of several new regular divisions made up from foreign garrisons, of the Indian Corps, and the 1st Canadian Division had brought the British strength up to 13 divisions and 5 cavalry divisions, besides a number of selected territorial battalions. This increase enabled French to divide his forces into two armies and gradually to extend his share of the front. But Joffre was insistent that he should relieve the French of the Ypres salient, which they had taken over in November, and made the intended French attack contingent on this relief. Sir John French considered that he had not sufficient troops for both purposes, and so decided to carry out the attack single-handed. An additional motive was his resentment of the constant French criticisms that the British were not "pulling their weight."

In design, however, the attack, entrusted to Haig's 1st Army, was both original and well thought out. After an intense bombardment of 35 minutes duration on a 2,000 yd. frontage, the artillery lengthened their range and dropped a curtain of fire to prevent the reinforcement of the enemy's battered trenches, which were rapidly overrun by the infantry.

Complete surprise was attained and most of the first positions captured, but when in the second phase, the frontage was extended, the artillery support was inadequate. Further, owing to scanty information and to the two corps commanders waiting upon each other a long pause occurred which gave the Germans five clear hours to organize fresh resistance. Then, too late and mistakenly, the attack was ordered to be pushed "regardless of loss." And loss proved the only result. An underlying factor was that the narrowness of the attack sector made the breach more easy for the defenders to close, although this defect was unavoidable owing to the general shortage of munitions. The British had been slower than the Germans to awaken to the scale of ammunition supply required for this new warfare, and, even so, deliveries fell far behind contract, owing largely to the handicap imposed by trade union rules on the dilution of skilled labour. These could only be modified after long negotiation and the shortage of shells became so obvious in the spring of 1915 as to lead to a public outcry which culminated in the establishment of a Ministry of Munitions, under Lloyd George, to co-ordinate and develop both manufacture and the supply of raw materials. Apart from shells, the crudeness and inferiority of all the British trench-warfare weapons compared with those of the Germans, made such a radical organization overdue, and its urgency was emphasized by the near approach of the time when Britain's new armies would take over the field. If the task was undertaken late, it was carried out with energy and thoroughness, and by 1916 the flow of munitions reached a volume, still expanding, which finally removed any material handicap on the strategy of the British leaders.

The tactical sequel of Neuve Chapelle was less fortunate. It was clear that the small-scale experiment had only missed success by a narrow margin and that there was scope for its development. But the Entente commands missed the true lesson, which was the surprise attainable by a short bombardment that com-

pensated its brevity by its intensity. And only partially did they appreciate that the sector attacked must be sufficiently wide to prevent the defender's artillery commanding, or his reserves closing the breach. Instead, they drew the superficial deduction that mere volume of shell-fire was the key to success. Not until 1917 did they revert to the Neuve Chapelle method. It was left to the Germans to profit by the experience against the Russians in May.

But before that came, the Western front was destined to increase the tally of military blunders. In the first, it was the Germans' turn to find and misuse a new key to the trench deadlock. This was the introduction of gas, and, unlike the British introduction of tanks later, the chance, once forfeited, did not return, owing to the relative ease of providing an antidote. In a local attack in Poland on Jan. 31, the Germans had tried the use of gas-shells, but the experiment had been a failure owing to the nullifying effect of the intense cold. At the next attempt it was discharged from cylinders owing to the failure of the authorities to provide the inventor, Haber, with adequate facilities for the manufacture of shells. Further, the initial disappointment led the German command to place little trust in its value. In consequence, when discharged against the French trenches at Ypres on April 22, there were no reserves at hand to pour through the wide breach it created. (*See* YPRES, BATTLES OF, 1915.) A strange green vapour, a surging mass of agonized fugitives, a 4 m. gap without a living defender—such was the sequence of events. But the heroic resistance of the Canadians on the flank of the breach and the prompt arrival of English and Indian reinforcements saved the situation in the absence of German reserves.

The chlorine gas originally used was undeniably cruel, but no worse than the frequent effect of shell or bayonet, and when it was succeeded by improved forms of gas both experience and statistics proved it the least inhumane of modern weapons. But it was novel and therefore labelled an atrocity by a world which condones abuses but detests innovations. Thus Germany incurred the moral odium which inevitably accompanies the use of a novel weapon without any compensating advantage. (*See* CHEMICAL WARFARE.)

On the Entente side, wisdom would have counselled a period of waiting until their munition supply had grown and the new British armies were ready, but the desire to regain lost territory and the duty of relieving the pressure on Russia, combined with ill-founded optimism to spur Joffre to premature offensives. The German losses were exaggerated, their skill and power in defence underrated, and a series of diffused and unconnected attacks were made. The chief was by the French between Lens and Arras, under Foch's direction, and the earlier experience of failure to make an effective breach in the trench barrier was repeated. The attack was launched on May 9 by d'Urbal's army on a four-mile frontage. It was quickly checked with murderous losses except on the front of Pétain's corps which, thanks to meticulous preparation, broke through to a depth of three miles. But the penetration was too narrow, reserves were late and inadequate and the gap closed. Foch, however, persevered with vain attacks which gained a few acres of ground at excessive loss. Meantime Haig's 1st Army had attacked towards Aubers Ridge simultaneously with the larger French attempt. The plan was to penetrate at two points north and south of Neuve Chapelle, 4 m. apart, the total frontage of the two being $2\frac{1}{4}$ m., and then to converge in exploiting the double penetration. But the Germans, profiting also from the experimental value of Neuve Chapelle, had developed their defences. Thus the attack died away quickly from a surfeit of German machine-guns and an insufficiency of British shells. Under pressure from Joffre the attack was renewed on May 15 on the Festubert sector south of Neuve Chapelle, and continued by small bites until May 27. The larger French offensive between Lens and Arras was not abandoned until June 18, when the French had lost 102,000 men—rather more than double the defender's loss.

The effect of these attacks was, moreover, to convince even the dubious Falkenhayn of the strength of his Western line and of the remoteness of any real menace from the Franco-British forces. His offensive on the Eastern front had already opened. Tactically unlimited, its strategic object was at first only the limited one of relieving the pressure on the Austrian front and, concurrently, reducing Russia's offensive power. Conrad proposed and Falkenhayn accepted a plan which aimed at a rupture of the Russian centre as the best means to this end, and in which the Dunajec sector between the upper Vistula and the Carpathians was selected as offering the fewest obstacles to an advance and best protection to the flanks of a penetration. The break-through was entrusted to Mackensen, whose force comprised the newly formed German 11th Army—strengthened by divisions from the West, and the 4th Austro-Hungarian Army. The Ypres gas attack and a large cavalry raid from East Prussia were initiated to cloak the concentration on the Dunajec river of 14 divisions and 1,500 guns against a front held by only six Russian divisions and lacking rear lines of trenches.

The Dunajec Break-through.—On May 2, after an intense bombardment had flattened the Russian trenches, the attack was launched and swept through with little opposition. The surprise was complete, the exploitation rapid, and despite a gallant stand on the Wisloka river, the whole line along the Carpathians was rolled up, until on May 14 the advance reached the San, 80 m. from its starting point. Defeat almost turned into disaster when this was forced at Jaroslav, but the impetus of the advance had momentarily spent itself and reserves were lacking. A new factor was introduced by Italy's declaration of war against Austria, but Falkenhayn persuaded the Austrian command, with some difficulty, not to move troops from the Russian front, and to maintain a strict defensive on their Italian frontier, which was secured by the mountain barrier. He realized that he had committed himself too far in Galicia to draw back, and that only by bringing more troops from France could he hope to fulfil his object of transferring troops back there, as this could only be possible when Russia's offensive power was crippled and her menace to Austria removed. Strengthened by these reinforcements, Mackensen attacked again in co-operation with the Austrians, retook Przemysl on June 3 and captured Lemberg on June 22, cutting the Russian front into two separated portions.

But the Russians, from their vast man-power resources had almost made good the loss of 400,000 prisoners, and Falkenhayn's anxiety about the stability of his Austrian allies decided him to continue the offensive, although still with limited objects and with one eye on the situation in France. He changed its direction, however, from eastwards to northwards, between the Bug and Vistula, where lay the main Russian forces. In conjunction, Hindenburg was ordered to strike south-east from East Prussia, across the Narew (*q.v.*) and towards the Bug. Ludendorff disliked the plan as being too much of a frontal attack; the Russians might be squeezed by the closing in of the two wings but their retreat would not be cut off. He urged once more his spring scheme for a wide enveloping manoeuvre through Kovno on Vilna and Minsk, but Falkenhayn rejected it, fearing that it would mean more troops and a deeper commitment. The result justified Ludendorff's expectation—the Grand Duke extricated his troops from the Warsaw salient before the German shears could close on him. Falkenhayn, on the other hand considered that Ludendorff had not put his full weight into the attack. (*See* further BREST-LITOVSK, BATTLES OF.)

Nevertheless, 750,000 prisoners had been taken by the middle of August, Poland had been occupied, and Falkenhayn decided to break off large scale operations on the Eastern front. Bulgaria's entry into the war was now arranged and he wished to support the combined attack of Austria and Bulgaria against Serbia, as well as to transfer troops back to meet the French offensive expected in September. Mackensen was sent to the Serbian front and Ludendorff was given a belated permission to carry out his Vilna scheme, with such resources as he had, but as an independent operation.

It began on Sept. 9, Below's Army of the Niemen and Eichhorn's 10th Army forming two great horns which gored their way into the Russian front, the one east towards Dvinsk and the other south-east towards Vilna. The Russians were driven

back in divergent directions and the Germany cavalry advancing between the horns far overlapped Vilna and drew near the Minsk railway. But the German strength was slender, the Russians free to concentrate against this isolated menace, and in face of the stiffening resistance Ludendorff took the wise course of suspending operations. The crux of the situation was that the Russian armies had been allowed to draw back almost out of the net before the long delayed Vilna manoeuvre was attempted; the degree of success attained with such weak forces was confirmation of its practicability and of Ludendorff's claim that a powerful blow delivered while the Russians were deeply enmeshed in the Polish salient might have annihilated the armed force of Russia. She had been badly lamed, but not destroyed, and although never again a direct menace to Germany, she was able to delay the full concentration of German strength in the West for two years, until 1918. Falkenhayn's cautious strategy was to prove the most hazardous in the long run, and indeed to pave the way for Germany's bankruptcy.

Thus, at the end of September, the Russian retreat, after a nerve-racking series of escapes from the salients which the Germans systematically created and then sought to cut off, came to a definite halt on a straightened line, stretching from Riga on the Baltic to Czernowitz on the Rumanian frontier. But the Russian armies had gained this respite at a ruinous price, and their Western allies had effected little in repayment of Russia's sacrifice on their behalf in 1914.

Allied Offensive in the West.—For the Franco-British relief offensive of Sept. 25 had been no more fruitful than its predecessors. The main blow was launched by the French in Champagne (*q.v.*), in conjunction with a Franco-British attack in Artois, on either side of Lens. One fault was that the sectors were too far apart to have a reaction on each other, but a worse was that the command tried to reconcile two irreconcilable factors—they aimed at a break-through but preceded it with a prolonged bombardment which gave away any chance of surprise. Joffre's plan was that the break-through in these two sectors was to be followed by a general offensive on the whole Franco-British front which would "compel the Germans to retreat beyond the Meuse and possibly end the war." The unquenchable optimist! The British attack at Loos (*q.v.*) was undertaken against the opinion of Haig, whose 1st Army had to carry it out. The British resources in artillery were still much less than those of the French, and Haig, after personal reconnaissance, reported that the sector was unsuitable for an attack. But Joffre, with the enchantment that distance lends, declared that it was "particularly favourable ground." Sir John French vacillated as usual, but finally ordered the attempt under pressure from Kitchener. The latter, in this reversal of his own previous attitude was apparently influenced by the grave situation in Russia, as well, perhaps, by his reaction from the disappointment at the Dardanelles. But as he had long since declared his view that the Western front was impassable, it is difficult to see how he could feel that a hopeless offensive there could bring fresh hope to the Russians. Both in Champagne and Artois the attacks penetrated the forward German positions without difficulty, but the delay in bringing reserves forward allowed the German reserves to close the gaps, a task simplified by the narrowness of the attack frontage. The slight gains of ground in no way compensated for the heavy price paid for them—the Allied loss was approximately 242,000 against 141,000 Germans. And if the Allied commands had gained more experience so had the Germans, in the art of defence. The British share in this offensive is, however, notable as marking the appearance in strength of the New Armies; at Loos they were "blooded" and if inexperience detracted from their effectiveness, their courage and driving force were an omen of Britain's power to improvise a national effort comparable with the long-created military machines of the Continent.

The direction of this effort inspired less confidence, and Sir John French gave place to Sir Douglas Haig as commander-in-chief, just as already in September the Russian command had been transferred from the Grand Duke Nicholas, nominally to the Tsar, as a moral symbol, but actually to a new commander-in-chief, Gen. Alexeiev, the newly appointed chief of staff.

The Italian Front, 1915.—Italy's military contribution to the Allied cause was handicapped not only by her unreadiness but by the awkward strategic position of her frontier, difficult for initiating an offensive and hardly more favourable for a secure defensive. The Italian frontier province of Venezia formed a salient pointing to Austria and flanked on the north by the Austrian Trentino, on the south by the Adriatic. Bordering on the Adriatic was a stretch of relatively low ground on the Isonzo front but the frontier then followed the Julian and Carnic Alps in a wide sweep round to the north-west. Any advance eastwards inevitably suffered the potential menace of an Austrian descent from the Trentino upon its rear.

Nevertheless, the eastern front, though difficult enough, seemed to offer more prospect of success, besides threatening a vital part of Austria, than an advance northward into the Alps. When Italy was preparing to enter the war Gen. Cadorna, who assumed command, drew up his plan on this basis of an offensive eastwards and a defensive attitude in the north. The overhanging menace of the Trentino was mitigated by the expectation of simultaneous pressure upon Austria from Russia and Serbia. But on the eve of Italy's declaration of war this hope faded, the Russian armies falling back under Mackensen's blows, while the Serbs, despite requests from the Allies, failed to make even a demonstration. This enabled the Austrians to despatch five divisions to the Isonzo from the Serbian front, these being relieved by three newly formed German divisions. Even so there were only some eight divisions in all available to oppose the Italians, who had a numerical superiority of more than three to one.

In order to secure good covering positions on the north a limited advance was made into the Trentino, with success, but another into the north-east corner of the frontier salient—towards Tarvis in the Carnic Alps—was forestalled. This local failure was to have unfortunate results later for it left the Austrians with a good strategic sally port into the Tagliamento valley. Meantime the main Italian advance, by the 2nd and 3rd Armies, had begun at the end of May, but out of their total of 14 divisions only seven were ready. Bad weather increased the handicap, the Isonzo coming down in flood, and the initial advance soon came to a standstill. The Isonzo front crystallized, like the others, into trench warfare. The Italian mobilization, however, was now complete and Cadorna mounted a deliberate attack, which opened on June 23. This first battle of the Isonzo continued until July 7 with little gain to show. A fresh series of efforts after a ten days' pause were hardly more effective, and the front then relapsed into the spasmodic bickering characteristic of trench warfare, while Cadorna made preparations for a new and larger effort in the autumn. When it was launched in October he had a two to one superiority in numbers but was weak in artillery. This defect coupled with the superior experience of the defender rendered the new offensive as barren as its predecessors. It was sustained perhaps too obstinately and when finally broken off on Dec. 5, the Italian loss in the six months' campaign totalled some 280,000—nearly twice that of the defenders, who had shown on this front a fierce resolution which was often lacking when they faced the Russians.

The Conquest of Serbia, Oct., 1915.—While stalemate, although with marked changes beneath the surface, had once more settled in on both the Eastern and Western fronts, the latter months of 1915 witnessed fluid operations elsewhere which were to have an uncalculated influence on the war.

Austria had proved capable of holding the Italians on the Isonzo, and once the Russian danger began to fade under the pressure of the summer offensive, her command was anxious to deal with Serbia conclusively. Austria's attempted invasions in August and September 1914, and again in November, had been brusquely repulsed by Serbian counter-strokes, and it was not pleasant for a great Power, especially one with so many Slav subjects, to swallow such military rebuffs. Her impatience coincided with Falkenhayn's desire to gain direct railway communication with Turkey, hard pressed at the Dardanelles. Throughout the summer the rival coalitions had been bidding for Bulgaria's

support, and in this bargaining the Entente suffered the moral handicap of military failure and the material handicap caused by Serbia's unwillingness to give up any part of Macedonia—of which she had despoiled Bulgaria in 1913. As Austria had no objection to offering territory that belonged to her enemy, Bulgaria accepted her bid. This accession of strength enhanced the chance of a decision against Serbia and in August Falkenhayn decided to reinforce Kövess's Austrian 3rd Army with Gallwitz's German 11th Army from the Russian front. In addition two Bulgarian armies were available. Mackensen was sent to direct the operations. To meet this new threat Serbia, apart from her own relatively small forces, had only a treaty guarantee of Greek aid and promises from the Entente Powers. The first disappeared with the fall of Venizelos, the pro-Ally Greek premier, and the second, as usual, was too late.

On Oct. 6, 1915 (*see* further, SERBIAN CAMPAIGNS) the Austro-German armies attacked southwards across the Danube, with a flanking movement across the Drina on the right. The sturdy resistance of the Serbs in delaying actions, and the natural difficulty of the mountainous country, checked the advance, but before Franco-British reinforcements could arrive, the Bulgarian armies struck westwards into southern Serbia, across the rear of the main Serbian armies. This drove a deep wedge between the Serbs and their allies, moving up from Salonika, and automatically loosened the props of the resistance in the north. With their line bent at both ends until it resembled a vast bow, threatened with a double envelopment, and with their retreat to the south cut off, the Serbian armies decided to retire west through the Albanian mountains. Those who survived the hardships of this mid-winter retreat were conveyed to the island of Corfu, and after being re-equipped and reorganized, joined the Entente force at Salonika in the spring of 1916. The conquest of Serbia, though not, as it proved, of Serbian military power, relieved Austria of danger on her southern frontier, and gave Germany free communication and control over a huge central belt from the North sea to the Tigris. For the Entente this campaign dug a military sump-pit which for three years was to drain their military resources, there to lie idle and ineffective. Yet ultimately that sump-pit was to overflow and wash away one of the props of the Central Alliance.

The Salonika Expedition.—When at the beginning of October the Entente Governments had awakened to Serbia's danger, British and French divisions had been despatched hurriedly from Gallipoli to Salonika, which was the only channel of aid to Serbia —by the railway to Uskub. The advanced guard of this relieving force—which was under the command of Gen. Sarrail—pressed up the Vardar and over the Serbian frontier, only to find that the Bulgarian wedge had cut it off from the Serbians, and it was forced to fall back on Salonika, pursued by the Bulgarians. On military grounds an evacuation of Salonika was indicated, but political reasons induced the Allies to remain. The Dardanelles failure had already diminished their prestige, and by convincing the Balkan States of German invincibility had induced Bulgaria to enter the war and Greece to break her treaty with Serbia. To evacuate Salonika would be a further loss of prestige, whereas by holding on the Allies could check German influence over Greece, and maintain a base of operations from which to aid Rumania, if, as expected, she entered the war on their side. To this end the Salonika force was augmented with fresh British and French divisions, as well as contingents from Italy and Russia, and there also the rebuilt Serbian army was brought. But apart from the capture of Monastir in Nov. 1916, and an abortive attack in April 1917, the Entente force made no serious offensive until the autumn of 1918. Its innocuousness was partly due to the natural difficulties of the country—the chain of mountain ridges which guarded the approach to the Balkans, partly to the feeling of the Allied Governments that it was a bad debt, and partly to the personality of Sarrail, whose conduct and reputation for political intrigues failed to command the confidence and co-operation essential if such a mixed force was to "pull its weight." On their side the Germans were content to leave it in passivity, under guard of the Bulgarians, while they steadily withdrew their own forces for use elsewhere. With gentle sarcasm they termed Salonika their "largest internment camp," and with half a million Allied troops locked up there the jibe had some justification—until 1918. (*See* further SALONIKA CAMPAIGNS 1915–18.)

The Mesopotamia Expedition to the Fall of Kut.—Nor was Salonika the only "drain" opened in 1915. Mesopotamia was the site of a fresh diversion of force from the centre of military gravity, and one which could only be excused on purely political grounds. It was not, like Salonika and the Dardanelles, begun to relieve a hard-pressed ally, nor had it the justification of the Dardanelles expedition of being directed at the vital point of one of the enemy States. The occupation of Mesopotamia might raise British prestige, and it might annoy Turkey, but it could not endanger her power of resistance. Although its origin was sound, its development was another example of "drift," due to the inherent faultiness of Britain's machinery for the conduct of war. (*See* further MESOPOTAMIA, OPERATIONS IN.)

The oilfields near the Persian gulf were of essential importance for Britain's oil supply, and thus when war with Turkey was imminent, a small Indian force, of one division, was despatched to safeguard them. To fulfil this mission effectively it was necessary to occupy the Basra vilayet at the head of the Persian gulf, in order to command the possible lines of approach.

On Nov. 21, 1914, Basra was captured, but the rising stream of Turkish reinforcements compelled the Indian Government to add a second division. The Turkish attacks in the spring of 1915 were repulsed, and the British commander, Gen. Nixon, judged it wise to expand his footing, for greater security. Townshend's division was pushed up the Tigris to Amara, gaining a brilliant little victory, and the other division up the Euphrates to Nasiriya. Southern Mesopotamia was a vast alluvial plain, roadless and railless, in which these two great rivers formed the only channels of communication. Thus a hold on Amara and Nasiriya covered the oilfields; but Nixon and the Indian Government, inspired by these successes, decided to push forward to Kut-al-Amara, a move which was 180 m. further into the interior but had a partial military justification in the fact that at Kut the Shatt-el-Hai, issuing from the Tigris, formed a link with the Euphrates by which Turkish reserves might be transferred from one river line to the other.

Townshend was sent forward in August, defeated the Turks near Kut, and his cavalry carried the pursuit to Aziziya, half way to Baghdad. Enthusiasm spread to the home Government, anxious for a moral counterpoise to their other failures, and Nixon received permission for Townshend to press on to Baghdad. But after an indecisive battle at Ctesiphon, the growing superiority of the Turkish strength compelled Townshend to retreat to Kut. Here, isolated far from help, he was urged to remain, as several fresh divisions were being sent to Mesopotamia. Kut was invested by the Turks on Dec. 8, 1915, and the relieving forces battered in vain against the Turkish lines covering the approach on either bank of the Tigris. The conditions were bad, the communications worse, the generalship faulty, and at last on April 29, 1916, Kut was forced to surrender. However unsound the strategy which despatched Townshend on this adventure, it is just to emphasize that the actual achievements of his small force in face of superior numbers, with inadequate equipment and primitive communications, and utterly isolated in the heart of an enemy country, wrote a glorious page of British history. When these handicaps are compared with the four to one superiority in number, and highly organized supply system of the force which ultimately took Baghdad, the comparison explains the awe in which Townshend and his men were held by the Turks.

The Home Front 1915.—Perhaps one of the most significant landmarks of the transition of the struggle from a "military" to a "national" war was the formation of a National Ministry in Britain which occurred in May 1915. For the prototype of Parliaments to abandon the deep-rooted party system and pool the direction of the war was proof of the psychological upheaval of traditions. The Liberal prime minister, Asquith, remained, but the real lead began to pass insensibly into other hands, notably those of Lloyd George. Churchill, whose vision had saved the

menace to the Channel ports and made possible the future key to the deadlock, was shelved, as already had been Haldane, the creator of the expeditionary force.

Political changes were general in all countries, and were symptomatic of a readjustment of popular outlook. The early fervour had disappeared and been replaced by a dogged determination which, if natural to the British, was in strange contradiction to popular, if superficial, conceptions of the French temperament.

Economically, the strain had yet to be felt severely by any country. Finance had shown an unexpected power of accommodation, and neither the blockade nor the submarine campaign had seriously affected the food supply. If Germany was beginning to suffer some shortage, her people had more tangible omens of success to fortify their resolution than had their enemies.

VII. FROM VERDUN TO THE ENTRY OF AMERICA

Verdun, 1916.—In 1914 the centre of gravity of the World War had been on the Western front, in 1915 it shifted to the Eastern front, and in 1916 once more moved back to France. Although the Entente had dissipated some of their strength in Salonika and Mesopotamia, the rising tide of England's new armies and of her munition supplies promised the power for an effort far larger in scale than before to break the trench deadlock. Measures had also been taken to keep these new divisions up to strength. By the end of 1915 the British force in France had risen to 36 divisions through the entry into the field of "Kitchener's Army," as well as of the territorial divisions. Although the principle of voluntary enlistment had not yet been abandoned, the method was systematized and based on a national register. This scheme, launched in Oct. 1915, under the aegis of Lord Derby, aimed to reconcile the demands of the army with the needs of industry, calling up men by groups as they were wanted, and taking single men first. But the response among the latter was not adequate to preserve this graduated principle and in Jan. 1916, by the Military Service Act, the voluntary system—system is hardly the correct term—was replaced by conscription.

At the close of 1915 the first serious effort to obtain unity of action between the Allies was made, and a conference of the leaders of the French, British, Belgian and Italian armies, with representatives present from the Russian and Japanese, was held at Joffre's headquarters in December. As a result they adopted the principle of a simultaneous general offensive in 1916 by France, Britain, Russia and Italy. In view of the rawness of the British troops, it was recognized that time must be allowed for training, and that the offensive could not begin before the summer of 1916, although it was hoped to carry out preliminary attacks to wear down the enemy's strength.

But German action was to dislocate this scheme, and only the British share came fully into operation, and not even that into full effect. Falkenhayn was about to fulfil his long-cherished plan for a Western offensive, but with characteristic limitations. Always a believer in the strategy of attrition, he now carried this ruling idea into tactics, and produced the new form of attack by methodical stages, each with a limited objective. In a memorandum to the German emperor at Christmas 1915 he argued that England was the staple of the enemy alliance. "The history of the English wars against the Netherlands, Spain, France and Napoleon is being repeated. Germany can expect no mercy from this enemy, so long as he still retains the slightest hope of achieving his object." Save by submarine warfare, however, England and her army were out of reach, for their sector of the front did not lend itself to offensive operations. "In view of our feelings for our arch-enemy in the war that is certainly distressing, but it can be endured if we realize that for England the campaign on the Continent . . . is at bottom a side-show. Her real weapons here are the French, Russian and Italian armies." He regarded Russia as already paralysed, and Italy's military achievements as unlikely to affect the situation. "Only France remains. France has almost arrived at the end of her military effort. If her people can be made to understand clearly that in a military sense they have nothing more to hope for, breaking-point would be reached, and England's best sword knocked out of her hand." He added that a break-through in mass was unnecessary, and that instead the Germans should aim to bleed France to death by choosing a point of attack "for the retention of which the French command would be compelled to throw in every man they have." Such objectives were either Belfort or Verdun, and Verdun was chosen, because it was a menace to the main German communications, because it offered a salient and so cramped the defender, and because of the moral effect if so renowned a place was lost to France.

The keynote of the tactical plan was a continuous series of limited advances which by their menace should draw the French reserves into the mincing-machine of the German artillery. And each of these advances was itself to be secured from loss by an intense artillery bombardment, brief for surprise and making up for its short duration by the number of batteries and their rapidity of fire. By this means the objective would be taken and consolidated before the enemy could move up his reserves for counter-attack. Although the French Intelligence branch at general headquarters gave early warning of the German preparations, the Operations branch were so full of their own offensive schemes that the warning fell on deaf ears. Further, the easy fall of the Belgian and Russian fortresses had led to a commonly held view that fortresses were obsolete, and Joffre, persuading the French Government to "declass" Verdun as a fortress, had denuded it of guns and troops. The forts were only used as shelters and the trench lines which took their place were inadequate and in poor repair. Yet in the outcome eight months' bombardment was to leave the forts almost undamaged!

At 7.15 A.M. on Feb. 21, the German bombardment began, on a front of 15 m., and progressively trenches and wire were flattened out or upheaved in a chaos of tumbled earth, giving to the countryside a weird resemblance to the surface of the moon. At 4.45 P.M. the German infantry advanced, although the first day only on a 2½ m. front. From then until Feb. 24 the defenders' line east of the Meuse was crumbled away as by the erosion of the tide.

"Operations" still argued that it was only a feint, but Joffre decided to send de Castelnau to discover the true situation and with full powers to act. De Castelnau swung back the right flank but ordered the line of the forts to be held at all costs and entrusted the defence to Pétain, for whose use a reserve army was assembled. Pétain's first problem was not so much defence as supply—the German heavy guns had closed all avenues into the salient except one light railway and the Bar-le-Duc road. While gangs of territorial troops worked night and day to keep this in repair and widen it, Pétain organized the front into sectors and threw in repeated counter-attacks, which, helped by the narrowness of the front, at least slowed down the advance. Falkenhayn sought, somewhat late, to widen the front, and on March 6 the Germans extended the attack to the west bank of the Meuse. But the defence was now stiffening, the numbers balanced, and the immediate thrust to Verdun was checked.

A slight lull followed, and during it the Allies of France made efforts to relieve the pressure on her. The British took over the Arras front from the French 10th Army, their front becoming now continuous from the Yser to the Somme, the Italians made their fifth attack, though in vain, on the Isonzo front, and the Russians hurled untrained masses on the German front at Lake Narocz, near Vilna, once more striking prematurely and gallantly sacrificing themselves to help their Allies. The slight gains were soon lost through a counter-stroke. These efforts did not prevent Falkenhayn pursuing his attrition offensive at Verdun. (*See* further VERDUN, BATTLES OF.) The advances were slight but they were cumulative in effect, and the balance of loss turned definitely against the defenders. On June 7 Fort Vaux fell, and the German tide crept ever closer to Verdun, seeming to the anxious watchers to resemble the forces of nature rather than of men. And in the Asiago (*q.v.*) region, Conrad had launched his offensive against Italy's Trentino flank.

Brusilov's Offensive.—Again Russia came to the rescue. In the spring of 1916 she had 130 divisions, but was woefully short

of equipment, facing 46 German and 40 Austrian divisions. The preparation and reorganization for her intended share in the year's Allied offensive were cut short by the emergency at Verdun and in relief of her French allies she had launched a costly and obstinately prolonged attack at Lake Narocz in March. When it was at last broken off, the preparations for the main offensive were resumed. This was to begin in July, coincidently with the Somme offensive and Brusilov, commanding the south-western front, was ordered to prepare such attacks as he could stage from his own resources as a distraction of the enemy's attention from the main offensive. But the distraction was released prematurely, on June 4, in response to Italy's appeal to Russia to prevent the Austrians reinforcing their Trentino attack. Without warning, because without any special concentration of troops, Brusilov's troops advanced against the Austrian 4th Army near Luck (*q.v.*) and the Austrian 7th Army in the Bukovina, whose resistance collapsed at the first shock. In three days Brusilov took 200,000 prisoners. This last vital effort of the Russian army in the war had important consequences. It stopped the Austrian attack on Italy, already impaired by an Italian riposte. It compelled Falkenhayn to withdraw troops from the Western front, and so abandon his plan for a counter-stroke against the British offensive preparing on the Somme, as well as the hope of nourishing his Verdun attrition process. It led Rumania to take her fateful decision to enter the war on the Entente side, and caused the supersession of Falkenhayn in the supreme command and his replacement by Hindenburg—with Ludendorff, officially styled First Quartermaster-General, as the directing brain.

Although Rumania's entry was the ostensible reason, the underlying one was the fact that Falkenhayn's "limited" strategy in 1915 had made possible the Russian recovery which stultified the strategy of 1916. Falkenhayn was history's latest example of the folly of half-measures, the ablest and most scientific general —"penny wise, pound foolish"—who ever ruined his country by a refusal to take calculated risks. In 1916 he had turned back westwards to pursue his long cherished goal, and his strategy had faithfully fulfilled the canons of military orthodoxy by taking for its objective the enemy's strongest army and the strongest point of that army's position. It certainly achieved the object of compelling the French to pour their reserves into the Verdun "blood-bath," but did not effect any decisive strategic result. Falkenhayn had rejected Conrad's proposal for a concentration against Italy such as had previously overthrown Serbia. Conrad's reasons had been that such a blow against the "hereditary enemy" would act as a tonic to the Austro-Hungarian forces and that the theatre of war lent itself to decisive results by a thrust southwards from the Trentino against the rear of the Italian armies engaged on the Isonzo. The success attained by the relatively light blow of 1917—Caporetto—lends historical support to his contention. But Falkenhayn was dubious both of the feasibility and value of the plan and was unwilling even to lend the nine German divisions which Conrad asked for to relieve Austrian divisions in Galicia. In default of this aid Conrad persisted in attempting his design single-handed, taking some of his best divisions from Galicia, and thereby exposing their front to Brusilov's advance without obtaining adequate force to achieve his Italian front plan. Falkenhayn's smouldering resentment at this disregard of his views was fanned into flame by the Galician disaster, and he intervened in Vienna to procure the deposition of Conrad. His own fall followed hard on Conrad's heels.

Brusilov's offensive continued for three months with fair success, but reserves were not at hand for immediate exploitation, and before they could be moved down from the north the Germans were patching up the holes. His later efforts were never so dangerous, but they absorbed all the available Russian reserves, and their ultimate loss of 1,000,000 casualties completed the virtual ruin of Russia's military power.

The Somme.—Great as was the influence of Brusilov's offensive on German strategy, its effect on the Verdun situation was less immediate, and on June 23 the Germans almost reached the Belleville height, the last outwork of Verdun. Pétain made all ready for an evacuation of the east bank of the Meuse, though to his troops he showed no sign of anxiety, and ever repeated the now immortal phrase, "On les aura!"

But on July 1, the long-planned offensive on the Somme (*q.v.*) began, and from that day on the Germans at Verdun received no new divisions, and their advance died away from pure inanition. Nevertheless, although the Germans at Verdun had fallen short of their object, moral and material, they had so drained the French army that it could play but a slender part in the Allied plan for 1916. The British had now to take up the main burden of the struggle, and the consequence was to limit both the scope and effect of the Entente strategy.

On July 1, after a week's prolonged bombardment, the British 4th Army (recently created and placed under Rawlinson) attacked with 15 divisions on a front of 15 m. north of the Somme, and the French with five divisions on a front of 8 m., mainly south of the river, where the German defence system was less highly developed. The unconcealed preparations and the long bombardment had given away any chance of surprise, and in face of the German resistance, weak in numbers but strong in organization, the attack failed along most of the British front. Owing to the dense and rigid wave formations that were adopted the losses were appallingly heavy. Only on the south of the British front, near Fricourt and Montauban, did the attack gain a real footing in the German defences. The French, with slighter opposition, and being less expected, made a deeper advance.

This setback negatived the original idea of a fairly rapid penetration to Bapaume and Cambrai, and Haig adopted the attrition method of limited advances aimed to wear down the German strength. Rejecting Joffre's desire that he should again throw his troops frontally on the Thiepval defences, the attack was resumed on the southern British flank alone, and on July 14 the capture of the Germans' second position offered the chance of exploitation, which was not taken. From now onward a methodical but costly advance continued, and although little ground was gained the German resistance was seriously strained when the early onset of winter rains suspended operations in November. The effect, however, can be exaggerated, for it did not prevent the Germans withdrawing troops for the attack on Rumania. But in one respect the Somme shed a significant light on the future, for on Sept. 15 the first tanks (*q.v.*) appeared. Their early employment before large numbers were ready was a mistake; losing the chance of a great strategic surprise, and owing also to tactical mishandling and minor technical defects they only had a limited success. Although the higher military authorities lost faith in them, and some urged their abandonment, more discerning eyes realized that here was a key which, when properly used, would unlock the trench barrier. The Somme offensive had a further indirect effect, for its relief to the Verdun pressure enabled the French to prepare counter-strokes, carried out by Mangin's corps on Oct. 24 and Dec. 15, which regained most of the lost ground with small casualties. These economic successes were due to a revival of surprise, to a more elastic use of the limited objective method, and to a high concentration of artillery, with a minimum of infantry, to occupy the defences crushed by the guns.

The Conquest of Rumania.—Rumania, sympathetic to the Entente cause, had been waiting a favourable opportunity to enter the war on their side, and Brusilov's success encouraged her to take the plunge. Her command hoped that this success, combined with the Allied pressure on the Somme and at Salonika, would draw off the German reserves. She might have fared better and contributed more if she had taken the decision earlier, when Serbia was still an active force and Russia a real one. The two years of preparation had doubled the numbers of the Rumanian army, but in reality reduced its relative efficiency, for while other armies had developed with experience, Rumania's isolation and the incapacity of her military leadership had prevented the transformation of her army from a militia of "bayonet men" into a modern force. Her 10 active divisions had only a low proportion of machine-guns, 5 of the 13 newly formed divisions had none at all, the artillery was inadequate and the air force negligible. She had only six weeks' supply of ammunition at the start and her allies failed to fulfil their guarantees of supply. Moreover, her

strategical situation was another source of weakness—her territory forming an "L" reversed with the bottom section, Wallachia, sandwiched between Transylvania and Bulgaria, while the length of the frontier was out of all proportion to the depth of the country, with a shortage of lateral railways and the capital within 30 m. of the Bulgarian frontier. Further, she had in the Dobruja, on the other side of the Danube, a "back-yard" strip which offered an easy way of access.

These handicaps were accentuated by the divergent counsels of the Allies. While the British General Staff favoured a southward advance against Bulgaria which might have crushed the latter between the Rumanians and the Salonika army, the Russians urged a westward advance which would, in theory, be in closer co-operation with their own Bukovina advance. The political and moral advantages of a move into Transylvania led the Rumanians to adopt the second course. This has been much criticized, but without sufficient appreciation of the fact that the advance into Transylvania placed the Austro-German command in an awkward predicament, which might easily have been disastrous if the invasion had not been so sluggish. At the outset she had 23 divisions against 7 opposing her, but within a week the enemy would be, and were, able to raise this figure to 15.

The Rumanian advance began, on Aug. 27, with three main columns each of about 4 divisions, moving north-west through the Carpathian passes, the general conception being to pivot on the left and wheel the right up into line facing west when the Hungarian plain was reached. To guard the Danube three divisions were left and three more in the Dobruja, whither the Russians had promised to send two—Rumania's original stipulation had been that a force of 150,000 Russians should be sent.

The slow and cautious advance of the Rumanian columns, hampered by the poverty and destruction of communications, but not by resistance, withheld danger from the five weak Austrian divisions which covered the frontier and enabled their reinforcement by five German and two Austrian divisions. In fulfilment of the other half of the plan, made by Falkenhayn before his fall, four Bulgarian divisions with Austro-German technical troops were to be placed under Mackensen for the invasion of the Dobruja.

While the Rumanian columns were creeping westward into Transylvania, Mackensen stormed the Turtucaia bridgehead on Sept. 5, destroying the three Rumanian divisions which covered the Danube front, and then, with his flank secure, pressed eastwards into the Dobruja. This automatically drew away reserves from, and thereby halted the Rumanian offensive in Transylvania, while Falkenhayn had arrived to take charge. Finding that the Rumanian columns, now at a standstill were dispersed over a 200-mile front, Falkenhayn concentrated against the southern column which had crossed the Rother Turm Pass, while using smaller forces to hold off the others. Having thrown this column back through the mountains by a convergent manoeuvre in which the Alpine Corps made a 50-mile march in three days, Falkenhayn then profited by the despatch of the Rumanian reserves against Mackensen to concentrate his forces against the Rumanian centre column at Brasov (Kronstadt). By Oct. 9 he had driven this back in turn but he missed his greater goal of encircling it, which would have opened for him a clear passage into Rumania. The mischance jeopardised the whole German plan and almost saved Rumania, for with all the passes still in their hands, her troops sturdily repulsed all efforts to press through on their heels. A prompt attempt by Falkenhayn to swing further south and force a way by the Vulcan and Szurduk passes was foiled and the beginning of the winter snows was on the point of blocking operations when a concentrated last-hour effort at the same point, Nov. 11–17, broke through. It was the signal for the next move in the German plan. Mackensen had switched his main forces westwards, and on Nov. 23 crossed the Danube close to Bucharest, on which both armies now converged. It fell on Dec. 6, and, despite belated Russian aid, the Rumanian forces were driven north into the upper section of the Rumanian "L." The brilliantly co-ordinated German strategy had crippled their new foe, gained possession of the bulk of Rumania, with its oil and wheat, and gave the Russians another 300 m. of front to hold. Sarrail, at Salonika, had not succeeded in detaining the Bulgarian reserves.

The Capture of Baghdad.—The only territorial success that the Entente could show for their year's campaign was away in Mesopotamia—the capture of Baghdad, and this moral token was seized on with an enthusiasm which, militarily, it hardly warranted. The bitter experience of the past had damped the ardour of the British Government, and Sir William Robertson, the new Chief of the Imperial General Staff, was opposed to any further commitments which drained the strength available for the Western front. But Maude, the new commander on the spot, by subtle, if unconscious, steps succeeded in changing this defensive policy into one of a fresh offensive. After thorough reorganization of the Mesopotamian force and its communications, he began on Dec. 12, 1916, a progressive right wheel and extension of his front on the west bank of the Tigris above and below Kut. These methodical trench-warfare operations had placed him ready for a spring across the Tigris at the Turks' line of retreat, which was thus parallel to his front. But despite his four-to-one superiority of force, the failure of his right to pin down the enemy and of his cavalry to cut off their retreat prevented a decisive success. But it led to permission for an advance on Baghdad, and he entered the Mesopotamian capital on March 11, 1917. A series of skilfully conducted operations then drove the Turks into divergent lines of retreat and secured the British hold on the province.

The Advance on Palestine.—Ever since the abortive Turkish attempt to invade Egypt early in 1915, the British had kept large forces there, even when the Dardanelles expedition was crying out for troops. When Gallipoli was evacuated, the release of the Turkish forces threatened a fresh move on Egypt. To anticipate this by gaining command of the Sinai desert, Sir Archibald Murray advanced in the spring of 1916, defeating the Turkish forces, freshly arrived, at Romani, Magdhaba and Rafa. The rate of advance was governed by the time taken in extending a railway and pipe-line (for water) across the desert. This new "Exodus" inspired the British Government to carry out an invasion of Palestine, at as cheap a cost in troops as possible. The towns of Gaza, on the coast, and Beersheba, 25 m. inland, guarded the approach to Palestine. Murray attacked Gaza on March 26, but the attempt fell short when on the brink of success. By nightfall Gaza was practically surrounded but the victorious position was given up bit by bit, not under enemy pressure but on the orders of the executive British commanders, through faulty information, misunderstandings and over-anxiety. Nor did the harm end there for Murray reported the action to the Government in terms of a victory, and without hint of the subsequent withdrawal, so that he was encouraged to attempt, without adequate reconnaissance or fire support, a further attack on April 17–19 which proved a costlier failure against defences now strengthened. (*See* further PALESTINE, OPERATIONS IN.)

The Capture of Gorizia.—The Austrian offensive in the Trentino had interrupted Cadorna's plans for a renewed effort on the Isonzo, but when the former was halted, Cadorna switched his reserves back to the Isonzo. In preparation for this offensive the whole sector from Monte Sabotino to the sea was entrusted to the Duke of Aosta's 3rd Army, under which 16 divisions were concentrated, against six Austrian divisions. Following a preliminary feint near the sea on Aug. 4, the attack opened well two days later. North of Gorizia Capello's corps swept over the long impregnable Monte Sabotino, which guarded the approach to the river, and, crossing the river on the night of Aug. 8, occupied the town. This compelled an Austrian retreat on the Carso sector to the south, but attempts to exploit the success eastward failed against fresh positions of resistance. Three more efforts were made in the autumn and if they imposed a wearing strain on the Austrians they caused greater loss to the attackers. During the year Italians had suffered some 483,000 casualties and inflicted 260,000.

The War at Sea, 1915–16.—Germany's first submarine campaign—associated by Allied opinion with the name of Admiral von Tirpitz, the exponent of ruthlessness—had been a signal failure, both in its meagre results and the disproportionate ethical

damage it did to Germany's cause. A series of Notes exchanged between the American and German Governments, culminated in April 1916 in a virtual ultimatum from President Wilson, and Germany abandoned her unrestricted campaign. The deprivation of this weapon spurred the German navy to its first, and last, attempt to carry out the initial plan on which it had begun the war. On May 30, 1916, the British Grand Fleet left its bases on one of its periodical sweeps through the North sea, but with reason to expect a possible encounter. On May 31, early in the morning, the German High Sea Fleet also put to sea, in the hope of destroying some isolated portion of the British fleet.

For such an encounter the British admiral, Jellicoe, had formulated an outline plan in the early months of the war. Its basis was the cardinal necessity of maintaining the unimpaired supremacy of the Grand Fleet, which he viewed as an instrument not merely of battle but of grand strategy, the pivot of the Allies' action in all spheres, economic, moral and military. Hence while desirous of bringing the German fleet to battle under his own conditions he was determined not to be lured into mine and submarine infested waters.

Early in the afternoon of May 31, Beatty, with his battle-cruisers and a squadron of battleships, after a sweep to the south was turning north to rejoin Jellicoe, when he sighted the German battle-cruisers, five in number. In the initial engagement two of Beatty's six battlecruisers were hit in vital parts and sunk; when thus weakened he came upon the main German fleet under Admiral Scheer. He turned north to lure them into reach of Jellicoe, 50 m. distant, who raced to support him. To describe the intricate and much debated manoeuvres which followed is neither possible nor would it be just within the limits of this article, a strategical and not a tactical survey. Mist and failing light put an end to an indecisive action, which, however, left the British fleet between the German and its bases. During the night Scheer broke through the destroyer guard, and, although sighted, was not reported. Then he slipped safely through a net which Jellicoe dared not draw too close in view of his guiding principle and the danger of torpedo attack.

But if the battle of Jutland (*q.v.*) could be counted a tactical advantage to the Germans, it had no effect on their strategic position. Britain's command of the sea was intact, and the grip on the blockade on Germany unrelaxed. Once more she fell back on submarine warfare, and the first development was an extension of range. In July one of her new large submarine-cruisers appeared off the American coast and sank several neutral ships. In British and Mediterranean waters the pressure began seriously to affect the sea-borne trade and food supplies of the Entente. Various remedies were tried—the most effective being a system of sailing in convoys—but the only truly adequate measure, that of penning the Germans in their bases by close-in minefields, was debarred by Britain's failure to obtain a decisive battle success. But if Britain was feeling the strain of economic pressure, so also was Germany, and her leaders feared that the race between decisive success on land and economic collapse would end against her. The naval authorities declared that a renewal of the "unlimited" submarine campaign, which with her increased numbers could now be far more intense, would bring the Entente to their knees. Accepting this opinion, Ludendorff consented to a step which he had hitherto opposed, and on Feb. 1, 1917, it was inaugurated—with the full realization that it involved the weight of America being thrown into the scales against them.

VIII. THE PENULTIMATE YEAR

Despite incessant provocation for two years, since the "Lusitania" incident, President Wilson had held to his neutral policy, and if his excess of patience angered many of his own people it at least was the means of consolidating American opinion and reconciling it as a whole to intervention in the war. Meantime he strove by speech and by the agency of Col. House—his unofficial ambassador—to find a basis of peace on which the belligerents could agree. This effort was doomed to failure by its misunderstanding of the psychology of the warring peoples and of the fundamental objects for which they were fighting. He was still thinking in terms of traditional warfare, between governmental policies, while the conflict had long since passed into the wider sphere of the struggle of peoples dominated by the primitive instinct of self-preservation.

The declaration of the unlimited submarine campaign brought convincing proof of the futility of these peace hopes and of the reality of the German intentions, and when followed by the deliberate sinking of American ships and an attempt to instigate Mexico to action against the United States, President Wilson hesitated no longer, and on April 6, 1917, America entered the war against Germany.

Her potential force in man-power and material was illimitable but, even more unready than Britain in 1914, it must be long in exerting more than a moral influence, and Germany confidently anticipated that the submarine campaign would take decisive effect within a few months. How near her calculation came to fulfilment the record of 1917 and 1918 bears witness.

The Western Front Campaign of 1917.—The year 1916 closed in gloom for the Entente The simultaneous offensive on all fronts, planned a year before, had misfired, the French army was at a low ebb, the Russian still lower, the Somme had failed to produce visible results in any way proportional to its cost, and another fresh ally had been overrun. At sea the negativeness of Jutland was a disappointment, and although Germany's first submarine campaign had been abandoned a stronger one was threatened. To offset these debits, the Entente could only show the capture of distant Baghdad and the limited Italian success at Gorizia in August, whose value, however, was mainly as a moral tonic to Italy herself.

Among the Allied peoples and their political representatives there was a growing sense of depression. On the one hand it took the form of dissatisfaction with the conduct of the war and, on the other, of discouragement over the prospects of a victorious conclusion to the war, and a tendency to discuss the possibilities of a peace by negotiation. The first-named tendency was the first to come to a head and was signalized in London, the political mainspring of the Allies, by the replacement of Asquith's Government on Dec. 11 by one with Lloyd George as its chief. The order of precedence in events had a significant effect. For Lloyd George had come into power as the spokesman of a widespread demand for a more vigorous and more efficient prosecution of the war.

The second tendency received an impulse from the German peace move of Dec. 12, after the fall of Bucharest, which proposed an opening of peace discussions. This suggestion was rejected as insincere by the Allied Governments, but it afforded the opportunity of President Wilson, on whose behalf Col. House had long been sounding the belligerent Governments as to the prospects of mediation, to invite these to define their war aims as a preliminary to practical negotiation. The German reply was evasive, the Allied replies were considered by their opponents inacceptable as a basis of discussion, and the tentative peace moves subsided.

But while this wave of depression was surging on the "home-front," the Allied commanders continued optimistic. In November Joffre assembled, at Chantilly, a further conference of the commanders at which it was agreed that the Germans were in great difficulties on the Western front, and that the situation of the Allies was more favourable than it had ever been.

The fighting strength of the British army had grown to about 1,200,000 men, and was still growing. The fighting strength of the French army had been increased by the incorporation of native troops to some 2,600,000, so that, including the Belgians, it was estimated that the Allies disposed of about 3,900,000 men against about 2,500,000 Germans.

Joffre declared that the French army could maintain its strength for one more great battle, but that thereafter it must progressively decline, as France had no longer a sufficient number of men of military age to replace losses. He therefore warned Haig that during the coming year the burden must fall more and more upon the British army. It was also agreed that in view of these factors the relative superiority of the Allies on the Western front would be greater in the spring of 1917 than at any time which could be

foreseen with certainty. In consequence it was decided to take the earliest opportunity of pressing the advantage gained on the Somme, and to continue the process of exhausting the enemy's reserves as preparation for an effort which should be decisive. An alternative proposal was made by Gen. Cadorna that the French and British should co-operate in a combined thrust from the Italian front against Austria with the object of knocking this "weaker partner" out of the war. But it was rejected by the French and British commanders, despite Lloyd George's espousal of it at the Allied conference held in Rome in January. Their objection was that it involved a fresh diversion of strength away from the main front, where alone, they held, success could have decisive results.

The Entente plan for 1917 was soon to be complicated by changes in the command. French opinion had tired of the meagre results of Joffre's attrition strategy, and the method of the limited objective had fallen into disfavour because of the unlimited losses on the wrong side, which accompanied it without apparent gain. They contrasted the dull course of his strategy with the brilliant results gained by Mangin at Verdun, in the autumn, under Nivelle's direction, and as a result Joffre gave place to Nivelle, who promised a real break-through. His confidence so inspired Lloyd George, the new British prime minister, that Haig was subordinated to him for the forthcoming operations—an arrangement which violated the axiom that a general cannot direct one force while exercising executive command of another. For carrying out a plan essentially audacious, Nivelle had two further handicaps; he failed to convert several of his subordinates to the idea, and he was given less rein by the Government than his predecessor. Again, while Joffre had intimated that the British must take the chief part, Nivelle changed this policy, and in his desire to conserve the glory for France overlooked how severely the French fighting power had been strained. Joffre's plan had been for a convergent attack on the great German salient Lens-Noyon-Reims, first against its west flank and then against its south—the British to attack north of the Somme, including but extending beyond the old battle ground, and the French south of it to the Oise. The attacks were to begin early in February and to be followed by a French main attack in Champagne. Nivelle's change was to ask the British to take over more of the front—south of the Somme—in order to release French troops for the Champagne blow, and as a result the start was postponed a month.

Before it could begin the Germans had dislocated it. Ludendorff's first step had been to set on foot a complete programme for the reorganization and expansion of German man-power, munitions and supplies. While this was developing, he intended to stand on the defensive, hoping that the new submarine campaign would either decide the issue or pave the way for a decisive blow on land when his new reserves of men and material were ready. Anticipating the renewal of the Entente advance on the Somme, he had a new line of defence, of great artificial strength, built across the chord of the arc Lens-Noyon-Reims. Then after devastating the whole area inside the arc, he began a methodical retirement, by stages, to the new line called by the Germans the "Siegfried" and by the Allies the "Hindenburg" line. A consummate manoeuvre, if brutal in application, it showed that Ludendorff had the moral courage to give up territory if circumstances advised it. The British, confronted with a desert, were inevitably slow in pursuit, and their preparations for an attack on this front were thrown out of gear, limiting them to the sector around Arras (*q.v.*), where the front was unchanged.

On April 9 Allenby's 3rd Army opened the spring offensive at this point, taking the long-sought Vimy ridge, but failed to develop its initial success, and continued the attack too long after the resistance had hardened. This costly action was partly prolonged in order to take the pressure off the French. For the French blow between the Somme and the Oise had been stultified by the German retirement, and the main attack on April 16 east and west of Reims (*see* CHAMPAGNE, BATTLES IN) was a worse fiasco with a dangerous sequel. With a prolonged bombardment giving away any chance of surprise, and without first drawing away the German reserves, the idea of a rapid break-through was doomed to fail. The high hopes that had been raised caused the greater reaction, and the troops were weary of being thrown against barbed wire and machine-guns to no apparent effect. Accentuated by service grievances, mutinies broke out in the French armies, and no less than 16 corps were affected. In these circumstances Nivelle was replaced by Pétain, whose first concern was to restore the shaken morale of the French troops, and for the rest of the year the British bore the brunt of the campaign. Their strength in France was now at its highest—64 divisions, supplied with an abundance of artillery and ammunition. The strain, however, was increased by the failure of Russia to make any effective contribution to the pressure on Germany, owing to the revolution which broke out in March. Haig decided to keep the Germans occupied by carrying out the original plan for an offensive in Belgium, and if the principle was right the method and choice of site were open to criticism.

The initial move was an attack on the Messines (*q.v.*) ridge in order to straighten out the Ypres salient and attract the enemy's reserves. Carried out by the 2nd Army under Plumer, with Harington as chief of staff, it proved a model example of the "limited" attack with success economically gained by able staff work and co-operation between the arms.

It was followed on July 31 by the main attack at Ypres (*see* YPRES, BATTLES OF, 1917) which, hampered by the heavy rain, was foredoomed by its own destruction of the intricate drainage system of the area. The British command had persevered for two and a half years with the method of a prolonged preparatory bombardment, believing that quantity of shells was the key to success, and that, unlike all the great captains of history, they could disregard the element of surprise. The offensive at Ypres, which was finally submerged in the swamps of Passchendaele in early November, threw into stronger relief than ever before the fact that such a bombardment blocked the advance for which it was intended to pave the way—because it made the ground impassable. The discomfiture was increased by the new German method of defence, which Ludendorff introduced, of thinning the front defences and using the men so saved for prompt local counter-attacks. The defence was built up of a framework of machine-guns distributed in concrete "pill-boxes" and disposed in great depth. On the British side the profitless toll of this struggle in the mud was to some extent mitigated by better staff work when the direction of the attack was handed over to Plumer's 2nd Army.

Three months of dreadful struggle came to an end with the British not appreciably nearer their immediate object of driving the Germans from their submarine bases in the Belgian ports, and if they had worn down the German strength they had worn down their own still more.

The Renaissance of Surprise at Cambrai.—The 1917 campaign in the West closed, however, on a note brighter in promise if not in accomplishment. Appreciating from the first days the futility of using tanks in these Flanders swamps, the Tank Corps headquarters looked around for an area where they could try out a new and different method. The chief general staff officer, Col. Fuller, drew up a project for a large scale raid to scour a canal-enclosed "pocket" near Cambrai (*q.v.*), where the rolling downland lent itself to tank movement. The basic idea was the release of a swarm of tanks without any preparatory bombardment to give warning of the attack. When their hopes at Ypres waned, the British command adopted the scheme, retaining the basic idea, but transforming the operation into a definite offensive with far-reaching aims, for which they had not the resources because of the drain of Ypres. The operation was to be carried out by Byng's 3rd Army with six divisions, and the date was fixed for Nov. 20. Led by nearly 400 tanks, the attack came as a complete surprise, and despite minor checks achieved a penetration far deeper and at less cost than any past British offensive. But all the available troops and tanks were thrown into the first blow, and the higher command failed to give Byng the few reserves they still possessed in time to exploit the success. The cavalry, as always throughout the operations on the Western front, proved

totally unable to carry out this important rôle.

Thus the advance died away, and on Nov. 30 the German army commander, Marwitz, launched a counter-stroke against the flanks of the salient created by the British advance. In the north it was parried, but in the south broke through, and a disaster was only averted by the superb counter-attack, first of the Guards Division and later of a tank brigade. But if Cambrai was a disappointment it revealed that surprise and the tank were the combination by which the trench barrier could be unlocked. Meanwhile Pétain, after overhauling his instrument, the French army, sought to test its readiness for 1918. In August a stroke by Guillaumat's army recovered all the remainder of the ground lost in 1916, and in October Maistre's army flattened the south-west corner of the German front, seizing the Chemin des Dames ridge.

The Collapse of Russia.—The temporary breakdown of the French fighting power was not the worst of the troubles which together crippled the Entente offensive in 1917. The collapse, first partial and then complete, of Russia was a loss which even the entry of America into the war could not possibly compensate for many months, and before the balance was restored the Western Allies were to be perilously near the brink of defeat. Russia's enormous losses, due to her own defective machine but incurred in sacrifice for her Allies, had undermined the morale even more than the material endurance of her forces. Revolution broke out in March, superficially against the corrupt *entourage* of the tsar, but with more deep-seated moral causes beneath. The tsar was forced to abdicate and a moderate Provisional Government climbed into the saddle, but without reins. This was only a makeshift, and in May another succeeded it, more Socialist in tendency and outwardly led by Kerensky. While clamouring for a general peace and undermining discipline by a system of committee control suitable to a trade union but not to the field of battle, Kerensky imagined he could send troops against the enemy by platform appeals.

Brusilov succeeded Alexeiev in the supreme command, and on July 1 the army gained some initial success against the Austrians, especially in the region of Stanislau, only to stop as soon as real resistance was met, and to crumble directly the Germans counter-attacked. By early August the Russians had been driven out of Galicia and the Bukovina, and it was only policy which halted the Austro-German forces on the frontiers of Russia itself. In September the Germans took the opportunity to practise their new method of attack intended for use in France, and this surprise attack, under Hutier's command, resulted in the capture of Riga. Next month the Bolsheviks under Lenin overthrew the wordy Kerensky, imposed their self-constituted rule on the Russian people and sought an armistice with Germany, which was concluded in December.

Italy's Caporetto Disaster.—The defection of Russia did not end the Entente tale of woe. Each autumn, with demoralizing regularity, Germany had seized an opportunity to eat up one of the weaker Allies. In 1915 it had been Serbia's fate, in 1916 Rumania's, and now it was Italy's turn, or so the Germans intended. Ludendorff's decision, taken in September, was determined by the appeals of the Austrian authorities, who felt that their troops could not endure the strain of another defensive battle on the Italian frontier. In May, Cadorna had attacked once more on the Isonzo front, but an Austrian counter-attack in the Carso sector had retaken part of the small gains. Losses, however, were more nearly balanced than formerly. The question of Allied co-operation on the Italian front was raised afresh without result, but Cadorna, nevertheless, initiated in August an "eleventh battle of the Isonzo." Capello's 2nd Army captured a large part of the Bainsizza plateau, north of Gorizia, but a long sustained effort brought no further success and Cadorna was forced to break off the offensive after four weeks' struggle. But it had so strained the Austrian resistance that, in Ludendorff's words, "it became necessary to decide for the attack on Italy in order to prevent the collapse of Austria-Hungary."

Ludendorff had a difficult problem to solve. Russia had not yet capitulated, the front there was already weakly held for its extent, and the British offensive in Flanders made impossible a large withdrawal of troops from France. All he could spare was his slender general reserve of six divisions, which had already been his instrument in countering the Kerensky offensive and in the Riga coup. His adviser in the strategic design of operations, Lt.-Col. Wetzell, was, however, of opinion that the application of even this small force at a "soft spot" such as was offered by the Tolmino-Caporetto sector, north of the Bainsizza plateau, would suffice to cripple the Italian menace. The result proved him right—the trouble was that it unduly exceeded the most sanguine expectations. On Aug. 29 Waldstätten, of the Austrian general staff, had brought to Ludendorff a scheme for a break-through at Tolmino, followed merely by rolling up the Isonzo front. But this plan was expanded into a more ambitious one without an increase of means. The Germans at Caporetto, like the British subsequently at Cambrai, were to provide an example of the profound strategic error of not "cutting your coat according to your cloth."

On hearing the Austrian proposals Ludendorff sent Gen. Krafft von Dellmensingen, an expert in mountain warfare and commander of the Alpine Corps in the Rumanian campaign, to reconnoitre the ground, and on receiving his report, approved the scheme. The six German divisions with nine Austrian formed the 14th German Army under Otto von Below, with Krafft as chief of staff and guiding brain. These troops were to penetrate the mountain barrier at the north-east corner of the Venetian salient, while Boroevic's two Austrian armies were to advance along the stretch of lower ground near the Adriatic shore. The organization and deployment of the attack in such mountainous country were difficult, but were ably overcome. Guns were brought up mostly by hand and at night; the infantry came up by night marches with all their ammunition and supplies on pack animals. Thanks to skilful precautions and the Italians' limited air reconnaissance, the concentration was undiscovered. On Oct. 24, after four hours' gas shell bombardment and one hour general, the blow was launched and pushed deep down the western slopes of the mountains, imperilling the Italian forces to both south and north. On Oct. 28 Below's van reached Udine, the former Italian general headquarters, and on Oct. 31 the Tagliamento.

Not the least significant feature of this offensive was the way it was prepared by a moral bombardment. Propaganda has been exploited for months as a means of sapping the Italian discipline and will to resist. But its effect can be exaggerated—the most formidable propaganda, as with the French in April, was that supplied by the attrition strategy of the Italian command, which had sickened the troops by its limited results at unlimited cost. Cadorna, too, offset undoubted ability by his lack of touch with and understanding of the fighting troops. Troops already too highly tried were kept too long without relief. Despite warnings of a hostile offensive, he had paid too little heed to Capello's complaints about the defensive suitability of the positions on which the Italian offensive had stopped, and had overruled his desire to forestall the enemy by a flank thrust northwards from the Bainsizza plateau.

But the result also surprised Ludendorff, who, with his slender forces, had not calculated on such distant objectives as were now possible of attainment. Boroevic was slow in following up the Italian right, and Ludendorff tried to switch part of his force to Conrad's army which flanked the north of the Venetian salient, but was foiled by the inadequacy of the rail communications. Even so, Cadorna, with his centre broken through, only saved his wings by a precipitate retreat to the line of the Piave, covering Venice, and on Nov. 9 the whole Italian army was behind this river, except for 250,000 prisoners in the enemy's hands, and nearly twice as many other casualties—killed, missing or sick. The same day Cadorna was superseded in supreme command by Diaz. Italy's allies had begun to rush reinforcements, a British and a French army corps, to her aid, and on Nov. 5 their political and military chiefs arrived at Rapallo for a conference, out of which sprang the Allied Council at Versailles, and ultimately a unified command.

The invaders had outrun their transport, and the resistance of

the Italians, morally braced by the emergency, succeeded in holding the Piave (*q.v.*) in face of direct assaults and strenuous efforts by Conrad to turn their left flank from the Trentino. Here Cadorna's preparations for defence had been long initiated and were well matured. At the beginning of December the British and French, who had been waiting in reserve in case of a fresh breakthrough, moved forward to take over vulnerable sectors, but the attack was only renewed in the north, and on Dec. 19 it came to an end with the snows. If Caporetto seriously damaged Italy, it also purged her, and after an interval of recuperation she was to vindicate herself at Vittorio Veneto.

The Capture of Jerusalem.—Once more a distant theatre of war provided the sole triumph of the Entente cause during the year—this time in Palestine (*q.v.*). The second reverse at Gaza, in April 1917, had led to a change in command, Murray being succeeded by Allenby, who was strong enough and fortunate enough to obtain the adequate force for which Murray had asked in vain. The British Government was anxious for a spectacular success to offset the moral depression of the Nivelle failure and the decline of Russia, and the British general staff desired to dislocate the Turkish attempt to recapture Baghdad by drawing away their reserves.

Allenby took over in July and devoted the first three months to intensive preparations for an autumn offensive, when the season would be suitable. The command was reorganized, the communications developed, and his own headquarters moved forward from Cairo to the front. By complete secrecy and ruses he deceived the Turks as to the main point of attack. The defences of Gaza were bombarded from Oct. 20 onwards, and an attack followed on Nov. 1 to pin the enemy and draw in his reserves. Meanwhile, as a necessary preliminary to the real blow, the inland bastion of Beersheba was seized by a convergent manoeuvre on Oct. 31, a prelude to the decisive attack on Nov. 6, which broke through the enemy's weakened centre and into the plain of Philistia.

Falkenhayn, now in command at Aleppo, had also been planning an offensive, but the better communications of the British had decided the race, and although Falkenhayn tried to stem the tide by a counter-stroke against Beersheba, the breaking of his centre compelled a general retreat. The pursuit was hampered owing to lack of water, but, even so, by Nov. 14 the Turkish forces were driven apart in two divergent groups, the port of Jaffa was taken, and Allenby wheeled his main force to the right for an advance inland on Jerusalem. He gained the narrow hill passes before the Turks could block them, and after a necessary pause to improve his communications, brought up reserves for a fresh advance, which secured Jerusalem on Dec. 9. By the time the winter rains set in the British had expanded and consolidated their hold on the region. As a moral success the feat was valuable, yet viewed strategically, it seemed a long way round to the goal. If Turkey be pictured as a bent old man, the British, after missing their blow at his head—Constantinople—and omitting to strike at his heart—Alexandretta—had now resigned themselves to swallowing him from the feet upwards, like a python dragging its endless length across the desert.

The Conquest of East Africa.—The year 1917 witnessed another overseas success, the clearing of German East Africa, although not the close of the campaign. More than a year elapsed after the rebuff at Tanga before a serious attempt was made to subdue the last German stronghold on the African continent. To spare troops from the main theatres was difficult, and the solution was only made possible by the loyal co-operation of the South African Government. In Feb. 1916 Gen. Smuts was appointed to command the expedition, and formed the plan of a drive from north to south through the difficult interior, in order to avoid the fever-rampant plain on the coast. In conjunction with this central wedge, a Belgian force under Tombeur was to advance eastwards from Lake Tanganyika, and a small British force under Northey was to strike in from Nyasaland in the south-west. The Germans under Lettow-Vorbeck were weak in numbers but handled with masterly skill, and with all the advantages of an equatorial climate, a vast and trackless region—mountainous in parts and covered with dense bush and forest—to assist them in impeding the invader. From Dar-es Salaam on the coast to Ujiji on Lake Tanganyika ran the one real line of rail communication, across the centre of the colony. After driving the Germans back across the frontier and seizing the Kilimanjaro gap, Smuts moved direct on this railway at Morogoro, over 300 m. distant, while he dispatched a force under Van Deventer in a wide sweep to the west to cut the railway further inland and then converge on Morogoro. Lettow-Vorbeck delayed this manoeuvre by a concentration against Van Deventer, but Smuts's direct advance compelled him to hurry his force back, and thus enabled Van Deventer to get astride the railway.

However, Letto-Vorbeck evaded the attempt to cut him off and fell back in September on the Uluguru mountains to the south. The Belgians and Northey had cleared the west, and the net had been drawn steadily closer, confining Lettow-Vorbeck to the south-east quarter of the colony. Early in 1917 Smuts returned to England, and Van Deventer conducted the final operations which ended with Lettow-Vorbeck, avoiding envelopment to the end, slipping across the frontier into Portuguese Africa. Here he maintained a guerrilla campaign throughout 1918 until the general Armistice. With an original force of only 5,000, 5% being Europeans, he had caused the employment of 130,000 enemy troops and the expenditure of £72,000,000.

The Mastering of the Submarine.—The military side of 1917 is thrown into shadow by the naval, or more strictly the economic, side. The vital issue turned on the balance between Germany's submarine pressure and Britain's resistance. April was perhaps the most critical month. The Allies lost nearly a million tons of shipping, 60% British, and although the German navy's promise of victory by the end of the month was proved a miscalculation, it was clear that, ultimately, the continuance of such a ratio of loss must starve the civilian population and automatically prevent the maintenance of the armies. Britain, indeed, had only food enough to sustain her people for another six weeks. The British Government sought to counter the menace by the indirect means of rationing, increasing home production and the expansion of shipbuilding; by the direct means of the system of convoys with naval escorts, and a counter-offensive against the submarine. Aided by new devices to detect the presence of submarines and the use of thousands of patrol craft, this highly organized campaign exacted an ever-rising toll, and by the end of 1917 the menace, if not broken, was at least subdued. In this task America's aid became a potent factor long before her military assistance. It embraced her provision of light craft to reinforce the British anti-submarine fleet, her rapidly developed construction of new mercantile ships, and still more her financial aid. By July 1917 Britain had spent over £5,000,000,000, her daily expenditure had risen to £7,000,000, and the burden of financing her Allies as well as her own efforts was straining even her resources, when America's aid came to ease the pressure.

These were the defensive benefits; the offensive were at least as great. No longer was the grip of the naval blockade hampered by neutral quibbles, but instead, America's co-operation converted it into a strangle-hold under which the enemy must soon grow limp, since military power is based on economic endurance. As a party to the war, the United States, indeed, wielded the economic weapon with a determination, regardless of the remaining neutrals, far exceeding Britain's boldest claims in the past years of controversy over neutral rights. The submarine menace, crippled in 1917, was ended to all intents during the early months of 1918. To this conclusion the greatest single contribution was the laying of a mine-barrage by the American navy across the 250 m. wide passage between Norway and Scotland. This was a direct counter to the main submarine operations against the ocean-brought supplies of Great Britain. For the small submarines which carried out the shorter range operations the ports on the Belgian coast had afforded a base unpleasantly close to English shores, but these also were now closed by the daring attacks of Sir Roger Keyes's force on Zeebrugge and Ostend. Yet the removal of the menace should not lead to an

underestimate of its powers for the future. The 1917 campaign was launched with only 148 submarines and from the most unfavourable strategic position. Great Britain lay like a huge breakwater across the sea approaches to northern Europe and the submarines had to get outside through narrow and closely-watched outlets before they could operate against the arteries of supply. And despite these handicaps they almost stopped the beat of England's heart.

The Air Offensive.—Another new form of action reached its crest at the same time as the submarine campaign. As the submarine was primarily an economic weapon, so was the aeroplane primarily a psychological weapon. The explosive bullet had virtually ended the Zeppelin raids in 1916, but from early in 1917 aeroplane raids on London grew in intensity until, by May 1918, the air defences were so thoroughly organized that the raiders thereafter abandoned London, as a target, for Paris. If the stoicism of the civil population took much of the sting from a weapon then in its infancy, the indirect effect was serious, interrupting business and checking output in industrial centres, as well as drawing off, for defence, many aircraft from the front. In reply the British formed an Independent Air Force, which carried out extensive raids into Germany during the closing months of the war, with marked effect on the declining morale of the "home front." To relate the action of aircraft in the military sphere is not possible, for it formed a thread running through and vitally influencing the whole course of operations, rather than a separate strategic feature.

The beginning of 1918 witnessed the development and thorough organization of another psychological weapon, when Lord Northcliffe was appointed director of propaganda in enemy countries, and for the first time the full scope of such a weapon was understood and exploited.

IX. GERMANY'S BID FOR VICTORY

On the Threshold of 1918.—The middle years of the World War had been, in a military sense, a tussle between a lean Hercules and a bulky Cerberus. The Germanic alliance was weaker in numbers but directed by a single head, the Entente stronger in numbers but with too many heads. Owing to their own excessive losses, diffusion of effort and the collapse of Russia, the Entente, at the end of 1917, were faced with the grim fact that the numerical balance had been reversed, and months must elapse before the prospective stream of America's new divisions came to tilt the scales once more in their favour. The emergency paved the way for the creation of a unified command, but it still needed disaster to bring it into being.

At the conference at Rapallo in November, the formation of a Supreme War Council was decided upon, to be composed of the principal ministers of the Allies, with military representatives, and to sit permanently at Versailles. If the fundamental defect was that it merely substituted a formal for an informal committee, a further flaw was that the military representatives had no executive status. In the economic sphere, where deliberation rather than instant action was necessary, it led to a real improvement in the combination of shipping, food and munition resources. Militarily, it was futile, for it set up a dual advisorship—the Versailles representatives on the one hand and the chiefs of the national general staffs on the other. As the menace of the German attack grew closer and with it the need for common action, this advisory body was converted into a military executive committee to handle an inter-Allied general reserve, a fresh compromise which set up a dual control—the commanders-in-chief and the Versailles committee.

If concentration of control was lacking, so also was concentration of force. Since early in November the stream of German troop-trains from East to West had been steadily swelling. When the 1917 campaign opened there had been a proportion of nearly three Allies to two Germans—actually, in March 178 British, French and Belgian divisions against 129 German divisions. But now the Germans had a slight balance and the likelihood of bringing still more. But the Allied statesmen, recalling how often their own offensive had failed with equal or greater superiority of force, were slow to appreciate the gravity of the menace or to respond to the sudden fall in the temperature of military opinion. Nor could they agree to draw reinforcements from the other fronts. The Italians strove against any withdrawal of the Allied contingents from their front, and the French opposed any reduction of the Salonika force. Lloyd George went further and urged an offensive in Palestine, a scheme which was sanctioned on the understanding that no reinforcements went there from France, but which also meant that none came from there to France. Robertson, the chief of the imperial general staff, disagreed both with this Palestine plan and the creation of the Versailles executive committee, and resigned, being succeeded by Sir Henry Wilson. The position was still further weakened by the insistence of Clemenceau, the new French premier, that the British should extend their front south to the Oise. This meant that Gough's 5th Army was dangerously stretched out and took over ill-prepared defences on the very front that Ludendorff was about to strike. Meantime, the German strength had increased to 177 divisions by the end of January, with 30 more to come. The Allied strength, owing to the despatch of divisions to Italy and the breaking up of others owing to the French shortage of drafts, had fallen to the equivalent of 173—counting as double the four and one-half large size American divisions which had arrived. For the French and British had been constrained to follow the Germans in reducing their divisions from 12 to 9 battalions each.

The prolonged pouring of soldiers' lives into the swamps beyond Ypres had led Lloyd George and his cabinet to withhold reinforcements for fear of encouraging fresh squandering. This undoubtedly weakened Haig's initial power of resistance to the German onslaught, yet it is just to point out that it was weakened worse—in quality as well as quantity—by the 400,000 British casualties suffered in the offensive of the later part of 1917. Moreover, we should not forget that the Government had the heavy responsibility of being the trustees for the lives of the nation. The real ground of criticism is that it was not strong enough to make a change in, or place a check upon, a command which it did not trust, while supplying the reinforcements necessary for defence. And for this lack of moral strength the public must share the blame, for they had already shown themselves too easily swayed by clamour against political interference with the generals, and too prone to believe that the politician is invariably wrong on such occasions. The civilian public, indeed, is apt to trust soldiers too little in peace, and sometimes too much in war.

These political handicaps, and their accompanying tendency to work deviously towards what dared not be demanded openly, were also seen in the project for a unified command. The prime minister, indeed, had gone so far in December as to disclaim faith in his own long-sought cure. Instead he sought a palliative in an inter-Allied executive committee, under Foch's chairmanship, which should control a common general reserve of 30 divisions. This scheme was stillborn in face of the opposition of the respective commanders-in-chief, Haig and Pétain. The decisive act came from Haig, who, when called on by Foch for his contribution of seven divisions, replied that he could spare none. He and Pétain united in preferring an arrangement between themselves for mutual support.

When the test came, a week later, this broke down, and Haig then took a foremost part in hastening and facilitating the appointment of a generalissimo, which he had formerly opposed. For the actual breakdown the blame has been commonly thrown upon the French, and there is no question that Haig understood from Pétain on March 24 that if the Germans continued their rapid progress the French reserves would have to be used to cover Paris. But in fairness it is essential to add that, whereas the original compact had only pledged the aid of some six French divisions, Pétain actually sent nine by March 24, and 21 (including four of cavalry) by March 26. If these reinforcements were, perhaps, slower in coming into action than in despatch, it does not affect the fact that the original pledge was amply exceeded. Thus, the fundamental fault would seem to lie

in trusting to an arrangement for such slender support by either Ally.

The German Plan.—On the German side the submarine panacea for victory had been replaced by a military panacea, and hopes were perhaps exaggerated by the unexpected collapse of Russia. But although Ludendorff promised victory in the field, he did not disguise that a Western offensive would be a far harder task than the conquests in the East. He realized also that it would be a race between the effect of Germany's blow and the arrival of American reinforcements, although he hoped to win the race. To secure the rear of his offensive, a definite peace was won from the Bolshevik Government of Russia by a military demonstration, and also forced on Rumania. And to secure if possible the economic base of his offensive the Ukraine was occupied, for its wheat supplies, with little resistance except from Czechoslovak troops, who had formerly been taken prisoners from the Austrian army.

Ludendorff's next problem was to decide his first point of attack. The sector between Arras and St. Quentin was chosen, on the western face of the great salient formed by the German front in France. The choice was governed by tactical reasons—this sector was the enemy's weakest point and the ground offered fewer difficulties than elsewhere—although Ludendorff had in mind the possibility of separating the Allied armies and driving the British back against the Channel coast, too closely penned in to evade the blows. From the experience of the vain Allied attacks Ludendorff had drawn the deduction that "Tactics had to be considered before purely strategical objects which it is futile to pursue unless tactical success is possible." Hence he formulated a strategical plan based on the principle of taking the tactical line of least resistance. Presumably he hoped by firm control to guide these tactical movements to a strategic destination. If so, he failed.

Where did the fault lie? The general view at the end of the war was that the tactical bias had led Ludendorff to change direction and dissipate his strength. That if the Franco-British command had previously erred by aiming at the strategically correct target without enough attention to the tactical difficulties, the German command had followed it with an equal if opposite error by concentrating on tactical success at the expense of the strategical goal. But a closer examination of the German documents since available, and of Ludendorff's own orders and instructions, throws a different light on the question. It would seem, indeed, that the real fault was that Ludendorff failed to carry out in practice the new principle he had adopted in theory; that he either did not grasp or shrank from the full implication of this new theory of strategy. He dissipated too large a part of his reserves in trying to redeem tactical failures and hesitated too long over the decision to exploit his tactical successes. Ludendorff's strategy in the East had been so masterly and so far-sighted that his indecision and short-sight in the West is difficult to explain. Perhaps he himself was feeling the strain of directing so many vast operations; perhaps it was that he missed the strategical insight and balanced view of Hoffmann who, after being at his side throughout the 1914–16 campaigns, had stayed in the East when Ludendorff went to the supreme command. The modern vice of seniority prevented Germany from making the fullest use of the man who perhaps approached nearer to military genius than any other military figure of the war.

In any case the campaign leaves the impression that Ludendorff had neither his former clearness as to the goal, nor quite the same grip on the changing situations. But in the organization of his attacks his powers were at their highest level. Surprise was to be the key by which a gate in the long-locked front was opened. In forging the key gas-shell was to be the main constituent, for Ludendorff had failed to grasp the significance of the tank and neglected to develop it in time. Only in Aug. 1918, when it was used to strike him a mortal blow did he put it in the "urgent" class of war material. The troops were trained in the new infiltration tactics already tested at Riga, and the most thorough arrangements were made for concealing and for exploiting the attacks. The assaulting divisions were to be brought up over night, the masses of artillery brought close to the front line in concealment, and their ranges obtained by methods which did away with preliminary "registration." The bombardment was to be brief but intense, and its surprise effect to be increased by lavish use of gas and smoke shell. Further, while Ludendorff had settled to strike first on the Somme sector, to which blow the code-name "Michael" was given, he also made preparations for successive attacks at other points, which besides being in readiness for the future helped to mystify the enemy. Two were on the British front and one on the French—"St. George I." against the Lys sector, "St. George II." against the Ypres sector and "Blücher" in Champagne.

The "Michael" attack was to be made by the German 17th, 2nd, and 18th Armies (62 divisions in all) on the 47 m. front Arras-St. Quentin-La Fere, but its main force was intended to be exerted north of the Somme, and after breaking through, the 17th and 2nd Armies were to wheel north-west and press the British army against the coast, while the river and the 18th Army guarded their flank. This plan was radically changed in execution because Ludendorff gained rapid success where he desired it little and failed to gain success where he wanted it most. The attack was launched on March 21 (*see* ST. QUENTIN, BATTLE OF 1918), and the surprise was helped by an early morning mist. But while the thrust broke through completely south of the Somme, where the defence—but also the attacking force—was thinnest, it was held up near Arras, a check which reacted on all the attack north of the river. Ludendorff, violating his new principle, spent the following days in trying to revive his attack against the strong, and strongly held bastion of Arras, maintaining this direction as his principal line of effort. Meantime he kept a tight rein on the 18th Army which was advancing in the south without serious check from its opponents. As late as March 26 he issued orders which restrained it from crossing the Avre and tied it to the pace of its neighbour, the 2nd, which in turn was held back by the very limited success of the 17th Army near Arras.

Thus we see that in reality Ludendorff was bent on breaking the British army by breaking down its strongest sector of resistance in a direct assault. And because of this obsession he failed, until too late, to throw the weight of his reserves along the line of least resistance south of the Somme. The intended wheel to the north-west might have come to pass if it had been made after passing the flank, and thus being directed against the rear, of the Arras bastion. On March 26 the attack north of the Somme (by the left wing of the 17th Army and the right of the 2nd Army) was visibly weakening as the price of its hard-earned gains. South of the Somme the left of the 2nd Army reached, and was now to be embarrassed by, the desert of the old Somme battlefields—a brake on progress and supply. The 18th Army alone was advancing with unslackened impetus. This situation led Ludendorff to adopt a new plan, but without relinquishing his old. He ordered for March 28 a fresh and direct attack on the high ground near Arras—by the right of the 17th Army and to be followed by a 6th Army attack just to the north between Vimy and La Bassée. But the promising situation south of the Somme led him to indicate Amiens as an additional main objective. Even so, he restrained the 18th Army from pushing across the Avre without further orders! On March 28 the fresh Arras attack was launched, unshielded by mist or surprise, and failed completely in face of the well prepared resistance of Byng's 3rd Army. Only then did Ludendorff abandon his original idea, and direct his main effort, and some of his remaining reserves, towards Amiens. By March 27 the advance had penetrated nearly 40 m. and reached Montdidier, cutting one railway to Paris; by March 30 the German flood was almost lapping the outworks of Amiens. Once the crust was broken, the very elaboration of the methods of control communication built up during three years of static warfare caused the greater flux behind the front. The extent of the retreat was primarily the measure of the loss of control by the British commanders.

Disaster had driven the Allies to an overdue step, and on Haig's appeal and Lord Milner's intervention Foch had been appointed

on March 26 to "co-ordinate" the operations of the Allied armies. If he had fallen into disfavour owing to the heavy cost of his attacks in Artois during 1915 and the barren fruit of the Somme in 1916, his will-power and energy earned and created confidence. On April 14 he was definitely made commander-in-chief of the Allied armies. But before this a fresh German menace had developed—though not intended as such.

When Ludendorff decided to change his main line of attack to the sector south of the Somme, he diverted reserves thither. But meantime he ordered the 18th Army to mark time for two days. When the attack was renewed in force on March 30 it made little progress in face of a resistance that had been afforded time to harden, helped by the cement of French reserves which were now being poured into the breach. A further effort on April 4 had still less success and Ludendorff, rather than be drawn into an attrition struggle, suspended the attack towards Amiens. With a large part of his reserves holding the vast bulge south of the Somme, Ludendorff turned, if without much confidence and merely as a diversion, to release, on April 9, his "St. George I." attack. (*See* LYS, BATTLE OF THE, 1918.) Its astonishing early success against a weakened front led him to convert it bit by bit into a major effort. The British were desperately close to the sea, but their resistance stopped the German tide after a 10 m. invasion just short of the important railway junction of Hazebrouck, and an attempt to widen the front towards Ypres was nullified by Haig's swinging his line back just before and by the gradual arrival of French reinforcements. Haig complained strongly that Foch was too slow in sending French reserves northward, but the event justified Foch's reluctance to commit himself thither and his seeming excess of optimism in declaring that the danger was past. Ludendorff had doled out reserves sparingly, usually too late and too few for real success; so apprehensive that his new bulge would become another sack, that after the capture of Kenmel Hill, when opportunity opened its arms, he stopped the exploitation for fear of a counter-stroke.

Thus Ludendorff had fallen short of strategic results; on the other hand he could claim huge tactical successes—the British casualties were over 300,000. The British lion had been badly mauled, and although fresh drafts to the number of 140,000 were hurried out from England and divisions brought back from Italy, Salonika and Palestine, months must elapse before it could recover its offensive power. Ten British divisions had to be broken up temporarily, while the German strength had now mounted to 208, of which 80 were still in reserve. A restoration of the balance, however, was now in sight. A dozen American divisions had arrived in France and, responding to the call, great efforts were being made to swell the stream. Further, Pershing, the American commander, had placed his troops at Foch's disposal for use wherever required. For Germany the sands were running out, and, realizing this, Ludendorff launched his "Blücher" attack between Soissons and Reims, on May 27. Falling by surprise with 15 divisions against seven, it swept over the Aisne and reached the Marne on May 30, where its impetus died away. (*See* CHEMIN-DES-DAMES, BATTLE OF THE, 1918.) This time the German superiority of force had not been so pronounced as before nor aided by nature's atmospheric cloak. It would seem that the extent of the opening success was due in part to the strategic surprise—the greater unexpectedness of the time and place of the blow—and in part to the folly of the local army command in insisting on the long-exploded and obsolete method of massing the defenders in the forward positions—there to be compressed cannon-fodder for the German bombardment. Pétain's recent instructions for a deep and elastic system of defence had been disregarded. This indeed was an additional form of surprise, for the object of all surprise is the dislocation of the opponent's *moral* and mind and the effect is the same whether he be caught napping by deception or allows himself to be trapped with his eyes open. Further, the Germans' success on May 27, 1918, deserves study in comparison with their other offensives whose success was almost in mathematical ratio to their degree of surprise. This final year, indeed, read in the light of previous years, affords fresh proof that surprise—or, more scientifically, the dislocation of the enemy's balance—is essential to true success in every operation of war. At the bar of universal history, any commander who risks lives without seeking his preliminary guarantee stands condemned.

But once again Ludendorff had obtained a measure of success for which he was neither prepared nor desirous. The surpriser was himself surprised. The attack had been conceived merely as a diversion, to attract the Allied reserves thither preparatory to a final and decisive blow at the British front in Flanders. But its opening success attracted thither too large, yet not large enough, a proportion of their own reserves. Blocked frontally by the river, an attempt was made to push west, but it failed in face of Allied resistance—notable for the appearance of American divisions at Chateau-Thierry, where they gallantly counter-attacked.

Ludendorff had now created two huge bulges, and another smaller one, in the Allied front. His next attempt was to pinch out the Compiègne "tongue" which lay between the Amiens and Marne bulges. But this time there was no surprise, and the blow on the west side of the "tongue," June 9, was too late to coincide with the pressure on the east. A month's pause followed. Ludendorff was anxious to strike his long-cherished decisive blow against the British in Belgium, but he considered that their reserves here were still too strong, and so again decided to take the line of least tactical resistance, hoping that a heavy blow in the south would draw off the British reserves. He had failed to pinch out the Compiègne "tongue" on the west of his Marne salient; he was now about to attempt the same method on the east, by attacking on either side of Reims. But he needed an interval for rest and preparation, and the delay was fatal, giving the British and French time to recuperate, and the Americans to gather strength. The British divisions previously broken up had now been reconstituted, and as a result of an urgent appeal made to President Wilson in the crisis of March, and the provision of extra shipping, American troops had been arriving at the rate of 300,000 a month since the end of April. The tactical success of his own blows had been Ludendorff's undoing; yielding to their influence, he had pressed each too far and too long, so using up his own reserves and causing an undue interval between each blow. He had driven in three great wedges, but none had penetrated far enough to sever a vital artery, and this strategic failure left the Germans with an indented front which invited flanking counter-strokes.

X. THE FINAL PHASE

The Turning of the Tide.—On July 15 Ludendorff launched his new attack, but its coming was no secret. East of Reims it was foiled by an elastic defence, and west of Reims the German penetration across the Marne merely enmeshed them more deeply to their downfall—for on July 18 Foch launched a long-prepared stroke against the other flank of the Marne salient. (*See* MARNE, SECOND BATTLE OF THE.) Here Pétain, who directed the operation, turned the key which Ludendorff lacked, using masses of light tanks to lead a surprise attack on the Cambrai method. The Germans managed to hold the gates of the salient open long enough to draw their forces back into safety and straighten their line. But their reserves were depleted, Ludendorff was forced to postpone if not yet to abandon the offensive in Flanders and the initiative definitely and finally passed to the Allies. Foch's first concern was to keep it, by giving the enemy no rest while his own reserves were accumulating. To this end he arranged with Haig, Pétain and Pershing for a series of local offensives, aimed to free the lateral railway communications and to improve the position of the front ready for further operations. To Haig he proposed an attack in the Lys sector, but Haig saw "no advantage in an advance over this flat and marshy region" and suggested instead the Somme area as more suitable and more strategically effective. Already, before the Marne counter-stroke, Rawlinson, commanding the British 4th Army in front of Amiens (*q.v.*), had submitted to Haig a plan for a large surprise attack there, and Foch agreed to this in place of his own proposal. He also placed under Haig the French 1st Army (Debeney) to

extend the attack to the south. Rawlinson's army was doubled, and by skilful precautions the enemy were kept in the dark until, on Aug. 8, the attack was delivered—led by 450 tanks. The blow had the maximum shock of surprise, falling on an opponent who had done nothing to strengthen his position by entrenchments, and south of the Somme the troops of the Australian and Canadian Corps rapidly overran and overwhelmed the German forward divisions. By Aug. 12 when the advance came to a halt through reaching the tangled wilderness of the old 1916 battlefields, if also through lack of reserves, the 4th Army had taken 21,000 prisoners at a cost of only 20,000 casualties. Great, if not fully exploited, as a material success, it was far greater as a moral one.

Ludendorff has said: "Aug. 8 was the black day of the German army in the history of the war. . . . It put the decline of our fighting power beyond all doubt. . . . The war must be ended." He informed the emperor and the political chiefs that peace negotiations ought to be opened before the situation became worse, as it must. After July 18 Ludendorff had by no means lost hope and as late as Aug. 2 was ordering preparations for four fresh attacks, including his cherished Flanders design, if on a reduced scale. But after Aug. 8 these dreams vanished. The conclusions reached at a Crown Council held at Spa were that "We can no longer hope to break the war-will of our enemies by military operations" and "the object of our strategy must be to paralyse the enemy's war-will gradually by a strategic defensive." In other words the German command had abandoned hope of victory or even holding their gains, and hoped only to avoid surrender—an insecure moral foundation.

On Aug. 10 Foch issued a fresh *directive* for the preparation of an "advance" by the British 3rd Army "in the general direction of Bapaume and Peronne." Meantime he wished Haig to continue the 4th Army's frontal pressure, but Haig demurred to it as a vain waste of life and gained his point. Economy of force was henceforth to be added to the advantages of the new strategy now evolved. Thus the momentum of the 4th Army had hardly waned, before the 3rd Army moved. From then on Foch beat a tattoo on the German front, a series of rapid blows at different points, each broken off as soon as its initial impetus waned, each so aimed as to pave the way for the next, and all close enough in time and space to react on each other. Thus Ludendorff's power of switching reserves to threatened spots was stopped, as his balance of reserves was drained.

On Aug. 10 the French 3rd Army had struck to the south; then on Aug. 17 the French 10th Army still farther south; next, on Aug. 21, the British 3rd Army, followed by the British 1st Army on Aug. 26. Ludendorff's order to the troops holding the Lys salient to retire was hastened in execution by the attacks of the reformed British 5th Army, and by the first week in September the Germans were back on their original starting line—the strong defences of the Hindenburg line. And on Sept. 21 Pershing completed the series of preliminary operations by erasing the St. Mihiel (*q.v.*) salient—the first feat of the Americans as an independent army. Pershing had originally intended to make this a stepping stone to an advance towards the Briey coalfields and the eastern end of the Germans' main lateral railway near Metz, but the project was abandoned for reasons that will be referred to later. Thus no exploitation of the success was attempted.

The clear evidence of the Germans' decline and Haig's assurance that he would break the Hindenburg line where the German reserves were thickest, decided Foch to seek victory that autumn instead of postponing the attempt until 1919. All the Allied armies in the West were to combine in a simultaneous offensive.

The Collapse of Bulgaria.—But before it could develop an event occurred in the Balkans which, in the words of Ludendorff, "sealed the fate of the Quadruple Alliance." He had still hoped to hold fast in his strong lines in the West, falling back gradually to fresh lines if necessary, and with his strategic flanks in Macedonia and Italy covered, while the German Government was negotiating for a favourable peace. At the same time there was alarm as to the moral effect of the Western front defeats on the German people, their will-power already undermined by shortage of food, and perhaps also by propaganda.

But on Sept. 15 the Allied armies in Salonika (*q.v.*) attacked the Bulgarian front, which crumpled in a few days. Guillaumat, who had succeeded Sarrail in Dec. 1917, had prepared the plan for an offensive, and when recalled to France in the crisis of July as governor of Paris he won over the Allied Governments to consent to the attempt. His successor in Salonika, Franchet d'Esperey, concentrated a Franco-Serb striking force, under Michich, on the Sokol-Dobropolye sector, west of the Vardar, where the Bulgarians trusted to the strength of the mountain ridges and were weak in numbers. On Sept. 15 Michich attacked and while the British attack at Doiran pinned a large part of the Bulgarian reserves, he broke right through towards Uskub. With their army split into two parts the Bulgarians, already tired of the war, sought an armistice, which was signed on Sept. 29. Franchet d'Esperey's achievement not only knocked away the first prop of the Central Alliance but opened the way to an advance on Austria's rear.

The Collapse of Turkey.—The offensive planned for the spring in Palestine had been interrupted by the crisis in France and the consequent withdrawal of most of Allenby's British troops. The depletion was made up by reinforcements from India and Mesopotamia, and by September Allenby was again ready to take the offensive. (*See* PALESTINE, OPERATIONS IN.) He secretly concentrated, on the Mediterranean flank, the mass of his infantry, and behind them the cavalry. In this way he changed a two to one superiority on the general front into four to one at the decisive point. At dawn on Sept. 19 the western mass attacked, rolling the Turks back north-east towards the hilly interior—like a door on its hinges. Through the open doorway the cavalry passed, riding straight up the coastal corridor for 30 m., before swinging east to cut the Turkish communications and close all exits of retreat. Completely trapped, the main Turkish armies were rounded up, while the British cavalry exploited the victory of Megiddo by a swift and sustained pursuit which gained first Damascus and finally Aleppo. Defenceless, and threatened with a direct advance of Milne from Macedonia on Constantinople, Turkey capitulated on Oct. 30.

The First Peace Note.—The capitulation of Bulgaria, convinced Ludendorff that it was necessary to take a decisive step towards securing peace. While he was scraping together a paltry half dozen divisions to form a new front in Serbia, and arranging a meeting with the political chiefs, Foch's grand assaults fell on the Western defences, Sept. 26–28, and the line threatened to crack.

The German supreme command lost its nerve—only for a matter of days, but that was sufficient, and recovery too late. On Sept. 29 they took the precipitate decision to appeal for an armistice, saying that the collapse of the Bulgarian front had upset all their dispositions—"troops destined for the Western front had had to be despatched there." This had "fundamentally changed" the situation in view of the attacks then being launched on the Western front, for though these "had so far been beaten off their continuance must be reckoned with."

This remark refers to Foch's general offensive. The American attack in the Meuse-Argonne had begun on Sept. 26, but had come practically to a standstill by the 28th. A Franco-Belgo-British attack had opened in Flanders on the 28th, but if unpleasant did not look really menacing. But on the morning of the 29th Haig's main blow was falling on the Hindenburg line, and the early news was disquieting.

In this emergency Prince Max was called to be chancellor to negotiate a peace move, with his international reputation for moderation and honour as its covering pledge. To bargain effectively and without confession of defeat he needed, and asked, a breathing space "of ten, eight, even four days, before I have to appeal to the enemy." But Hindenburg merely reiterated that "the gravity of the military situation admits of no delay," and insisted that "a peace offer to our enemies be issued at once."

Hence on Oct. 3 the appeal for an immediate armistice went out to President Wilson. It was an open confession of defeat to

the world, and even before this—on Oct. 1—the supreme command had undermined their own home front by communicating the same impression to a meeting of the leaders of all political parties.

Men who had so long been kept in the dark were blinded by the sudden light. All the forces of discord and pacifism received an immense impulse.

While the German Government was debating the conditions for an armistice and questioning Ludendorff as to the situation of the army for further resistance if the terms were unacceptable, Foch continued his military pressure.

The Final Advance.—The plan agreed upon between Foch and the Allied commanders had been for a series of convergent and practically simultaneous attacks:—

1 and 2. By the Americans west of the Meuse, and by the French west of the Argonne, both in the direction of Mezières—beginning on Sept. 26. (*See* MEUSE-ARGONNE OPERATION.)

3. By the British on the St. Quentin-Cambrai front in the general direction of Maubeuge—beginning on Sept. 27. (*See* HINDENBURG LINE, BATTLES OF, 1918.)

4. By the Belgian and Allied forces in the direction of Ghent—beginning on Sept. 28.

The general aspect was that of a pincer-like manoeuvre against the vast salient jutting out between Ypres and Verdun. The attack towards Mezières would shepherd that part of the German armies towards the difficult country of the Ardennes and away from their natural line of retreat through Lorraine; it was also dangerously close to the hinge of the Antwerp-Meuse line which the Germans were preparing in rear. The attack towards Maubeuge would threaten the other main line of communication and retreat through the Liège gap, but it had further to go. In these attacks, the Americans had the hardest natural obstacle, the Argonne forest; the British had to face the strongest defences and the heaviest weight of enemy troops.

Pershing's attack, adding surprise to its five to one superiority in numbers, opened well, but lost impetus owing to the difficulties of supply and exploitation in such country. When it was eventually suspended on Oct. 14, after bitter fighting and severe losses, the American army was still far distant from the vital railway. A new force, it was suffering the growing pains which the British had passed through in 1915–16. Pershing's difficulties were enhanced by the fact that he had waived his own proposal for an exploitation of the St. Mihiel success towards Metz in view of Haig's objection to a move which, however promising in its ultimate aim, would diverge from the general direction of the other Allied attacks. Haig desired that Pershing's attack should converge towards his in order more immediately to ease the task of the British troops. Foch's original plan for the general offensive had accordingly been readjusted, and in consequence Pershing had not only a more difficult sector but a bare week in which to prepare his blow. The shortness of time led him to use untried divisions instead of switching the more experienced divisions used at St. Mihiel. But in the outcome, Haig's insistence was proved unnecessary, for the British attack broke through the Hindenburg line before the Meuse-Argonne attack had drawn away any German division from his front.

Haig, by pushing forward his left wing first, facilitated the attack of his right on the strongest section of the Hindenburg line—the Canal du Nord—and by Oct. 5 the British were through the German defence system, with open country beyond. But on this front the attackers were in actually inferior numbers to the defenders, their tanks were used up, and they could not press forward fast enough to endanger the German retreat.

Within a few days the supreme command became more cheerful, even optimistic, when it saw that breaking into the Hindenburg line had not been followed by an actual break-through of the fighting front. More encouragement came from reports of a slackening in the force of the Allies' attacks, particularly in the exploitation of opportunities. Ludendorff still wanted an armistice, but only to give his troops a rest as a prelude to further resistance and to ensure a secure withdrawal to a shortened defensive line on the frontier. By Oct. 17 he even felt he could do it without a rest. It was less that the situation had changed as that his impression of it had been revised. It had never been quite so bad as he had pictured it on Sept. 29. But his first impression had now spread throughout the political circles and public of Germany—as the ripples spread when a pebble has been dropped in a pool.

The combined pressure of the Allied armies, and their steady advance, were loosening the will-power of the German Government and people. The conviction of ultimate defeat, slower to appeal to them than to the army chiefs, was the more forcible when it was realized. And the indirect moral effect of military and economic pressure was accentuated by the direct effect of peace propaganda, skilfully directed and intensively waged by Northcliffe. The "home front" began to crumble later but it crumbled quicker than the battle front.

The Collapse of Austria.—The last Austrian attempt at an offensive on the Italian front, in conjunction with the German assaults in France, had been repulsed on the Piave in June. Diaz waited until conditions were ripe for an offensive in return, until Austria's internal decay was spreading and she was without hope from Germany. On Oct. 24 Cavan's army moved to seize the crossings of the Piave and on Oct. 27 the main attack opened, driving towards Vittorio Veneto (*q.v.*) to divide the Austrians in the Adriatic plain from those in the mountains. By Oct. 30 the Austrian army was split in two and the retreat became a rout, and the same day Austria asked for an armistice, which was signed on Nov. 4.

The Curtain Falls on the Western Front.—Already on Oct. 23 President Wilson had replied to the German requests by a note which virtually required an unconditional surrender. Ludendorff wished to carry on the struggle in hopes that a successful defence of the German frontier might damp the determination of the Allies. But the situation had passed beyond his control, the nation's will-power was broken, and his advice was in discredit. On Oct. 26 he was forced to resign.

Then, for 36 hours, the chancellor lay in coma from an overdose of sleeping draught after influenza. When he returned to his office on the evening of Nov. 3, not only Turkey, but Austria, has capitulated. If the situation on the Western front was felt to be rather easier, Austrian territory and railways were now available as a base of operations against Germany. Several weeks before, military opinion had tended to regard such a contingency, then unrealized, "as decisive." Next day revolution broke out in Germany, and swept rapidly over the country. And in these last days of tremendous and diverse psychological strain the "reddening" glare behind was accentuated by a looming cloud on the Lorraine front—where the renewed American pressure, since Nov. 1, was on a point more sensitive than other parts, where "they must not be allowed to advance if the Antwerp-Meuse line was to be held any longer." If this continued the Rhine and not the frontier would have to be the next line of resistance.

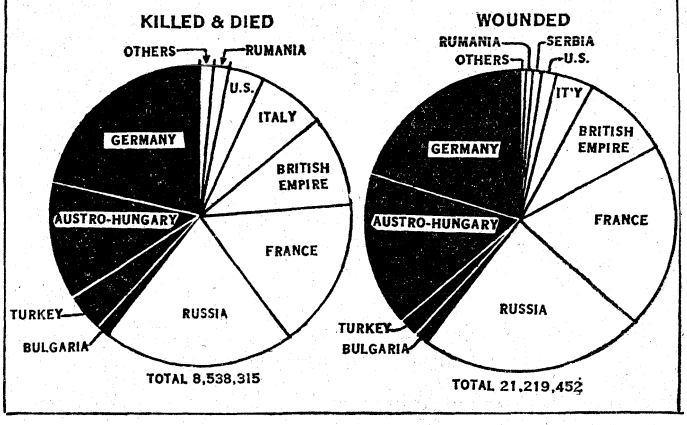
But hourly the revolution was spreading, fanned as peace negotiations were delayed, by the Kaiser's reluctance to abdicate. Compromise with the revolutionaries was the only chance, and on Nov. 9 Prince Max resigned to the Socialist Ebert. Germany had become a republic in outward response to President Wilson's demand and in inward response to the uprising of the German people against the leaders who had led them into disaster. The German fleet had already mutinied when their commanders sought to send them out on a forlorn hope against the British.

On Nov. 6 the German delegates left Berlin to treat for an armistice. Their acceptance of the severe terms was hastened less by existing military events than by collapse of the "home front," coupled with the imminence of a fresh blow. The Allied advance was still continuing, in some parts seeming to gather pace in the last days, but the main German forces had escaped from the perilous salient, and their complete destruction of roads and railways made it impossible for supplies to keep pace with the advancing troops. A pause must come while these communications were being repaired, and thus the Germans would have breathing space to rally their resistance. The advance reached the line Pont à Mousson-Sedan-Mezières-Mons-Ghent by Nov.

	Total Mobilized Forces	Killed and Died*	Wound Casualties	Prisoners and Missing	Total Casualties	Total Casualties in Per Cent of Total Mobilized
Allies						
Russia	12,000,000	1,700,000	4,950,000	2,500,000	9,150,000	76·3
France†	8,410,000	1,357,800	4,266,000	537,000	6,160,800	73·3
Brit. Emp†	8,904,467	908,371	2,090,212	191,652	3,190,235	35·8
Italy	5,615,000	650,000	947,000	600,000	2,197,000	39·1
U. S.‡	4,355,000	126,000¶	234,300¶	4,500	350,300	8·0
Japan	800,000	300	907	3	1,210	·2
Rumania	750,000	335,706	120,000	80,000	535,706	71·4
Serbia	707,343	45,000	133,148	152,958	331,106	46·8
Belgium	267,000	13,716	44,686	34,659	93,061	34·9
Greece	230,000	5,000	21,000	1,000	27,000	11·7
Portugal	100,000	7,222	13,751	12,318	33,291	33·3
Montenegro	50,000	3,000	10,000	7,000	20,000	40·0
Total	42,188,810	5,152,115	12,831,004	4,121,090	22,089,709§	52·3
Central Powers						
Germany	11,000,000	1,773,700	4,216,058	1,152,800	7,142,558	64·9
Austro-Hungary	7,800,000	1,200,000	3,620,000	2,200,000	7,020,000	90·0
Turkey	2,850,000	325,000	400,000	250,000	975,000	34·2
Bulgaria	1,200,000	87,500	152,390	27,029	266,919	22·2
Total	22,850,000	3,386,200	8,388,448	3,629,829	15,404,477	67·4
G. Total	65,038,810	8,538,315	21,219,452	7,750,919	37,494,186§	57·6

* Includes deaths from all causes. † Official figures. ‡ Includes Marines serving with the Army. ¶ Includes "Died of Wounds" (14,500). § See note "¶."

MILITARY CASUALTIES IN THE WORLD WAR, AS ESTIMATED BY THE UNITED STATES WAR DEPARTMENT



11—the line of the opening battles in 1914—but strategically it had come to a standstill.

To meet this situation Foch had concentrated a large Franco-American force, of 28 divisions and 600 tanks, to strike below Metz directly east into Lorraine. The general Allied advance had almost absorbed the enemy's reserves, and now this decisive manoeuvre was to fall on his bared flank. It promised the chance of turning the whole of his new line of defence and if rapidly successful might intercept his retreat. In addition Trenchard's Independent Air Force was about to bomb Berlin, on a scale hitherto unattempted in air warfare. And the number of American divisions in France had risen to 42. Whether this final thrust, intended for Nov. 14, would have solved the hitherto insoluble problem of maintaining the momentum of advance after an initial break-through can never be known. But the attempt was unnecessary. For with revolution at home and the gathering menace on their frontier, the German delegates had no option but to accept the drastic terms of the Armistice, which was signed in Foch's railway-carriage in the Forest of Compiègne at 5 A.M. on Nov. 11, and at 11 o'clock that morning the World War came to an end.

XI. EPILOGUE

Controversy has long raged as to what was the deciding act of the conflict, what were the causes of victory, and, even less profitably, which country won the war.

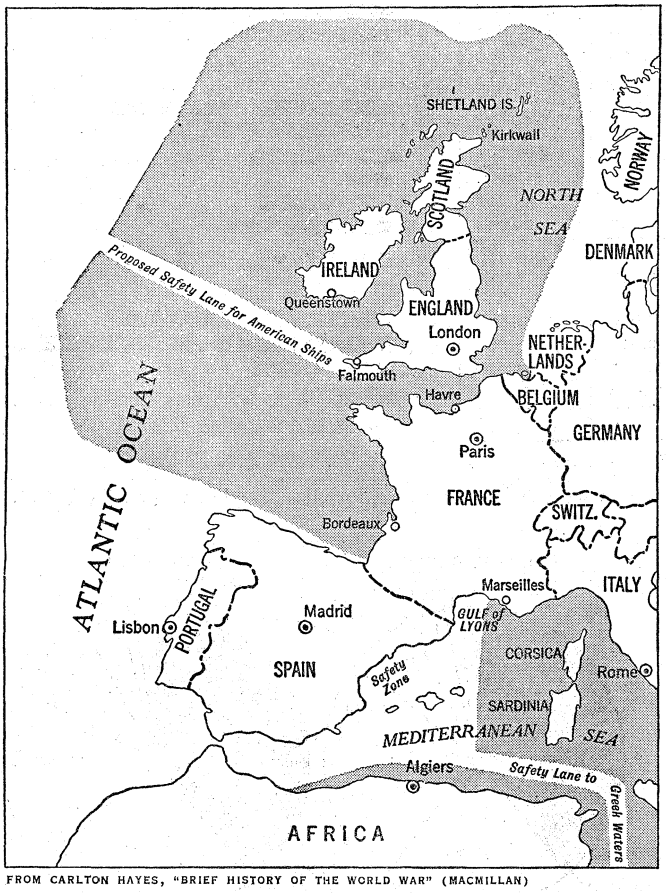
The truth is that no one act, still less one cause, was, or could be, decisive. The Western front, the Balkan front, the tank, the blockade and propaganda have all been claimed as the cause of victory. All claims are justified, none is wholly right. In this new warfare between nations victory is a cumulative effect, to which all weapons—military, economic, and psychological—contribute. Victory comes, and can only come, through the utilization of all the resources existing in a modern nation.

Among the fundamental causes of Germany's surrender the blockade, wielded by the British navy, is seen to assume larger and larger proportions as the fog of war disperses in the clearer light of these post-war years. It was a constructive hold which the Germans were powerless to loosen. Helplessness induces hopelessness, and history attests that loss of hope and not loss of lives is what ultimately decides the issue of war. The intangible all-pervading factor of the blockade intrudes into every consideration of the military situation.

The naval factor again intervenes in the question whether Germany could have avoided capitulation in Nov. 1918 and whether, but for the revolution, her armies could have stood firm on their own frontiers. For even if the German people, roused to a supreme effort in visible defence of their own soil, could have held the Allied armies at bay the end could only have been postponed—because of the grip of sea-power.

But in hastening the surrender, in preventing a continuance of the war into 1919 military action ranks foremost. Hence the success of the Allied armies is chief among the immediate causes of victory. That conclusion does not necessarily, or even naturally, imply that at the moment of the Armistice Germany's military power was broken or her armies decisively beaten. Nor that the Armistice was a mistaken concession. Rather does the record of the last "hundred days," when sifted, confirm the immemorial lesson that the true aim in war is the mind of the hostile rulers, not the bodies of their troops; that the balance between victory and defeat turns on mental impressions and only indirectly on physical blows. It was the shock of being surprised and the feeling that he was powerless to counter potential strategic moves which shook Ludendorff's nerve more than the loss of prisoners, guns, and acreage.

It is even more futile to ask which country won the war; France did not win the war, but unless she had held the fort while the forces of Britain were preparing and those of America still a dream the release of civilization from this nightmare of militarism would have been impossible. Britain did not win the war, but without her command of the sea, her financial support and her army to take over the main burden of the struggle from 1916



FROM CARLTON HAYES, "BRIEF HISTORY OF THE WORLD WAR" (MACMILLAN)

SAFETY LANES FOR NEUTRALS IN MINE FIELDS

onwards, defeat would have been inevitable. The United States did not win the war, but without their economic aid to ease the strain, without the arrival of their troops to turn the numerical balance, and, above all, without the moral tonic which their coming gave, victory would have been impossible. And let us not forget how many times Russia had sacrificed herself to save her Allies; preparing the way for their ultimate victory as surely as for her downfall. Finally, whatever be the verdict of history on her policy, unstinted tribute is due to the incomparable endurance and skill with which Germany more than held her own for four years against superior numbers, an epic of military and human achievement.

The development of the means and methods of warfare during the struggle are described in the articles: STRATEGY; TACTICS; TANKS; CAVALRY; ARTILLERY; INFANTRY; AIR WARFARE.

The campaigns and battles have received separate and detailed treatment in articles such as the following: ANTWERP, SIEGE OF, 1914; ASIAGO, BATTLE OF, 1916; BELGIUM, INVASION OF, 1914; BREST-LITOVSK, BATTLES OF; CAMBRAI, BATTLE OF, 1917; CAMEROONS, OPERATIONS IN, 1914–16; CAPORETTO, BATTLE OF; CARPATHIANS, BATTLES OF THE; CAUCASUS, CAMPAIGN IN THE; DARDANELLES CAMPAIGN; DUNAJEC-SAN, BATTLES OF THE; EAST AFRICA, OPERATIONS IN; FRONTIER, BATTLES OF THE; JUTLAND, BATTLE OF.

LEMBERG, BATTLES OF; LODZ, BATTLE OF, 1914; LUCK (LUTSK), BATTLES OF; MARNE, BATTLE OF THE; MASURIAN LAKES, BATTLES OF THE; MESOPOTAMIA, OPERATIONS IN; NAREW, BATTLES OF THE, 1915; NAROCZ, BATTLE OF LAKE; WORLD WAR I: *Naval;* PRZEMYSL, SIEGES OF; SALONIKA CAMPAIGNS; SERBIAN CAMPAIGNS; SOMME, BATTLES OF THE; VERDUN, BATTLES OF; VISTULA-SAN, BATTLES OF THE; VITTORIO VENETO; YPRES, BATTLES OF: Battles of 1914; Battles of 1915; Battles of 1917; YSER, BATTLE OF THE; ZEEBRUGGE, ATTACK ON.

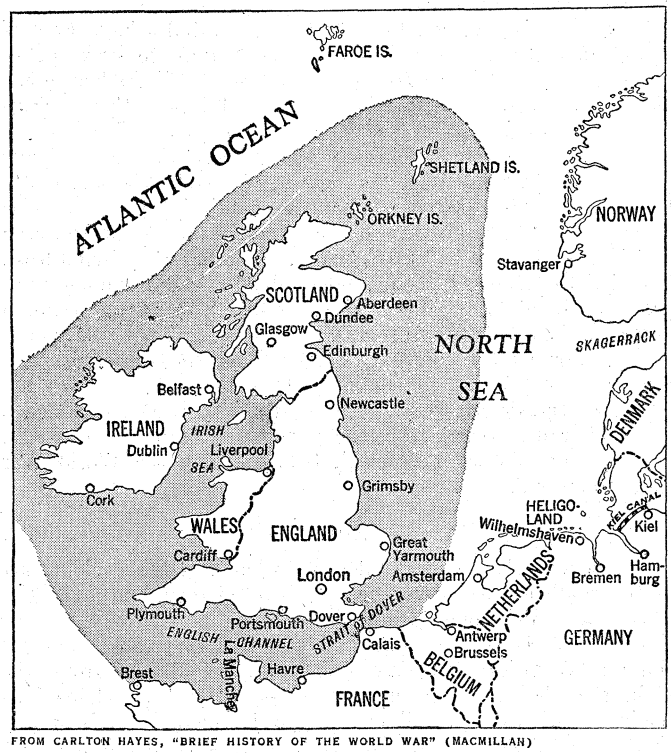
The mechanism of war, the organization of naval, military and air forces, and the scientific aspects of military machinery are also dealt with in such articles as those on ADMIRALTY; AIR FORCES; BALLISTICS; BOMB; BRIDGING, MILITARY; CAMOUFLAGE; CHEMICAL WARFARE; FLAMETHROWER; INTELLIGENCE, MILITARY; MINES, MINELAYING AND MINESWEEPING; MOTOR TRANSPORT, MILITARY; ORDNANCE; PARAVANE; RANGE-FINDERS; SMALL ARMS, THE DEVELOPMENT OF; SUPPLY AND TRANSPORT, MILITARY. (B. H. L. H.)

NAVAL

To follow the worldwide ramifications of naval operations during World War I it is best to consider, year by year, the events in each area. At the outset they covered all the seas of the earth, but as the net was drawn around the Central Powers, the area of naval warfare was gradually reduced to European waters and to the seas around the British Isles. In the end, it was due to the irresistible force of sea power (*q.v.*) that the war was brought to a close.

Preliminary Moves.—In July 1914 in place of the usual summer manoeuvres, a test mobilisation of the British Fleet in Home waters was carried out. The ships of the 2nd and 3rd Fleets, their crews completed from the Reserves, joined the 1st Fleet at Portland on July 16th for exercises in the Channel. On July 23, the day of the Austrian ultimatum to Serbia, the fleets were ordered to disperse. The ships of the 2nd and 3rd Fleets returned to their Home Ports.

The 1st Fleet remained at Portland, the defence flotillas were sent to their stations around the coast, and at the same time



FROM CARLTON HAYES, "BRIEF HISTORY OF THE WORLD WAR" (MACMILLAN)

GERMAN WAR ZONE, FEBRUARY, 1915

the Mediterranean fleet was ordered to concentrate at Malta. On July 29 the 1st fleet left Portland for Scapa Flow, and, by Aug. 2 the 1st and 2nd fleets were at their war stations, the 3rd fleet was on the move, the defence flotillas were at their posts, and the organisations for taking up auxiliaries and for arming merchant liners were in force. On Aug. 1 the order for general mobilisation was issued, followed next day by the calling up of the naval reserve. Owing to the recent exercise the machinery

of mobilisation worked smoothly and by the morning of Aug. 4 the state of naval readiness around the British Isles was such as to preclude the possibility of surprise before the outbreak of hostilities.

The German High Sea Fleet, which had been visiting Norwegian ports, was recalled. By July 30 all ships had returned to Wilhelmshaven and Kiel and no German ships were sighted by the British Fleet as it passed northward to its war stations.

Distribution of Fleets.—The following table shows the distribution of the British and German Fleets upon the outbreak of hostilities.

	British	German
North Sea and Home Waters		
Dreadnought battleships:		
13·5 inch guns	10	..
12 inch guns	10	9
11 inch guns	..	4
Pre-dreadnought battleships	38*	22†
Battlecruisers	4	4
Cruisers	24	5
Light cruisers	24	27
Destroyers	270‡	144
Submarines	65	28 (?)§
North Atlantic and Trade Routes		
Cruisers	20	..
Mediterranean		
Battlecruisers	3	1
Cruisers	4	..
Light cruisers	4	1
Destroyers	16	..
Submarines	6	..
North America and West Indies		
Cruisers	4	..
Light cruisers	1	2
South Atlantic and West Coast of Africa		
Cruisers	4	..
Light cruisers	1	..
Gunboats	1	..
Cape of Good Hope		
Light cruisers	3	..
East Indies Station		
Pre-dreadnought battleship	1	..
Light cruisers	2	1
Sloops and gunboats	4	..
China Station		
Pre-dreadnought battleship	1	..
Cruisers	2	2
Light cruisers	2	3
Destroyers and torpedo boats	12	..
Submarines	3	..
Sloops and gunboats	16¶	3
Australia and New Zealand		
Battlecruiser	1	..
Light cruisers	7‖	..
Destroyers	3	..
Submarines	2	..
Sloops	1	..
West Coast of North America		
Sloops	2	..
Submarines	2	..

*Including 5 "Canopus" and 9 "Majestics," obsolete ships of the third fleet.

†Including 10 obsolete "Wittelsbach" class stationed in the Baltic.

‡116 attached to Grand Fleet and Harwich Force. Remainder were old boats employed in patrol flotillas.

§Number is uncertain.

¶10 of these were non-seagoing river gunboats.

‖3 of these were old ships of the "P" class.

THE NORTH SEA AND CHANNEL 1914

The Commencement of Hostilities.—On the morning of Aug. 4 the Grand Fleet, commanded by Admiral Sir John Jellicoe, left Scapa Flow on the first of its many "sweeps" through the North Sea. Its object was to intercept any German commerce raiders that might put to sea before war was declared. At 11 P.M. that night all ships received the fateful wireless message to "commence hostilities against Germany." For three days the fleet cruised without seeing an enemy and on Aug. 7 returned to Scapa. The 10th Cruiser squadron, drawn from 3rd fleet cruisers, was not yet complete and this shortage of cruisers enabled one raider, the "Kaiser Wilhelm der Grosse," to escape through the cordon. Meanwhile the Harwich Force (Commodore Tyrwhitt) made a search of the Heligoland Bight, which resulted in the sinking of the minelayer "Königin Luise" by the "Amphion." But the German mines had been laid and the "Amphion" ran into them on her return and was sunk. Thus early was first blood drawn upon both sides and Germany showed her intention to disregard, not only the customs of the sea, but her own signature to the Hague convention, by laying mines without warning, in international waters.

The Expeditionary Force.—The decision, on Aug. 5, to send the Expeditionary Force to France threw upon the navy the duty of safeguarding its passage. In the Channel were stationed the 5th, 7th and 8th Battle squadrons (eighteen pre-dreadnoughts) with one French and two British Cruiser squadrons. The Dover Straits were guarded by British and French destroyer and submarine flotillas, and an aerial patrol was established between the North Foreland and Ostend. Further north the Harwich Force patrolled the "Broad Fourteens" to the Dutch coast and the Grand Fleet took up a position in the centre of the North Sea, its cruisers and destroyers spread southward, ready to counter any move of the High Sea Fleet. Several unsuccessful submarine attacks were made upon ships of the Grand Fleet and on Aug. 9, "U. 15" was rammed and sunk by the cruiser "Birmingham" close to the fleet rendezvous. Regardless of the submarine risk, the fleet maintained its watch and from Aug. 15 to 17, when the bulk of the troops were afloat the Heligoland Bight was closely blockaded. Nothing was seen of the German fleet, whose inertness appeared surprising, it not then being realised that the policy of the German High Command was to preserve its fleet and to make only minor attacks with submarines and mines. By Aug. 18 the first four divisions were in France without the loss of a man and five days later the 5th Division was safely across. The enemy made their only appearance on Aug. 18, when two cruisers were sighted but escaped without being brought to action. The safe transport of the main body of troops being complete the Grand Fleet battleships withdrew to the west coast of Scotland, leaving two battlecruisers in the Humber to support the southern force.

Heligoland Bight Action.—To assist the Belgian army in creating a diversion on the German flank a brigade of Royal Marines was sent to Ostend: they landed with difficulty, in bad weather, on Aug. 27–28 from battleships of the Channel Fleet. This force being exposed to a sudden blow from the German Fleet, the Harwich flotillas, supported by battlecruisers and cruisers from the Grand Fleet, made an organised drive towards the German coast on the morning of Aug. 28. The outcome was the battle of the Heligoland Bight (*q.v.*) in which three German light cruisers and a destroyer were sunk and several other ships damaged, whilst the damage to British ships was small. This success in the first serious contact with the enemy at sea, did much to dispel the gloom cast by the retreat of the Allied armies before the German advance.

The shifting of the British army base from the Channel Ports to St. Nazaire, following the retreat from Mons threw a heavy burden upon the navy and especially upon the Admiralty transport service. Ships could no longer be spared for the Ostend diversion and the Royal Marine brigade was withdrawn on Aug. 31. The moving of the base began on Sept. 2 and was smoothly and rapidly completed.

In the last days of August, German mines, laid in the open

sea off the Humber and Tyne caused the loss of several neutral ships and of the minesweeping gunboat "Speedy." Submarines were active in the North Sea and on Sept. 1, the report that one had entered Scapa Flow caused the Grand fleet to put hurriedly to sea. After sweeping in force to the Skaagerak the fleet returned on Sept. 5 to Loch Ewe to fuel and on that day the British navy suffered its first loss by submarine attack, when the scout "Pathfinder" was sunk by "U. 29."

On Sept. 10, in order to cover the passage of the 6th Division to France, a great sweep was made through the North Sea by the Grand Fleet supported by the Harwich Force and the Channel squadron. The Bight of Heligoland was searched but no German ships were seen excepting several submarines, one of which was rammed by the "Zealandia." On Sept. 12 the British submarines scored their first success when "E. 9" sank the cruiser "Hela" off Heligoland. The High Sea Fleet being known to be escorting troops in the Baltic, the opportunity was taken to give the Grand Fleet a few days rest, the first since war broke out. The fleet arrived at Loch Ewe on Sept. 13: its rest was but a short one for on the 17th it was again sweeping down the North Sea to the Horns Reef following the sinking of the "Cressy," "Hogue" and "Aboukir." These three cruisers were sunk within an hour by a single submarine ("U. 9"). They were steaming in line abreast on the "Broad Fourteens" patrol, having been deprived of their destroyer support by bad weather. The "Aboukir" was hit first and the other two were torpedoed in succession as they closed to pick up survivors. In this disaster 1,400 lives were lost: and orders were given that in future, heavy ships were not to stop to pick up survivors of consorts torpedoed by submarines, nor were armoured ships to be used for patrol or examining merchant ships in submarine waters.

The Fall of Antwerp.—In the closing days of September, the Belgian Government asked for assistance in the defence of Antwerp. Some naval guns were sent and a brigade of Royal Marines reached the city on Oct. 2, followed by two untrained brigades of the newly formed Royal Naval Division. On Oct. 2 the eastern approach to the Dover Straits was closed by a minefield, extending from the Goodwins to Ostend, every publicity being given to its limits. The 7th Division was landed at Zeebrugge on Oct. 7 without loss, in spite of a number of submarine attacks, but this desperate attempt to support the Belgian Army failed. Antwerp surrendered on Oct. 10 and the coast ports fell into the hands of the enemy as the Belgian Army retreated to the line of the Yser. One of the Naval Brigades, in the retreat, was forced across the Dutch frontier and interned. The German pursuit of the exhausted Belgian Army along the coast was stayed by the gallant work of a British flotilla under the command of Rear-Admiral Hood. (*See* BELGIAN COAST OPERATIONS.) Meanwhile the Harwich Force watching for a move on the part of the Germans, obtained its reward on Oct. 16, when the "Undaunted" and four destroyers met and chased four German destroyers and sank them all. This was the only attempt, apart from submarine activities, by the German navy to interfere on the Belgian Coast at this phase.

Submarine Menace to the Grand Fleet.—The last days of September saw the Grand Fleet at Scapa Flow and from Oct. 2–12 the whole fleet was at sea engaged in safeguarding the passage of the Canadian convoy. On Oct. 7 a German submarine entered Loch Ewe, rendering that place unsafe as a fleet anchorage. The fleet returned to Scapa Flow, where a partial submarine obstruction was in place, on Oct. 12. At this time submarines were active in the vicinity of the northern bases and several attacks were made upon patrolling cruisers. On Oct. 15 the cruiser "Hawke" was sunk with heavy loss off the Aberdeen coast and the next day a submarine was again reported inside Scapa Flow. Knowing that the German fleet was still in the Baltic, Jellicoe decided to seek a safe anchorage to the westward until the submarine defences of Scapa Flow could be made secure. On Oct. 20 he took the fleet to Lough Swilly where it remained until the end of the month, resting and carrying out practices. Meanwhile three British "E" class submarines had entered the Baltic. They were not successful in attacking the German fleet, but their presence caused much anxiety and gave moral support to the Russian fleet.

Loss of the "Audacious."—On Oct. 26, whilst carrying out firing practices off Lough Swilly, the battleship "Audacious" struck a mine. In spite of endeavours to tow her into harbour, she sank some hours later, her crew being saved. The loss was a serious one and came at an unfortunate moment. On that day the Belgian army supported by Hood's flotilla were making their last grim stand upon the Yser (*see* BELGIAN COAST OPERATIONS) and news of the Grand Fleet so far away might tempt the Germans to strike a blow at Hood before help could reach him. Also war with Turkey hung in the balance and news of a disaster to the Grand Fleet might have affected the issue. Consequently the Government kept the loss secret until the necessity was past.

Lord Fisher.—On Oct. 29 Lord Fisher (*q.v.*) relieved the Marquis of Milford Haven as First Sea Lord. A conference was held at the Admiralty, which Admiral Jellicoe attended, to decide upon future naval policy. On Nov. 2 the British Government declared the whole of the North Sea a prohibited area and warned all neutrals that, unless they adhered to the routes prescribed by the British authorities, they used the area at their own risk. On Nov. 3 a German cruiser squadron appeared off the Suffolk coast in the morning mist, fired a few shells on to the beach at Gorleston and at the old gunboat "Hazard" and retired. The battle squadrons having left Lough Swilly on Nov. 2, remained in the north part of the North Sea whilst a search was made by the battlecruisers and light forces, and returned to Scapa Flow on Nov. 17. The German cruiser "Yorck," on her way home from the Gorleston raid, struck a mine off the Jade River and was sunk. The defences of Scapa Flow were now far enough advanced to give a certain sense of security to the fleet, but between Nov. 23–26, when the fleet was absent in support of aerial operations in the Heligoland Bight, six submarines were sighted close to the base and one ("U. 18") was sunk by the local defence flotilla. Nov. 26 was marked by the loss of the battleship "Bulwark," which blew up at Sheerness owing to accidental ignition of cordite and sank with great loss of life.

The Scarborough Raid.—The Grand Fleet returned to Scapa Flow on Nov. 27 and there followed a month of gales of exceptional violence which delayed the completion of the submarine defences. On Dec. 15 a German force was reported at sea and the 2nd battle squadron and battlecruisers were sent south. The weather was so heavy that some of the light cruisers and destroyers had to be left behind, and to this fact and to the mist, the German force that raided Scarborough and the Hartlepools on Dec. 16, owe their narrow escape. The two towns were bombarded, 120 civilians were killed and over 400 wounded and, after laying mines off the Yorkshire coast, the Germans retired. In the mist and heavy sea a short, indecisive fight took place between the light forces, but the heavy ships, although very close, did not sight one another. The Grand Fleet swept in full force into the Bight on that day and Dec. 17, but the enemy had retired behind his minefields. It returned to Scapa on Dec. 20 and on Christmas Day was again in the Heligoland Bight, supporting an air raid upon Cuxhaven, after which it returned to Scapa on Dec. 27 in a heavy gale.

THE TRADE ROUTES 1914

Germany's oceanic trade was brought to a standstill at the very outset of the war, the approaches to her Home Ports being closed by the British Fleet, and with the cutting of the German cables in the Dover Straits on Aug. 5, she was isolated from the ports of the world. At the outbreak of hostilities there were permanent British squadrons stationed in China, Australia, the East Indies, at the Cape and in the Mediterranean, while the Home fleet protected the all important trade routes of the Atlantic. In August 1914, there was one light cruiser in the South Atlantic and the 4th Cruiser squadron (Craddock), detached from the 1st fleet, was in the West Indies. The 5th Cruiser squadron (Stoddart) was at once dispatched to the mid-Atlantic, between Africa and Brazil, and the ships of the 6th Cruiser squadron were scattered on special escort duties on the Atlantic Routes. The 9th Cruiser squadron (de Robeck) operated between Finisterre-Azores-Ma-

deira; the 10th Cruiser squadron (de Chair) formed the northern patrol with the Grand Fleet; the 11th Cruiser squadron was stationed off the west coast of Ireland and the 12th Cruiser squadron, supported by a French squadron, guarded the Channel approaches.

Germany was credited with the intention of arming merchant ships as commerce raiders and the small enterprise she displayed in this direction was one of the surprises of the early months of the war. Only five such ships appeared: the "Kaiser Wilhelm der Grosse," which evaded the Grand Fleet, the "Kronprinz Wilhelm" from New York, the "Cap Trafalgar" from the River Plate, the "Cormoran" and "Prince Eitel Friedrich" in China. The "Dresden" and "Karlsruhe," in the West Indies, were the only German cruisers in the Atlantic.

The British 11th and 12th Cruiser squadrons, besides protecting trade, were at first occupied in safeguarding the passage of the Expeditionary Force. De Robeck kept a close watch upon the Spanish ports where some of the 70 interned German ships were suspected of trying to get to sea and arm. None did so and on Aug. 26 the "Highflyer," of his squadron, found the "Kaiser Wilhelm der Grosse" coaling off the African Coast and sank her.

The North Atlantic.—The "Dresden" was at Port au Prince (Haiti) on July 26, and the "Karlsruhe" at Havana on July 28. Both sailed for unknown destinations and Craddock sent the "Berwick" and "Bristol" to locate them, following himself in the "Suffolk." On Aug. 6 the "Suffolk" came upon the "Karlsruhe" engaged in arming the "Kronprinz Wilhelm." The merchant ship made off and the "Suffolk" chased the "Karlsruhe" until dark, when she was headed off by the "Bristol." A short moonlight action ensued, but the German's superior speed enabled him to escape. The "Dresden's" whereabouts were unknown and Craddock, anxious for the safety of the North Atlantic trade, took his squadron to the northern area. Several German ships in New York were expected to attempt to get to sea and arm, but none ventured to move and by Aug. 13 the "Karlsruhe" had been located at Curaçoa and the "Dresden" off Pernambuco. The Admiralty on that day stated that British trade in the North Atlantic was proceeding as usual. Craddock, with his flag now in the "Good Hope," sailed south in search of the two German cruisers. Leaving two French cruisers to watch the West Indies, he searched the Pernambuco and mid-Atlantic areas and then joined hands with Stoddart. By the beginning of September, a number of armed merchant ships had joined the British Cruiser squadrons, which were also reinforced by four old battleships. By this time the North Atlantic was clear of enemy cruisers and owing to the movements of the squadron under von Spee, interest was transferred to the southern part of that ocean, to which Craddock's command was specially allocated.

The "Cap Trafalgar" which left the River Plate on Aug. 22 was found by the "Carmania" on Sept. 14 off Trinidada Island. After spirited action between the two armed merchant ships, the German ship sank and the damaged "Carmania" crawled back to Gibraltar for repairs. With the West Indian cruisers pre-occupied in watching the newly opened Panama Canal, the "Karlsruhe" was successful as a raider until she blew up at sea on Nov. 4; she had several narrow escapes and during her three months' career captured 17 ships.

THE FAR EAST AND PACIFIC 1914–15

When war was declared, Admiral Jerram was at Hongkong completing his mobilisation. With his squadron concentrated on Aug. 12, he destroyed the German wireless station at Yap Island. By Aug. 20 he had established a close watch on Tsingtau. Admiral von Spee was at the Caroline Islands with the cruisers "Scharnhorst," "Gneisenau" and "Nurnberg." He left on Aug. 6 for Pagan Island, where he was joined on the 12th by the cruiser "Emden," which had slipped out of Tsingtau, on Aug. 7, with supply ships. At Pagan Island von Spee heard of the Japanese ultimatum to Germany. Japan commenced hostilities against Germany on Aug. 22 and Jerram was thus freed to co-operate with the Australian squadron (Admiral Patey) in preventing von Spee from breaking through to the Indian Ocean.

The Fall of Tsingtau.—The primary objective of the Japanese was the German stronghold at Tsingtau. As soon as war was declared the port was blockaded by the Japanese Fleet and H.M.S. "Triumph" and Japanese troops were landed on Sept. 2. By Sept. 21 the fortress was invested by land and sea and on the next day, British troops having joined the Japanese, the general attack commenced. Tsingtau held out until Nov. 7 when it surrendered.

The Pacific Expeditions.—The Australian squadron, under Admiral Patey concentrated at Port Moresby on Aug. 7 and, on the 9th, appeared off Rabaul, the government centre of German New Guinea. No German ships were present and after destroying telegraphic communication the squadron sailed to meet the New Zealand Samoa Expedition at Suva. Von Spee's whereabouts being unknown, the presence of the battlecruiser "Australia" with this expedition was necessary. Samoa surrendered on Aug. 30 and Patey sailed to escort the Australian expedition against Rabaul. Little resistance was made to the landings on Sept. 11 and German New Guinea, with the Bismarck Archipelago, capitulated on Sept. 15. Patey's force was thus freed to attend to the Australian and New Zealand convoys, as by this time it was certain that von Spee's destination was South America.

The "Emden."—On Aug. 28 the German light cruiser "Emden" entered the Indian Ocean by way of the Molucca Strait and after being nearly found by the British cruiser "Hampshire" on Sept. 4 she made her dramatic appearance off the River Hoogly on Sept. 14. She ranged the Bay of Bengal until Sept. 25, bombarding Madras on the 22nd. Then for a month she cruised in the western approaches to Ceylon, coaling at Diego Garcia. On Oct. 21, after a narrow escape from the "Hampshire" and the armed merchant cruiser "Empress of India," she crossed the Indian Ocean, appearing off Penang on the 28th. There she sank the Russian cruiser "Zhemchug" and the French destroyer "Mousquet," and doubled back round the north of Sumatra. Unable to find her storeships, which had been sunk by the "Yarmouth," she made for the Cocos Islands. There on Nov. 9th, she was brought to action and sunk by H.M.A.S. "Sydney," so ending her remarkably successful raiding career in which she had sunk 15 ships.

Von Spee in the Pacific.—With Japan's entry into the war, von Spee's position in Chinese waters became untenable, and he decided to make for South America. After despatching the "Emden" on her memorable cruise, he sailed east, passing through the Marshall Islands on Aug. 22. Here he detached the "Nurnberg" to Honolulu and sailed himself for Christmas Island. Arriving on Sept. 6, the "Nurnberg" rejoined next day, having cut the British cables at Fanning Island. On Sept. 14 von Spee appeared off Samoa and finding the place already in British hands, again sailed east. By this date Craddock had taken over the command of the South Atlantic and was coming south in search of the "Dresden." Von Spee, after bombarding Tahiti on Sept. 22, visited the Marquesa Islands on Oct. 1 and arrived at Easter Island on Oct. 12. Here he was joined by the light cruisers "Leipzig" from North America and "Dresden" from the Atlantic. On Sept. 15 Craddock was ordered to concentrate his force upon the Falkland Islands and was promised reinforcements. He heard on Sept. 26 that the "Dresden" was off Chile and it was by then certain that South America was von Spee's destination. By Oct. 22 Craddock had collected his ships at the Falkland Islands and he then searched round the Horn, leaving the old and slow battleship "Canopus" to join him through the Magellan Straits. Meanwhile von Spee had arrived off Valparaiso and was cruising off the coast.

Coronel and the Falkland Islands Battles.—Craddock, after rounding the Horn, continued his search to the north and sent the light cruiser "Glasgow" into Coronel. Von Spee hearing of her at that port on Oct. 31, turned south to cut her off. Craddock, having heard the "Leipzig's" wireless, was searching for her on his way north. Neither admiral was aware of the proximity of the other until they met on the evening of Nov. 1, and the battle of Coronel (*q.v.*) was fought. The cruisers "Good Hope" and "Monmouth" were sunk and the other British ships made their escape and returned to the Falkland Islands. Von Spee, after

his victory, paid a visit to Valparaiso and then sailed south to St. Quintin Bay, about 300 miles north of the Magellan Straits.

The news of the Coronel defeat created consternation in England and immediate steps were taken to retrieve the position. The battlecruisers "Invincible" and "Inflexible," from the Grand Fleet, were placed under the orders of Admiral Sturdee, who was given a wide commission to seek out and destroy von Spee, wherever he might be, in the South Atlantic or Pacific Oceans. Sturdee left Plymouth on Nov. 11 and concentrated his force at the Abrolhos Rocks on Nov. 26, the same day that von Spee left St. Quintin Bay for the Falkland Islands. Now that von Spee's position was better known four other squadrons were quickly concentrated in order to deal with him. Patey, in the battlecruiser "Australia," with a squadron of British and Japanese ships watched the middle Pacific; a Japanese squadron was concentrated at the Galapagos Islands and the Battlecruiser "Princess Royal" was sent to the West Indies, in case von Spee should attempt to pass the Panama Canal. De Robeck on the African Coast and Stoddart off Montevideo were reinforced with armoured ships, in case von Spee should escape Sturdee, who, after searching the South American Coast, arrived at Port Stanley on Dec. 7 Von Spee rounded the Horn on Dec. 2, delayed for three days to coal from a prize in the Beagle Channel, and arrived off Port Stanley on the morning of Dec. 8. Sturdee put to sea and there followed the battle of the Falkland Islands (*q.v.*) in which the German squadron was destroyed, only one ship, the "Dresden," escaping.

The End of the Cruiser Campaign.—Despite the incessant demands for the protection of troop convoys and support for military expeditions that had so hampered the Admirals in their first duty of commerce protection, the British Navy in the first eight months of the war cleared the German flag from the outer seas. By the end of 1914, only one of the thirteen German cruisers abroad was unaccounted for and of the five armed merchantships only two remained at large. The "Dresden," escaping from the Falkland Islands battle, was hunted and helpless until she was sunk by the "Glasgow" and "Kent" at Juan Fernandez on Mar. 14. The "Kronprinz Wilhelm" (April 8) and "Prinz Eitel Friedrich" (Mar. 12) were interned at Newport News, and the "Königsberg," having been discovered in hiding in the Rufiji River was destroyed on July 11. By the end of Mar. 1915, the Canadian, Australian, New Zealand and Indian armies had been carried overseas, garrisons abroad had been replaced by territorial troops, without the loss of a troopship and naval support had been given to six considerable military operations. This was accomplished with the loss to the Navy upon the outer seas of three cruisers ("Good Hope," "Monmouth" and "Pegasus") and of 62 merchant ships. The German cruisers had caused a loss amounting to less than two thirds of 1% of British seaborne commerce during the period.

THE MEDITERRANEAN 1914

The Goeben and Breslau.—The first duty of the British Mediterranean squadron was to watch the movements of the German cruisers "Goeben" and "Breslau." On Aug. 3, their whereabouts being unknown, Admiral Milne stationed the 1st Cruiser squadron (Troubridge) with destroyers to prevent them entering the Adriatic and sent the battlecruisers "Indomitable" and "Indefatigable" towards Gibraltar to stop them interfering with the transport of Algerian troops or escaping into the Atlantic. At 10.30 A.M. on Aug. 4 the German cruisers, who that morning had bombarded Phillipville, were sighted by the British battlecruisers and were shadowed by them into Messina. On Aug. 5, the situation was complicated by the Italian declaration of neutrality and by Austria not yet being at war with Britain, while the information received by Milne was conflicting. Expecting the Germans to break westward, he placed his force to prevent them escaping from the north of Messina, leaving Troubridge to deny them the Adriatic. On the evening of Aug. 6th the Germans sailed from the south of the Straits, gallantly and skilfully shadowed by the "Gloucester." Troubridge did not bring them to action and when they passed Cape Matapan, the "Gloucester" was recalled from her precarious position. Milne followed into the Aegean on the 9th but was too late to prevent the two German ships entering the Dardanelles on Aug. 10. Their escape was unfortunate as it had a far-reaching effect upon subsequent events in the Near East.

After the safe passage of the Algerian troops the security of the Mediterranean was undertaken by the French fleet, which, using Malta as its base from Aug. 16, established a blockade of the Adriatic. Admiral Carden was appointed to command the reduced British force in the Mediterranean and with it he established a blockade of the Dardanelles. On Nov. 3rd, on Turkey declaring war, he bombarded the outer forts of the Dardanelles as a demonstration. The watch upon the Dardanelles was kept with few ships for the cruisers were called upon to guard the Malta–Port Said route during the passage of troop convoys. It was uneventful, except for the daring exploit of Submarine "B. 11," which on Dec. 13 dived through five rows of mines in the Dardanelles, torpedoed and sank the Turkish battleship "Messudieh" and returned safely.

OVERSEA CAMPAIGNS 1914–15

Togoland and the Cameroons.—A stroke by the Gold Coast forces on the outbreak of war led to the occupation of Togoland and the destruction of the important German wireless station at Kanima. Before the end of August the colony had surrendered and an attack was launched upon the German Cameroons. On Aug. 25 the British cruiser "Cumberland" and the gunboat "Dwarf" left Sierra Leone to attack Duala, followed by the cruiser "Challenger" and the Niger flotilla with a British and French military force. A base was established in the Cameroon estuary and after a month of flotilla warfare, in which the "Dwarf" played a prominent part, the river was cleared of mines and obstructions. The "Challenger" then entered and on Sept. 27 Duala surrendered to a combined naval and military attack. Nine large German steamers, a floating dock and two railway termini were captured. River warfare in support of the military advance inland then developed. The "Cumberland," "Challenger" and French cruiser "Bruix," being required elsewhere, were relieved by the cruiser "Astraea" from the Cape and with the arrival of the old cruiser "Sirius" and the sloop "Rinaldo" in April 1915 a blockade was established to prevent supplies reaching the enemy from the Spanish island of Fernando Po. The colony was, by this time, in Allied hands, but fighting in the hinterland continued for two years.

German South West Africa.—The attack upon this colony, started in Aug. 1914 by the South African Government, was delayed by the Boer revolt, but, the revolt having been suppressed, it was resumed early in 1915. The Union Army, escorted by the battleships "Albion," the "Astraea" and two armed merchant cruisers occupied Walfisch Bay and Swakopmund in January. The "Albion" was then sent to the Dardanelles and the "Astraea" to the Cameroons and, with the exception of some naval armoured cars the campaign became a purely military one. It was brought to a successful conclusion in July 1915 by the surrender of the colony.

German East Africa.—The German cruiser "Königsberg" was at sea on the outbreak of war and on Aug. 6 she made her only prize in the Gulf of Aden. Two days later, the "Astraea" and "Pegasus" appearing off Dar-es-Salam, the Germans blocked the entrance to the port, but agreed that the ships there should be considered British prizes, and the wireless station was destroyed. The "Königsberg," her base closed against her, was not heard of until Sept. 20, when she appeared off Zanzibar and finding the "Pegasus" with engines disabled in the roadstead, sank her at her moorings. Admiral Charlton, with the Cape squadron, was, by now, on the "Königsberg's" trail and she took refuge amidst the swamps of the Rufiji River, where she was located by the "Chatham." On Nov. 1 the East African Expeditionary Force, escorted by the battleship "Goliath" and cruiser "Fox," arrived from India. On Nov. 2 the troops landed at Tanga, under cover of the "Fox," but the attack made two days later was repulsed and the troops were re-embarked.

Following this reverse no serious military operations against the colony were undertaken until early in 1916. The 600 miles of coastline, with its many harbours, remained in the hands of the Germans and it was not until March 1915 that ships

could be spared to establish an efficient blockade. Meanwhile a strict watch had to be kept upon the "Königsberg" in the Rufiji River and several relief ships slipped through with arms and stores for the colony. On Dec. 14, boats sent in to Dar-es-Salaam to take possession of the prizes, were fired upon and the town was then bombarded and the ships sunk. In the Rufiji River a ship was sunk to block the "Königsberg" in, but the cruiser was unapproachable until the arrival of shallow draught ships and aeroplanes. On June 3, 1915 the small monitors "Severn" and "Mersey" arrived with four seaplanes, and a month was occupied in preparing these craft for their work. On July 6 the first attack was made, the "Königsberg" was damaged but the monitors were forced to retire. On July 11 the attack was renewed and pressed home by the monitors, and the "Königsberg" was destroyed.

Persian Gulf and Mesopotamia.—An Indian Division, escorted by the "Ocean," and the sloops "Espiègle" and "Odin" arrived at Bahrein late in October and on the 30th received orders to commence hostilities against Turkey. On Nov. 6, after bombarding Fort Fao at the entrance of the Shatt-al-Arab, the troops landed. Advancing against considerable opposition, supported by the "Espiegle" and "Odin," an entrenched position was established at Abadan by Nov. 10. The force pressed forward supported by the two sloops and Basra was entered on Nov. 22, and a further advance ended on Dec. 9, in the occupation of Kurnah, at the junction of the Tigris and Euphrates. By this rapid and well planned stroke the command of the Persian Gulf and of the outlet from the Persian oilfields was assured.

In December the "Ocean" was withdrawn to the Dardanelles and the flotilla consisted of the "Espiègle" and "Odin," the vessels of the Royal Indian Marine and a number of armed river steamers and launches. In March of 1915 the "Clio" and four armed boats arrived from Egypt and in the late autumn the first of the new "Fly" class gunboats arrived from England.

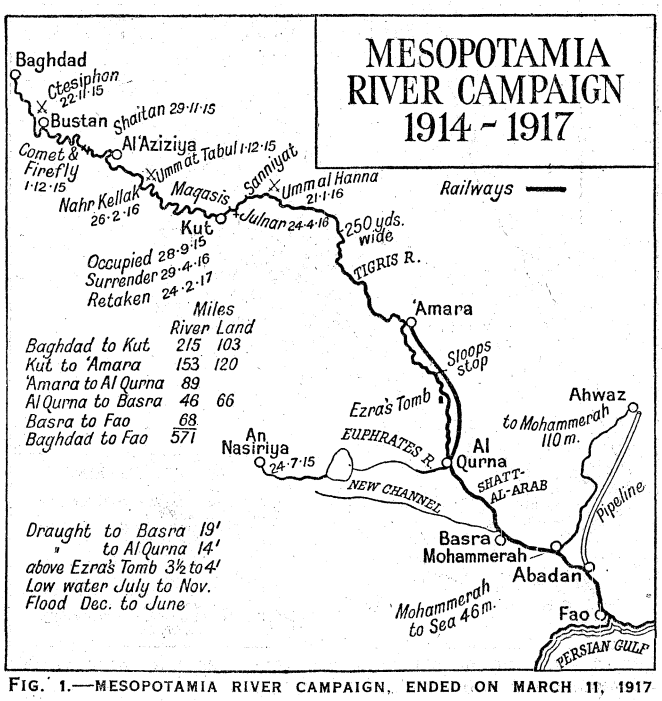


FIG. 1.—MESOPOTAMIA RIVER CAMPAIGN, ENDED ON MARCH 11, 1917

Throughout 1915 the flotilla formed the spearhead of the advance of the Army. It protected the oil pipe line by patrolling the Karun River and in April the Euphrates flotilla assisted in defeating the Turkish attack upon Basra. The remarkable amphibious battle north of Kurnah on May 31, was followed by the dash up the river by the flotilla after the retreating Turks, with General Townshend on board, and the capture of Amara. With the flotilla reinforced by four seaplanes from the Rufiji River, Townshend captured Kut and continued his pursuit of the Turks until he was brought up at Ctesiphon on Oct. 5. The political and military situation in the Near East then led to the illfated attempt upon Baghdad. The naval flotilla consisted of the gunboat "Firefly," the "Comet," two armed launches and four armed horse boats. After the repulse of the army at Ctesiphon, the withdrawal of the river transport was covered by the flotilla with the loss of "Firefly," "Comet" and "Shaitan," which grounded and were abandoned. Townshend reached Kut on Dec. 3, but by the 9th that place was invested and the flotilla was withdrawn down river.

Egypt.—By mid-November 1914, the careers of the "Emden" and "Königsberg" being ended the Indian Ocean was secure. The British cruisers were ordered homewards and Admiral Peirse, in the battleship "Swiftsure," reached Suez on Dec. 1 and detained in the Canal enough ships to meet the threatened Turkish attack upon Egypt. During December the "Doris" and the Russian cruiser "Askold" made a series of successful raids in the Gulf of Iskanderun and on the Syrian Coast. At the end of January 1915, when the Turkish attack developed, a strong naval force under Peirse's command took up its position in the Canal. The Turks made their attempt on the Canal on February 2 and 3 and were easily repulsed, the Canal traffic being but little interfered with. By Feb. 11, all threat to the Canal having disappeared, Peirse was able to send most of his ships to reinforce Carden's forces at the Dardanelles. A further threat to the Canal in April 1915 was frustrated by the presence of strong British and French naval forces.

HOME WATERS AND THE BALTIC 1915

The Battle of the Dogger Bank.—The year opened with the loss of the battleship "Formidable," which was torpedoed by "U. 24" off the Start on the morning of Jan. 1. In the North Sea the first weeks of January passed quietly, but on the 19th reports of German activity brought the British battlecruisers into the Heligoland Bight. Nothing was seen, but a Zeppelin raid on the East Coast indicated a repetition of the Scarborough raid. The battlecruisers remained concentrated in a position south of the Dogger Bank, supported by the Grand Fleet battleships to the northward. On the morning of the 24th the Germans were sighted and there followed the battle of the Dogger Bank (*q.v.*). The German squadron was driven back to its base with the loss of the cruiser "Blücher" and two battlecruisers badly damaged. Beatty's flagship "Lion" was severely damaged but returned safely to Rosyth. After the Dogger Bank action a change was made in the command of the High Sea Fleet and a policy of extreme caution was initiated. The German fleet put to sea only to cover minelaying operations and always retired behind its minefields on the approach of the enemy. Four of these "one day out and one day back" sorties in March, April and May were threatened by the Grand Fleet in force and the Germans retired.

The Baltic.—In the Baltic the Russian fleet, assisted by a few British submarines, was successful in holding the older ships of the German fleet in check. In June a German attempt to land troops in Courland in support of their army was defeated by the Russian destroyers and on July 2 the German minelayer "Albatross" was driven ashore by the Russian cruisers and the cruiser "Prinz Adalbert" was torpedoed and seriously damaged by the British submarine "E. 9." In August a part of the High Sea Fleet made a serious attempt to force the Gulf of Riga, but on Aug. 19 the battlecruiser "Moltke" was badly damaged by a torpedo from submarine "E. 1." The operations were abandoned and for some time the Baltic was the scene of only minor operations, but, in the closing months of 1915, the German iron trade with Sweden was harassed by British submarines, which sank 14 steamers engaged in the trade and the cruisers "Prinz Adalbert" and "Bremen" and a destroyer.

The Grand Fleet.—Improvements in the British intelligence, especially in directional wireless, gave timely warning of any movements of the German Fleet. By the end of the first quarter in 1915, the Allied flank in Flanders was stabilized, supplies to the army were ensured by the grip of the Dover and Harwich forces upon the narrow seas while the northern bases had been made

practically submarine proof. These factors led to a general redistribution of the British fleet. The Channel fleet was broken up and most of its ships were sent out to the Dardanelles. The Grand Fleet battle squadrons remained at Scapa Flow and Cromarty and the battlecruisers at Rosyth. During the year the Battle fleet swept down the North Sea to the Heligoland Bight no less than 17 times and many other searches were made of the Danish and Norwegian coasts by the battlecruisers and light forces. During one of these cruises "U. 29" was rammed by the "Dreadnought." The British Navy was short of destroyers until the autumn, when the new vessels began to appear. Until then constant calls were made upon the Grand Fleet for destroyers to assist the auxiliary patrol in hunting submarines. The work of the destroyers was incessant and arduous and due to their efficiency the Germans gained no major success with submarine or mine against the British fleet during the year. The northern blockade was maintained with increasing efficiency by the 10th Cruiser squadron, now composed entirely of armed merchant cruisers. The fleet base at Scapa Flow developed into a great training establishment for new personnel. A system of gunnery and other training was organised which brought the many new ships joining the fleet to a state of fighting efficiency in minimum time and new officers and men were trained for the ancillary services all over the world. This year of strenuous work was marked by no outstanding event after the Dogger Bank action and it closed with the disaster to the armoured cruiser "Natal," lost by internal explosion at Cromarty on New Year's eve. During August and September, Zeebrugge and Ostend were several times bombarded by the monitors and other ships of the Dover Patrol, in support of the Allied offensive. The results were inconclusive owing to the difficulties of fire observation and to the fact that the ships, finding themselves outranged by the heavy German shore guns were forced to keep at extreme range.

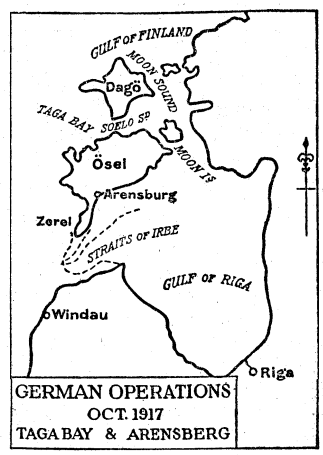


FIG. 2.—MAP SHOWING GERMAN OPERATIONS AT TAGA BAY AND ARENSBERG, OCTOBER, 1917

Submarine Warfare.—By the beginning of 1915 the ocean high-ways had been made safe for commerce, but the narrow seas around the British Isles were becoming unsafe for any traffic. On Feb. 17, 1915, Germany declared these waters to be a "War Zone" and announced her intention of using submarines to sink merchant-ships. Thus commenced the submarine campaign (*q.v.*). In the first quarter of 1915, 38 British ships were sunk by submarines and by Dec. 31 this number was swelled to 259. In the same period 48 ships were sunk by mines and the tonnage loss for the year approached 900,000 tons. For these two forms of warfare against trade Britain was unprepared and the submarine and minelaying tactics of the enemy produced a situation beyond the capacity of the weak and scattered coastal patrol and minesweeping flotillas. Trawlers, drifters, yachts and small steam and motor vessels of all kinds were armed to reinforce the flotillas. By the beginning of 1915, no less than 750 of these craft were in commission and their numbers were rapidly swelled at the opening of submarine warfare. By August 1915 the auxiliary patrol was a complete organization and the coastal waters were divided into twenty-one patrol areas. In each area destroyers and auxiliary craft were employed in submarine hunting, minesweeping, guarding channels, guiding traffic, rescue work and in many other duties. The auxiliary ships were manned by seamen, yachtsmen and fishermen, enrolled in the Royal Naval and Royal Naval Volunteer Reserves. As in days of old, the seafaring population of the country, of all classes, came forward in the hour of need and in its ceaseless watch around the coast until the end of the war, the auxiliary patrol paid a heavy price and rendered to the country service of incalculable value.

THE DARDANELLES CAMPAIGN

Early in 1915 political complications in the Balkans and the Russian wish for an open Dardanelles to ensure munitions supply, made imperative some demonstration of the Allied power in the Eastern Mediterranean. It was decided to attack the Dardanelles, where, since September, Admiral Carden had been keeping a close watch. In the redistribution of the British fleet, after the Falkland Islands battle, Carden was strengthened with a number of the older battleships and cruisers. The French Government offered a squadron and both naval and military aid was promised by Russia in the Black Sea. By the end of February, Carden's force consisted of the battlecruiser "Inflexible," the new battleship "Queen Elizabeth," 16 old battleships (4 French), 20 destroyers (6 French), a flotilla of 35 minesweeping trawlers and a seaplane carrier were on their way, and a varying number of cruisers and submarines were under his orders. Admiral de Robeck was appointed second in command. The Greek Government handed over the Island of Lemnos as an advanced base and Admiral Wemyss was appointed to command it.

From the first the naval view was that any attack upon the Straits by ships could be only a diversion unless it was backed by a strong military expedition. Steps were accordingly taken to send troops to the Aegean, but the situation on the eastern and western fronts caused delay and it was not until Feb. 20, after the first bombardment, that the decision was made to send out five divisions (4 British and 1 French).

The First Bombardment.—Bad weather in January made reconnaissance of the Straits difficult, but enough was done to enable Carden to recommend, on Feb. 15, that a naval bombardment was not a sound operation without a strong military force to consolidate the work of the fleet. But the political situation was critical and Carden was pressed by the War Council to

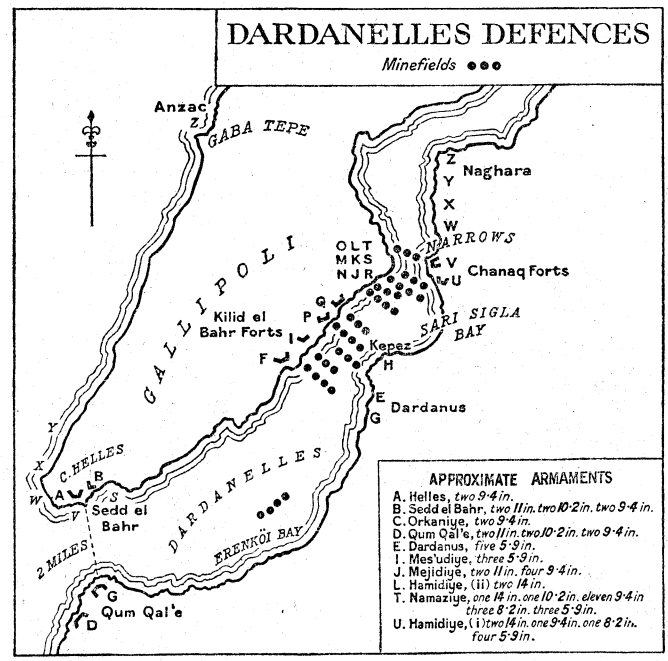


FIG. 3.—MAP OF DARDANELLES DEFENCES, SHOWING APPROXIMATE ARMAMENTS AND POSITION OF MINEFIELDS

commence operations. Pointing out that no progress could be expected until the minesweepers and seaplanes arrived, Carden decided to bombard the outer forts on the first opportunity. Owing to bad weather this did not occur until the 19th and at 10 A.M. on that day the battleship "Cornwallis" fired the first shot of the campaign at Fort Orkaniye. The forts were hit repeatedly and made no reply, but when the "Vengeance" (flying de Robeck's flag), closed to moderate range she received a hot fire from all guns. Thus early it was proved that long range bombardment of modern earthworks was ineffective unless the

ships can close to decisive range and knock out each gun by direct hits. (*See* NAVAL STRATEGY AND TACTICS.)

Carden was now informed that he was expected to force the Straits without military assistance. On February 25, after a four days gale, a bombardment, commencing at moderate range, was intensified by British and French ships closing in towards the shore. The four outer forts were silenced and the minesweepers began clearing the Straits. Next day, demolition parties, supported by marines landed to complete the destruction of the forts, and the fleet, going as far up the Straits as had been swept, bombarded the inner forts at long range. As before the forts made no reply when hit, but the ships were badly worried by mobile howitzers on each shore, which could not be located. Gales delayed operations for two days and on March 1 and 2 the Narrows were again attacked, with similar results, the ships being constantly hit by an increasing number of hidden howitzers. Each night the minesweepers were driven off by gunfire as they attempted to sweep the minefields off Kephez. On March 3 de Robeck reported that the Straits could not be forced unless one shore or the other were occupied and that no progress was possible without military assistance. This was emphasized on March 4 by the repulse of the demolition parties, showing that the time was past for employing small forces onshore.

As yet, no definite decision had been made as to the scope of any military operations. In spite of the Admiralty's reiterated demands for troops and the doubts of General Birdwood on the spot, that the fleet could force a passage unaided, Lord Kitchener, at the War Office, in his instructions to General Sir Ian Hamilton, on the latter's appointment as commander-in-chief, only contemplated "the employment of military force on any large scale . . . at this juncture. . . . in the event of the fleet failing to get through after every effort has been exhausted." (*See* W. S. Churchill, *The World Crisis.*) Mr. Winston Churchill, as First Lord, continued to urge the fleet to new efforts and on March 11, Admiral Carden was told "the results to be gained are . . . great enough to justify loss of ships and men if success cannot be obtained without it."

A naval attack was, therefore, planned for March 18, by which time General Sir Ian Hamilton would have arrived. Meanwhile daily bombardments of the forts produced indefinite results and desperate attempts were made nightly without success to sweep up the Kephez minefields. All experience proved that until the mobile guns were suppressed they could prevent minesweeping operations, and until the minefields were cleared ships could not approach to decisive range at which alone they could destroy modern earthworks. On March 16 Admiral Carden's health broke down and he was forced to hand over his command to Admiral de Robeck, who at once proceeded to carry out the attack planned.

The Naval Attack of March 18.—The plan of attack arranged for the four modern ships ("Inflexible," "Queen Elizabeth," "Lord Nelson" and "Agamemnon") to engage the inner forts at 14,000 yards, whilst a British and French division, of four old ships each, alternately pressed home the attack to 10,000 yards, which was the limit of the swept area. Two old battleships on each side were to attempt to keep down the fire of the small guns onshore. The action commenced at 11.30 A.M. on the 18th. Little reply came from the forts, but unseen guns opened a heavy fire. The "Agamemnon" was frequently hit and the "Inflexible" forced out of the line with her forebridge burning. At noon the French division passed through the British line, closed to 10,000 yards and received a hot fire from the forts. The "Gaulois" was forced out of action and the "Bouvet" was heavily hit, but the squadron gallantly held its place and by 1.45 the fire of the forts was slackening. De Robeck then sent the British division in to relieve the French and ordered the minesweepers up to clear the channel. At 2.0 P.M. as the French squadron was steaming out the "Bouvet," struck a mine, blew up and sank in a few minutes, with nearly all hands. The British division engaged the forts with apparent success until 3.0 P.M. when the "Irresistible" struck a mine and sank, her crew being saved. The fire from the forts now became intermittent, but at 4.5 P.M. the "Inflexible" was mined and ten minutes later a similar fate befell the "Ocean." The "Inflexible" reached Tenedos and was beached, but the "Ocean" was abandoned and sank. The ships withdrew just after 6 P.M. and as they did so the forts opened a heavy but inaccurate fire; the attempt to force the Straits thus ended in failure. The forts had been damaged but were not put out of action and the minefields were still intact. The loss to the Allies had been severe: three battleships sunk, three heavy ships badly damaged and others severely handled.

The First Landings.—For political reasons the campaign had to be continued and the failure of the fleet to force the Straits necessitated the landing of an army upon the Peninsula. For this operation the transports were unprepared and the army was concentrated in Egypt to reorganise, a valuable month thus being lost. (*See* DARDANELLES CAMPAIGN.) Meanwhile the fleet reconnoitred and prepared for the landing and, when the weather permitted, harassed the Turkish reinforcements now crowding on to Gallipoli. Smyrna was strictly blockaded and the Russian fleet was active off the Bosphorus.

By April 23, the transports had reassembled at Mudros and the work of getting into position for the landings commenced. The weather favoured the operation and early on the morning of the 25th, landings were effected on five beaches around Cape Helles and Gaba Tepe (Anzac). At the same time, French troops gained a footing on the Asiatic side and a demonstration was made in the Gulf of Xeros; 18 battleships, 12 cruisers, 29 destroyers, 8 submarines and a host of small craft supported the landing. At each beach, the covering ships went close inshore in support, whilst the attendant ships carried the troops and aided by small craft and boats suited to the particular beach, landed them. Opposition was severe and losses very heavy but by sunset the army was established ashore and the naval parties had the work of organising the beaches well in hand. Thenceforward the campaign became mainly a military one in which the rôle of the Navy was to support the troops by gunfire, to evacuate wounded and to ensure the supply of food, water, stores, munitions and reinforcements to the beaches. This task was an arduous and dangerous one and casualties on the beaches were heavy. The old battleships "Albion" (April 28) and "Prince George" (May 5) were so damaged by gunfire that they had to be docked and on May 13, the "Goliath" was torpedoed by a Turkish destroyer and sank with great loss of life. The appearance of German submarines in the Mediterranean now rendered the position of heavy ships employed off the Peninsula precarious. The "Queen Elizabeth" was ordered home to join the Grand Fleet and the replacement of battleships by monitors and old "bulged" cruisers commenced, but two more battleships were lost: the "Triumph" on May 25 and the "Majestic" on May 27, both torpedoed by "U. 21."

Lord Fisher Resigns.—The War Council decision on May 14 to continue the campaign led to the resignation of Lord Fisher (*q.v.*). This was followed by the reconstruction of the Government and the removal of Mr. Winston Churchill from the office of First Lord of the Admiralty. Throughout the summer months the navy supported and supplied the army on the peninsula, and more troops being sent out, a successful landing was made at Suvla Bay on the night of Aug. 6–7. But neither here nor at the other positions was any appreciable progress made onshore and all idea of forcing the Straits with the fleet was consequently abandoned. Submarines alone could pass the Narrows and of the 12 boats (9 British and 3 French) which made the adventure, 7 were lost. The presence of these vessels in the Marmora, however, produced such alarm as greatly to interfere with the Turkish supplies to the Peninsula.

The Evacuation.—By the end of October the defeat of the Serbian Army and the opening of the Salonika Campaign hastened the decision to withdraw from Gallipoli, and preparations for this difficult operation commenced. Night by night, the vast accumulation of stores were removed and on the night of Dec. 18–19 the troops were withdrawn from Suvla Bay and Anzac under cover of the fleet. So successful was the operation that the Turks knew nothing about it and awoke to find that their enemy had vanished. The more difficult evacuation of the Helles Beaches was accomplished on Jan. 8–9, 1916, without the loss of a man. Little of value was left in the hands of the enemy and

with these two wonderful examples of naval and military co-operation the ill-fated campaign was brought to a close.

HOME WATERS 1916

Heavy weather in January hampered the work of the 10th Cruiser squadron on the northern patrol and caused damage to the submarine defences of Scapa Flow and on the 6th the battleship "King Edward VII.," struck a mine off Cape Wrath and was lost. Scheer succeeded von Pohl in command of the High Sea Fleet in January and he at once adopted more energetic tactics. On Feb. 10 German destroyers appeared on the Dogger Bank and sank the sloop "Arabis," whilst minesweeping. A sweep by the Grand Fleet followed with the usual barren result. During the dark February nights the raider "Moewe" slipped homeward through the blockade after her successful cruise and the "Greif," another raider, in attempting to break out was brought to action by the armed merchant cruiser "Alcantara" on Feb. 29 and both ships were sunk. Cruising constantly during March the Grand Fleet saw nothing of the enemy until March 24–25 when the Harwich Force met a Division of enemy destroyers at night. The German "G. 194" was rammed and sunk by the light cruiser "Cleopatra" and a British destroyer was lost by collision. On April 23 the German fleet put to sea, the battlecruiser "Seydlitz" being forced to return after striking a British mine. Zeppelins raided the East Coast on the night of April 23–4 and at daybreak Yarmouth and Lowestoft were bombarded by the German battlecruisers. The Harwich Force engaged them and the light cruiser "Conquest" received heavy damage from their fire as they hurriedly retired eastward, reaching their minefields just in time to escape Beatty's battlecruisers. The 3rd Battle squadron (7 King Edward's) was stationed in the mouth of the Thames at the end of April to deal with the coastal raids and on April 26 a heavy mine and net barrage was laid in the Straits by the Dover Patrol. On May 4–5 an aerial attack, supported by the Grand Fleet, was made upon the Zeppelin sheds at Tondern. One Zeppelin was destroyed at sea. Mines were laid off the Horns Reef and Borkum before the fleet returned north.

The Battle of Jutland.—At the end of April, in deference to protests from the United States and other neutrals, the German submarines received orders to cease sinking merchant ships without warning. Scheer thereupon determined to use the submarines thus released in an attempt to trap the British fleet. By May 23, 22 submarines were stationed off the British bases, and the High Sea Fleet was to put to sea on that day in the hope of enticing the Grand Fleet over them. The plan had to be modified as the weather delayed the German fleet until May 30. On that day, following upon reports of unusual activity by the enemy, the Grand Fleet sailed on one of its periodical southerly sweeps. On May 31, after a preliminary action between the rival battlecruiser forces in which the British suffered heavy losses, the two main fleets met and the battle of Jutland (*q.v.*) was fought. The German fleet after sustaining severe damage and being skilfully extricated from a very dangerous situation, eluded the British fleet at night and retired behind its minefields at daylight on June 1. The Grand Fleet returned to its bases on the 2nd and 3rd of that month.

June 5 was marked by the tragic loss of the "Hampshire," with Lord Kitchener on board, after striking a mine on the Orkney coast.

There were no large fleet movements during June as the High Sea Fleet was repairing its damage after Jutland. All the damaged British ships rejoined the Grand Fleet by the middle of July when a number of exercise cruises took place. In the second week in August, just as before Jutland, an unusual number of submarines were reported in the North Sea. Expecting another move on the part of the High Sea Fleet, Jellicoe swept south in force on August 18. Next morning ten Zeppelins were located stretched across the North Sea. By noon a fleet action appeared imminent, the battle fleets being only 42 miles apart, but warned by the Zeppelins, Scheer turned and made for home, and was soon beyond pursuit. The German battleship "Nassau" was twice torpedoed by a British submarine as the fleet put to sea; the cruisers "Nottingham" and "Falmouth" were torpedoed and sunk; and two submarines were accounted for by the British flotillas during the operation.

During the autumn British squadrons were constantly at sea on observation cruises, while regular British cruiser patrols were established in the North Sea and a submarine patrol was maintained off the German ports. But the German fleet made no move until the night of Oct. 26, when two German destroyer flotillas, working from Zeebrugge, made their first raid on the Dover Straits, sinking two British destroyers and seven drifters and escaping unscathed. On Nov. 5 a division of the German fleet put to sea to help a stranded submarine. The British submarine "J. 1" was waiting and succeeded in torpedoing and damaging the battleships "Kronprinz" and "Grosser Kurfürst."

Jellicoe, First Sea Lord.—The long winter nights at the end of November enabled the raiders "Moewe" and "Wolf" to break through the blockade. This was annoying but not serious, for it was the submarine which had now become the menace to shipping and exceptional measures were called for to deal with it. At the end of November, therefore, Admiral Jellicoe was appointed First Sea Lord to take over this great task. Admiral Beatty succeeded him in command of the Grand Fleet.

In September war against merchant ships was renewed with ever increasing vigour. During 1916, 436 British merchant ships were lost, totalling 1,250,000 tons. Of these 322 were sunk by submarines, 88 by mines and 26 by raiders, etc. During the year a further 218 merchant ships had been attacked by submarines and had escaped.

THE MEDITERRANEAN 1915–16

The French fleet based upon Malta blockaded the Straits of Otranto watching for the Austrian "Dreadnought" squadron. The latter made no move but the Austrian submarines were active and the battleship "Jean Bart" (Dec. 1914) and the cruiser "Leon Gambetta" were torpedoed and sank. The French admiral withdrew his heavy ships to Malta and kept watch upon the narrow waters of the Adriatic with cruisers and destroyers. In May 1915, after prolonged negotiations as to the distribution and command of the Allied fleets in the Mediterranean, Italy declared war against Austria. The Italian fleet, reinforced by 4 British battleships and 4 light cruisers and by 12 French destroyers and 7 submarines became responsible for the Adriatic blockade. The French Admiral remained nominally in command of the Mediterranean, controlling the western basin, whilst naval operations in the Levant were under British control. The Italian battle squadron was based upon Taranto, but it was upon the cruisers, working from Brindisi, that the principal burden devolved. The cruisers "Dublin" (June 9) and "Giuseppe Garibaldi" (July 18) were torpedoed by Austrian submarines and the latter sank. In September a barrage of British net drifters was placed across the Straits of Otranto, but owing to the depth of water it was not very effective.

The Dardanelles campaign dominated other events in the Mediterranean during 1915 and, with the appearance of German submarines in that sea during the summer, the task of protecting the stream of transports and supply ships became very difficult. In the autumn the almost simultaneous decision to evacuate Gallipoli and to commence the Salonika Campaign (*q.v.*) made demands upon the British transport service which all but stressed its powers to breaking point, and the losses caused by submarines became very serious.

Dedeagatch was bombarded on Oct. 21 and a British squadron was constantly operating at Salonika and on the Bulgarian coast until the end of the war. The collapse of Serbia in November 1915 was followed by an Austrian naval raid upon Durazzo. The raiding force was engaged by the "Dartmouth," "Weymouth" and "Nino Bixio" (Italian), the Austrians escaping with the cruiser "Helgoland" badly damaged and a destroyer sunk. Corfu was occupied as a base for the Serbian army in Jan. 1916 but the subsequent vacillating conduct of Greece did much to hamper the Allies during the Salonika campaign (*q.v.*).

The year 1916 in the Mediterranean was a continual struggle with the German and Austrian submarines, whose use of the

Greek ports and islands called for constant British and French activity around that coast. In December after an Allied force, landed from the fleet, was treacherously fired upon at Athens, a strict blockade of Greece was declared and enforced by the Allies. The British Aegean squadron, which was reinforced at the end of the year by four battleships, kept a close watch upon the Dardanelles and the Syrian coast during 1916.

Overseas Campaigns.—On Feb. 28, 1916, the final surrender of the colony brought the Cameroon Campaign to an end. In East Africa, although the coast was blockaded by the Cape squadron, the coast towns remained in German hands until September 1916. By this time all were occupied and the colony was cut off from the sea. The command of Lake Tanganyika was established by two British motor boats, carried 2,000 miles overland from Capetown, but fighting in the interior continued until after the Armistice. In Mesopotamia, 1916 was a year of pause and preparation for the next campaign. Kut surrendered on April 29 after a gallant naval attempt to relieve the town had failed five days previously.

UNRESTRICTED SUBMARINE WARFARE 1917

After the refusal of the Allies to consider her proffered peace terms at the end of 1916, Germany saw that her fate was sealed unless she could by some means, break the Allies' sea power (*q.v.*). The German High Naval Command was granted its wish and it was proclaimed that, after Feb. 1 submarines would sink all merchant ships on sight and without warning. The commencement of this ruthless campaign (*see* SUBMARINE CAMPAIGN) was followed by the severance of diplomatic relations between the United States and Germany and on April 6 the United States entered the war against the Central Powers. The German aim was to strike a fatal blow by bringing the Allied, and more especially the British, seaborne trade to a standstill by sinking so many ships as to reduce seriously available tonnage and to make the merchantmen refuse to face the risk of sailing. To some extent this latter was successful at first, in the case of neutral shipping, but British merchantmen continued to put to sea in spite of the heavy toll taken by the submarines. During February and March a weekly average of 23 British ships were lost and in April, the darkest month for British shipping, 196 vessels of nearly 600,000 tons were sunk. These losses were so serious, that, had they continued, success must have ultimately rewarded the German effort.

The Convoy System.—Every known method of protecting shipping at sea was adopted: camouflage (*q.v.*), defensive gun armaments, zig-zag courses in submarine waters and directing traffic along routes patrolled by craft armed with every anti-submarine device were all tried; but still the toll of losses grew. In spite of constant changing of the patrolled routes, by the end of March this system had definitely broken down and the Convoy System (*q.v.*) was adopted. To this there was, at first, much opposition, both from the fleet and from merchant owners and ship masters, and the difficulties appeared insuperable. Chief amongst these was the finding of sufficient escort ships, mainly destroyers, for the convoys. The destroyers from the Grand Fleet and Harwich could not be spared, as the High Sea Fleet was still in being and a menace, and there were but few others. The arrival of an American flotilla at Queenstown and of a Japanese one in the Mediterranean eased the situation: the Admiralty under Jellicoe persevered and by the end of May the Convoy System was in full swing. Its effects were immediate. In the second quarter of 1917 the weekly average losses amounted to over 30 merchant ships: in the third quarter this was reduced to just over 20 and in the last quarter to well below that figure, whilst in 1918 the average weekly loss was under 15. In all, 88,000 ships sailed under convoy during the war with a loss of only one half of 1%. During 1917, 1,134 British ships were sunk by submarines, whilst 841 others were attacked and escaped: 137 were sunk by mines, mostly laid by submarines and 38 by surface craft. The total tonnage loss for the year was over 3,500,000 tons and as a counter to this great loss 75 German submarines were sunk.

VARIOUS OPERATIONS 1917

The Dover Raids.—The German submarine and destroyer bases at Zeebrugge and Ostend were frequently bombarded by the monitors of the Dover Patrol but, although much damage was done, the lock gates and basins were not hit. The mine and net barrage in the Straits was constantly patrolled by destroyers and drifters and German destroyers made several attempts, by night raids on the patrols, to open a way for their submarines into the Channel. On the night of March 17 a German flotilla attacked the patrol, sank the destroyer "Paragon" and damaged the "Llewellyn." On April 20, they were not so successful, for the raiding flotilla was met by the "Swift" and "Broke" and, in the spirited hand-to-hand fight that ensued the German destroyers "G. 42" and "G. 45" were sunk. Thereafter, except for ineffectual sorties on April 26 and May 2, no raid was made upon the Dover Straits for nearly a year. Further north the Harwich Flotilla was constantly on the alert and on Jan. 23, in a night melée with a flotilla off the Dutch coast, the German leader was forced into Ijmuiden badly crippled, another boat was driven back to Zeebrugge and the British destroyer "Simoon" was sunk.

The Scandinavian Convoy.—Although to a great extent covered by the Grand Fleet cruisers and escorted by destroyers, the Scandinavian convoy was open to bold attack by the German surface craft and two such attacks were successful. On Oct. 17 two German light cruisers met this convoy of nine vessels, sank the escorting destroyers "Strongbow" and "Mary Rose" and the ships of the convoy without warning and escaped unscathed. Again on Dec. 12 a German flotilla attacked the convoy and sank the destroyer "Pellew" and four armed trawlers, most of the merchant ships escaping. These two mishaps led to a reorganization of this convoy route and to the strengthening of the escorts.

The Action of November 17.—Owing to delays in the production of mines, the British policy of intensive mining off the entrances to the German ports was not put in force until October. This was followed by a great increase in the German minesweeping service, some of the flotillas having to work as far as 150 miles from Heligoland. In November the Grand Fleet cruisers constantly raided the Bight and the Cattegat and on Nov. 2 the decoy ship "Kronprinz Wilhelm" was sunk in the latter area. On Nov. 17, two British light cruiser squadrons, supported by battlecruisers, attacked the German minesweepers and their covering force in the Bight. A long range action followed, the Germans retiring under smoke-screens to the minefields, when two battleships appeared in support and the British force withdrew. In this indecisive affair the light cruiser "Königsberg" was heavily hit and one German outpost vessel was sunk and on the British side the light cruiser "Calypso" was hit and her captain killed. On Dec. 23 three destroyers escorting the Dutch convoy steamed into a German minefield off the Maas Lightship and were sunk in quick succession. The Grand Fleet suffered a heavy loss when the battleship "Vanguard," on July 9, was lost at Scapa Flow with nearly all hands, owing to an internal explosion.

At the end of the year Admiral Wemyss relieved Admiral Jellicoe as First Sea Lord and Vice-Admiral Keyes took over the command of the Dover Patrol, in succession to Vice-Admiral Sir Reginald Bacon.

The Baltic in 1917.—A few British submarines operated in the Baltic throughout the year, being employed mainly on reconnaissance work by the Russian Admiral. In October, after Riga was captured by the German Army, an attempt to open up the Gulf of Riga was made by the High Sea Fleet, and a military force was successfully landed on Osel Island. The Straits of Irben were swept but the battleships "Bayern," "Grosser Kurfürst" and "Markgraf" all struck mines. The Russian battleship "Slava" was sunk but after three German battleships had been attacked by British submarines the naval force was withdrawn, leaving Osel Island in military occupation.

Mesopotamia, 1917.—After many months of preparation, General Maude commenced his advance up the Tigris in Feb. 1917. The army was supported by a flotilla of eight new river gunboats and a number of armed river steamers. Kut was retaken on Feb. 24 and in the heavy fighting that followed the

naval flotilla played a prominent part. The 6-inch and 4-inch guns of the gunboats did much to convert the Turkish retreat into a rout and the British flag was hoisted over Baghdad on March 11. (*See* MESOPOTAMIA, OPERATIONS IN.)

The Mediterranean, 1917.—Allied naval strategy was centred in the Adriatic during the year, for the French and Italian battle squadrons had to keep a watchful eye upon the Austrian dreadnoughts. But the enemy submarines and not the battleships became the dominating factor and, using the Austrian bases, they operated all over the Mediterranean. Their target was a vast one consisting of the great volume of trade to the East, swelled by troop and supply ships feeding the armies at Salonika (*q.v.*), in Egypt, in Syria (*q.v.*) and in Mesopotamia. The 40-mile Otranto Straits were too deep for mining and were patrolled by 50 British North Sea drifters, supported by British and Italian cruisers and destroyers. Stopping the passage of enemy submarine was a difficult task and the patrols were always open to sudden raids. On May 15 Austrian cruisers and destroyers descended upon the patrols and sank 14 drifters before they were chased back to Cattaro by the cruisers "Weymouth" and "Dartmouth." The latter ship was torpedoed during the action but did not sink.

Owing to separate commands in the different areas, difficulties arose in the co-ordination of the methods of protecting merchant ships from submarines and by the middle of the year the losses in the Mediterranean became very serious. In August a British commander-in-chief was appointed to Malta as the single authority responsible for trade protection in that sea. A convoy system was started, under the escort of British and Japanese destroyers and the toll of losses was gradually reduced. A further co-ordination of naval effort followed the meeting of the Allied Naval Council at Malta in November. During the year a British squadron of two battleships and a number of cruisers cruised in the Levant, watching the Dardanelles and co-operating with the Salonika force. On the Palestine coast, a flotilla of monitors, destroyers and gunboats took an active part in the battles of Gaza (*q.v.*), which led to the fall of Jerusalem (Nov. 11).

THE NORTH SEA AND CHANNEL 1918

During 1918 the mine became predominant as a counter to the submarine and a duel developed between the two weapons. The mine barrage in the Dover Straits was strengthened and with the patrol craft armed with every known anti-submarine device nine submarines were accounted for in that area during the early weeks of the year and it became evident to the German naval command that the passage of the Straits was virtually closed to them. They made two attempts to reopen the Straits. On Feb. 15 a destroyer flotilla raided the patrols at night, sank seven drifters and a trawler and escaped without being brought to action. On March 21 a similar raid was not so fortunate, the German flotilla being met by British destroyers. One German destroyer was rammed and cut in half by the "Botha," another was sunk by gunfire and the Germans were chased into Ostend. The "Botha" was torpedoed but reached Dover safely.

Zeebrugge and Ostend.—This proved to be the last German attempt upon the Straits, but as long as their bases at Zeebrugge and Ostend remained in being, raids were to be expected. As early as 1914, Jellicoe had proposed an attempt to block these places, but it was not until the last months of his time at the Admiralty that active steps were taken to put the plan into execution. Admiral Keyes was appointed to Dover to carry it out. After weeks of secret preparation, the mixed force selected sailed on the afternoon of April 22 to attempt to block the entrances at Zeebrugge and Ostend. (*See* BELGIAN COAST OPERATIONS.) The flotilla returned to Dover next morning, its mission at Zeebrugge accomplished. At Ostend the blockships failed to find the entrance, but this was remedied a fortnight later, when a volunteer crew took the "Vindictive," of Zeebrugge fame, into Ostend and sank her in the entrance. These two brilliant actions did not entirely block the Flanders Coast bases, but their moral influence was great and they acted as an added inducement to the German submarines to shun the waters of the Dover command and to confine their efforts to gain the open sea to surmounting the lesser perils of the northabout route.

Last Sortie of the German Fleet.—The Scandinavian convoy remained a bait for the High Sea Fleet and on April 23 it put to sea, for the last time in full strength, to try to intercept it. The date was an unfortunate one for the German enterprise for on that day both outward and homeward bound convoys were in the vicinity of the Forth. The British intelligence system failed to warn Beatty that enemy were at sea and the German battlecruisers reached the Norwegian coast at Lat. 60 N. before they were reported. Here the "Moltke" broke down and had to be taken in tow. The German fleet made for home at its best speed; the "Moltke" was torpedoed by Submarine "E. 42" on her way south, but managed to reach her base.

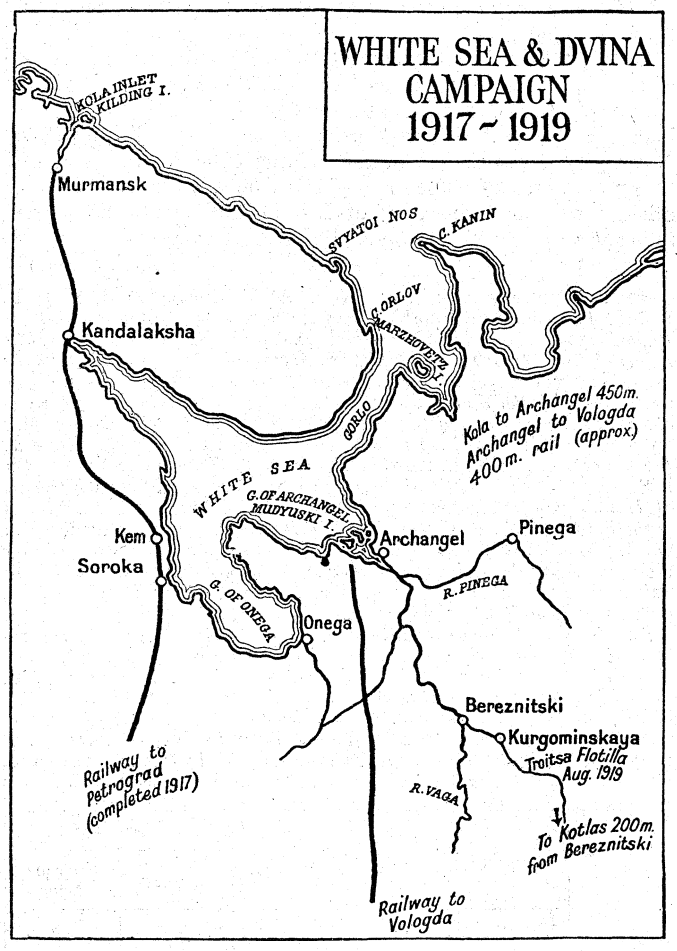
The Northern Barrage.—Frequent raids were made by the British cruisers and destroyers upon the flotillas engaged in clearing ways for the German submarines through the minefields and on April 15, during a raid into the Cattegat, 14 German trawlers were sunk. From the commencement of the British intensive mining policy in the autumn of 1917 until Feb. 1918 over 16,000 mines had been laid in the Heligoland Bight. On Feb. 15 a deep minefield was laid in the Cattegat and the following month saw the beginning of the greatest minelaying operation of the war, the laying of the Northern Barrage. (*See* MINES [NAVAL], MINELAYING AND MINESWEEPING.) This vast undertaking, the closing by mines of the northern entrance to the North Sea from the Orkneys to the Norwegian coast, involved the laying of over 70,000 mines. The mines were made in the United States and were laid by British and American vessels, escorted by the squadrons of the Grand Fleet, with which for some time an American battle squadron had been working. The Northern Barrage was successful both as a moral deterrent and by the number of submarines destroyed in it.

The End of the Submarine Campaign.—By the middle of 1918 the mastery of the Allies over the submarine was in sight, both from the number destroyed and from the lessening toll they took of merchant ships. In the first nine months of the year over 60 submarines were sunk by the Allied naval forces: the average weekly loss of British merchant ships was over 17 in the first quarter of the year and by the third quarter this figure was reduced to under 11. During 1918, 1,108 submarine attacks were made upon British merchant ships; of these 581 were sunk and 527 escaped, a far higher percentage than hitherto. During 1918 only 8 British ships were lost by mines, a figure that attests the efficiency of the Auxiliary Patrol and Minesweeping services.

On July 19 a naval air raid, supported by the Grand Fleet, was made upon Tondern and a Zeppelin shed was destroyed. In another raid on August 11 made into the Heligoland Bight by cruisers and coastal motor boats, a Zeppelin was brought down and destroyed, but the motor boats suffered heavily from the enemy air craft. These proved to be the last two important operations of the Grand Fleet during the war.

The White Sea, 1918–19.—The closing of the Black Sea and the Baltic brought the northern route to Russia into prominence and vast quantities of munitions and fuel were, in 1917, sent to the ice free port of Murmansk (connected by rail to Petrograd in 1917) and to Archangel, which was open from July to October. When Russia collapsed in 1917 the old battleship "Glory" and the cruisers "Cochrane" and "Amiral Aube" (Fr.) were sent to Murmansk and were followed in May 1918 by the cruiser "Attentive," the seaplane carrier "Narana" and a force of 9,000 troops (2,100 British). The object of the expedition was to prevent Germany using these ports as submarine bases, to keep open supplies and give support to the anti-Bolshevik forces under Kolchak (*q.v.*). Archangel was occupied in August after a spirited duel between the "Attentive" aided by the Narana's seaplanes and the forts, and an advance was made along the railway towards Vologda and up the Dwina river towards Kotlas, the latter being supported by a flotilla, which included a British monitor and a number of local river steamers fitted out as gunboats and motor launches, mostly manned by British crews. Troitsa, 250 miles from Archangel, was occupied

in September, when the flotilla had to retire before the river began to freeze. In April 1919 a British flotilla, which eventually included 6 monitors, 6 river gunboats, minesweepers, and coastal motor boats, 18 seaplanes and a kite balloon, assisted in the attempt to advance to Kotlas, but Kolchak's effort failed and political influences caused the Allied Governments to order a withdrawal from North Russia. The flotilla successfully covered



the re-embarkation with the loss of two small monitors. By the end of Sept. 1919 the evacuation was complete.

The Baltic, 1918.—The British submarine flotilla, working under the orders of the Russian commander-in-chief, was stationed at Helsingfors during the winter of 1917–18. After the break-up of Russia, the Germans advanced upon Helsingfors, and on April 3, 1918, the flotilla of seven boats was taken to sea through the ice and sunk to avoid falling into the hands of the enemy.

The Mediterranean and Black Sea, 1918.—Early on the morning of Jan. 20, the "Goeben" and "Breslau" suddenly reappeared in the Mediterranean. Shadowed down the Dardanelles by two British destroyers, they made for Imbros Island, where they found the monitors "Raglan" and "M. 28" at anchor. The two British ships were soon set on fire and sunk but in rounding the south of the island the Germans met disaster. The "Breslau" struck a mine and sank and the "Goeben" shortly afterwards struck two mines in quick succession. In a sinking condition she crept back into the Straits and was beached in the Narrows. Continuous attacks upon her from the air failed to do material damage and a desperate attempt to torpedo her, made by "E. 14," resulted in the loss of the submarine. Eventually the "Goeben" was towed off and once more made her escape to Constantinople.

The loss of merchant tonnage on the congested traffic lanes of the Mediterranean remained severe and although the unified control of Trade Protection gradually reduced this loss the Mediterranean was one of the chief danger areas on the trade routes until the end of the war. The Otranto barrage, though a deterrent, was unable to close the passage to the German and Austrian submarines and its patrols were always open to sudden raids. On April 22 Austrian destroyers made a descent upon the patrols but were driven off and in June the Austrian dreadnought squadron at last moved out of Pola and sailed for Cattaro with the intention of attacking the barrage. The squadron was attacked by Italian torpedo boats, the dreadnought "Svent Istvan" was sunk, the attack was abandoned and the Austrians returned to Pola. On Oct. 31 the defences of that port were pierced by the Italian mosquito craft and the battleship "Viribus Unitis" was torpedoed and sunk. During the closing months of the war a flotilla of British monitors and small craft were employed on the northern shores of the Adriatic in co-operating with the flanks of the Italian Army in their final struggle with the Austrians.

The Black Sea.—Until the break up of Russia, sporadic fighting took place between the Turko-German naval forces and the Russian Black Sea fleet, in which the Russian dreadnoughts dominated the situation. After the mutiny of the Black Sea fleet, a danger arose that one or more of the battleships might fall into the hands of the Germans as potential fighting units. The Allied Aegean squadron was therefore strengthened in 1918 by 4 French battleships and 2 British dreadnoughts. It was one of the latter ("Superb") that on Nov. 12, 1918 led the Allied fleets up the Dardanelles and subsequently to Constantinople.

THE FINAL PHASE

As the months of 1918 drew on the menace of the submarine waxed less and less and during May, June and July over 600,000 American troops were safely carried across the Atlantic and landed in France. It was the beginning of the end. In August the German Western Front began to crack under the blows of the French and British armies: Austria was breaking up: September saw the Bulgarian front give way and, in October, Germany, racked by internal troubles, was forced to her knees.

Scheer, who had relinquished the command of the High Sea Fleet to von Hipper on being called to Headquarters in August as Chief of the Naval Staff, received orders late in September to be prepared to leave the Flanders Coast. In October the retirement began, hastened from the sea by the ships of the Dover Patrol. Ostend was clear of German troops on Oct. 17 and two days later they were in full retreat from Zeebrugge. Eighteen destroyers and torpedo boats escaped to the Bight but a number of submarines were left behind and blown up.

Mutiny in the German Fleet.—After its futile sortie in April the High Sea Fleet made no move and signs were not wanting that its fighting spirit had departed. As early as May 1917 there had been unrest amongst the personnel and outbreaks of mutiny occurred in the battleships "Westfalen," "Kaiser," "Kaiserin" and "König Albert." In the spring and early summer of 1918 further outbreaks called for stern repressive measures. The continued inactivity of the fleet and the withdrawal of the best of its personnel for service in the submarines and in the flotillas, so undermined its morale that when called upon to make a final effort it failed.

Scheer had planned a last raid into the Channel by the whole High Sea Fleet, whilst a concentration of submarines in the North Sea attacked the Grand Fleet on its way south. The submarines were recalled from their war upon commerce at the end of October and were stationed off the Scottish coast, but, when, on Oct. 29, the signal was made to prepare for sea, open mutiny broke out and the fleet refused to sail. From that moment the High Sea Fleet ceased to exist as a fighting machine and the war at sea was over. Most of the crews of the destroyer and submarine flotillas remained loyal until the end and one of the latter inflicted the last casualty of the war upon the British navy when, on Nov. 10, the old battleship "Britannia" was torpedoed off Cape Trafalgar.

The Armistice.—Under the terms of the Armistice, Germany agreed to surrender 10 battleships, 6 battlecruisers, 8 light cruisers, 50 destroyers and all submarines. These terms were enforced without delay and two scenes followed that will be forever memorable in the long sea history of Britain. On Nov. 20, Rear-Admiral Tyrwhitt, with the Harwich flotillas, met the surrendering submarines off the Essex coast and escorted them into Har-

wich. Slowly, the long line of 129 submarines passed into the harbour, watched, in dead silence, by great crowds on either shore. Thus was the greatest menace to Britain's sea power laid to rest. The next day, Nov. 21, Admiral Beatty with the Grand Fleet, met the German Fleet off the Firth of Forth. Between two long lines of British ships the High Sea Fleet steamed to its anchorage below the Forth Bridge and there, at sunset, the German flag was hauled down and was not hoisted again. Thus the proud fleet of Germany surrendered to its enemy, who for over four years had watched and thwarted its every move.

The Peace Terms.—In June 1919 the naval conditions of the Peace terms were signed. They were drastic and reduced Germany at a blow from the position of a great sea power to that of a minor one. The maximum strength of the German navy was fixed at 6 small battleships, 6 cruisers, 12 destroyers, 12 torpedo boats and no submarines, with a personnel not to exceed 15,000 officers and men.

Within two months of the signature, the remaining 8 dreadnoughts with 8 light cruisers and 92 of the latest destroyers and torpedo boats were surrendered, disarmed but with their guns on board, and, within one month, all submarines, either built or building, were either surrendered or broken up.

The disposal of this great array of ships became the subject of delicate discussion between the Allies. Great Britain wanted to destroy them all but France and others wished to add their share to their fleets. The question was partially settled by the Germans themselves, when on June 21, the fleet interned at Scapa Flow, was scuttled. There were at anchor in the war base of the Grand Fleet, 11 battleships, 5 battlecruisers, 8 light cruisers and a number of destroyers. At 10 A.M., by preconcerted signal, the crews opened the valves and the ships began to sink. Only four, the "Baden" (the latest battleship) and three light cruisers remained afloat. This act cost Germany dear, for she had to surrender in place of the battleships, 300,000 tons of floating docks, her remaining five light cruisers and 42,000 tons of floating cranes, etc., in lieu of the destroyers.

Comparative Naval Losses.—The warship losses of the powers engaged are shown in the following table.

	Great Britain	France	Italy	Japan	United States	Russia	Turkey	Austria	Germany	
									Losses	Surrendered
Dreadnoughts	2*	..	1*	1*	..	2*	..	2	..	18
Pre-dreadnoughts	11*	4	3	..	..	2	1	1	1	..
Battlecruisers	3	..	..	1*	..	..	..	..	1	6
Cruisers	13*	5	1	..	1	2	..	..	6	..
Light cruisers	12	..	2	2	..	..	1	3	17*	23
Destroyers	67	12	8	1	2	20	3	6	66	92†
Submarines	54	14	8	..	..	20	..	14**	199	All

*One lost by accidental internal explosion. †Also 50 of the newest torpedo boats.
**By the peace terms Austria was left without coast line and her navy ceased to exist.

In addition to those shown in the table, Great Britain lost 60 minor war vessels (torpedo boats, sloops, gunboats, monitors, coastal motor boats, etc.), her losses in this type being heavier in proportion than that of the other Allies. British losses of auxiliary vessels totalled 17 armed merchant cruisers and 828 other vessels. This latter figure included 288 colliers and oilers, 246 trawlers and 130 drifters. Submarines accounted for 35% of the loss amongst auxiliary vessels, 28% were sunk by mines and 9% were lost by wreck or fire.

Under the urgent stress of war, science brought about the rapid development of certain new weapons and new methods; the submarine and the mine and their countermeasures; the increased range of the great gun and in the power of explosives; the use of poison gas and the birth of aircraft as fighting machines. Reference to all these matters will be found elsewhere; they were common to all belligerents and did not alter the course of the war at sea. For, upon the sea, history was repeated. Like France and Spain in the wars of the 18th century, Germany found herself, at the outset, in the grip of the blockade of the British Fleet. Isolated from the world and cut off from oversea supplies, she attempted by her submerged blockade, like Napoleon with his Continental System (*q.v.*), to strike a vital blow at Britain's seaborne trade. Like the Continental System, the Submerged Blockade came near to success, but, in the end, under the steady pressure of the Allied navies, it failed. With supplies unlimited the wasteful struggles between the great armies might have been prolonged indefinitely, but with the Central Powers denied their wants by the Allied blockade at sea, whilst the Allied armies received their every need from overseas, there could be but one end.

Upon the British Merchant Navy fell by far the greatest burden of carrying the seaborne trade that kept the Allied armies in the field and fed the civilian populations; heavy indeed was the price it paid in the faithful performance of this duty. To the Royal Navy fell the lion's share of the fighting upon the sea: its great traditions were maintained and glorified and when the Armistice called a halt the two navies of Britain had once again carried the country in triumph to the end of a great war.

(S. T. H. W.)

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WORLD WAR II. On Sept. 1, 1939, the mighty wehrmacht of the third German reich smashed across the borders of neighbouring Poland, and thus began the costliest, bloodiest, most colossal war in the history of man. Whereas the land and air fighting of World War I had been confined largely to the continent of Europe, the second World War embraced all the continents but one—South America; North America became involved in the Aleutians. Almost the whole of Europe was enslaved. Everywhere, even in small neutral countries, men and women were forced to adjust their lives to the hardship and suffering of total war.

Although the war officially began with the invasion of Poland, its roots can be traced back more than 20 years previously. Moreover, it must also be considered that hostilities actually began in 1931, with the Japanese invasion of Manchuria. From what was later known, it became evident that the Japanese conquests in Asia, the Italian invasion of Ethiopia, the Spanish Civil War, were all opening skirmishes in the tremendous world-wide conflict that began in 1939.

All of these warlike actions followed a logical progression of first, a disregard for treaty obligations, and later, open violation of existing pacts. In each case, the aggression was unopposed by military action on the part of the principal powers. Thus, by a series of retreats before force, the peace-loving world plunged itself into the conflict.

I. CAUSES AND EVENTS LEADING UP TO WAR

The great Eurasian land mass, in the period between World War I and World War II, was a continent seething with hatred and unrest, springing mainly from economic views based on the

"haves and have nots" theory, as well as from racial jealousies and dislocations following World War I. It did not take long for the flame of hope which fired the vision of man after the treaty of Versailles to subside. In Asia, a disunited China fought endless civil wars, piteously bleeding itself to a point where it proved an easy target for the depredations of the Japanese in 1931.

In Europe, the communist revolution in Russia continued for

TABLE I.—*List of Nations Engaged in World War II*

The United Nations			The Axis
Argentina	France	Peru	Albania
Australia	Greece	Philippines	Bulgaria
Belgium	Guatemala	Poland	Finland
Bolivia	Haiti	Saudi Arabia	Germany
Brazil	Honduras	Syria	Hungary
Canada	India	Turkey	Japan
Chile	Iran	Union of South Africa	Rumania
China	Iraq	United Kingdom	Slovakia
Colombia	Lebanon	United States	Thailand
Costa Rica	Liberia	U.S.S.R.	
Cuba	Luxembourg	Uruguay	
Czechoslovakia	Mexico	Venezuela	
Denmark	The Netherlands	Yugoslavia	
Dominican Republic	New Zealand		
Ecuador	Nicaragua		
Egypt	Norway	Italy ("Co-belligerent")	
El Salvador	Panama		
Ethiopia	Paraguay		

years to destroy lives and rent the unity of that sprawling country of 172,000,000 souls. England and France, exhausted and sick of war, settled back into a shell of complacency to enjoy for a while the material fruits of the peace they thought they had won. Want and suffering stalked the Balkans and central Europe. Before long, economic depression and social unrest gripped the entire continent. With the rise to power of Benito Mussolini in Italy, and Adolf Hitler in Germany, the stage was set for the enactment of man's greatest tragedy.

Hitler, Appeasement and Munich.—Europe, since the Treaty of Westphalia in 1647, was built upon a precarious keystone known as "the balance of power." To all intents and purposes, the "balance of power" was eliminated when, in 1871, Bismarck united the Germanic peoples under the first reich, and established Germany as a dominant power in Europe. The Treaty of Versailles with its system of guarantees and collective security was an attempt to restore the old theory of "balance of power" in modern dress. The aim of Adolf Hitler and the nazi party was to restore the Bismarckian theory and once again establish Germany as supreme on the continent of Europe.

These two opposing theories clashed in the period leading up to the Munich agreement. The Bismarckian theory, backed by the weight of overwhelming military force, won.

The march of events was rapid. In 1933, when Hitler was appointed chancellor by the aging Von Hindenburg, he quickly succeeded in uniting the German people and moulding them to his purpose. By 1936, the third reich had amassed enough strength to break with the tottering League of Nations and force the annulment of the Treaty of Locarno. Germany and satellite Italy were preparing for war. Even at this time, they had a tremendous military advantage over the other countries of Europe who were still clinging desperately to the hope of peace.

In 1937, Neville Chamberlain succeeded Stanley Baldwin as prime minister of Great Britain. In him was dramatized the tragic policy known as "appeasement." Appeasement was based upon two principles: (1) that the Treaty of Versailles was unjust in its treatment of Germany and Italy, and (2) that if these wrongs were rectified, Germany and Italy would re-enter the League of Nations and resume co-operation with a peaceful Europe. This policy was backed by the public opinion of Britain and France. The people of these countries dreaded another war, and reached out eagerly toward what Chamberlain described as "peace in our time."

Crisis came in Sept. 1938. Germany, after careful preparation, demanded incorporation into the reich of the Teutonic Sudetenland area of Czechoslovakia. The independence of Czechoslovakia —a new nation carved out of Austria-Hungary by the Treaty of Versailles—was guaranteed by pacts with France, and indirectly, Britain. The burning question was: Should the postwar system of collective security be abolished in favour of appeasement?

Czechoslovakia was strong and well armed, a potential "dagger pointed at the heart of Germany." To strip it of the Sudetenland would be to strip it of its defenses, its war industries, its power to resist. The granting of Hitler's demands would mean the loss to Britain and France of a powerful ally on Germany's exposed southeastern flank. Nevertheless, the policy of appeasement won out. Rather than risk war, Chamberlain, in a sudden, dramatic move, communicated with Reichsfuehrer Hitler at Berchtesgaden and Godesberg. Then he flew to meet with Hitler, Mussolini and Premier Daladier of France, at the historic Munich conference. On Sept. 9, 1938, an agreement was signed. The vital Sudetenland areas of Czechoslovakia were sacrificed. In return, Chamberlain came home with an agreement with Hitler that neither side wanted war, and that Germany and Britain would settle all future questions by consultation rather than by military action. This was Chamberlain's "peace in our time."

The Retreat from Munich.—For a brief, fleeting period, the Allied peoples clung to the shaky belief that Hitler was now satisfied, that he had "no further territorial ambitions in Europe," that he was now going to let them go their way in peace. All this was shattered in five days' time—less than six months later.

On March 10, 1939, sudden revolt flared in Slovakia against the Czechoslovak government in Prague. On March 13, thousands of German troops moved into position along the now defenseless borders of Czechoslovakia. On March 14, Czech President Hacha was summoned to Berlin to confer with Reichsfuehrer Hitler. On March 15, Hacha issued a statement placing all of Czechoslovakia under the "protection" of Germany.

Three hours later, Hitler was in Prague.

For the shocked democratic peoples, the dream was over. Illusion was blasted by realization. Germany's plan was more than merely uniting the Germanic peoples. The Czechs were not Teutons. Germany's plan was imperialism and conquest. The nazi hymn, "Today Germany Is Ours; Tomorrow the Whole World," suddenly rang in the ears of the people of Britain and France with more meaning than ever before.

Overnight, "appeasement" became a word despised—a symbol of weakness and failure. Frantically, the democracies began preparations for a war which had already been stalking them for eight years, disguised in a cloak of peace. Appeasement was dead, but the poisons engendered by appeasement still coursed in the veins of the democracies. Britain introduced a limited form of conscription. Plans were drawn up for a partially mechanized army of 19 divisions or 300,000 men. Naval and aeroplane construction was rushed. War orders were placed in the United States. Industrial armament production was speeded up.

In France, the social reforms instituted by the popular front government were revised. Everything, however, was limited because of a peculiar, comforting assurance built up by four years of defensive warfare in World War I, that the defense was supreme in modern conflict, and that behind the indestructible barrier of the Maginot line the democracies could fight a successful limited defensive war for years.

It took the bitter, tragic lesson of 1940 to teach the democracies that there was no such thing as limited war when the enemy was prepared for total war. For France, the lesson came too late.

The War of Nerves.—After Prague, Europe entered on a period characterized by frantic diplomatic jockeying on both sides. For Britain and France, it was an attempt to muster the maximum amount of Allied strength for the coming struggle. For Germany and Italy, it was an attempt to weaken that growing strength, and to strike at the morale and the will to resist of the democratic peoples.

France reaffirmed her alliance with Poland, Britain broke with traditional aloofness toward eastern Europe and signed mutual assistance pacts with Poland and Turkey. Britain also made formal guarantees of the independence of Greece and Rumania. France joined in these commitments. All this was an effort to create a bloc of small, powerful nations, to surround Germany with a periphery of steel and limit further German aggression.

On their own part the axis powers launched an Italian invasion

of Albania, adjoining Greece, on Good Friday, 1939. In addition, they kept worrying the great Polish touchstone.

Poland came into the news as early as March 24, 1939, just nine days after the German entry into Prague. On that date, Hitler made formal demands on Poland, which he designated as an attempt to bring to an end the oscillation in the relations between Germany and Poland. These demands included the return to Germany of the free city of Danzig, and the right to construct across the Polish Corridor a military highway and railroad between Germany proper and East Prussia. In return, Hitler promised Poland a free zone in Danzig, and a 25-year nonaggression pact which would guarantee the new Polish boundaries as permanent.

Poland, remembering similar promises made to Czechoslovakia and strengthened by the assurances of Britain and France, consistently refused these demands. In the meantime, to back up their nonaggression front with force, Britain and France turned to the one European power which possessed an army capable of challenging Germany on the eastern front. That power was soviet Russia.

In April 1939, the British and French opened negotiations with the soviet government. For months the negotiations dragged on. From day to day it seemed that an agreement was about to be reached, but always some new point arose to delay the settlement. It was reported that Russia demanded a free hand in the Baltic in return for joining the nonaggression front. On the other hand, the Russians were obviously wary of committing themselves, for three reasons: (1) The failure of the Allies to include Russia in the Munich conference; (2) scepticism over the desire and ability of Britain and France to wage war against Germany; and (3) complete disgust at the snail-paced, blundering methods of Chamberlain and the other Allied statesmen, as compared with the lightning axis diplomatic moves.

All this, it must be remembered, was in addition to the traditional Russian reluctance to wage offensive war. The principal Russian objective was to push its own frontiers as far as possible to the west, as a more and more impregnable defensive barrier. War, at this time, on the side of Britain, would not serve this purpose.

Suddenly, without warning, came the blow which shocked the civilized world—the German-soviet nonaggression pact. The announcement came on Aug. 23, 1939, while the Anglo-French-soviet discussions were still in progress. The pact included (1) an agreement, covering a period of ten years, that each country would refrain from acts of aggression against the other, either alone or in combination with other nations; (2) an agreement to consult regarding common interests; and (3) an agreement to adjust by peaceful means any conflicts which might arise between them.

Two days earlier, a betting commissioner would have offered odds of 10,000 to 1 against a *rapprochement* between naziism and its sworn archenemy, communism. Yet, there it was. The Allies had suffered crushing diplomatic defeat. The nonaggression front was irreparably broken. The German-soviet pact was all that Hitler needed to assure him freedom of action. Her eastern flank secured, her enemies in the west weak and bewildered, Germany was now ready to strike.

After a week of intensification of the demands on Poland, plus a vicious propaganda campaign of hate against the Polish people, the German war machine moved across the Polish border at dawn on Sept. 1, 1939. Two days later, Britain and France declared war.

Europe was in flames.

II. THE POLISH CAMPAIGN

The nations taking part in this opening campaign of World War II were Germany, Poland and Russia. Except for ineffective minor Polish cavalry forays into East Prussia, the entire action was fought on Polish soil. The campaign obviously had been well prepared by the German high command, and represented an almost perfect co-ordination of all arms and branches of the service. Even the weather co-operated, as the German tanks rolled forward irresistibly across the hot, dry Polish plains. The military strength developed by Germany in the few years of Hitler dictatorship became evident. The mass of aeroplanes, tanks and armoured units unveiled in the campaign seemed incredible, in view of the supposed shortage of raw materials. The development of air and armoured forces and their tactical employment opened new fields for military thought, and demonstrated the German conception of "lightning war" (blitzkrieg).

Thirty-five days after the opening gun had been fired, Polish resistance was crushed. The Polish campaign will go down in military annals as one of the most brilliant triumphs in the history of German arms.

Objectives.—The primary objective of the German high command was the total destruction of the Polish army. The rapid elimination of Poland as a military factor in the east was considered absolutely necessary, before the Allies could organize sufficiently to bring dangerous pressure to bear in the west. To accomplish this objective all available man power and matériel were hurled into a series of tremendous annihilating drives.

The Polish objective appears to have been a delaying action along the western border while mobilizing her full strength, hoping to hold Germany until Allied pressure in the west and Allied naval action in the north could divert the main German strength to other areas.

Plans.—The German scheme of manoeuvre was a simple double envelopment to be effected by two major groups of armies. The first group, striking from the southwest, was to drive northeast toward Warsaw. The second group, striking from Pomerania and East Prussia, was to drive south toward Warsaw. Thus, the two forces would meet at the Polish capital in a gigantic pincers movement, cutting off all Polish units between Warsaw and the German border and destroying them. The air force was to disrupt Polish mobilization and assist in the advance of the two army groups. Ground action was to be paced by rapid penetration by the armoured forces.

The Polish plan appears to have been a gradual withdrawal from the frontier areas, using covering forces which were to fall back slowly to a strong defense line based on the Vistula-Narew-Bug-San river valleys. This was nothing more than a delaying action, to cover mobilization, in the first phase of the defense scheme. The second phase of Polish defense was to be main resistance on the river line by all available units. Evidently the Poles were counting on the gradual employment of reserves from the eastern part of the country, and the effectiveness of Allied action on Germany's west flank. However, German air action and the rapid advance of the German ground forces, effectively prevented the second phase of the Polish defense scheme from ever taking form.

Forces.—At the outbreak of war, it was estimated that the Germans had close to 1,350,000 men mobilized, including 90 infantry divisions and 9 armoured divisions. By far the greater part of this strength was concentrated on the Polish border, under the command of Col. Gen. Walther Von Brauchitsch. Available for action on the eastern front, the Germans had four air fleets and two special air commands totalling about 6,500 first-line craft in all. German naval superiority in the Baltic was preponderant but took very little part in the campaign. All equipment was new, excellent and well tested in the Spanish Civil War. Commanding the southern group of armies was Col. Gen. Karl Rudolf Gerd von Rundstedt. Col. Gen. Fedor von Bock was the commander in the north. Marshal Hermann Goering commanded the air forces.

The Polish army never had time to complete its mobilization. During the campaign, Poland was unable to place more than 500,000 men in the field. This figure included 30 infantry divisions, 1 cavalry division, 11 separate cavalry brigades, 12 regiments of heavy artillery and 1 partially organized armoured division. There were virtually no modern tanks, and a pronounced weakness in heavy artillery, antitank and antiaircraft guns. Other equipment ranged from fair to poor, with the exception of that of the cavalry units. The air force totalled no more than 800 planes, many of them obsolete. The Polish commander in chief was Marshal Edward Smigly-Rydz. Gen. Bortnowski commanded the northern

army group, Gen. Kutrzeba and Gen. Rommel the central group, and Gen. Casimir Sosnkowski the southern group.

Operations.—Hostilities began at 5:45 A.M., Sept. 1, 1939. Simultaneously, strong German forces struck across the border from Pomerania, East Prussia, Bohemia, Moravia and Slovakia. On the north, the Pomeranian army crossed the Polish frontier at Chojnice, and struck out in the direction of Chelmno and the Vistula river, where it made a junction with the German army advancing south from East Prussia. The Polish commander, Gen. Bortnowski, fought successive actions on the Netze, Brahe and Vistula river lines, but finally was forced to retire beyond the Vistula. For a while the East Prussian army had been halted by stubborn Polish resistance, but by the end of the first week, Danzig and the entire northwestern corner of Poland was in German hands. German forces were already in the vicinity of Warsaw, though slowed by prepared Polish defenses.

In the meantime, von Bock's southern armies struck across the frontier at three points, and with amazing speed smashed through the Jablonica pass. By Sept. 2, von Bock was in the vicinity of Teschen. In rapid succession, Czenstochowa, Kattowitz and Cracow, the principal southern city, were occupied. German mechanized spearheads ranged far ahead of the main forces, disorganizing Polish resistance with the bewildering rapidity of their advances. These mechanized forces were reported at Kielce on Sept. 5, at Piotrkow on Sept. 6, and north and west of Lodz on the 7th. In addition, they were operating far to the north against Polish units retreating from Posen. More than anything else, the quick-striking armoured columns hastened the crumbling of Polish resistance. By the end of the first week of war, the southern group of armies was in a position to commence joint action with the northern group, against the Polish forces defending Warsaw.

Everything favoured the Germans. The weather was hot and dry, enabling the German mechanized forces to sweep irresistibly across the flat terrain. The Poles bravely but foolishly resorted to combat on open ground, rather than withdrawing to a position defense on the Vistula river line. The Germans never lost the initiative. They adhered to their timetable of conquest with remarkable accuracy.

Another crushing factor was the German air force. In the air, the German purpose was threefold: (1) to destroy Polish communications, thus disrupting troop and supply movements and preventing mobilization; (2) to destroy Polish air power; and (3) to destroy Polish industry and other military objectives behind the lines. In four days, practically all of these objectives were accomplished. By Sept. 2, the few main highways and north-south rail lines had been knocked out. By Sept. 3, Polish air bases had been eliminated and the Polish air force blasted from the skies. By Sept. 4, Polish factories as far to the east as Lwow were blazing from German bomb hits. Warsaw and the other leading Polish cities were methodically being pounded into ruins.

In the second week of the campaign, the Polish forces under Generals Kutrzeba and Bortnowski launched a counterattack against the left flank of the German southern army group. This was an obvious attempt to gain time to prepare for a defense of Warsaw. It succeeded in halting the Germans only temporarily, however. In the south, Sandomierz, at the junction of the San and Vistula rivers, was taken. In the north, Gen. von Keuchler's East Prussian army swung eastward and on Sept. 10, crossed the Narew river. The Poles fell back for the defense of Warsaw. The northern and southern German army groups were now joined. The main Polish forces were virtually surrounded and cut off from hope of reinforcement and supplies. All communication lines had been wrecked by the effective work of the German *Luftwaffe.*

The Poles, however, were still counting on a heroic resistance around Warsaw and a retreat to the favourable defensive terrain of the marshy, mountainous eastern section—when the fatal blow struck. A Russian invasion force crossed the eastern Polish frontier. This sealed the doom of the Polish armies. Polish will to resist was crushed. On Sept. 18, Russian and German forces met at Brest-Litovsk. Warsaw bravely withstood a destructive siege until Sept. 27. The fortress of Modlin fell one day later. On Oct. 5, all resistance ceased when the city of Lublin capitulated to the Germans. The campaign was over. Europe had had its first taste of blitzkrieg.

Summary.—The German campaign in Poland was unquestionably one of the most brilliant of all time. It was characterized by long and careful planning, perfect co-ordination of all arms and branches of the service and exceptional espionage and sabotage activity behind the enemy lines. In less than 15 days of serious fighting, the Germans had wiped out a nation almost equal to itself in size. About 700,000 Polish prisoners were taken, in addition to 40,000 horses, 1,600 guns, 8,000 machine guns and a quantity of other valuable equipment. Practically the entire Polish air force of 800 planes was destroyed. Against this, the German losses, as announced by Reichsfuehrer Hitler on Oct. 6, were 10,572 dead, 30,322 wounded and 3,400 missing.

From a military point of view, the rapid Polish defeat was attributable to three main factors: (1) the failure of the strong central Polish forces to launch an offensive into Germany or against the flanks of the advancing German armies; (2) the failure of this same central Polish army to withdraw, in time, to the Vistula-Narew-Bug-San river line, thereby allowing itself to be virtually surrounded; and (3) lack of Allied support.

The primary German objectives were thus accomplished in the briefest major campaign the world had yet seen. The Polish army was destroyed. The Polish nation had lost its identity. The eastern front had been liquidated. With the annexation of eastern Poland, Russia apparently was satisfied. Germany was now free to turn its attention to the west.

As for Poland, its soldiers fought bravely and well. The siege of Warsaw was an epic of human courage and endurance. The Polish leadership, however, was not equal to the ability of its soldiers and its people. The Polish army command made one mistake after another, first, in overestimating its own strength and in underestimating the strength of the enemy; second, in trying to defend the open border regions instead of falling back in time to the strong river defense line; and third, in completely neglecting the time element and the blistering pace at which the German war machine was geared to operate. Poland was out of the war before Poland had even organized to fight.

III. THE "PHONY WAR" PHASE
(Sept. 3, 1939–May 10, 1940)

The Western Front.—On Sept. 3, 1939, two days after the German invasion of Poland, Britain and France declared war on Germany. For the 35 days of the Polish campaign, and for approximately eight months afterward, the western front settled down to a period of strange, unbroken quiet. It was during this period that the defensive theory flourished more than ever before, and fattened the complacency and limited-war complex of Britain and France. It was also during this period that newspapers and statesmen the world over took to calling World War II the "phony war" and "sitzkrieg."

Indeed it was strange. The two mightiest systems of fortifications ever developed faced each other across the length of the Franco-German frontier. For miles back from the border, the Maginot line of the French and the Westwall of the Germans (also called the Siegfried or Limes line) bristled with supposedly impregnable, concrete and steel casemates. In the Maginot line, the French had concentrated the cream of their fortress troops, heavily reinforced by regular army units. In the Westwall, the Germans used landwehr, or fortress troops, plus battle-tried veterans thrown in after the victorious Polish campaign. Both lines were armed with the most destructive weapons ever devised. Yet for nine months nothing happened. Not a single major engagement developed along the entire frontier. Night after night, patrols clashed in the no man's land between the two systems of fortifications. Minor actions flared in the Saar valley, along the Moselle, through the Bienwald forest, and around the towns of Saarbrucken, Sierck, Bliescastel, Perl and Wissembourg. But that was all. The communiqués became a monotonous repetition. Each day it was "no activity," "usual inactivity," or "nothing to report."

And so it went throughout the winter and early spring of 1939–1940. Little by little, the war faded from the front pages of the newspapers. Only the war at sea attracted attention and, at the end of November, the conflict between Russia and Finland came to the fore.

The Finnish-Russian Winter War.—This was an unexpected struggle which appeared to be wholly unrelated to the major conflict in western Europe. Later evidence proved to the contrary, but at the time, the action was characterized as a simple, clear-cut act of aggression by soviet Russia against its small northern neighbour.

After the partition of Poland, Russia had forced nonaggression pacts on the three Baltic states, Lithuania, Latvia and Estonia. In effect, these nonaggression pacts amounted to the incorporation of the little countries into the soviet union, a development which actually took place several months later. At the time, it appeared as if Russia had taken this action in accordance with secret clauses of the German-soviet nonaggression pact of Aug. 23, 1939. Now we know differently. The Russian people were exercising their implacable defensive instinct, making a tremendous effort to extend their defensive frontiers as far as possible against the one enemy they knew could menace them, Germany. The "realists in the Kremlin" foresaw the startling events of 1941 and, although their methods were tinged with cruelty, evidently they were providing for the defense of their homeland, which they knew someday had to come.

On Oct. 7, 1939, the soviet government made demands on Finland, similar to those made on the Baltic countries. Specifically, Russia wanted certain islands in the Gulf of Finland as a protecting screen for the great Russian naval base at Kronstadt, a foothold at Hangoe on the southern coast of Finland and cessions of territory which would strengthen the vulnerable defenses of Leningrad.

Negotiations proceeded in deadlock until Nov. 30, 1939, when the Russians opened hostilities by bombing the Finnish capital, Helsinki. This was the beginning of a terrible winter campaign, fraught with suffering for both sides, and fought at times in temperatures of nearly 60° below zero. Finland had a total of 330,000 men to throw into the struggle against an overwhelming estimate of 450,000 first-line troops plus considerable reserves for the Russians. In addition, the small Finnish air force and navy were no match for the soviets. The Finns, however, had the advantages of well-organized interior communication lines, and an easily defensible terrain consisting of marshes, lakes and trackless forests, reinforced by a strong system of defense works in the south known as the Mannerheim line.

At first, the Russians made easy inroads from Kandalaksha, Murmansk and Kem, advancing by sheer weight of numbers. Then it became evident that although a well-planned Russian battle campaign had been drawn up by an efficient general staff, the plan was being carried into operation by another, greatly inferior Russian general staff. The Finns fought valiantly and skilfully, with utter disregard for the numerical superiority of the enemy. During December, their highly mobile forces won a series of spectacular victories over the Russians. On Dec. 12, it became apparent that the Finnish 2nd corps had inflicted a severe defeat on Russian forces attempting to flank the Mannerheim line north of Lake Ladoga. On Dec. 19, a ski-mounted division of the Finnish 1st corps threw the Russians back in an engagement which came to be known as the battle of Salla. On December 21, the most impressive victory of all was scored when one division of the Finnish 2nd corps smashed a strong Russian column which had advanced as far as Suomussalmi in a drive across the narrowest part of Finland to the Gulf of Bothnia.

Through the month of Jan. 1940, the Finns continued to score local successes and hold the Russians at bay. The main Russian effort was directed at the Mannerheim line. In the air, Russian bombing planes inflicted heavy damage on towns and bases in south Finland. The Finns, however, were winning the campaign and their heroic efforts attracted the sympathy and admiration of the entire world.

Then, toward the end of Jan. 1940, a great change became apparent in the Russian conduct of the campaign. General Gregory M. Stern was recalled from his post in the far east and put in charge of operations. Fresh, well-equipped Russian troops made their appearance on the fighting fronts. Air attacks were now concentrated on communication lines and military objectives, instead of cities. But most important of all, there was a complete change in Russian tactics. Instead of spreading out along the whole front, the full weight of the Russian attack was hurled at the Mannerheim line. Enormous concentrations of fire and heavy aerial bombardment were laid down on the fortifications. Constant attacks were made by a combination of mechanized forces and infantry, which punched holes in the defenses and spread out fanwise to take other positions from the rear. This was blitzkrieg in the German style. In less than six weeks, it had broken the back of the Finnish resistance.

An armistice, with Germany as the intermediary, was signed on March 13, 1940. The terms of the peace gave Russia everything it had asked for—and more. The entire Karelian isthmus, including the fortified zone and the city of Viipuri, passed into Russian hands. A strip of territory north of Lake Ladoga was granted to the Russians, together with a long-term lease on the Hangoe naval base. In addition, the Russians obtained rights of passage across the Petsamo district and an agreement to construct a railroad across Finland, connecting the Leningrad-Murmansk line with the Gulf of Bothnia.

Thus ended a campaign which was the most puzzling of the war. For more than a year and a half after hostilities had ceased, the world was still asking itself questions. Why had Russia attacked Finland? Was it merely to keep up with the pace of aggression set by co-partner Germany? Why had Russia risked prestige by waging war in midwinter, using inferior troops? Was Germany with Russia, or against Russia? Why had Hitler allowed this campaign? Why did Hitler act as an intermediary in the peace negotiations and hold off the Allies from sending aid to Finland?

These questions were answered in part eighteen months later—when Hitler's legions again struck to the east.

IV. PRELUDE TO THE STORM

Western Europe, in the meantime, was going through the last stages of lassitude in the so-called "phony war" phase. After the interesting but distant furor of the Russian-Finnish War had died away, Britain and France settled back again to a period of waiting. The theory that time was working on their side was still supreme in the minds of the democratic leaders. They still believed that Hitler could not win a long war, that he had to risk everything in one all-out attack, and that the defensive magnificence of the Maginot line and the Belgian fortifications could shatter anything Hitler could throw against it.

One thing the democratic leaders did not take into consideration was the effect that this psychology would have on their people. Actually, Hitler, the great master of mass psychology, had much more efficiently prepared the morale and economy of the German people for a long war. For Germany, the change-over from peace to war involved no more than a minor increase in previous conditions and restrictions. On the other hand, the economies of Britain and France were totally disrupted by the war. Men were torn away from their civilian occupations to serve in the armed forces of their nations. They wanted action—to tackle an unpleasant job, to finish it off as quickly as possible and then to go home. Instead, they were put to work building fortifications and digging ditches. The same thing happened at home. Instead of the terrible bombing of cities they had been taught to expect, the people went through night after night of uneventful, irksome blackout. The people of Britain and France had finally been aroused—but there was nothing for them to do. Before long, both nations were caught in that deadly psychological vise known as boredom!

It was during this period that powerful peace efforts began to sweep Europe. Obviously these efforts were German-inspired. At that time, nothing would have suited Hitler's purpose more than a negotiated peace based on his rapid conquest of Poland. To all

intents and purposes, such a negotiated peace would have been tantamount to a military victory. In connection with this, certain American and Allied leaders expressed interest in moves to bring the conflict to an end. All such efforts failed, however, principally because the British and French peoples were sufficiently aroused to demand the final destruction of Hitlerism and its constant threat to their security and happiness.

Suddenly, toward the end of March, there were signs that the calm was about to be broken. Observers noted that great decisions were being made inside Germany. Rumours grew that the Allies were going to take action to stop the passage of iron ore from Norway to Germany. In France, the Daladier government gave way to the more vigorous government of Paul Reynaud. On March 18, 1940, the world was stirred by the announcement of the first Hitler-Mussolini conference at the Brenner pass. On March 25, the British destroyer "Cossack" violated Norwegian territorial waters and rescued several hundred British merchant seamen from the German prison ship "Altmark." On April 7, the British began laying mines inside the Norwegian three-mile limit. "What does it all mean?" the world asked. A few days later the world knew.

V. THE NORWEGIAN CAMPAIGN
(April 9, 1940–June 10, 1940)

Striking with all the savage ferocity that characterized the Polish campaign, the German war machine launched an offensive against neutral Denmark and Norway at dawn on April 9, 1940. By midafternoon of the same day, all of Denmark had been occupied, and the government of that country had capitulated to the Germans. Denmark merely served as a springboard to the north. The main action of this campaign was fought in Norway, with German, British, Norwegian and some French forces taking part.

Objectives.—In the popular mind, the principal issue of this campaign was the control of the iron ore route from Narvik, in northern Norway. This was an outstanding factor, but actually the stakes were much higher. First and foremost, the entire action was a test of Allied war strength, a probing finger put out by the German high command to determine the extent to which the Allies were prepared to fight total, dynamic war in the west. Secondary German objectives were (1) to prevent the Allies from seizing Scandinavia as a base from which to attack north Germany, and (2) to secure air and submarine bases for themselves, as near as possible to Britain and the vital Allied shipping lanes.

The Allied objectives are not immediately clear. Perhaps Britain was contemplating the seizure of Norway for operations against Germany, but certainly when the Germans attacked, the plan was far from the point of execution. Once the action began, the Allied objective appears to have been one of defense—to hold as much of Norway as possible against the time when future offensive operations could be undertaken.

Plans.—The German plan of action was a brilliant combination of intrigue and military astuteness. The Norwegian government and population had been sown with German agents and Norwegian traitors. It was even reported that Germans who had been taken into Norwegian homes during the evacuation of children in World War I were sent back to Norway for "fifth column" activity. Weeks before the campaign began, merchant ships with holds crowded with German soldiers were sent into Norwegian ports. Corrupt Norwegian officials had been bribed and promised high positions in the "new order." At the zero hour, all these forces were to strike at once, seizing the main cities and military objectives, and holding beach-heads for the landing of heavy seaborne and air-borne reinforcements from Germany. The full force of the German *Luftwaffe* was to be thrown into the air over the Skagerrak to clear a water passage for German troop transports, and to counter British naval superiority in the narrow straits.

The British plan of action was limited by the elements of surprise and unpreparedness. It included immediate naval and air operations to hamper the German occupation, and the landing of expeditionary forces on the Norwegian coast. The plan appears to have envisaged a junction with the Norwegian army in a joint effort to wipe out the German landing parties, while the royal navy and air force cut off reinforcements and supplies from Germany. Apparently the British were planning to outfit Narvik, the great iron ore port, as a landing base for a British expeditionary force.

Forces.—In the first week of the campaign, the Germans used no more than 25,000 men to effect landings and seize control of the nerve centres of the country. Later, these units were reinforced until they totalled more than 100,000. The German equipment was excellent. They were able to land heavy artillery, mortars, antiaircraft guns, even a considerable amount of mechanized equipment. Perhaps the greatest factor in the campaign, however, was the overwhelming air superiority available to the Germans. Every air base in Norway was in their hands. From these, and auxiliary bases in Denmark and northern Germany, probably two full air fleets were employed in the action.

It is doubtful if the Norwegians were ever able to mobilize more than 30,000 men, most of whom were stationed in the less-important, far northern sectors. The British, moreover, landed forces totalling only 12,000 men. The Norwegian equipment was poor and obsolete. Because of the German air superiority, the British were unable to get heavy artillery or mechanized equipment ashore, and their own scattered air units were forced to operate from improvised landing fields or from bases in Scotland, across the North sea. As David Lloyd George characterized it, this was the first tragic example of the Allies fighting a campaign with "too little and too late."

Operations.—The Germans struck in the early dawn of Tuesday, April 9, 1940. While Denmark was being occupied, simultaneous actions flared up and down the length of the long Norwegian coast. Oslo, the capital, was taken in one day. German warships slipped into Oslo fjord, German planes flew over the city and German troops poured from the holds of innocent-looking merchant vessels which had been moored in the harbour. Norwegian coastal batteries opened up, sinking the German cruiser "Karlsruhe" and severely damaging the cruiser "Bluecher," which sank later after hitting a mine. This was the only serious resistance. In a few hours the city flew the nazi flag.

The same thing happened at Bergen, Trondhjem, Stavanger and Narvik, the other principal cities. Sabotage, espionage and treachery worked with marvellous efficiency. The Norwegian army was racked by confusion. Orders were bungled. Officers surrendered their troops without fighting. All communication lines were in German hands. With methodical precision, the Germans seized every military establishment in the country.

There were reports of naval engagements in the Atlantic, the North sea and the Skagerrak; and the Allies claimed the sinking of several German troop transports. In a clash between the 32,000-ton British battle cruiser "Renown" and the 26,000-ton German battleship "Scharnhorst," the "Scharnhorst" was damaged, but escaped behind a smoke screen. At Narvik, an indecisive engagement took place between British and German destroyer flotillas.

At the end of the first week, the British landed expeditionary forces at Andalsnes and Namsos in central Norway, and at Narvik in the north. Small forces of French Alpine troops were included in this force. The Allies made a valiant attempt to push inland and join the Norwegian army in engaging the Germans. The cause, however, was hopeless—made so by the overwhelming German air superiority. British warships had been forced to withdraw from the narrow waters of the Skaggerak. German reinforcements were pouring into the country by the tens of thousands. The *Luftwaffe* effectively prevented the landing of Allied reinforcements and heavy equipment. As a result, on May 5, 1940, Allied troops withdrew and left south and central Norway to the invader. The British continued operations at Narvik for more than a month. A destroyer squadron, led by the grand old battleship "Warspite" wiped out the German naval units stationed there. Early in June, Narvik fell to the Allies, but the taste of victory was short lived. The Allies were withdrawn a few days later when the debacle in France required their recall. The campaign came to an end on June 10, 1940.

Summary.—The Norwegian campaign was another brilliant, easy triumph of German arms. Once again the Germans demonstrated to the world that perfect co-ordination of all arms of the service is an absolute necessity in successful total war. German intelligence and espionage were superb. The air force and the mechanized forces co-operated magnificently. Even skilled mountain troops were used to flank Allied positions in the rugged terrain of central Norway. All of the German objectives were accomplished. They had secured themselves against the possibility of an Allied attack from Scandinavia. They had established much-needed air and submarine bases directly on the north Atlantic. They had retained control of iron ore shipments from Narvik. All this was accomplished at the cost of extremely light casualties, announced officially as 1,300 dead.

By far the most significant aspect of the campaign, however, was the blow to Allied prestige and the exposure of Allied weakness. Norway had lost her independence in less than a month. The British government was shaken to its foundations. On May 10, 1940, Neville Chamberlain was forced to resign, and Winston Churchill, the first lord of the admiralty, was appointed prime minister in his place. At last England had a leader who understood the situation. But it was too late to avert the disaster. Hitler now had the information he wanted. The Norwegian experiment was an unqualified success. The Allies had revealed themselves as weak, internally divided and pitifully unprepared. On May 10, the very day Winston Churchill assumed office, the nazi armies struck again.

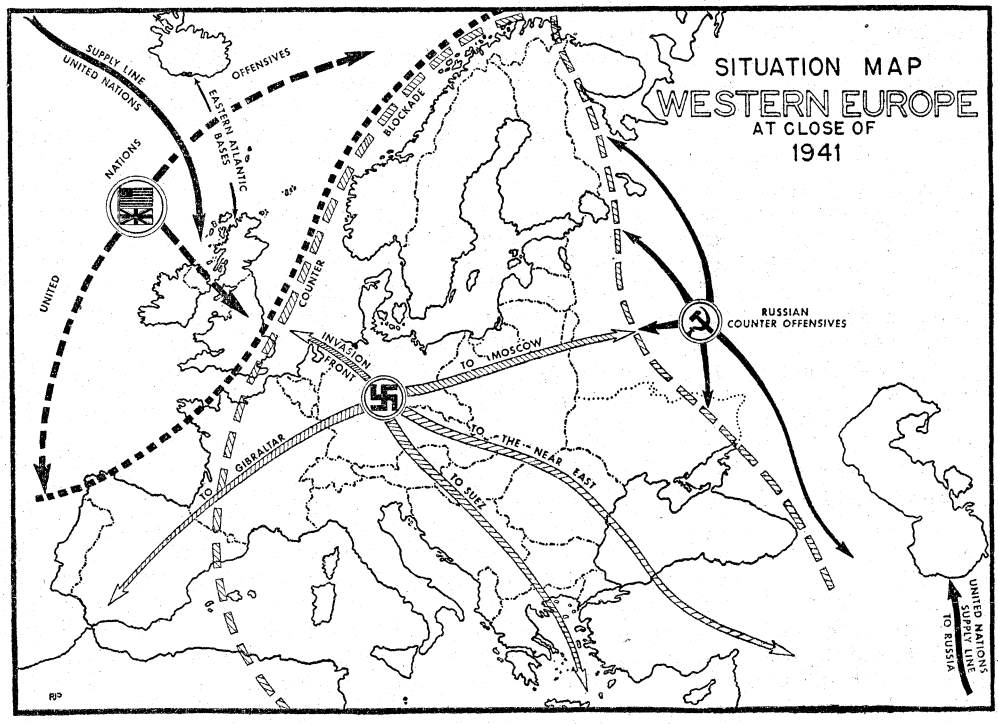
VI. THE BATTLE OF WESTERN EUROPE
(May 10, 1940–June 25, 1940)

In the bloody dawn of May 10, 1940, the curtain rose on the main act of the great European tragedy. Poland and Norway had been trial performances—dress rehearsals to test enemy strength and to try out new weapons and methods. This was the principal event—the tremendous clash of titans toward which Europe had been rushing for nine years. The battle of western Europe was the most colossal since the great Allied offensive of 1918. In it participated the armies of Germany, Italy, Britain, France, Holland and Belgium—an aggregate of some 4,000,000 men. The action was fought on a line extending from the North sea to the Mediterranean. When the smoke of battle had died away, the face of Europe was completely altered. Holland, Belgium and Luxembourg had ceased to exist as nations. France, called the greatest military power on earth, was smashed. Her mighty armies were broken, two million of her soldiers captives. Britain had reeled back, battered and bleeding, to the protecting fortress of her own island. Never, in so short a space of time, had such a far-reaching military decision been reached.

Objectives.—The objectives in this campaign are simple to catalogue. For Germany, it was the annihilation of Allied military power. For the Allies, it was the annihilation of German military power. Holland and Belgium fought defensively for their homelands, with the long-range objective of helping Britain and France smash the enemy. For Italy, the objective was one of territorial annexation, and an impressive military display to assure a favoured place at the expected peace conference.

Plans.—The German plan of attack was based on the well-known "von Schlieffen plan," originated by Alfred von Schlieffen, chief of the German general staff from 1891 to 1907. This plan was designed before World War I as the most effective method of delivering a quick knockout blow to France, by means of an attack through the Low Countries. In World War II such an attack would filter through the main Allied defenses, outflanking and by-passing the powerful Maginot line. The broad strategy of the von Schlieffen plan was this: A great German army of 2,000,000 men was to be thrown into battle on the western front, with only small forces left to face the enemy in the east (in this case, Russia, still neutral and at peace). The left flank of the western army was to act defensively, holding the French along the heavily fortified Rhine and Moselle frontiers (the Maginot line and the Westwall). The right flank was to wheel about in a great many-pronged southward advance, smashing through the Low Countries into northern France. This route of invasion would follow the easiest road into the heart of France—the flat coastal plain along the shores of the North sea and the English channel.

To counter this expected German thrust, the Allies relied on supposedly impregnable defense positions in depth to absorb the main shock of the German advance until a crushing Allied counteroffensive could be organized. The Netherlands' fortifications consisted mainly of lines based on her "water defenses," which were essentially flooded areas in the path of the enemy. Belgium had an extensive system of defensive fortifications running along the left bank of the Meuse river as far as Liége, and from Liége to Antwerp along a formidable artificial defensive barrier known as the Albert canal. France, of course, had the Maginot line, extending from Switzerland to the corner of France where the Belgian, French and German frontiers came together. There were two glaring weaknesses in this defense scheme: (1) A wide gap existed between the Dutch and Belgian fortifications, making possible the flanking of the Belgian positions if the Netherlands fell; and (2) the Maginot line did not extend to the sea, leaving the vital Franco-Belgian border relatively unprotected, if the Belgian line were flanked or breached.



In addition to this, another vital defect in the Allied defense scheme must be emphasized. That was indecisiveness. Before the German attack, the British and the French faced a serious problem. With the French-Belgian frontier relatively without defenses, and with Belgium stubbornly clinging to neutrality, it could not be decided whether the British-French forces should (1) hold in strength along the Belgian frontier, or (2) advance to the assistance of the Belgians and the Dutch, providing of course, the Low Countries decided to resist and showed some ability to hold the Germans until help

arrived. The matter was still under discussion when the Germans struck. As a result, the decision to advance was hastily made, and the British-French forces moved out of their positions with a fatal lack of preparation. There were scarcely any provisions for adequate reserves and the skilful employment of air power. Thus the Allies themselves left a weakly-defended gap on the north flank of the Maginot line which later proved to be their undoing.

Forces.—It is estimated that the Germans used 150 divisions of all types in the invasion of the Low Countries. This included 12 armoured divisions, plus special field services of various kinds. Assisting the invasion, Germany used approximately 6,000 planes, with adequate reserves to maintain this figure as constant. As usual, German equipment was of the best, with the cream of German man power and production being thrown into action for the supreme test.

Of France's army of 2,700,000 men, approximately 400,000 were available to assist the Low Countries at the start of the campaign, but before the curtain dropped on the battle of France, virtually every man had seen battle. Although French equipment was generally good, in some instances it was obsolete and untested. The French air force was comparatively small, relying on major assistance from the royal air force of Britain. Between them, the Allies could muster no more than 6 armoured divisions, inferior in equipment and fire power to the German *Panzer-divisionen.*

The British expeditionary force in France numbered 350,000 men. This army was well equipped, well trained and supported by a considerable air force. The B.E.F. was, perhaps, the most powerful factor on the side of the Allies up through the tragic days of Dunkirk. British planes proved superb in air battle. British production, however, was unable to match German efforts, and by the end of the campaign, lack of replacements reduced the effectiveness of the royal air force to a minimum. In addition, the independent R.A.F. demonstrated a definite lack of experience in co-operating with the ground forces. It had been trained to act alone, and thus found itself far behind the Germans in this important phase of the tactics of modern warfare. Another factor which handicapped the British toward the end of the campaign was that many of their planes were forced to operate from distant bases in the British Isles.

Belgium and the Netherlands added a total of 900,000 men to the Allied front, most of them ill armed and ill equipped. The joint air strength of the two countries numbered approximately 900 planes, of which less than half were modern combat machines. The principal contribution of the Low Countries was extreme valour, which, unfortunately, in itself has never proved sufficient to win a modern military campaign.

The Battle of the Netherlands.—The German attack on the Low Countries was launched simultaneously against the Netherlands and Belgium. Both drives were component parts of the one great offensive. However, for the purpose of clarity, this survey will consider the Dutch and Belgian phases separately, especially since the Dutch army was defeated and ceased to be a factor early in the battle.

At dawn on May 10, 1940, the Germans attacked across the Dutch border at several points. In the first few hours of battle, it became apparent that at least five spearheads were smashing into the country, all converging on the principal cities of Amsterdam, Rotterdam and The Hague. The most powerful ground attack struck across Limburg toward Maastricht, aimed directly at the immense gap between the Belgian-Dutch defense lines. This drive succeeded almost immediately. As a result, the bulk of the Dutch army was isolated from all reinforcement from the south.

At the same time that these ground attacks were launched, two innovations in modern warfare were thrown into the battle with startling success: (1) The fifth column, used so successfully in Norway, completely paralyzed much of the Dutch defense effort. The hand of the saboteur, the secret agent and the traitor was felt at vital points throughout the country; (2) Parachute troops and air-borne infantry, co-operating with the fifth column, completed the destruction of the country from within. In the first few hours of conflict, parachute troops, guided by undercover agents stationed at the points of landing, did enormous damage to the Dutch resistance. Every air field was taken and held until reinforcements arrived by transport plane. Every principal city was occupied by these aerial invaders while the main German armies were still miles away. Communications were severed, bridges were blown up, and before long the bewildered Dutch army found itself surrounded by the enemy on all sides. All this was accompanied by the most intensive air bombardment the world had yet seen. Sections of Rotterdam were literally levelled to the ground.

For five days, the valiant Dutch put up brave resistance, but on May 15, realizing the futility of further bloodshed, General Henri Gerard Winkelman surrendered the bulk of his armies to the Germans. Only scattered units remained to fight with the Belgians, the French and the English, south of the Scheldt river.

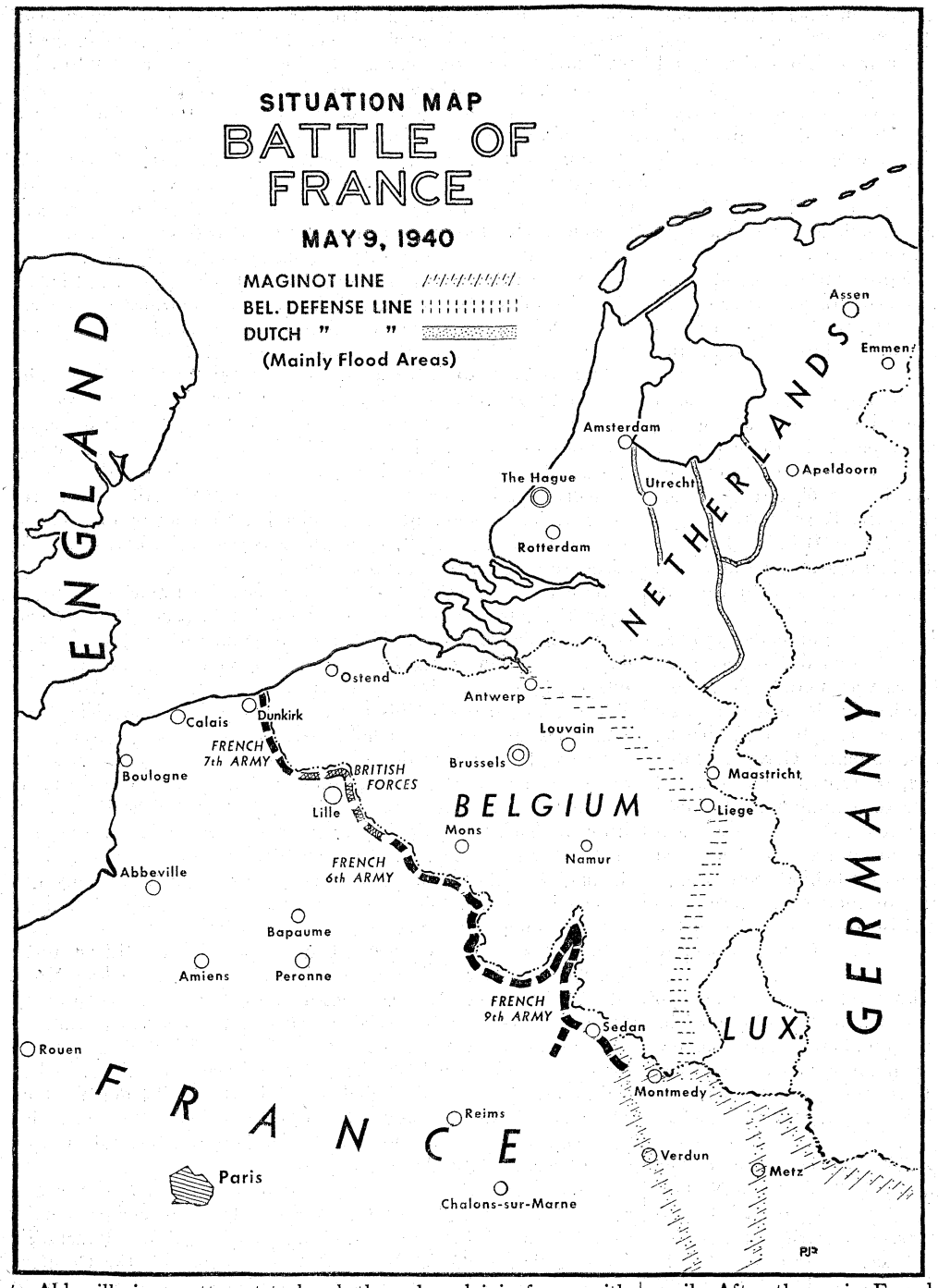
The Battle of Flanders.—No sooner had the Germans launched their first attacks across the Belgian border on May 10 than the British and French troops moved out of their prepared positions in northern France, and advanced to meet the enemy and assist their Belgian allies. This operation included the first of many blunders, from the effects of which the Allies never recovered. The wisdom of the advance itself cannot be questioned, but the tactical deployment of these forces with the absence of adequate reserves was a serious error.

With the advancing Allied forces went the French 9th army, under the command of General Andre Corap. The 9th army had been assigned to protect the corner of France where the Maginot line fortifications came to an end. Believing that the area was sufficiently covered by the crack Belgian Chasseurs Ardennais division, Corap moved his 9th army north from the vicinity of Sedan, leaving only small holding forces behind to reinforce the Belgians. In a sudden devastating blow, an entire German corps was thrown at the lightly-defended Sedan sector. The Germans smashed through into France, almost unhindered. The French 9th army fell back to repair the damage, but it was too late. Engaged in the rear by these same German break-through forces, and on the flank by other strong German units, the French 9th army was hopelessly beaten. The enemy poured into France in a flood which was never dammed.

In Belgium, the Germans had swept past the Liége forts, breached the Albert canal at several points and engaged an Allied army which included almost the whole of the British expeditionary force, the whole of the Belgian army, and two French armies—totalling more than 1,000,000 men. The position of this entire force was endangered by the German break-through at Sedan, and at other weakly defended places in the Allied defense line. The lack of Allied reserves to meet these break-throughs, plus German pressure on the Franco-Belgian border, appeared to bring about an Allied withdrawal.

From Sedan, German mechanized units crossed the Oise and raced down the valley of the Somme. These mechanized units were supported by ground divisions and aided by devastating German air attacks. As they advanced to the sea, the Germans turned north and south against the Allied flanks, threatening to disrupt supplies. In a few days, the panzer divisions reached the English channel at Abbeville. The huge Allied army in Belgium was cut off from communication with the main armies in France by a thin, yet tenuous, enemy line stretching from Sedan to the sea. The rapidity of these events, plus the deadly German air attacks along the entire front, caused demoralization and confusion in the Allied ranks. Cohesion was lost, and counteraction by the Allies was ineffective.

The Belgian cities of Louvain, Antwerp and Brussels fell to the Germans inside the "Flanders pocket," and the Allies withdrew to the Dyle river line. A German crossing of the Meuse and the Sambre farther south, forced a further retirement from the Dyle river. At this point, the Allies were faced with being cut off from sea communication by a German double-envelopment drive, the south wing of which would come up from Abbeville, the north wing down from Antwerp. There was only one thing to do and Viscount Gort and General Blanchard, the Allied commanders, did it. It was to strike at the yet-thin German line from Sedan



to Abbeville in an attempt to break through and join forces with the main Allied armies in France. A strong offensive was consequently launched from north of the Scarpe toward Cambrai and Bapaume. This was one of the most crucial moves of the war. On it hung the fate of Belgium, France, even Britain itself. It was the only means by which the shattered Allied armies could reorganize to meet further German attacks

Little by little the gap between Bapaume and Péronne grew smaller. In the face of the fierce Allied offensive, the gap was narrowed from 30 miles to 18 miles, to 12. The British-French pressure from the north had some effect, but the broken French armies south of the Somme were not equal to the task. For two days the intense struggle continued. Then, the southern French armies sank back, exhausted. The effort was in vain. The Bapaume-Péronne gap was never closed. The Allies had lost their last chance to stave off defeat.

In the meantime, Maxime Weygand was recalled from the near east to replace Maurice Gustave Gamelin as the French commander in chief. His principal task was to organize forces to stem the tide, and gain time for the organization of a co-ordinated defensive front. In the face of the demoralization of the Allied forces, and the lack of sufficient air and ground strength, this was difficult. At the same time, Weygand had to imbue the commands with new methods of overcoming the German air and tank attacks, which had been so disastrous in the preceding engagements.

On the battle front, German superiority was now making itself painfully felt. The royal air force was depleted, and the French air force all but shot out of the skies. Never had the *Luftwaffe* operated with more effectiveness. Planes acted as artillery for the advancing German mechanized columns, blasting great holes in the Allied defense positions. Planes bombed Allied communication lines day and night, destroying the great channel ports, and disrupting Allied troop movements, which were still being conducted on a 1918 scale. Planes strafed and bombed civilians, causing them to rush headlong onto the highways, blocking them for military use. Parachute troops devastated whole sections of the French countryside, adding to the great stream of refugees choking the roads to the south. Air-borne infantry helped seize Allied airports. Planes were playing the greatest part in the shattering of French morale.

Despite all this, toward the end of May, General Weygand almost accomplished a miracle. He gathered troops from all over France, from the Maginot line and the Italian border. He strengthened the Aisne-Somme line. He even concentrated a force of 30 divisions at Rethel for an offensive up the Meuse valley to relieve the Allied forces in the Flanders pocket. However, it was to no avail. After the main French forces had fallen back across the Somme, even Weygand's efforts could not avert the inevitable. It was impossible for the French to muster adequate man power, equipment and especially morale, to meet the Germans on anywhere near equal terms. Thus, as early as the middle of May, all was already lost.

It was at this point that the death knell of the Allied forces in Flanders was sounded, when in the early morning of May 28, 1940, King Leopold of the Belgians suddenly surrendered his entire army to the Germans. The pros and cons of this surrender have been discussed time and time again, but only history can determine the righteousness of the action. In a single move, the north flank of the Allied armies was swept away by the Belgian capitulation, leaving the Allied position virtually surrounded and indefensible. However, the position of the Allies and the Belgians was already desperate. The British, French and Belgians had been fighting unceasingly against heavy odds for nearly three weeks. After the surrender of the Dutch, the Belgians, on the

north, had been bearing the brunt of the German attacks. To avoid disaster, the Allies had been forced to conduct one withdrawal after another. Finally they found themselves with their backs to the channel. Their supply facilities were too limited to maintain their forces. It was this lack of supply that made the position almost helpless. It is therefore possible that two decisions were made independently, but at approximately the same time—(1) The decision of the Belgians to surrender, and (2) The decision of the British and the French to evacuate the British expeditionary force by sea.

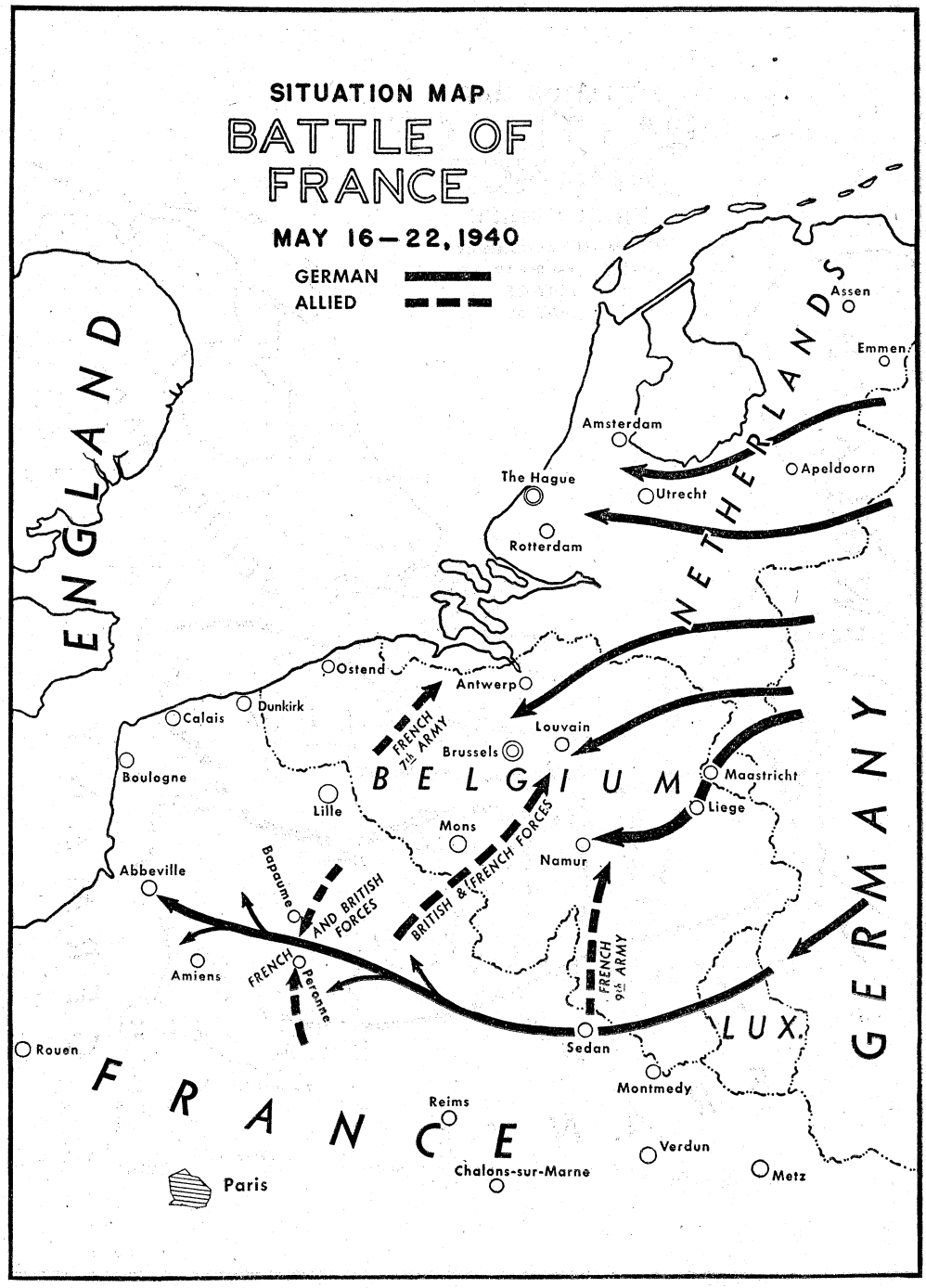
Thus, a phase in the battle of Flanders was over, with the Allies suffering crushing defeat. German operations had been conducted on a brilliant scale; German air-ground co-operation had been almost perfect. However, Allied failure can be traced to one further fact—indecisiveness. First, indecisiveness about advancing to meet the enemy in Belgium, until after the Germans had actually attacked, resulted in their finally doing so without adequate preparations. Unprotected by proper reserves, the Allied southern flank was then turned. When this happened, indecisiveness again paralyzed the Allied effort. They delayed their decision to withdraw until it was too late. An earlier decision to withdraw might have permitted the Allies to use their whole force south of the Somme, in an action similar to the successful defense of the Marne in World War I.

As for the Germans, a special tribute must be paid to the excellence of their supply system. As the main forces of the Germans moved down from the north, crushing first the Dutch, then the Belgian and Allied armies, not once did the German lines of supply break down. Particularly remarkable was the German feat in advancing and supplying large forces through the narrow space of the Bapaume-Péronne gap, following the break-through into France. Seldom has military history seen such an effective solution to such a great problem of supply and maintenance.

The Evacuation of Dunkirk.—After the Belgian surrender, and the Allied decision to evacuate, one phase of the Battle of Flanders yet remained to be fought. Defiantly, the British army fell back on Dunkirk, the one channel port still in Allied hands. Fierce rear-guard actions by the remaining French units covered their retreat. History must not forget the part played by these valiant Frenchmen. All hope for themselves gone, knowing instinctively that their own country was lost, they unflinchingly shed their blood that their British comrades might escape to face the enemy once again.

Dunkirk is still looked upon by military experts as a miracle. The British imperial general staff doubted that 25% of the B.E.F. could be saved; yet 330,000 men (including French, Dutch and Belgians) were taken off the bloody beaches of Dunkirk. This was a victory for the people of Britain. From the British coast across the channel, every available boat, from fishing smacks to private yachts set out for Dunkirk. Destroyers, transports, tugboats, ferries—they all took part in the evacuation. Women, sometimes even children, piloted the rescue boats. Under a veritable hail of German bombs and bullets, this motley fleet shuttled back and forth until every possible man was safe in Britain. For the first time, the weather came to the aid of the Allies, as a continuing dense fog blanketed the operations from beginning to end. Every British plane was thrown into the fight; London was stripped of its aerial defenses; but control of the air over Dunkirk was wrested from the Germans just long enough to accomplish the miracle.

With Dunkirk, the disastrous Battle of Flanders ended in a brief flash of glory for the Allies. But the brilliance of the successful evacuation could not hide the fact that the British had suffered a terrible defeat, that Britain itself was in dire peril.



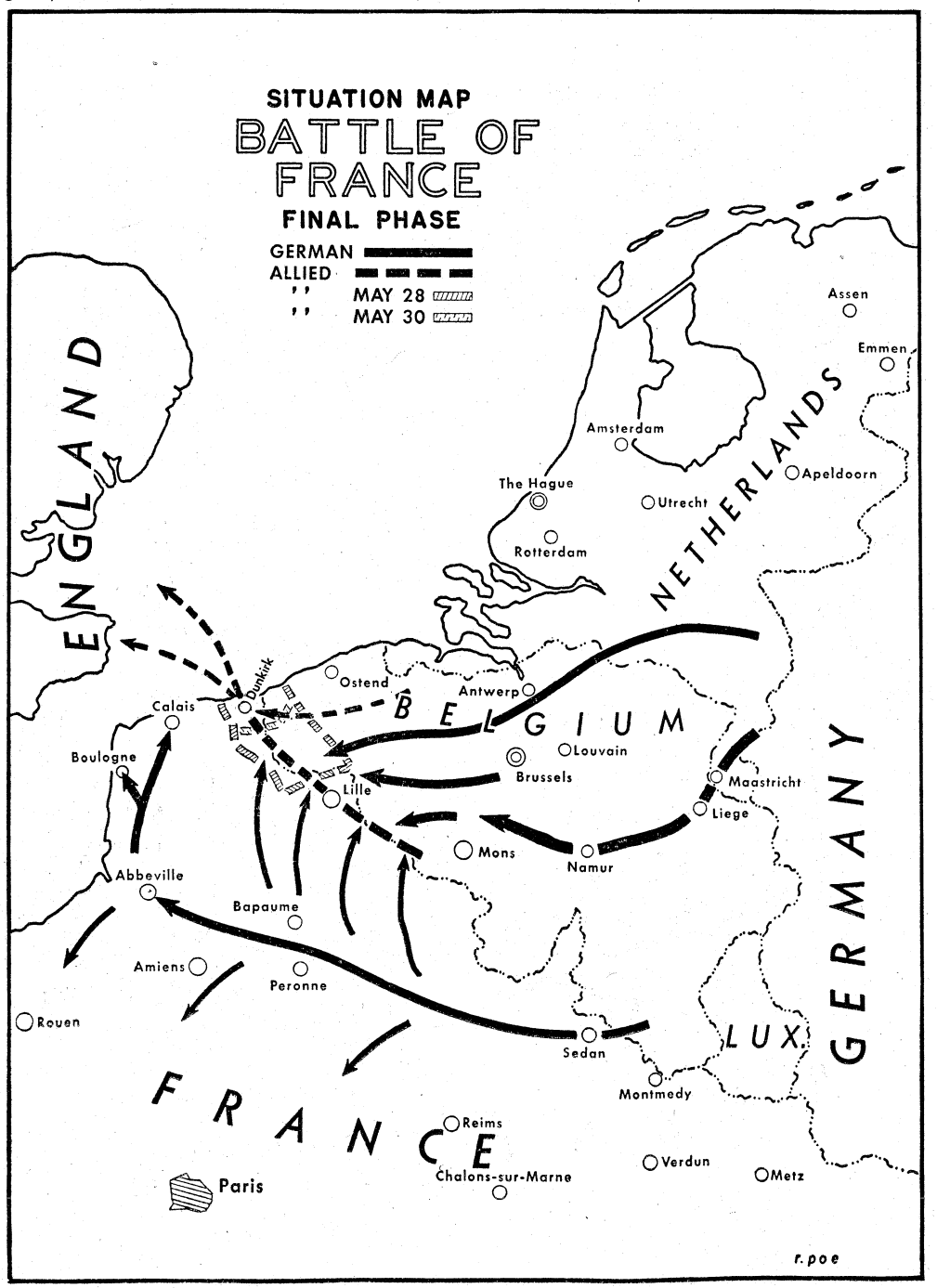
England had no army. The B.E.F. had been saved, but all of its equipment had been left behind. There were no tanks, no heavy guns. Britain was helpless in the face of an all-conquering foe who stood just a few miles across the open water of the English channel.

Fortunately for Britain, the Germans turned south to mop up France.

We still do not know the reasons impelling the Germans to turn on France instead of finishing off England, but certainly this was one of the most vital decisions of the war—possibly the one decision on which the entire outcome may hinge. It is the opinion of most military experts that while a part of the German armies was engaged in mopping up France, the major forces should have immediately prepared and attempted the invasion of Britain. The British had but few air units left and little ground armament. The greatly superior German air force should have been able to handle the British fleet; and the harbours of France, Belgium, Holland, Norway and Denmark easily could have provided enough small boats to carry an overwhelming invasion force. However, we do not know all the facts, and in this case, too, it is only proper to let history decide.

The Battle of France.—The final phase of the great battle for western Europe opened at 4:00 A.M., Wednesday, June 5, 1940. While the Germans were engaged in pursuing the British to Dunkirk, General Weygand had built a defense line hinging on the Maginot line at Montmèdy, and following roughly the line of the Aisne and Somme rivers. Defending this line, Weygand had no more than 60 French divisions. Only one British division remained in action, anchoring down the extreme western flank of the French positions. Opposing these forces, the Germans had at least 100 divisions, probably 130 to 140. The entry of Italy into the war threw several more divisions into the battle on the side of the axis.

The Germans, following their familiar pattern, opened with heavy artillery barrages and murderous bombing assaults on the French lines. Then they thrust mechanized spearheads across the Somme, from Laon to the sea. For a brief period the French seemed to be holding. Bringing up hundreds of their famous World War I 75's, they deployed them in great depth and masses, fired point blank at the German tanks, and managed to smash one attack after another. The gesture was gallant, but futile. Cohesiveness and morale were gone. The German mechanized divisions found the few weak spots they needed, smashed through; and the deadly routine of Poland was repeated. Spearheads fanned out behind the French positions, disrupting communications and forcing retreats. On June 8, the Germans crossed the Aisne. A few hours later, Roye, on the Avre and Noyon, on the Oise, had been taken. Farther west, the Germans crossed the Seine at Amiens, and the entire French left flank was forced to fall back to the Bresle. Here the French held but once again it was to no avail. *Panzerdivisionen* were operating far to their rear at Forges-les-Eaux on the Seine. The French retreated again, to a line stretching from Chemin-des-Dames to the sea. They were dangerously near Paris.



On June 10, 1940, Italy, with her total war strength of some 60 divisions, entered the war on the side of Germany, but it made no difference to the final outcome. For months, a neutral Italy had immobilized large masses of French troops on the southern border On June 10, the Germans forced another crossing of the Seine near Rouen, and converged on Paris from the Aisne and Oise sectors. Up till now, Weygand almost miraculously was holding his armies together in fairly orderly retreat. On June 10 Paris was evacuated, and the French set up a new defense on the Loire It was with the fall of Paris that the French resistance showed signs of com-

plete deterioration. And small wonder. With thousands of French prisoners in German hands; with German mechanized and air forces smashing their communications from the rear; with millions of pathetic refugees impeding their retreat, it is difficult to see how the French managed to put up effective resistance as long as they did.

On June 14, the Germans took Reims and Chalôns-sur-Marne. A day later, the mighty fortress of Verdun, symbol of an unyielding defense in 1914, fell after less than six hours of assault. This indicated the crumbling of the French armies. The end was near. The fall of Verdun put the Germans at the rear of the storied Maginot line. In a few short hours, the great bastion which was to have stemmed the nazi tide from all of western Europe, was rendered useless. Evacuation of the Maginot line began almost immediately after the German capture of Verdun. It had not been built to fight an enemy at its rear!

In the meantime, the French government had moved to Tours, and then to Bordeaux. On June 14, the day of the fall of Verdun, Premier Paul Reynaud proclaimed the helplessness of the situation. Two days later, he resigned. He was replaced by the aged Marshal Henri Phillipe Pétain, victor of Verdun in World War I. The very day that Pétain assumed office, the last French defense line on the Loire was cracked. The tragedy was entering on its final scene. The onrushing Germans split the main French armies and penetrated the Rhone valley. On June 17, the 84-year-old Pétain "with a broken heart" asked for honourable terms of armistice. On June 21, while the fighting continued, Adolf Hitler presented his harsh terms in the same railway car at Compiègne where the Armistice of Nov. 11, 1918, had been signed. The following day, the French delegates signed the German terms, and then opened negotiations for an armistice with the Italians. With fighting still in progress and with isolated French units still resisting heroically, the French and the Italians worked out the terms of their armistice in the Villa Incisa, 12 miles from Rome. On June 24, 1940, the Franco-Italian armistice was signed. Six hours later, at 12:35 A.M., June 25, 1940, the battle for western Europe came to an end. For France, the war was over.

The Franco-German and Franco-Italian Armistices.—The terms of the German and Italian armistices were strikingly similar in content, and had as their common objective, the utter subjugation of France and its elimination as a dominant power on the continent of Europe. In addition to stripping France of practically all its continental defenses, the treaties called for the military occupation of more than half the area of the country, with the French people themselves paying the cost of the occupation—an estimated 3,000,000 francs per day. The Germans occupied the entire west coast of France, and all the territory north of a line running from the Swiss border near Geneva, through Dole, Châlons-sur-Saône, Moulins, Vierzon, to 20 km. east of Tours and thence southerly to St. Jean-Pied-de-Port on the Spanish border. This was considerably more territory than the Germans had taken by military conquest at the time the armistice was signed. In contrast, the Italians occupied no more than the relatively small area their troops had conquered up until the cessation of hostilities on June 25. The French agreed to demilitarize the nearby Toulon naval base and an area 50 km. wide west of the line marking the farthest point of Italian advance.

Other articles of the armistice agreements called for the demilitarization within 15 days of the great French naval bases of Bizerta, Ajaccio and Oran, and the demilitarization of certain fortified colonial areas in French North and East Africa. To administer the occupied territories, armistice commissions were provided for in several articles of both the German and Italian treaties. In addition, a great many of the arrangements were detailed, placing French trade, communications and merchant shipping under direct axis control. France was specifically forbidden to render any form of assistance to Britain for the remainder of the war. All French prisoners of war were to remain in axis hands. Axis prisoners were to be released immediately, however. In article XIII, the French were required to maintain in good order all property to be delivered to Germany, and to provide all labour necessary for the repairing of docks, railroads and other facilities to be used by the Germans. Article XIX (German), concerning prisoners of war, also provided for the return to Germany of all German refugees in France named by the German government.

By far the most provocative provision of the armistices was article VIII (German) and article XII (Italian), which called for the concentration, demobilization and disarmament, at French ports, of all French naval vessels. This provoked a bitter storm of protest in Britain, which had agreed to the French surrender, only if the French fleet were put under British control. The direct result of this French concession to the axis was violent British military action involving the seizure of all French vessels in British-controlled waters which reached its tragic climax in the British attack on French fleet units in the harbour of Oran (see *The War at Sea*). Later, to allow the French to protect themselves against British attacks, the axis permitted the French fleet to remain mobilized.

This and other controversies rising out of the armistice terms, caused a breach between the British and French governments which was never healed.

Aftermath of the Fall of France.—It is not exaggeration to say that the collapse of France, in less than eight weeks of active fighting, shook the entire world. The effects of this cataclysm which brought all the democracies to the very brink of disaster, were immediately felt in every corner of the globe.

In Europe, the spirit of France was crushed. The people of what was once the continent's strongest land power, walked about in dazed, hopeless dejection. This attitude spread to the government, and soon it became apparent that France was too weak, too crushed even to maintain firm holds on her own colonies. The government—by then functioning at the city of Vichy—became honeycombed with collaborationists; and under the guidance of Pierre Laval, vice-premier in the Pétain cabinet, the republic was abolished in favour of a totalitarian regime. Pétain was named chief of state. The masses were inarticulate, but among most of the ruling politicians, the order of the day was "co-operation" with the German conquerors.

In eastern Europe, repercussions of the French collapse were felt within a week of the armistice. With Franco-British guarantees now proved worthless, Rumania was literally torn asunder. Russia demanded the annexation of Bessarabia and northern Bucovina. Rumania acceded, but turned to Germany for further protection. This was to no avail. At a "consultation" a few weeks later, Hitler ceded most of Rumanian Transylvania to Hungary, and the Rumanian Dobruja to Bulgaria. This was Hitler's reward for two good little axis satellites. It served to bring them closer into the axis camp.

Spain, in the meantime, became closer knit to the axis by virtue of the gentle pressure of German armies on her northern border. The economic position of Germany and Italy was greatly improved by the conquest of France, and practically all of Europe's Atlantic coastline was now a huge network of air and submarine bases stretching in an arc about the British Isles. The direct result of this was a tremendous increase in British shipping losses. Experts put the average monthly loss for Britain at 325,000 tons in the latter months of 1940. In addition to a German frontal assault, Britain also faced the prospect of starvation by blockade.

In the far east, French collapse immediately galvanized Japan into action. French Indo-China was forced to stop all traffic into Free China, and thousands of Japanese "inspectors" (wearing full field packs and well schooled in such intricacies as close-order drill), poured into the French colony to "inspect" the railroads for violations of this agreement. As an appeasement measure, Britain also closed the Burma road to China-bound supplies. On Sept. 27, 1940, Japan became a full-fledged member of the axis by signing the tripartite pact in Berlin.

In America, the United States stirred uneasily at the news of France's fall, and issued a warning to all European powers that transfer of European colonies in the western hemisphere to non-American nations would not be tolerated. In the near east and Africa, unrest and indecision wracked the still-unconquered

French Colonial armies. Late in Aug. 1940, British Somaliland, no longer protected by the French forces in neighbouring French Somaliland, fell easy prey to a powerful Italian invasion.

The greatest and most unexpected aftermath of the fall of France, however, was the refusal of Britain to give up the fight, and the subsequent air struggle which was named "The Battle of Britain" by Prime Minister Winston Churchill.

VII. THE BATTLE OF BRITAIN

Never in the history of the world has a people responded so magnificently to national crisis as did the British people in the dark days following the French debacle of June, 1940. Fate saved the British Isles after Dunkirk, when the conquering Germans made the mistake of turning away from helpless England to concentrate on wobbling France instead. After that, the British Isles were saved by the British people.

In the last days of June, when France was reeling to final defeat, the picture looked utterly hopeless. England had practically nothing but her bare hands with which to fight the greatest military power on earth. Some members of Britain's ruling class wanted to make peace with Hitler then and there. But Britain's common people, and their great spokesman, Winston Churchill, would not allow it. If they had only their bare hands with which to fight—fight with their bare hands they must. At last the common people understood what they were fighting for. The issue became for them something more than the incomprehensible ideologies of naziism and democracy. It took Dunkirk to do it, but now they realized the slavery and starvation which a Hitler victory would bring to them and to the entire civilized world. Free men were now fighting to retain their individual freedom.

Three days after Dunkirk, factories began to hum, thousands rushed to take up arms. Home guards set about the task of building defenses against parachute troops and sea-borne landings. For 15 and 16 hours a day, men and women sweated over machines, working to the point of exhaustion, forging the sinews of a new army to be built on the ashes of the old. Tanks and planes rolled from the factories in an unprecedented stream. This was truly a miracle comparable to Dunkirk. In a few short weeks, Britain was fighting with bare hands no longer.

On June 19, just after France asked for an armistice, the Germans struck the first major blow at Great Britain. At first 100 planes a day dropped their bombs on British cities. Soon it was 200 planes; before long, nearly a thousand. Britain was extremely vulnerable to air attack. Its enemies controlled a long line of air bases from Norway to Spain, some of them just a few minutes away from Britain's most vital industrial areas. Yet, with ever increasing strength, the British struck back. Each night bomber formations of the R.A.F. set out for Germany and German-occupied territory to blast away at military objectives there. The air war swelled in intensity. Both sides were soon dropping their bombs on open cities, killing civilians by the hundreds. "Military objective" became a hollow phrase, meaning roughly, every square inch of enemy territory that could be reached with high explosive and incendiary bombs.

Britain, in the meantime, had become a veritable fortress. The world was thrilled by the sight of a nation of nearly 50,000,000 people under heroic siege. The beaches, the moors of England became a tangled mass of fortifications. Every possible landing was protected with barricades, and a close network of defensive positions grew up from Land's End to John o' Groat's. Thousands of foreign refugees and persons of doubtful loyalty were thrown into concentration camps, to eliminate any possibility of a fifth column. Everywhere men in uniform waited grimly for the approach of the foe.

The German plan appeared to be this: (1) Systematic bombing of British cities and military objectives to destroy morale and the will and power to resist invasion; (2) Destruction of the British sea lanes by bombing and submarine attack, to shut Britain off from supplies and reinforcements from America and the empire; (3) Destruction of the royal air force and all royal air force bases by bombing attack, to allow a combination sea-borne and air-borne invasion to land on Britain, unhindered; (4) Finally, after this preparatory softening-up, actual invasion of the British Isles by parachute troops, air infantry and regular army units transported in specially built barges assembled on the French, Dutch, Belgian and Norwegian coasts.

The plan never succeeded of execution. In the cities, the people of Britain merely buried their dead, shook their fists at the foe and returned to work. In the air, the royal air force refused to be shot out of the skies. Fighting at odds of five and six to one, the R.A.F. waged one of the most magnificent underdog battles in history. And it won. By the end of August, it was reported that 1,000 German planes were raking Britain in a single day. All parts of England and Wales were raided, and many points in Scotland, but the principal German effort was directed at London. On August 21, however, the R.A.F. destroyed no less than 200 enemy aircraft. For days, similar enemy losses were reported. This broke the back of the German offensive. Gradually the bombing attacks slackened.

What caused the British success in beating off the Germans? It can be attributed to three main factors: (1) Although outnumbered, the British fighter planes were superior to the Germans' in almost all technical characteristics, *i.e.*, speed, fire power, manoeuvrability; (2) The British planes were operating with interior lines of communication and out of home bases; thus short-range fighters could be refueled and used over and over again; (3) Indirect American assistance in the form of planes, armaments, shipping, manufactures and food was by this time making itself powerfully felt.

Nov. 14 marked the opening of a new phase of the battle of Britain. With a terrific, concentrated raid on Coventry, using more than 500 planes in this single operation, the Germans began the wholesale, wanton destruction of British cities. For ten and a half hours, incendiaries and high explosive bombs were rained on Coventry, a Midlands industrial city, virtually levelling it to the ground. Coventry suffered a civilian death toll mounting into the hundreds. In the next few weeks, Southampton, Sheffield, Bristol, Birmingham and Liverpool underwent the same horror. The climax was reached on Dec. 29, with a terrible incendiary attack on the city of London. By the end of 1940, the bombings had taken a staggering civilian toll—23,081 killed, 32,296 wounded. But by the end of 1940, the will of the people of Britain to resist was unbroken and they were cemented more firmly than ever before.

Moreover, the royal air force was gaining in strength and striking power. The German invasion fleet on the shores of occupied Europe was smashed time and time again in a series of destructive R.A.F. attacks. German air and submarine bases from Bergen to Bordeaux were blasted incessantly. Night after night, the R.A.F. avenged the German bombings by striking deep into Germany and across the Alps into Italy. The Ruhr, Berlin, Bremen, Mannheim, Danzig, Pilsen, Turin, Genoa and Milan all felt the devastating power of the R.A.F. Following the big raid on the city of London, Bremen was subjected to three terrible incendiary attacks in reprisal. The British had a limited number of planes, and they had to fly farther to reach their targets, but apparently they caused considerable damage to military objectives, preferring to strike at industrial facilities and transportation centres rather than open cities.

As 1941 began, the direct German bombing attacks on Britain gradually lessened. The German armies turned away from the shores of the English Channel to prepare a new blow to the southeast. For the time being the Battle of Britain was over. Nazi Germany had suffered its first defeat—at the hands of the British people.

VIII. THE END OF 1940

As the black year 1940 drew to its close, there were signs all over the world that the struggle was soon going to spread. In the far east, Japan moved troops from south China, continued to make demands on French Indo-China, and was obviously preparing to strike southward. In America, the United States was swinging steadily to the side of Great Britain. Supplies were being rushed to Britain—although still carried in British ships,

and still on a "cash-on-the-barrelhead" basis. The election of Franklin D. Roosevelt for a third term as president was taken as a sign that the people were willing to go all-out in an effort to aid Britain. Congress passed the Selective Service act, calling for the conscription of an army with a potential strength of 4,000,000 men. Important changes were made in the army and navy commands. And the attitude of the people became consistently more menacing against Germany and Italy. (*See* also WAR ORGANIZATIONS, U.S.)

The Balkans and the near east seethed with unrest, murder and political intrigue. In Europe and Africa, two active conflicts were already raging—the Anglo-Italian war in Egypt and Libya, and the Italian invasion of Greece.

IX. THE GREEK-ITALIAN WAR

On Oct. 28, 1940, Italy, in an obvious attempt to keep pace with axis partner, Germany, launched an unprovoked invasion of Greece from neighbouring Albania. At the time, it was not clear whether this was a private Italian venture, or a segment of the axis general plan of war. Later history has proved that the Greek invasion was an independent effort on the part of Mussolini to impress Hitler with Italian initiative and strength. It also became apparent that Italy expected little more than token resistance from the Greeks. The whole venture proved a miserable failure, however, and Hitler had to rescue his pompous ally from the snow and muck of Albania in the German Balkan campaign of April 1941.

When the attack began, Greece's army numbered no more than 150,000 ill-equipped men, with about 600,000 untrained reserves. Its air force consisted of about 200 planes, and its navy was tiny and obsolete. Despite these relatively insignificant forces, from the very outset the Greek resistance was surprisingly good. As the campaign progressed, considerable British air support, plus a lot of supplies and ground reinforcements, stiffened the Greeks until an amazing victory was almost within their grasp.

For the first few days, the Italians attacked indifferently. Then realizing the strength of the Greek opposition, major Italian units were thrown in, and advances were made all along the Greek-Albanian frontier. The most powerful thrust was in the direction of Salonika. The fighting took place on the most difficult terrain in all Europe, where the wild, mountainous battle ground proved of immeasurable value to the Greeks.

At the end of the first week, the Italian drive began to slow down. Soon afterwards it came to a complete standstill. It was then that British reinforcements began to pour into Greece. Air bases were set up on the Greek islands, and soon British bombers were ranging over the cities of southern Italy. At the end of ten days, it became evident that the Italian preparations for the Greek campaign were exceedingly incomplete. The Greeks launched a counterattack, which did not end until the Italian armies had been shattered and thrown far back into Albania. In less than a month, not an Italian soldier remained on Greek soil. At the end of November, Koritza, the main Italian base in Albania, fell to the Greeks. Two weeks later, Argyrokastro, Porto Edda and other important Albanian bases were in Greek hands. British and Greek planes blasted the two remaining Albanian ports of Durazzo and Valona. Italian cities were subjected to a merciless bombing from bases only 300 miles away. The British and Greek navies literally swept the Strait of Otranto of Italian ships. The veteran Italian chief of staff, Marshal Pietro Badoglio, retired. Italy was humbled and degraded in the eyes of the world and her axis partner, Germany.

This was the situation when the German drive into the Balkans wiped away the stigma, and re-established axis supremacy in southeastern Europe.

X. THE NORTH AFRICAN CAMPAIGN

Beginning at the end of 1940, the axis-British struggle for the control of north Africa seesawed back and forth through the early months of 1941 and into the beginning of 1942. The campaign can be divided into three distinct phases, all of which when viewed in retrospect must be considered as part of one continuing operation. This was the longest single campaign of the war, and the issue was still in doubt as 1941 drew to its close.

First Phase, *Sept. 20, 1940–March 31, 1941.*—The nations engaged in the north African campaign during these months included Italy, Britain and Germany. In addition to the British force from England, other Allied units included Moslem Indian troops, New Zealand and Australian forces, South Africans and native and colonial troops from French Equatorial Africa, under control of the Free French government. The action during the first three months was confined principally to the Egyptian and Libyan coastal area and the operations were mainly the result of air and ground forces, assisted by some naval activity along the Mediterranean shores.

Objectives.—The British objective was to drive the Italians back from western Egypt, to continue the attack to the west along the Libyan coast and to destroy the Italian Libyan armies. Secondary objectives included the capture of additional Mediterranean air and naval bases for future operations against axis supply lines and the Italian mainland, and security for the Suez Canal. The Italian objectives appeared to be, first, destruction of British military power in north Africa by the taking of Alexandria and the Suez Canal; and later, the logical assumption of the defensive to protect Libya and the gains made in Egypt.

Plans.—The British plan of operations appears to have been a straightforward advance to discover the principal Italian opposition followed by a rapid "pincer" or encircling manoeuvre and the swift destruction of the enemy forces. The plans included the co-ordinated action of all arms in the air and on the ground, combined with naval action from coastal waters by units of the British Mediterranean fleet. Considerable attention had been given to Italian defensive works and elaborate plans existed for the siege and reduction of any extensive defensive positions.

The Italian plans do not appear to have been either well prepared or, if prepared, followed in sufficient detail to warrant extensive examination. Plans for the preparation of defensive works appear to have been elaborate and well executed in so far as the actual locating and construction of works were concerned. No general plan for wide-scale defensive operations along the whole Italian position appears to have existed.

Forces.—In Dec. 1940, it was estimated that the Italian forces in north Africa numbered close to 250,000. In addition the Italian army had a minimum of 300–350 planes. Armoured forces included both medium and light tanks, while other mechanized equipment included light weapon carriers. All arms were represented, with extensive motor transportation. It is estimated that only small Italian naval forces were available for coastal operations in this phase of the campaign.

British forces numbered approximately 100,000 mixed troops. No official figures indicate the total planes available, but it is calculated that not more than 100 aircraft were in action during the campaign. Adequate service troops were available to maintain engineer and water-supply needs. In the Mediterranean, the British fleet was well prepared to join in supporting action co-ordinated with air and ground operations.

Operations.—On or about Sept. 20, 1940, Marshal Rodolfo Graziani launched his main attack across the Libyan desert. Within a few days he penetrated as far as Sidi Barrani, 70 mi. inside the Egyptian frontier. Here he stopped. Apparently he was consolidating his position for a further drive on Matruh, Alexandria and the Suez canal. However, months passed without the Italians moving toward the east.

Suddenly, on Dec. 9, the British struck westward. Two days later they had reoccupied Sidi Barrani. Striking with a powerful force of mechanized troops, they shattered the Italian armies, took some 40,000 prisoners, and by Dec. 16, had retaken Sollum. On Jan. 3, 1941, the British launched the first attack of the new year against the Italian stronghold at Bardia. This Italian defensive position was held by 45,000 troops and estimated as a formidable obstacle to attack. However, the operations began with severe British air and naval attacks ranging as far to the west as Castel Benito and Tripoli. On Jan. 3, the British ground forces attacked with Australian shock troops. One by one the

concrete fortifications were smashed. On Jan. 5, the Italian flag was lowered and Bardia was in British hands. In two and a half days British forces had advanced from Matruh and Sidi Barrani, launched an attack against a formidable defensive position, defeated a superior Italian garrison and captured the city of Bardia. About 45,000 more were added at Bardia to the growing list of Italians in British hands.

The next British objective was the defended Italian position at Tobruk, about 70 mi. west of Bardia. Ground operations began with prompt organization and dispatch of columns west and south from Bardia to take up encircling positions around the city of Tobruk. Overhead the air forces undertook the bombardment of Gazala, Derna, Tobruk, and Tripoli on the African coastline, while long-range bombing missions were carried out against Taranto, Palermo and Naples. Two weeks after the fall of Bardia the attack on Tobruk opened with a feint assault, followed by a principal assault. The attack was successful, and several gaps were opened in the outer circle of fortified defenses. Troops poured through these openings and advanced eight miles to the city. Planes and naval units smashed at the defenders. The combined British efforts resulted in the fall of the city of Tobruk within 24 hours. About 25,000 prisoners were added at Tobruk to the large numbers of the Italian Libyan army already captured. The result of the British victory added a third large Italian base and port along the African coast for future British use.

The next Italian position some miles west of Tobruk was Derna —not a heavily fortified city. No rigid defense lines had been constructed similar to those which had characterized the defense at Bardia and Tobruk. The British expected that Derna would be deserted. Reports indicate that the British plan was to continue the westward push, and that the Derna action was to be a secondary assignment to a small force. In fact, Derna was well defended by 10,000 well-equipped Italian troops. The battle was short but intense. Italian air and ground forces, tanks and artillery fought stubbornly. Despite this, however, reinforced British units took the town on Jan. 30. A few thousand prisoners were added to the already staggering total in British hands. The balance of the Italian garrison withdrew in the direction of Bengasi.

British forces quickly consolidated their position in Derna, and resumed the push toward Bengasi. The British plan of operations included the concentration of forces for the main pressure from the east, combined with a pincer movement from the south. On Feb. 9, the British reported, "Bengasi is in our hands." Retreating Italian forces from Bengasi met heavy resistance from the British pincer column moving up from the south and west. About 20,000 prisoners were taken. After the fall of Bengasi, small British units continued the drive as far as El Agheila, a distance of 170 mi., where they remained as weak holding forces until the start of the second phase of the campaign.

Second Phase, *March 31–April 30, 1941.*—Simultaneous with the attack on the Balkans, the axis launched a vigorous offensive against the British in north Africa. The same nations which engaged in the first phase of the north African campaign also took part in the second phase. Germany, however, which played a minor role in the early campaign, assumed command of the axis operations in this phase. Late in March, it became apparent when the British drive bogged down at El Agheila, that large German forces were reaching Africa by air and water transport. The move was accomplished by heavy bombing attacks on the British Mediterranean base of Malta, and by British naval and military preoccupation in other theatres, notably the Balkans. On March 30, the axis struck a series of heavy blows, the full force of which the British were unable to withstand.

Objectives.—The principal axis objective was to regain the ground lost during the first phase, and to secure a favourable area for future operations to the east. The British objective appeared to be wholly defensive—the protection of gains already made, and the protection of the west flank of the Suez.

Plans.—The axis plan appeared to be the concentration of mechanized forces, including armoured scout cars, motorcycle troops, reduced-size panzer or armoured forces, tanks and motorized infantry. These ground forces were supported by adequate combat aviation. Following the transportation and concentration of these forces, the plan consisted of a rapid advance to the east to overrun the British garrison. It appeared that the axis plan was to avoid moving forces along the coastal areas, where they would be subject to British naval attacks. All plans included unity of command and continuous co-ordination of all air and ground units. The British plan was a stubborn defense of all areas gained in the first British campaign. Reduced forces were to defend fortified positions, with naval assistance from coastal waters and such air assistance as was available. The extent of the plan appeared to include increase in existing forces by the addition of units released from operations on Ethiopia, and the prompt creation of a strong defensive position immediately within or along the Egyptian-Libyan frontier. In all cases, the British plan was to protect the west flank of the Suez canal. Apparently the plan did not include unified command of all forces available for operations.

Forces.—Various estimates were made of the size of the German and Italian forces engaged in the campaign. Early estimates indicated German strength at 30,000 including small Italian forces. In addition, an estimated reserve of an equal number was reported in the vicinity of Tripoli. No final figures were available but it appeared unlikely that the combined axis forces, exclusive of reserves, numbered more than 35,000 during actual operations. British forces were far inferior in numbers to the axis forces. The commanding general in Africa at a later date attributed axis gains to the reduced numbers of the British in Libya and Egypt. Demands made upon the British for the campaign in the Balkans were announced as the reasons for the reduction of the north African forces.

Operations.—The campaign opened with lightning speed when axis mechanized forces struck to the east against the most advanced British stronghold at El Agheila. On March 24 this position fell and the axis columns pushed on to the east. On April 1, Marsa-el-Brega and Agedabia were captured, and on April 4 Bengasi was evacuated by the British and occupied by the axis forces. British reports claimed that there were no losses in completing the successful withdrawal from Bengasi. Three days later it appeared that the British plan was to withdraw to the east, perhaps to Egypt. On April 7, Derna was captured and valuable water supplies lost. On the same day an axis raiding party captured three general officers and some 2,000 retreating British forces near Mechili about 50 mi. southwest of Derna. It was not clear at this time that the axis forces were moving on a broad front, but the extent of the raids made south of the coast jeopardized the British withdrawal. By April 8, axis forces were continuing to advance toward Tobruk and on the 9th it appeared that Tobruk was in danger. By the 13th the fortified position at Tobruk had been encircled and the British positions to the east were in difficulties. Axis columns swept beyond Tobruk and captured Bardia, Ft. Capuzzo near the Libyan frontier, and Sollum across the Egyptian border. It is estimated that one Australian division and one mechanized brigade, both reduced in numbers, were holding the fortified position at Tobruk. It was apparent that the British could still provision or withdraw this garrison by naval forces controlling the water route to the port. The factor of risk in regard to relative strength of air forces made the position difficult to defend. By April 15, it became apparent that the force of the axis drive had been extended and the British forces were holding east of Sollum. British naval and air forces launched attacks against axis columns along the coast. Axis reports indicated that these attacks were repulsed. Around April 16, British reinforcements began to arrive from Ethiopia and defensive positions east of Sollum were strengthened. During the next ten days, British naval and air units attacked the axis base at Tripoli, and launched numerous air attacks along the coast. By April 22, it appeared that Germany had consolidated areas gained, and adopted defensive positions west of Sollum, while continuing to besiege Tobruk. On April 26, the axis forces launched a sudden raid east of Sollum, and advanced as far as Bugbug. British forces withdrew in the direction of Sidi Barrani, and appeared ready to fall back to prepared positions as far to the

east as Matruh. When axis forces suddenly withdrew to the west, the British counterattacked in that direction. A second axis raid met this counterattack and pushed the British some 25 mi. east of Sollum. By April 30, the situation appeared to have been stabilized. Until the third phase began, action was confined to sporadic raids between the defensive positions, with minor naval forays along the coast.

Concerning the operations in the second phase of the campaign, General Sir Archibald P. Wavell, British commander in north Africa, was quoted by the press in the following comment:

> Our conquests in Cyrenaica were left to be held by a garrison of partly trained and partly equipped troops. I made a miscalculation there.
>
> I didn't expect the enemy to counterattack until the end of April at the earliest, by which time I hoped to have back at least part of a seasoned Indian division from Italian East Africa, and to have completed the equipment of troops left in Cyrenaica, which consisted of a British armoured brigade, an Australian division and an Indian motor brigade. All of these were short of equipment, transport and training.
>
> Unfortunately, the enemy attacked at least a month before I had expected it possible.

Third Phase, *Nov. 18–Dec. 31, 1941.*—After a lull of several months, during which both sides seemed to be gathering strength and waiting for favourable weather, the British suddenly struck back at the axis forces on Nov. 18, 1941. Thus began the third phase of the north African campaign, which was still in progress at the end of 1941.

Objectives.—In the main, the long-range British objectives were essentially the same as those which guided the first British drive into Libya in Jan. 1941. The axis objective was fundamentally one of defense—to fight a delaying action against the superior enemy forces until sufficient reinforcements arrived from Europe to allow resumption of the offensive against the British. The exigencies of the Russian campaign had weakened the Germans to an extent where they had had to delay plans for an offensive of their own.

Plans.—The British plan of action appears to have been an attempt to utilize superior numbers of troops, superior air power and an equality in mechanized equipment, to smash the enemy in a series of encircling movements and head-on tank battles. Instead of driving along the sea-coast, as in the first phase of the north African campaign, the British struck in strength from several points further south, sending out advanced mechanized columns in an effort to split the enemy forces into smaller groups for eventual destruction in frontal battles. An important part of the plan of action was the use of the royal navy to prevent any sea-borne reinforcement of the axis units, and to attack axis-held ports from adjoining coastal waters. Thus, this was to be a land-sea-air offensive, with co-ordination of all three arms of the service.

The axis plan of action was to exact as heavy a toll as possible from the British personnel and mechanized equipment, and then, upon the addition of axis reinforcements, to launch a counter-offensive into western Egypt.

Forces.—It was estimated that in Nov. 1941, the British forces in north Africa numbered approximately 85,000 troops. These included three armoured divisions of approximately 3,000 tanks, many of them of U.S. manufacture. The British air strength numbered no more than 150 planes at any one time.

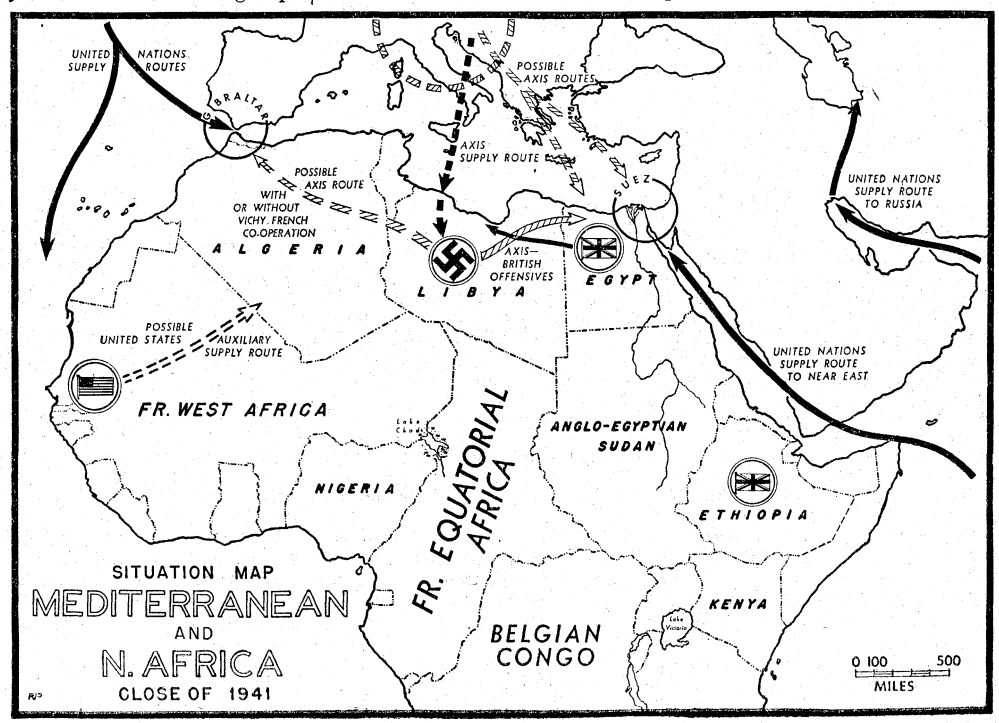
The axis forces numbered approximately 55,000 with three reduced-size panzer divisions. The axis had no naval support, and the total of axis planes engaged never numbered more than 90 to 100.

Operations.—The operations in this phase of the war began on Nov. 18, 1941, when the British, after long months of preparation, attacked in force across the Egyptian-Libyan frontier. Contrary to expectations, the attack came from five points, well to the south of the coastal towns of Bardia and Sollum. The first of these columns curved around to invest the axis stronghold of Sidi Omar, just across the border. Another struck out southward through the desert. The main columns, however, swung north after crossing the border, in an attempt to reach the sea and trap large axis forces in Sollum, Bardia, Gambut, Fort Capuzzo and Rezegh. At the same time empire forces in Tobruk, consisting principally of Indians, Australians and Poles, launched an attack from that besieged town, with the object of smashing through the rear of the enemy lines and re-establishing contact with their own troops. The royal air force struck heavily against axis airdromes and fortifications, as well as the Italian ports of Naples, Brindisi, Messina and Tripoli; while the royal navy carried out bombardments of enemy land installations all along the Libyan coast.

The advance was rapid. On Nov. 24, 1941, the British claimed the capture of Fort Capuzzo, Bardia and Gambut. The driving empire forces pushed westward toward besieged Tobruk, and a great tank battle developed at Sidi Rezegh. The British claimed control of the air in the middle eastern theatre, and German attempts to bring in reinforcements from Europe by towed glider planes, as in the Cretan campaign, were smashed.

For three days heavy fighting continued in the Rezegh area. On Nov. 27, 1941, the British announced that contact had been made with the Tobruk garrison. The bulk of the axis forces were caught in a pocket between Rezegh, Tobruk and the sea. The only axis offensive action, a diversion raid across the Egyptian border, had in the meantime been driven back. The British capture of Gialo oasis, far to the south, was also confirmed.

On Nov. 28, 1941, the second phase of the battle of Rezegh began. The axis forces trapped by the thin British line between Rezegh and Tobruk, launched a strong attack in an attempt to break free. Heavy fighting continued for several days, with German reinforcements moving up to join the battle from the west. On Dec. 3, 1941, by taking Rezegh, Zaafran and Bir el Hamid, the axis forces once again assumed control of the corridor south of Tobruk. Tobruk itself was again isolated. The British were



compelled to withdraw to a defense line extending from south of Rezegh to Fort Capuzzo. Bardia and Gambut were retaken by the axis, and the Sollum area remained firmly in axis hands. The initiative was with the axis during this period. The British appeared to be in the process of reorganization.

On Dec. 6, 1941, the British began the third phase of the battle of Rezegh with an attack in the vicinity of El Duda. Heavy losses in men and equipment were reported on both sides. On Dec. 10, 1941, it became evident that the British had won a victory, when the axis announced a general withdrawal of its units to the west of Tobruk. Except for scattered pockets of axis resistance, the area between Tobruk and Bardia was now under British control. Gambut and El Adem were reoccupied by the British.

Then began a systematic pursuit by the empire forces of the retreating axis units. On Dec. 11, 1941, the German high command admitted defeat in north Africa. Bardia and Sollum were still in axis hands, but they were isolated, miles behind the rapidly moving fighting front.

The axis withdrawal to the west continued, with the British maintaining contact in close pursuit. Axis losses were severe, as the retreating columns split into two bodies and fought unsuccessful rear-guard actions at Mechili and in the area southeast of Derna. On Dec. 20, 1941, Derna fell. The pursuit continued along the coast. On Dec. 25, 1941, the British took Bengasi without a fight. The main axis forces had destroyed the town and retreated to the south. British units, in the meantime, had driven across Cyrenaica and reached the Gulf of Sirte southwest of Agedabia, thus cutting off the main route of axis retreat into Tripolitania. As 1941 drew to its close, the main bodies of the British and axis forces were engaged in battle in the region of Agedabia. The final issue, however, remained to be determined.

Summary of the North African Campaign.—In the first phase of the north African campaign, the British attained practically every objective. To all intents and purposes, the Italian army in Libya had been crushed and eliminated as a threat to the Suez Canal. In addition, new air and naval bases had been secured by Britain, in a plan of operation which could be characterized by one word—pursuit. The principal tactical achievement was the development of unified command within the British forces. All operations on land, and the bulk of the naval and air assistance appeared to be under the control of a single commander. The completion of this early action in north Africa increased the prestige of the British forces, and resulted in prompt reinforcements for the British armies in Greece and east Africa.

In the second phase, this sapping of British strength in north Africa proved almost fatal. In two weeks, axis forces stiffened by strong German reinforcements drove the British out of the positions they had gained in eight weeks of hard fighting. Bengasi, Derna, Bardia and Sollum were recaptured by the axis. Tobruk was encircled and under siege. Powerful defensive positions were established within western Egypt as springboards for future offensive operations. Vast quantities of British and former Italian equipment were captured. As a result of all this, valuable naval and air bases were lost to the British, and with reduced British forces in western Egypt facing superior axis forces, the west flank of the Suez Canal appeared to be in serious danger. However, Tobruk still held, and the British fleet was still supreme in the Mediterranean. The British position in north Africa was in danger, but still capable of strong defense.

In the third phase, it was apparent that British forces had been reorganized and re-equipped to conduct open mechanized warfare in this theatre. The addition of modern mechanized and motorized equipment and other supplies received from the U.S., counted heavily in the British success. It must be remembered that the bulk of the German mechanized and air forces were engaged in the eastern theatre against Russia. This factor meant that the axis units in Libya could expect little reinforcement. Taking advantage of these circumstances, the British opened and conducted a skilful campaign, up until the close of 1941.

XI. THE EAST AFRICAN CAMPAIGN

The campaign in east Africa involved British empire forces and the Italian armies. The scene of the operations included Eritrea, British Somaliland, French Somaliland, Italian Somaliland, Ethiopia, the Anglo-Egyptian Sudan and Kenya Colony.

Operations.—For the British, the principal objective in this campaign was the elimination of the Italian armies in east Africa. Other objectives included the protection of the Suez Canal, the recapture of British Somaliland, the invasion and capture of Eritrea and Italian Somaliland, the restoration of Ethiopia and the control of French Somaliland.

The Italian objective was to retain control of all Italian possessions in east Africa and to adopt an offensive against the British, wherever and whenever the situation would permit. A desirable objective for offensive action was the Suez canal.

Plans.—The result of the operations indicates that the general plan adopted by the British was to cut off the western area of Eritrea, cut off the southern area of Italian Somaliland, then to converge forces within Ethiopia, find the main opposition and destroy it.

The Italian general plan included the defense in strength of positions in Eritrea, principally in the vicinity of Cheren, combined with defense along the Juba river in Italian Somaliland, the protection of the railroad from Addis Ababa to the coast, and the defense of the capital, if that became necessary. Apparently no Italian naval action could be planned. It also appears that no definite plan of operations was made for the resumption of offensive action outside of the area under Italian control.

Forces.—The British forces included large numbers of Indian troops, described as Moslems; in addition to colonial forces from Egypt, the Anglo-Egyptian Sudan, and Kenya Colony. Some Australian, New Zealand and South African forces participated. And in addition to British ground forces, units of the royal air force and the British fleet took part in operations. No reports were available as to the total number of all forces. It appears that the British were superior in numbers to the Italians in Eritrea, and it is estimated that the total of British strength was approximately 40,000. In other theatres, principally in the Kenya, Italian Somaliland, and southern Ethiopian operations, the British forces were smaller and an estimate of total strength approximates 30,000. Equipment appears to have been excellent. Motor transportation operating in rugged terrain had to be in good condition, and a considerable quantity had to be available for replacement of losses. Mountain artillery was employed, and some motorized guns and weapons carriers as well as armoured scout-car units were used. Air action for observation and bombing was reasonably superior to the Italian.

Italian forces in all operations varied in strength depending upon the location of the action. In the north, in Eritrea, it is estimated that Italian strength did not exceed 35,000 of all arms. In Ethiopia larger forces of approximately 50,000 were known to be engaged. Outpost garrisons near Lake Tana, west of Addis Ababa, and near the Kenya border were estimated at 15,000 total. In Italian Somaliland, reports indicate that around 10,000 organized troops were engaged in defense. An estimate of total Italian strength indicates approximately 110,000 total, although it is not believed that all forces took part in the operations. A considerable percentage of Italian strength was represented by the native Ethiopian forces. Some 30,000 to 40,000 of these had been organized and trained by the Italians. These are considered as additional forces to the estimated total for Italian troops. At the beginning of the campaign, Italian equipment appeared to be excellent in artillery and in motor transportation. During operations, however, no replacements could be secured, and both supplies and equipment suffered as a result. Large numbers of captured weapons indicated that old equipment had been put into use and that the modern equipment had been lost or worn out. Some Italian air forces operated, but no information was available on the condition of equipment used or the numbers involved.

Operations.—During the last week of Jan., 1941, British forces operating out of Kassala in the Anglo-Egyptian Sudan invaded Eritrea and advanced to the town of Biscia, at the western end of the railroad leading to Massawa on the seacoast. Italian defense lines were outflanked and the British captured the railway terminus. This invasion was combined with simultaneous patrol action from several points along the Anglo-Egyptian Sudan frontier into Ethiopia. Patrol action was also begun from Kenya Colony into Ethiopia and Italian Somaliland. During the first week in February, the British forces in the north advanced from Biscia to Agordat, an important city at the junction of the Addis Ababa highway with the railroad to the seaport of Massawa. The Italian defense was light and after a short engagement, the main forces retreated into the mountains and the British captured the town. About 1,500 prisoners were taken and some animals. It became apparent at this time that the British plan to use native Indian troops had been wise. The Indian forces fought well against the Italians and it appeared that their advance was welcomed by the natives. Meanwhile in the south, a small force from Kenya embarked on small schooners and motorboats and made a successful attack from the sea against Ras Chiamboni on the coast of Italian Somaliland. Some Nigerian troops were reported in this action. Border raids continued on all fronts. Late in February, the action on the north continued and the British besieged a large Italian force in the city of Cheren. The British plan to cut off Eritrea was dependent on the capture of this important centre. Elaborate plans were made to surround the defenses and a stiff engagement was anticipated. In the south, south African troops pushed along the coastal roads in Italian Somaliland and captured Chisimaio on the Indian ocean. In this operation, small naval units, including air forces, lent assistance. The result of this operation gave these forces an opportunity to prepare for further action against the capital, Mogadishu. Before the end of the month, a crossing had been made over the Juba river and the road to the capital was open to the invaders. After two days of extended marching, the British forces reached and captured Mogadishu and Italian Somaliland was lost to Italy. The British claimed about 9,000 prisoners. Small forces secured the capital and columns were sent to the north to join other forces invading Ethiopia from the

southeast. The result of these operations realized one of the British objectives, the separation of the southern Italian colony from Ethiopia. Considerable satisfaction was evident, due to the fact that British Somaliland, still in Italian control, was less than half the size of the most recent British capture of Italian Somaliland.

During the first three weeks of March, invading British columns from Kenya joined forces with British troops operating north from Dolo in Italian Somaliland and captured Neghelli in southern Ethiopia. These columns prepared to move to the north against the capital, Addis Ababa. Larger British forces which had invaded Ethiopia from Italian Somaliland succeeded in reaching Jijiga about 50 mi. east of Harar. This operation opened the way to attack against the important capital-to-the-sea railroad which joined the highway running north from Harar. In the north, Cheren still held out against the British pressure. It became apparent that ground forces alone could not succeed against stubborn Italian defenses. Plans were made to secure co-operation from the royal air force. In the Gulf of Aden, British naval units succeeded in attacking and recapturing the capital of British Somaliland, Berbera. While the main area of this colony was still under Italian control this action assisted ground forces operating in Ethiopia by keeping Italian troops engaged to the east.

In the last week of March the city of Cheren in Eritrea fell. The British plan to secure air co-operation had proved to be successful. The air operations broke the defense strength of Italians and ground forces were able to move forward and capture the city. It was estimated that 30,000 Italians had been engaged in this operation. The bulk of the main forces retreated to the vicinity of the capital, Asmara, and to the south into Ethiopia. The British continued to advance with the object of completing the operation and securing control over all of Eritrea. Naval forces moved in closer from the Red sea and tightened the blockade around Massawa on the coast. In Ethiopia, the city of Harar fell on the same day Cheren was captured in the north. Italian resistance at Marda pass near Harar had been light and the British forces moved rapidly to Diredawa on the railroad. The capture of Diredawa broke the rail connection between the capital and the coast, and forced the Italian troops to move to the west toward Addis Ababa.

Early in April, the main Italian resistance collapsed on all fronts. In the north the British captured Asmara and occupied the port of Massawa. The control of Eritrea was completed and large British forces had invaded Ethiopia moving south through Aduwa. The capture of Aduwa, scene of the Italian debacle in 1896, was accomplished by British forces hurrying to complete the operations to the south around Addis Ababa. These forces had advanced rapidly and reports indicate that the movement was made at the rate of 25 mi. per day. The bulk of the main Italian forces retreated to the mountains. The Italian commander, the Duke of Aosta, with a force of about 40,000 including some 30,000 native Ethiopian troops, took up a defensive position near Amba-Alagi. Peace terms were offered by the British but were refused and the converging British forces joined at Addis Ababa and completed the main operations. The principal objectives of the campaign had been accomplished and complete control was won when the remaining Italian forces surrendered during the second week of May.

Summary.—The successful conclusion of the east African campaign resulted in considerable gains for the Allies. The principal objective, the elimination of the main Italian armies in east Africa, had been accomplished. Eritrea, Ethiopia and Italian Somaliland had been won from Italy. British Somaliland had been recaptured. Along the Red sea, the Gulf of Aden and the east African coast, Britain had secured the ports of Massawa, Berbera and Mogadishu and controlled the port at Jibuti in French Somaliland. The Suez canal was secured from southern attack. The British naval operations from the Indian ocean to the Suez were rendered secure from Italian attack. Large British forces in Kenya and the Anglo-Egyptian Sudan could be released for duty in other theatres. A considerable number of prisoners had been taken and some useful supplies of ammunition, guns and other weapons secured. Politically, the British gained considerable prestige and the return of the emperor, Haile Selassie, to the control of Ethiopia augured well for the future. British naval and air units had managed to get and give co-ordinated aid when and where needed. Although unity of command had not been tried, the results had been satisfactory and the operations successful.

On the Italian side the results had been disastrous. Large forces had been captured and considerable supplies destroyed or lost. The colonies had passed out of Italian control and practically all Italian identity in east Africa seemed to disappear. The success won by Italian arms against Ethiopia and the dream of African empire appeared to vanish with the defeats suffered at the hands of the Allies. The axis cause had lost a valuable area of operations and now faced Allied forces in Africa which were refreshed by victory and strengthened by the release of forces from east Africa.

XII. THE BALKAN CAMPAIGN

The nations engaged in the Balkan campaign during 1941 included Italy, Germany, Hungary, Rumania, Yugoslavia, Bulgaria, Greece and the British empire. For the most part all operations were confined to air and ground activities with the exception of initial naval escort and convoy duty by units of the British fleet and the later naval and air engagements at the close of the campaign. The decisive actions were the result of air and ground combat.

Objectives.—The German objective in this campaign was to deny the land area of the Balkan peninsula to British forces and to secure a route leading to the area occupied by main British armies in the eastern Mediterranean. This action no doubt included future steps for the capture of the strategic island of Crete. Secondary objectives included the rescue of Italian forces engaged in cumbersome combat with Greece, the elimination of Greece as a British ally, the reduction of potential opposition in Yugoslavia, the extension of the German political and military control in Rumania and Bulgaria, and the addition of all available supplies and sources of supplies for future German war needs.

The Greek forces already engaged in major warfare with Italian forces sought to defend their home front and to secure an area for future attack in company with British allies.

The British objective in compliance with treaty guarantees was to support the Greek efforts against Italian aggression, and to secure a European land base for future use in resuming an offensive against Germany.

Plans.—The German plan of operations appeared to have been a simple advance to the southeast and south seeking to strike the main British and Greek forces and destroy them. In detail this basic plan included the political control of Rumania and Bulgaria to secure an advance base of operations, the separation of Yugoslavia from Greece and the destruction of the Slav forces. In addition, Germany sought to unite her forces with Italian forces in Albania by an advance west from Bulgaria.

The British and Greek forces, limited because of the results of the Italian campaign, and because of necessary requirements for African defenses, adopted a purely defensive plan. Only limited British air and ground forces were available. The whole British effort appeared to be more a compliance with treaty provisions than a determined attempt to seek decisive results. The number of British troops engaged suggested a token force. The plan included a defense along the Bulgarian border coupled with renewed attacks to the west against Italy and the addition of strong resistance in the north by Yugoslavia. The Yugoslavian forces were committed to adoption of the defense of the frontier, but could not be counted upon to enter into any co-ordinated plan of joint British and Greek campaign.

Forces.—The forces involved are estimated approximately as follows: Yugoslavia, 550,000 including 15–20 divisions, 500–700 planes, without adequate reserves of trained man power or modern supplies; Greece, approximately 300,000 including 15 divisions with less than 100 planes operated by British and some Greek aviators. For the most part, the bulk of these forces were engaged in Albania and less than 30% could be expected to assist the British during the German campaign; British troops were estimated at 5 divisions, approximately 100,000, including about 150 planes and small naval craft in support. These actual and potential allies combined presented approximately 1,000,000, with more than 50% of the total represented by the Yugoslavian forces as yet untried in battle and subject to the serious danger of national disorders within the home front.

The German forces in the Balkan area since early in January had been increased to approximately 550,000. The German system of assigning specially designed task forces had been carefully carried out in the creation of this Balkan army Air and ground forces were placed under responsible commanders charged with specific missions under a single supreme commander responsible for the whole campaign. In addition, the Germans could count upon increased assistance as soon as the Italian forces in Albania resumed the offensive and a union of forces could be made.

Operations.—The initial moves made by Germany were launched from Bulgaria against Yugoslavia. These forces sought to separate the Yugoslav forces in the southeast from those to the north One German column overran the small Croatian divisions along the frontier and reached the valley of the Vardar river. At this point the German column split into two parts, one part continuing to the west and southwest to join Italian forces in Albania, the other part turning south through the Vardar valley in the direction of Salonika. Other German columns invaded Yugoslavia from the Struma valley west towards Skoplje, through the Dragoman pass towards Nish, southwest from Rumania toward Belgrade and in the north across the frontier towards the cities of Ljubljana and Zagreb. Along the Bulgarian-Greek border, German forces invaded southward toward Salonika. Success in northern Yugoslavia was assured by the capture of the principal cities of Ljubljana, Zagreb and Belgrade. Political dissension resulted in the establishment of a separate Croat state, and weakened the potential strength of Yugoslavian resistance. In the southeastern part of Yugoslavia strong resistance was overcome in the Vardar valley, and Serbian forces were separated from the Greeks In Greece, Salonika was captured and eastern Thrace cut off from the remaining Greek and British forces. Junction was made between German and Italian columns on the sixth day of the invasion when advance elements met in the vicinity of Struga. Specially trained and equipped mountain troops were used by Germany. In all instances, German armoured forces operating with close and continuous air support, drove Allied forces to the south, overran defensive positions all along the British-Greek front, and meanwhile threatened rear area installations by

heavy air bombing attacks.

Between April 6 and April 8, the initial German attacks succeeded in separating the Yugoslav forces from the Greek forces along the Bulgarian frontiers. This defeat resulted in opening an approach for German columns directly to the Monastir gap at the approximate junction of the Albanian, Yugoslavian and Greek frontiers, and also at the centre of the first British-Greek defensive position. It appears that this gap at Monastir was lightly defended by small Greek forces. Main Greek forces were engaged with Italian troops to the west in Albania. Main British forces were engaged with German columns to the east in Thrace. This disposition of Allied forces had been made dependent upon the ability of the Yugoslavs to delay the initial advances of the German columns operating in the direction of the Vardar river.

On April 9 the British forces, principally made up of Australians, reinforced the Greek garrisons in the Monastir gap area. By April 11 it was evident that this position was untenable and during the period April 11–14 the defensive action was withdrawn first to a line running to the west from Mt. Olympus. When the flank and rear of this line was threatened, a second withdrawal was made to an area around Thermopylae. Here the New Zealand forces held the right (east) and the north of the line, while the Australians held the left (west) flank. For a period of about one week, British forces had been required to fight without substantial assistance from the Greeks. On April 21 the Greek forces capitulated in the west. The result was that large German forces were released for attack against the British position.

During the period April 22 to April 24, the British forces fought a stubborn defense in the vicinity of Thermopylae. The German control of the air and the constantly increasing strength of armoured and mechanized forces made the British position hopeless. The British plan for evacuation was carried out successfully but with considerable loss. During the hours of darkness on April 24–26, the British reported that 19,000 troops had been evacuated from the port of Megara, west of Athens. On the third night, 16,000 were evacuated. Further evacuation was less successful, although small forces were cleared near Peloponnesus where more than 700 were rescued. At the close of the campaign, British claims indicated that from all sources about 45,000 had been evacuated from the area. By May 1 the major hostilities had ended and minor actions consisting of local guerrilla warfare in remote Albanian and Yugoslavian mountain districts, and mopping up actions along beaches and within scattered villages were continuing. Later in 1941, however, the guerrilla attacks in Yugoslavia forced the Germans to move in several divisions to maintain their hold on the country.

Summary.—The Balkan campaign began on April 6, 1941 and major operations were completed in about three weeks ending with the British evacuation by May 1, 1941. Results indicate that the German objectives were achieved in all particulars, while the British and Greek forces, as well as the Yugoslav troops, suffered complete defeat. For Yugoslavia the results of two-day combat found the effective defensive power of the nation scattered and the organized forces rapidly disappearing. Political weakness had prevented unified action and revolts within the state precluded the adoption of a strong defense. The military operations were brief, but according to nazi reports more than 300,000 Serbian prisoners had been captured. It is difficult to estimate results alone in the light of military values. The Yugoslav capacity to resist had disappeared. No organized army existed to defend the country. The area occupied afforded Germany not only strategic security, but also specific if limited supplies of raw materials, control over all available industrial potentials, and considerable booty in the form of modern war equipment. Yugoslavia lost control of the Adriatic coast line to Italy, and faced the necessity of supporting both Italian and German occupation forces controlling all military objectives within the state. On all fronts, military, political and economic, the Yugoslavs lost national identity.

Greece lost heavily in the Balkan campaign. After months of valiant defense against Italy, and at times approaching the possibility of victory over this invader, Greece was overrun by strong German invasion forces. Germany claimed more than 200,000 Greek prisoners and considerable war equipment. Along with Yugoslavia bewildered within and rapidly defeated from without; Bulgaria, overrun without resistance and weakened by failure to achieve unity; and Rumania, long since subject to nazi control; the small, unified, defiant Greek nation, whose brave struggle had won the praise of democratic peoples and the support of the British, fell before superior force despite valiant efforts to resist.

The British lost the great opportunity to secure a base on the continent from which future attacks might be launched against Italy and Germany. The loss of an ally, Greece, was secondary in military importance so far as strength in numbers and equipment was concerned. This loss was of primary importance so far as the strategic value of the Greek land and sea areas was concerned. In addition, the unstable character of the governments in Rumania, Bulgaria and in Yugoslavia, all subject to the control of the most powerful invader, might have been swung to the side of the Allies if the British had been able to repulse and eventually advance northward against Germany.

The official British reports on the campaign claimed no more than 60,000 as a total for the forces involved in the campaign. The British claimed about 45,000 had been evacuated indicating over-all losses of about 25% in man power. Of this potential loss, the German claims indicated approximately 9,000 British had been taken as prisoners.

British naval losses were admitted to include a destroyer, an escort vessel and four transports. This indicates about 30,000 tons. Considerable armoured equipment was lost, and although claimed to be destroyed before falling into German hands, all abandoned equipment was lost for British use. British available air forces had been small and the relatively few planes in action had been destroyed or withdrawn.

Germany claimed over 500,000 prisoners, 500,000 rifles, 1,000 guns, thousands of machine guns, vehicles and large amounts of ammunition. More than 300,000 tons of shipping constituted the German report of Allied losses in naval and air warfare. Germany admitted losses of 300 officers and 5,000 men killed, wounded or missing in action.

The military action appears to indicate the following factors contributing to German success:

a. Concentration of well-balanced task forces—even including specially prepared mountain troops—adequate in strength and equipment, trained and organized for a particular mission and operating under a single commander.

b. Close and continuous co-ordination of all air-ground operations.

c. Battlefield mobility and the rigid adherence to the single over-all mission—the relentless pursuit, encirclement and ruthless destruction of the main forces of the enemy.

British failure is indicated by:

a. Lack of adequate strength and subsequent inability to organize a co-ordinated defense.

b. Lack of equipment, particularly in air forces.

c. Inadequate naval strength, permitting replacements of men and materials.

XIII. THE CAMPAIGN IN CRETE

The German conquest of Crete was accomplished during the period May 20–June 1, 1941. A military analysis of the campaign indicates that the outstanding military development was the employment of air forces in this operation. Reports indicate that this was the first occasion in military history of the transportation, supply and support of a full-sized expeditionary force by air. The nations involved in this campaign include Germany, Italy, the British empire and Greece.

Objectives.—The German army sought to secure a land base in the Mediterranean for air operations against Allied fleet operations, against land bases and sea bases in north Africa and the Suez canal, and in support of axis land operations in Libya. Secondary objectives included the denial of a land base to the British for air operation against German-controlled oil fields in the Balkans, and against axis fleet operations along the island route from the Black sea to the Adriatic; the opportunity to further political pressure on Turkey to join the axis powers; the establishment of air control over the Mediterranean and the establishment of a base for any future military operations in the near east.

The British objectives in this campaign appear to have been the defense of the island of Crete in order to deny the site to the axis powers, and the retention of the military advantages which the island afforded the British and their allies.

Plans.—The German plans were based upon a principal reliance on their air forces to accomplish the objectives of this campaign. Early in May the German armies had completed the conquest of the Balkans. Adequate ground forces existed and supplies were considered ample for an attack against Crete. Naval forces were entirely inadequate. The final plan included an air attack against the royal air force to establish air superiority, the air operations against the royal navy to overcome naval superiority, air transportation of land forces to the theatre of operations, air support for landing forces and an air combat force to secure success for land operations.

The outstanding element of this German plan was that all operations were placed under a single responsible commander. This meant that air, land and naval forces were to be employed as one man decided. This contrasts somewhat with the absence of a unified command in the British plan described below.

The British plans for the defense of the island of Crete included the disposition of ground forces to protect the airfields and to protect the naval base at Suda bay. The British plan indicates that the defense was based upon maximum dispersion of available ground forces to defend likely areas of German attack, coupled with some reliance on small air forces and the limited employment of superior naval strength when operations permitted such use. It must be emphasized that all British plans were subject to the independent actions of the three separate and separated British land, air and naval commanders. These commanders were located in Cairo in Egypt. Only during a part of the operations was the naval commander with the fleet in the Mediterranean. The air force commander was in Cairo reorganizing air forces and taking instructions from the air ministry in London. Although General Freyberg directed ground operations in Crete, the principal ground force commander was similarly in Cairo, reorganizing the British army in north Africa, with the highest headquarters located in London.

Forces.—German forces have been estimated as follows from various British reports covering the operations:

	Approximately
Parachute division	5,000
Air infantry troops	5,500
Mountain division	5,000
	15,500

An over-all estimate of the German strength indicates a grand total of approximately 18,000. The equipment of these forces is reported to have included light artillery and some motorcycle transportation. Reports of operations by German light tanks were not confirmed. It is likely that the Germans employed commandeered transportation secured after making successful landings. The outstanding characteristic of the German forces was the number of aircraft employed. Various estimates have been based upon published reports of the operations. An approximate figure indicates that the Germans used about 1,500 planes of all classes including gliders. About 50% of this total represented transports. The balance included fighters and bombers in about equal proportions. This composition of the German forces and the organization of the air equipment represented an advantage over the British defense organization and equipment.

The British reports of the operations indicate that the original garrison was approximately one brigade of around 3,500. In addition, there were some Greek detachments of smaller size. Following the evacuation of Allied forces from Greece, large numbers were added to the original garrison. These troops included the Australian, New Zealand, British and Greek forces which had been engaged in that campaign and some marine and naval units which had successfully evacuated these troops. From various sources the size of the defense forces at the opening of the Crete campaign is estimated as follows:

British forces including New Zealand, Australian and marine troops	23,000
Colonial troops including Crete and near east	4,000
Greek forces	10,000
Approximate total	37,000

It must be remembered in any consideration of this estimate that these forces did not represent organized combat troops. In equipment these forces were sadly lacking essential items required for defense. Heavy artillery, tanks, transportation, barbed wire, tools for hasty fortifications, harbour defense installations all were limited in amounts. The outstanding contrast between the British forces in Crete and the German forces was the size of the air forces. No authorized statement of totals was available but from reliable sources it is believed that the British had less than 50 planes in Crete during the operations. Some of these planes had been in the Balkan campaign, some were stationed in Crete and a few were reported to have operated from British airfields in Egypt. Reports of operations clearly indicate great inferiority in air forces. Naval forces were superior in strength to German and Italian naval units. Reports indicate that during operations, the British fleet lost six vessels and suffered damage to several more naval units. No totals were given but, in effect, the relative naval strengths of the opponents show far greater superiority for the British.

Operations.—The initial phase of the German operations included the concentration of German men and matériel at selected sites along the Greek coast and on Italian-controlled bases. Bomber and fighter planes were assembled at Greek airfields at Meneidi, Eleusis, Argos, Attica, the Peloponnesus, Italian Rhodes and the Aegean islands. The actual full-scale combat operations were preceded by extensive air reconnaissance and two or three days of heavy bombing against Crete antiaircraft defenses. (During the course of these initial actions, the Germans sought to find the extent and strength of the British air forces, the amount of opposition to expect from air bases and antiaircraft defenses in Crete and the extent and strength of any British naval forces.) The result of this initial phase was that the Germans established air superiority, discovered the size of resistance in Crete and reduced naval resistance in Suda bay. The actual objectives on the island of Crete were the airfields in Maleme, Retimo and Herakleion. In addition to these objectives, the marine base at Suda bay was another important target.

The German landing attack was reported as beginning early in the morning of May 20, 1941. The actual landing of parachute troops was preceded by several hours of intensive air bombing attack and machine-gun attack by low-flying planes. These attacks succeeded in forcing defenders inside defensive positions and opened the way for parachute landings. About 2,000 parachute troops were dropped near airfields in the vicinity of Maleme. In addition to parachute troops, air-borne infantry was landed from towed gliders. These gliders, carrying 12 men each, were towed by transport planes. Each transport plane towed two or sometimes three loaded gliders. Gliders were landed on level stretches of ground along beaches or near airport sites. Gliders were reported to be about 50 ft. in length with a wing span of 80 ft. It appears that none was equipped with a motor although there were reports of outboard motors for use after making landings in harbours. Armament consisted of one machine gun mounted on the wing. All men carried in the glider landed with full equipment and small infantry supporting weapons (light mortars, machine guns) were carried with them. (The use of gliders was a novelty, but it is not believed to have been extensive enough to affect the results of the action.)

Parachute troops appeared to follow the normal procedure observed in other German actions of this type. Personnel and supplies were dropped in chutes of varying colours. The release of parachutes was begun close to the ground, reported heights ranged about 300 ft. Casualties were reported to be heavy when landings were attempted close to defensive positions. Other landings more distant from prepared defenses were more successful. By morning of the first day, the parachute and glider troops had landed and succeeded in capturing the Maleme airfield. The result of this success was that larger forces were landed by transport planes on the captured airport. Thus the first objective, capture of a landing site, had been accomplished in daylight hours. Late in the afternoon of the first day (May 20) additional parachute landings were made near airfields in the vicinity of Retimo and Herakleion. Estimates indicate that about 4,000 such troops were dropped in these actions. These operations were not successful and British defenses succeeded in retaining the airfield objectives. The principal result of the German action here was that without actually capturing air landing sites, the German forces prevented British troops from moving to the east to the aid of the garrison at Maleme. Later German action of ground forces moving eastward from Suda bay resulted in the loss of Retimo and Herakleion by the British.

On May 21 and 22, continued German action at Maleme succeeded in driving the British to prepared positions near Galatas. Overhead, both day and night, the air combat forces continued relentless bombing attacks on known defenses. Meanwhile the parachute forces discovered and notified air forces of the location of other land and air defenses. Superiority in the air, and the capture of the air landing site, permitted the landing of mountain division forces. The objective was to clean up British defenses in the western part of the island and then drive to the east in the direction of Suda bay. Reports on these air landings indicate that motorcycle detachments were included in the air-borne troops and also that light antiaircraft and antitank batteries were landed at this time. All German operations were successful, the western end of the island was cleared of opposition, and preparations were made to begin a strong offensive from the Maleme area to the east in the direction of Suda bay.

On May 23 and May 24, German operations began along the western coast against the British fleet. The objective of the British fleet was to prevent naval landings by the Germans. The results of the German and Italian attempts to land by water-borne transport were disastrous. No official figures are available, but the British reported success in preventing the landings and achieved the principal objective of the British fleet. It followed, of course, that the British fleet had taken a decided risk by exposing naval units without adequate air protection to attack by superior German air forces. The result of the inevitable German-British air-naval engagement was disastrous for the British. Six naval vessels were admitted to have been lost and a great percentage of the British fleet engaged in these operations was severely damaged. The decision was finally reached that the naval forces could not continue to operate against superior air force and the fleet was withdrawn on May 23.

These air and naval operations permitted the Germans to continue land operations against defense forces unable to secure naval or air combat assistance. Meanwhile, German action alone had resulted in the destruction of nearly all the British air forces available. Another decision to withdraw was made, and the few remaining British planes were ordered to return to Egyptian bases. Complete isolation resulted for the besieged British forces in Crete. On May 27, Canea fell. On the same day, a small Italian force, estimated as a regiment, landed by boat at Sitia in the eastern end of the island. The next day this force began to move in the direction of Herakleion. All the British defense was now at the mercy of superior forces. Around Canea, the British began to withdraw to the south coast to effect an evacuation from Sphakia. German forces pushed to the east to Suda bay and to Retimo. Junction was made at Retimo, and later at Herakleion, with the parachute forces landed in these areas earlier. Pursuit of the British forces continued to the south and considerable fighting took place in the mountains north of Sphakia. The main British forces succeeded in retreating from the island, although air attacks on naval units resulted in the loss of several transports. By June 1, 1941, the loss of Crete was conceded, and German and Italian forces continued to consolidate gains and mop up the remaining isolated and weak resistance on the island.

Summary.—German losses reported by the government admit a total of 5,893. British forces lost 12,920 while successfully evacuating 14,580. Germany claimed over 12,000 British prisoners. The brief operations secured for Germany all of the objectives of the campaign. A land base had been secured in the Mediterranean for operations against the British fleet and in north Africa. The oil fields of the Balkans were made more secure against Allied air attacks, and axis shipping from the Black sea to the Adriatic was less vulnerable to both air and naval attack. Turkey was forced to reconsider political action in relation to the axis, and Germany had secured a potential base of operations for future military action in the near east. In the tactical field, Germany had attempted and succeeded in organizing and launching the first all-air-controlled invasion of a land base de-

fended by superior land and naval forces. Once again it was proved that air forces can defeat naval forces inadequately supported in the air.

The British had lost a valuable position in the Mediterranean from which her fleet and land bases in Egypt were vulnerable to attack. British air forces were denied desirable sites for air attack against axis-controlled shipping. Political prestige was lost, in so far as the near east and Turkey were concerned.

The air invasion consisted principally of air-borne ground forces prepared to fight on land with the co-ordination of air support. Most important was the element of surprise, both as to the time of attack and the method to be employed. A military analysis cannot fail to emphasize that a paramount lesson of this campaign was the German organization of a task force equipped with adequate means to accomplish a specific job, all forces within it being under a single responsible commander.

XIV. THE NEAR EAST

The nations involved in the campaign in the near east included Vichy France, Free France, the British, Germany, Italy and Russia. In addition to these nations, the states of Palestine, Trans-Jordan, Syria, Iraq and Iran were the scenes of the operations and participated in the action.

Objectives: General.—The principal British objectives in all military operations in this area included the denial of the area to any axis forces. This objective included the security of the east flank of the Suez canal and the whole British position in the eastern Mediterranean. Additional objectives included the control of the Vichy-dominated government and armed forces in Syria; the control of the governments in Iraq and Iran; the security of oil supplies in this area; the control of the Trans-Iranian railway from the Persian gulf to the Caspian sea; the protection of the area across the routes to the Suez and to India; the extension of political pressure toward Turkey in regard to the Allied cause; and the extension of British prestige generally in the near east.

The axis objectives were principally concerned with securing control of the governments in Syria, Iraq and Iran in order to assure themselves of the vast near eastern oil fields and to facilitate further moves toward Suez or to the east.

Syria sought to retain its form of government operating under an agreement made between Vichy France and Germany signed in May 1941.

Iraq and Iran hoped to retain independence and to maintain a neutral status in regard to the axis and the Allies. Iran particularly hoped to be free from Russian intervention. Both states resented Allied or other control of the oil and other resources within their borders.

Iraq.—The Iraqi government was unstable during the early months of 1941. As a result of a revolt within the state a pro-axis premier took charge of the principal government powers including control of the armed forces. An early British agreement with Iraq permitted British forces to occupy certain sections of Iraq. The change in government leadership rendered the agreement void and increased the risk of essential German control. Despite attempts to reconcile political disagreements and reach a peaceful solution, hostilities began in May 1941.

Plans.—The axis plan apparently included the establishment of rear bases in Greece, the Aegean sea and the Italian island of Rhodes, while establishing advance bases in Syria and if possible in Iraq. Air transportation seemed to be the principal means relied upon for all movements to the near east. Action in Iraq appeared to be a prelude to action in Syria.

The British plan included attack upon all axis bases by air from Egypt and the near east, combined with fleet action along the Syrian coast and ground action in Iraq. The Iraq action was considered a necessary preliminary to operations in Syria.

The Iraqi plan was not immediately clear. It appeared to include the defeat of British forces within the border coupled with joint action with German forces whenever the new Iraqi government secured control over sizable groups of Iraqi armed forces.

Operations.—Axis forces established rear bases for air operation in Greece, the islands of the Aegean sea, and in Italian Rhodes. Advance bases were established within Syria at Aleppo, Palmyra and Damascus. Air and naval forces mined the eastern and southern coastal waters off Cyprus. The British royal air force began operations by bombing the rear bases and the forward bases of the axis forces. Germany replied by bombing Alexandria and the Suez canal, and followed up these attacks by bombing British forces at the Iraqi airport of Habbaniya and establishing an advanced airbase in the vicinity of Mosul. The British had already sent forces from Libya and Egypt to Palestine and Trans-Jordan. A large British column was formed and Iraq was invaded in the direction of Habbaniya. At this airport, British forces, already in possession by virtue of the earlier but disputed Iraq-British agreement, had been surrounded by Iraq troops and bombed by German air forces. The British column succeeded in making the relief of the besieged troops and drove the Iraqi forces eastward to Feluja. The Iraqi troops had resisted stubbornly at this point and flooded the area between the Euphrates and Tigris rivers, preventing the uninterrupted advance of the British on the city of Baghdad. Meanwhile German officers were organizing Iraqi troops for an attack on Basra in the south, while German air forces continued to hold Mosul, and continued air attacks on all British forces. The British royal air force attacked motor convoys of ground forces moving from Syria in the direction of Iraq. The British fleet occupied bases at the head of the Persian gulf and moved north and attacked Basra. After three weeks of scattered air and ground action the Iraqi rebel government fled to Iran. The collapse of all Iraqi resistance followed promptly. German forces withdrew from Mosul and Basra while Iraqi troops surrendered at Baghdad. The operations closed with the British forces in complete control of all Iraq.

Summary.—Within three weeks British forces had succeeded in defeating a rebellious army in the neighbouring state of Iraq, denied the area to the axis powers and secured the land area and the natural resources of the country. Iraq lost complete control of her own future, at least for the duration of the war, and suffered slight but apparently unnecessary casualties.

Syria.—The existence of axis officials in Syria, particularly those members of the armistice commission, resulted in a growing control by Germany over the Syrian government, the armed forces and the productive wealth of the state. Within the armed forces the majority appeared to favor the Vichy French government and to oppose the Free French organization. Axis activities within the state established the risk to the Allied positions in the near east. Operations resulting from the military actions in Iraq led to the opening of hostilities in Syria.

The British plan of operations included a land invasion of Syria from Palestine, Trans-Jordan and Iraq. In addition the royal air force was to attack axis air forces and French garrisons resisting the invasion. Meanwhile, the British fleet operating in the eastern Mediterranean was to be employed against the seaports to assist the land attacks.

The axis plan of operations appeared to be limited to air action plus the activities of many German nationals who were already in the country co-operating with the French army of the Levant.

British forces included Arabs, British, Scots, Anzacs, Canadians, Sikhs and Gurkha Indians and the Free French forces under General De Gaulle. The Vichy forces of the French army of the Levant included Senegalese, Annamites, Algerians, Moroccans, Lebanese and regular French troops. The total of British forces has been variously estimated as three to five divisions plus native troops and Free French forces. British equipment was considered excellent and included considerable artillery, tanks, armoured vehicles and about four hundred planes. Axis air forces were inferior in numbers and the number of troops appeared small and were apparently unorganized. Within the British forces, consideration had to be given to the Arabians' tribal feelings in regard to the holy city of Damascus as well as additional consideration to the possible loss of Vichy-controlled naval units to Germany if the French army of the Levant was too severely handled. All forces were mixed and this factor affected the conduct of the operations.

Operations.—On June 8, British forces invaded Syria from Palestine in the direction of Beirut on the coast, from Trans-Jordan through the mountains in the direction of Damascus, and from Iraq in the direction of Deir Ez-Zor and toward Aleppo. In the southwest the columns moving north toward Beirut joined at the ancient city of Tyre. Australian forces led the attack to Sidon from Tyre and succeeded in capturing the city. Strong French resistance resulted in the recapture of Sidon, and not until the British fleet bombed French positions from coastal waters could the British counteroffensive succeed in taking Sidon a second time. As these columns moved to the north the fleet continued to operate against French ports and against French columns moving along the coastal highways. Beirut fell after combined action by the ground forces moving north from Sidon and from the vicinity of Kisswe south of Damascus.

Farther to the east, British forces moved to the capture of the town of Kisswe and after four days of strenuous resistance captured the stronghold and moved north to besiege Damascus.

In the north, two columns separated by about 100 mi. moved simultaneously from the Iraq frontier toward the objectives of Aleppo and Palmyra. The northern column of Arabian troops continued to push toward Aleppo and toward the coastal city of Latakia. The southern column moving through Deir Ez-Zor swung to the south to capture Palmyra. Success at Latakia in the north would assist the fleet in the defense of Cyprus. Success at Palmyra would open the route to Tripoli through the city of Homs.

As the ground operations continued, the royal air force continued operations against obstacles holding up the advance. That action continued to effect necessary co-operation. It must be recorded that the limited axis intervention in these operations, the division of loyalties within the French army of the Levant, the precarious loyalties and tribal customs of some of the native forces and the mixed character of the Allied forces, all contributed to the final results of the military action. After 33 days of combat, the campaign ended on July 10 when an armistice was declared and hostilities ceased. Four days later, on Bastille day, the formal treaties were signed.

Summary.—In less than five weeks the British had succeeded in the invasion of Syria and the defeat of armed resistance within that territory. Reports indicated that the Syrian losses were about 9,000

casualties while the Allied losses totalled about 1,500. By terms of the treaty, French prisoners were released and repatriation granted to those who requested it. Of a total of around 33,000 French forces it was reported that approximately 14,000 were repatriated to France. The British secured rights to occupy Syria for the duration of the war and this permission included control of war materials and public utilities.

Iran.—In April 1941, the state of Iran made an agreement with Germany which permitted large numbers of German specialists to enter the country to assist in the operation of oil wells and the operation of pipe lines. This country produced an estimated 78,000,000 barrels of oil annually. Pipe lines ran to the Persian gulf and extensive oil wells were in operation near the Caspian sea and the Iraq border. Just to the west of the Iran border pipe lines from Kirkuk in Iraq ran to Syria and Palestine. To the east are Afghanistan and Baluchistan, doorways to the British empire in India. The Trans-Iranian railroad connects the Caspian sea with the Persian gulf. To the north are Russia and Turkey. Late in August, Russia was engaged in war with Germany, and Turkey was still a doubtful neutral. German infiltration into Iran had continued despite frequent protest by the Allies. The British decided to take action and opened hostilities at the end of the month. The nations involved in this campaign included Germany, Iran, Russia and the British.

The axis objective appeared to be the maintenance and extension of growing controls over the Iran government and the natural resources of the country. The British objective was to further Allied control in the near east and deny the axis access to oil and to a position for future attack. The Iran government apparently wanted to retain its independence, be free from both Russian and British interference and continue friendly relations with Germany.

No organized axis forces participated in the campaign. Apparently all axis action was confined to the operations of axis representatives in control of oil industries and possibly control of railroads. The Iranian army had an estimated strength of about 200,000 including reserves. Equipment was not complete and in some cases far from modern. Operations were so limited that it is doubtful if more than a few hundred men were in action. Small naval patrol boats comprised the navy.

British forces were smaller in numbers than the Iranian forces. But here again operations were limited and only small British land forces were required. British naval forces were far superior to the Iranian naval units.

The Russian forces outnumbered all other contestants. Apparently three to four divisions were assembled for operations. Air forces appeared numerous but few were actually engaged in operations.

Operations.—Russian forces in the north moved south on either side of the Caspian sea. In the northwest one column captured Tabriz as the second column moved south along the seacoast toward Pahlavi. To the east of the Caspian, another column captured Bandar Shah, the northern terminus of the Trans-Iranian railroad.

On the first day of hostilities, red bombers flew over the capital city, Tehran, dropped bombs, and within a few hours orders had been issued by the Iranian government to cease firing. In the west the British invaded Iran from Iraq, captured an oil field near the border, and drove toward Kermanshah. British naval forces defeated the tiny Iranian navy, sank several axis merchantmen and landed forces at Bandar Shahpur, the southern terminus of the Trans-Iranian railroad at the head of the Persian gulf. These forces moved rapidly to the north and captured oil refineries at Abadan. British forces concentrated in Baluchistan were not required for operations. Hostilities ceased within an estimated 80 hr. after they began. Iranian resistance was easily overcome.

Summary.—Within a few hours the Allies had established control over Iran. For the British the victory provided a controlled route for supplies to Russia and brought Russia closer to the Allied camp. German infiltration into Iran had been eliminated and the way was open to establish an Allied line south of the Caspian if the Germans crossed the Dnieper. Germany lost an opportunity to secure a base for future operations against Russia and the British and realized that axis intervention in the near east had been progressively eliminated. Iran lost her independence and faced the occupation by Russian and British forces for the duration of the war.

Russia secured a valuable supply route to the south and the Persian gulf. In addition the ties were strengthened between Russia and the Allies, and an area was secured for possible resistance against the axis if operations to the north required a new defense.

Summary of Near East.—The Allies, operating with mixed forces, had secured Iran, Syria and Iraq from the axis or axis-controlled governments. Large areas were occupied, rich in oil and affording valuable sources of raw materials for war. Allied prestige was increased in the east. The route to India was secure. The Russian left flank was supported and a supply route assured to the Persian gulf. The right flank of the Suez had been secured and England's position in the eastern Mediterranean strengthened.

XV. THE RUSSIAN CAMPAIGN

The nations involved in this campaign included Germany, Finland, Hungary, Rumania, Italy and Russia. The areas of the countries of Latvia, Lithuania, Estonia and Poland were included in the war zone. The period of time covered by this analysis of the campaign begins on June 22, 1941 and covers the six months to the end of the calendar year.

Objectives.—The principal objective of the Germans and their allies appears to have been the elimination of the Russian armed forces. The German nation sought security in the east to permit freedom of action to the southeast, the south, the southwest or the west. Success for Germany would result in the acquisition of the industrial areas of Russia west of the Urals, insure vast additional stores of grains and foodstuffs, open the way to the oil supplies in the near east and Russia, encompass the rich agricultural areas of the Ukraine and the Donetz basin and furnish materials for continuing the war for an indefinite period. Strategically, the elimination of the Russian forces and the occupation of large areas of Russia would result in surrounding China with axis forces both to the east and to the west. Also, this success would bring the axis closer to the near east and to the road to India. It appears that Finland sought the return of the areas lost to Russia in the recently completed war. Other German allies had individual motives which looked toward the acquisition of territory lost to Russia or the gain of new territories to extend the power of the invaders. Adolf Hitler, the German leader, claimed that the security of the German state and of all Europe depended upon the defeat of Russia, and the elimination of the threat by Russia to extend the system of bolshevism throughout the world.

The Russian objective appears to have been the defense of the homeland. It followed that the objective included the defeat of the German and other invading forces, and the eventual destruction of the nazi and axis system in Europe.

Plans.—Terrain, geography, racial hatreds, time and the weather, were considerations included within the German plans for the conduct of operations in this campaign. Germany was familiar with the terrain on which the operations would take place. The areas in Latvia, Lithuania, Estonia and Poland were areas in which both Germany and Russia had manoeuvred on former occasions. The large plains to the east; the area covered by the Pripet marshes; the river systems; the road nets leading to the north to Leningrad, to the east to Moscow, to the southeast to Rostov; the supplementary rail nets leading to these centres and to the ports in the Baltic and on the Black and Caspian seas; these were terrain features which were the subject of continuous examination by the German high command. The geography of the area of the campaign found Russia far removed from outside sources of supply. So far as the geography is concerned, the factor of great distances marked this campaign distinctly. On the initial combat front, the opposing forces faced each other along a line equal in length to the entire United States-Canadian border. On the north flank, national hatreds smouldered within Latvia, Lithuania, Estonia and Finland, each a nation which had recently lost territory to Russia. In the south, Rumania had lost a valuable area to the Russian state. Within Russia the nucleus of a revolt existed in the disaffected group representing and supporting the Ukrainian republic. All these groups could be counted upon to fight against the Russian national objectives. The time factor demanded that the German objectives be accomplished at the earliest possible date and at the expense of the minimum effort. The weather forecast indicated that the Germans could count on approximately three months of reasonably good weather.

All these considerations undoubtedly were weighed carefully by the German high command before the opening of hostilities. It appears that the estimate made by Germany as to the duration of the campaign was a maximum of four months, with some reasonable expectations that success might be secured in three months or even less. It appears that the tactical plan was to include the familiar pattern of the "keil" and "kessel" method of attack, in which a wedge is driven into the enemy line to create a gap which allows large motorized and mechanized forces to rush through and to cut off and encircle and destroy the armed forces trapped by this operation. All operations on the ground were to be preceded by large-scale air attacks to gain air superiority over the Russians. The first objectives of the attack were to be Leningrad on the north and the port facilities on the Baltic, Moscow in the centre, Rostov and the Ukraine in the south. The Finnish plans appear to have been a deliberate ground attack across the frontier over the areas recently lost to Russia, and assistance to German forces to the south of Finland with the possible acquisition of control of the Russian ports on the Baltic.

The Russian plans for the campaign included a defense in depth along the frontiers facing Finland and Germany as well as Rumania in the south. This plan of defense was adopted with a view of the assumption of the offensive whenever the situation would permit. The Russian form of defense included a strong resistance in great depth around large, as well as small, centres of population. In addition, the Russians developed the plan of the destruction of supplies and the deliberate burning and blowing up of buildings and utilities whenever the German advance threatened these installations. As the campaign progressed over the first six months, the Russians in December adopted a strong offensive plan which included the pursuit of the retreating Germans and the initiation of relentless attacks whenever the opportunities were available. In all plans made by the Russian forces, the assistance of the civilian population was considered as a military factor. Russia has always classified the armed

forces as the People's army, and for defense purposes has considered the civilian population available for guerrilla warfare and for siege defense.

Forces.—The potential strength of the Russian army has been estimated as 10,000,000 men. This figure does not indicate clearly the maximum total initially available for front line use, or the final total engaged during the period covered by this analysis. Russia has considerable man power, and under the demands of a long war could probably organize, train and equip for combat, several million men. It is not known definitely how many men were engaged at the opening of the campaign. The total was likely below 2,000,000.

As the campaign continued over several months, it is likely that the Russian forces increased in numbers, and it is possible that at the close of the year Russia had some 4,000,000 men in uniform at the front. In equipment the Russian forces appeared to have ample supplies of moderately good types of modern design. In the air, Russian planes were not superior to the German planes but there were large numbers of these and they continued to engage in operations despite admittedly high losses. In mechanized equipment the Russians appeared to have large amounts of vehicles of all classes although it was admitted that they did not compare with the superior German types in operation. In artillery and in smaller field guns, the Russians were well equipped and most of the equipment appeared to be excellent. Small arms and supplies of ammunition appeared to be excellent. In organization the Russians were unwieldy and lacked the flexibility of modern armies in combat. After the Russian-Finnish campaign there was an attempt to reorganize the forces to approach the modern balance between artillery and infantry in the combat forces. However, in defensive warfare, the larger Russian organizations in the field were considered to have adequate strength to offer continued resistance to attack by the modern German columns. In addition, the Russian plan for active defense called for heavy counterattacks limited in extent and suited to the larger Russian type of organization. All Russian forces were well equipped to conduct protracted resistance in isolated groups against German advances. In addition, the Russian civilian population was armed in many instances and prepared to engage in guerrilla warfare.

German forces were estimated to have been around 3,000,000 at the opening of the campaign. It is very likely that these German forces outnumbered the Russians in the first few weeks of the operations. Later estimates of both forces are extremely unreliable due to the conflicting claims made by each side as to the losses suffered as the result of action. It appears that the Russians gradually increased the numbers engaged while the Germans maintained around 3,000,000 total during the first six months of combat. German equipment was generally considered superior in all respects at the opening of the campaign. In the air, Germany had the finest combat aviation seen in operation during any of the campaigns of this war. Mechanized equipment was far superior to the opponent's. Late reports had it that the German government sought clothing for men at the front, but these reports indicate a failure to plan for a long campaign rather than a basic fault in the type of armament available for combat.

A comparison of forces indicates that the Russians had less than 100 divisions available along the front at the opening of the campaign. This total was probably increased to around 175-180 divisions during the first six months. Germany probably had 120 divisions at the start of operations and the Finns, with German assistance, had another 16-20 divisions in the north. To these totals of German and allied strength must be added the size of several air fleets, and the accompanying supply and administrative services. All totals shown are subject to considerable doubt, as figures were not available to neutral observers during the early months.

Operations.—The campaign opened when German forces crossed the frontier and German planes bombed Russian defenses early (3:00 A.M.) on the morning of June 22, 1941. First reports were incomplete. It appears that the operations to the close of June involved three principal areas of attack. On the north, German columns advanced through East Prussia in the direction of Vilna and Leningrad. In the centre, German columns advanced on a broad front in the direction of Bialystok, Minsk, Smolensk and Moscow. On the south the direction of advance was toward Kiev in the Ukraine. On June 23, Brest-Litovsk was captured. In a few days, the advance along the centre resulted in a German manoeuvre which surrounded large Russian forces in the Bialystok and Minsk areas. Meanwhile German and Finnish forces crossed the Finnish frontier and launched attacks along the Karelian isthmus and in the direction of Murmansk and Kandalaksha. Smaller forces were concentrated along the frontier opposite Petrozavodsk and north of Lake Ladoga. On the Russian-Rumanian frontier, Russian forces attacked to the southwest, the German-Rumanian forces succeeded in crossing to the east bank of the Prut river. The German attacks along the entire front were made along the familiar pattern of large-scale air attacks, followed by large mechanized attacks combined with motorized units. The German advance was rapid and the fighting around Bialystok and Minsk severe. Russian forces appeared to be offering strong resistance despite the success of German columns in breaking through and surrounding large groups along the extended Russian front.

During the month of July the German forces continued to advance against strong Russian resistance on all sectors of the front. On the Finnish front General von Falkenhorst, in command of German and Finnish forces, advanced on Kandalaksha and captured Salla on July 10. Farther south on the Finnish front, combined German and Finnish columns drove forward toward Petrozavodsk and to the southeast along the Karelian isthmus. The capture of Petrozavodsk would result in cutting the Murmansk-Leningrad railroad. During the month, the reports of these operations were obscure, but it appeared that the Finns advanced steadily against growing Russian resistance. This advance seriously threatened the Russian right, north flank. On the north central front, German columns continued to advance in the direction of Leningrad and the Gulf of Riga. Large Russian forces were trapped in the vicinity of Tallinn. Other Russian forces were heavily engaged in the defense of the islands of Oesel and Dagoe in the Gulf of Riga. At the end of the month, Russian forces were engaged in bitter defensives against combined German-Finnish-Rumanian-Italian and Hungarian arms all along the extended front lines. In the centre, the Germans had advanced from Bialystok, in the direction of Smolensk, and captured the city on the 14th. Russian forces had withdrawn to the Vyazma area, and also were concentrated in the Rogachev area and near Gomel. In this area, fighting had been severe during the entire month, and several counter-attacks had been launched by the Russians against the southern flanks of the German columns advancing toward Smolensk, and after its capture, advanced to the east. By Aug. 1, Germany had reached a line generally along the Vitebsk-Orsha and Mogilev sector while the Russian forces had in many cases remained behind to fight heavy rear guard actions which proved costly to the German armies. On the south, the Germans penetrated deeply into the Ukraine from the northwest in the direction of Kiev, and from the southwest in the direction of Balta and Odessa. During the period July 14 to July 17 in this sector, German columns approached closely to Kiev while Hungarian and German forces advanced more than 60 mi. across the former Russian-Polish frontier. Rumanian forces captured Kishinev, the capital city of Bessarabia. In the south, German columns were north and south of Kiev at the close of the month as the other allied forces continued to make advances through Bessarabia. Reports of large air and tank battles were made regularly by both sides and it is likely that these were of considerable importance. During the month of August, reports continued to indicate German advances all along the front. On the Finnish front it was reported that two large Finnish-German forces under the command of General von Falkenhorst had been increased in size and had received additional equipment including planes. These forces continued a steady and deliberate advance to the east and on Aug. 15 captured Sortavala. On the south General Mannerheim was in command, and his forces continued their attacks along the Karelian isthmus and to the southeast around Lake Ladoga. Viipuri was captured toward the close of the month, and the front apparently became stabilized temporarily about 100 mi. northeast of Leningrad. In the Leningrad area, German forces under General von Leeb continued to push forward to clear up the situation around this city, and to reduce Russian resistance in the Tallinn area. Novgorod was captured on Aug. 16, and a few days later the German motorized columns cut the Leningrad-Moscow railroad, about 75 mi. southeast of the city. Throughout the month, heavy fighting took place around the suburbs of the city of Leningrad. On the central front, generally described as the Moscow front, German forces were commanded by General von Bock. In this area the German forces met strong resistance east of Smolensk and to the south in the Gomel area. Strong German attacks drove the Russians out of Gomel toward the close of the month and the central German columns advanced to the east. Russian counterattacks were reported throughout the entire month against these German forces, and it appeared that the German advances were appreciably slowed down. On the southern front, the German forces under General von Rundstedt and the Rumanian forces under Antonescu continued the advance into the Ukraine and along the shores of the Black sea. Early in August the Odessa-Cherkasy railroad was cut by German armoured forces operating in this area. As a result of this action, large Russian forces were compelled to withdraw in the direction of the Crimean peninsula. German columns drove to the east in the direction of Kirvoi Rog, and to the south between Odessa and Nikolayev. On Aug. 15, Germany claimed the capture of Kirvoi Rog and also announced that German forces had advanced north of Nikolayev. Late in the month Odessa was surrounded and the Russians suffered heavy losses as a result of German attacks on convoys trying to evacuate forces from the city. On the 26th Dnepropetrovsk was captured and it appeared that the Crimean peninsula would be cut off from the mainland. All along the extended front from Murmansk to the Crimea, the Germans and their allies had advanced to the east during this month of August. Russian resistance had increased and Russian forces which had been encircled by German columns had refused to surrender and were continuing to offer serious resistance to capture or destruction. The Finnish front was not completely quiet but it appeared to be stabilized temporarily. Leningrad was under heavy and persistent attack and the Germans claimed that Tallinn had been evacuated by Russia with heavy losses. The German claims were indicative of complete as-

surance that the final victory was a matter of a short delay. It remains true, however, that throughout the month the claims of both sides were considered exaggerated and it was difficult to be convinced that a final outcome of the struggle was imminent.

September proved to be a costly month for all forces engaged. Russia had serious losses, not alone in man power, but also in vital areas. Viipuri was lost to General Mannerheim, and it appeared that continued advances would be made by the German and Finnish forces in the southern Finnish theatre. Such an advance would threaten Moscow from the northwest.

There were some signs that a separate peace might be made with Finland, but these indications never became the subject of report from official sources.

Leningrad had been completely surrounded, and to the west Russia had lost Tallinn in Estonia. On the central front, strong German drives pushed the Russians to the east despite spirited defense. Some German forces on the right flank of the central group turned to the south to assist in the encirclement of Kiev in the Ukraine.

Farther south, strong German columns attacked Kiev from the south and the southeast and besieged the city, the third largest in Russia. It appeared at first that the capture of this important centre would result in extensive losses of men and equipment, but the Russians claimed that they were able to withdraw large forces to the east. East of the city, the retiring Russian forces were engaged by the Germans, and severe losses were inflicted.

The new direction of the German drive threatened Kharkov. Meanwhile, along the Black sea and the Sea of Azov, Odessa was still besieged and the Crimean peninsula cut off from the mainland. German attacks continued on this area and particularly upon the naval base at Sevastopol, and the eastern exit leading to Rostov.

It was expected that the Germans would increase the tempo of the attacks in order to seek a decision before the advent of full winter weather.

In October, the German government announced a final drive on Moscow to end the war before the close of the year. Early in the month, Russian counterattacks began in the Leningrad area. Throughout the entire month, the German forces before this city appeared to be on the defensive frequently, and appeared to be unable to attack successfully and capture the city. In the Moscow area Vyazma fell on Oct. 13, and within a few days the Russian government announced a state of siege in Moscow. German columns approached within 60 mi. of the city. On the Finnish front, strong attacks were launched in the Lake Ladoga region, and both the Russians and the invaders suffered severe losses. On the southern front Odessa was captured, and in the Ukraine Stalino and Taganrog fell. The German advance on the central front continued and on Oct. 24, the leading elements were reported within 37 mi. of the capital city. On Oct. 25, Kharkov was taken and German columns moved forward rapidly to Rostov. By Nov. 1, it became apparent that despite these advances the speed of the German drives had slowed down. It was also expected that renewed drives would be initiated. In the Crimea the capital city, Simferopol, was captured and the naval base at Sevastopol besieged. Air attacks upon Russian shipping in the Black sea continued to take heavy toll of lives and continued to disrupt the Russian plans for the defense of this area. German columns moved to the east toward Rostov and claimed the capture of that city. On the Moscow front, furious engagements with large losses on both sides found the Germans along the line Kalinin-Klin-Moshaisk-Maloyaroslavetz-Tula on Nov. 25. Moscow was in serious danger of capture. In the south, at the close of November, the Germans had withdrawn from Rostov to the west, and it appeared that they would go on the defensive in this area. Late in November the attacks on the city of Moscow were resumed.

December marked the limit of the eastern advance of the German forces. Russia rallied, and with the aid of reserves of both men and supplies stopped the German assault. Some German attacks were made along all fronts during the month, but the principal German action was defensive and at times the Russian attacks took on the character of a pursuit. Around Dec. 15 the German forces began a general withdrawal to the west. This may have been an action which had been the result of a previously made plan to occupy a selected defensive position. It was not clear as the year closed whether the withdrawal was such a strategic decision or the result of spirited Russian attacks. Along the entire Moscow front, the Russian forces continued to launch heavy attacks at the close of the year. On the 29th, the Russians claimed the recapture of Kerch and Theodosia. On all fronts the Russians appeared to have adopted an extensive offensive which promised to be serious for the safety of the German position if it remained unchecked. The year ended on a hopeful note for the Russian nation; the greatest armed force on the continent had launched a determined attack lasting some six months and had failed to take the principal objectives of that attack. In addition, the Russians had not only stopped this attack, but had adopted the offensive and it appeared that unless the Germans built up a heavy defensive without delay, the Russians would be able to drive the invaders out of the country.

Summary.—It appears that the German armies and their allies employed all known modern means to overcome the Russian armed forces. The announced plans of the German armies contemplated an early decision. The results of the first six months indicate that these plans were not accomplished. It appears that the method of mass defense used by the Russians, the enormous distances involved, and above all the willingness on the part of all Russians, both in and out of uniform, to resist, combined to prevent the German success.

In this campaign, the great German transportation system broke down for the first time. The great distances and the weather contributed to make it more and more difficult to supply the German columns as they advanced deeper into the vastness of the country. Thus the value of the German air and mechanized forces was reduced, and the Russians were given valuable time to establish their own industry and supply facilities out of range of the Germans, beyond the Urals. This was one of the major factors of the campaign and, indeed, the entire war.

As for the Russians, the wisdom of their strategical conception cannot be overemphasized. Their avoidance of major engagements on the frontiers, their tactics of drawing the Germans deeper into Russia until supply difficulties and winter blunted the enemy's weapons, all were masterpieces of military tactics.

At the end of 1941, Russia still remained a potent force in the east. Germany was not free to engage in any adventure of great consequence elsewhere on the continent so long as Russia remained undefeated. The strength of German forces available for another operation was decreased as a result of the Russian campaign. The spread of the war in December brought other powers into the conflict and made more serious the failure of the German armies to attain their Russian objectives.

XVI. DIPLOMATIC DEVELOPMENTS DURING 1941

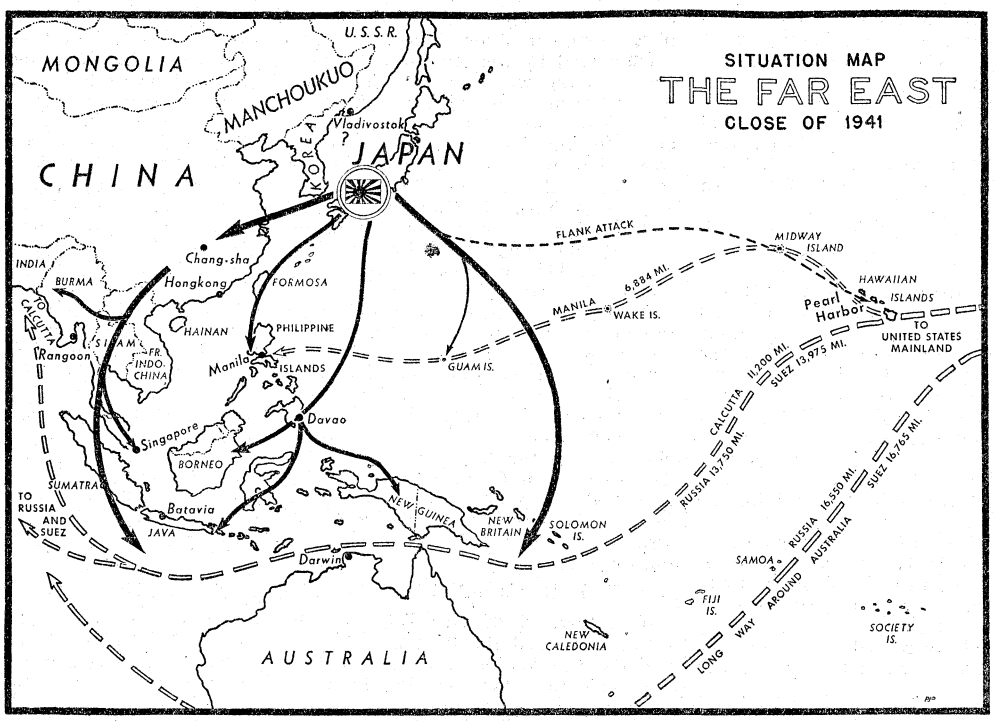
The Spread of the War.—During 1941, the main diplomatic action concerned the Balkans, Vichy France, Russia, Turkey, Japan and the United States. In most cases, diplomatic action constituted a prelude to military action. In Yugoslavia, the overthrow of the pro-axis government of Dragisha Cvetkovitch by pro-Ally General Dushan Simovitch led to the outbreak of the Balkan campaign. Early in June, a sudden coolness in German-soviet relations was followed by a German ultimatum demanding territorial and economic concessions, and the opening of hostilities on June 21. Turkey maintained the delicate seesaw of her relations between the Allies and the axis, although late in the year, the acceptance of American lend-lease aid caused a definite swing in the direction of the United Nations camp. Spain, Sweden and Vichy France continued to struggle desperately to appease the axis, and at the same time to retain as much of their territory and integrity as possible.

It was in the United States, however, that the most momentous events took place. With the conclusion of the Battle of Britain, a tremendous wave of sympathy for Britain and her Greek allies swept through the country. A Gallup poll in January indicated that 68% of the population believed that American security was linked with a British victory. It was then that a bitter, prolonged fight broke out between the "non-interventionists" (isolationists) on the one hand, and the followers of President Roosevelt's preparedness policies on the other. The non-interventionists, led by Charles A. Lindbergh, Senator Burton K. Wheeler and the "America First Committee," insisted that Roosevelt was plunging the country into war, and that all energy should be devoted toward increasing U.S. military and naval effectiveness and that limitations should be placed on the shipment of war materials to the nations combatting Hitler. The fight spread to the floors of congress, where for two months debate raged on the passage of the lend-lease act, known as the Barkley-McCormack bill, H.R. 1776, in the official archives. The bill was passed on March 11, 1941, and constituted America's first active participation in the war. It provided for: (1) the immediate transfer of existing war supplies to Britain, and all other nations fighting the axis, and (2) the establishment of the United States as "the arsenal of Democracy." Two days later, the house of representatives voted an enabling act of $7,000,000,000 to put lend-lease into effect.

In the meantime, Roosevelt had sent Harry Hopkins as his personal envoy to Britain, and Col. William J. Donovan on a secret mission to Europe, Africa and the near east. Wendell Willkie, the defeated Republican presidential candidate in 1940, also made a widely-publicized fact-finding trip to England. On February 9, Winston Churchill tied America and Britain closer together with a historic speech in which he said, "Give us the tools, and we will finish the job."

At the end of March, in a sudden dramatic move, the government ordered the seizure of 300,000 tons of axis shipping tied up in United States ports. This involved 28 Italian, 2 German and 35 Danish vessels—and evoked fierce protest from Germany and Italy. America was moving closer toward active participation in the war.

In April, Italy suddenly closed her consulates in Newark and Detroit. A stream of lend-lease supplies was by this time flowing across the Atlantic to Britain. On May 21, the first open act of aggression against the United States took place when the "Robin Moor," a merchant vessel, was torpedoed in the south Atlantic. On June 16, to curb espionage activity, the United States ordered the closing of all German consulates and agencies by July 10. A similar request was handed to the Italian ambassador, ordering the closing of Italian consulates and agencies by July 15. A few days



later, the axis retaliated by closing American consulates in Germany and Italy. Shortly afterwards, the German and Italian consular officials were on their way home in the U.S. army transport, "West Point." The break was near.

On July 7, American troops landed in Iceland and the United States announced that she was taking over the protection of Greenland and Iceland for the duration of the war. By this time, America and Britain had promised full support to Russia in her war with Germany, and quantities of American supplies were pouring into the soviet union by way of Murmansk and Vladivostok. Britain was beginning to look toward American entry in the war, and British General Wavell called for an A.E.F. to be sent to Europe. On July 23, 1941, Japan suddenly seized bases in French Indo-China, with the concurrence of Vichy France. The United States and Britain immediately applied economic sanctions to Japan, cutting her off from vital tin, rubber, oil and steel, and beginning the deterioration of Anglo-Japanese and American-Japanese relations.

In August, President Roosevelt sent Harry Hopkins to Moscow, and opened the Basra route of supplies to Russia. Early in the month, in a momentous meeting at sea, President Roosevelt conferred with Prime Minister Churchill and evoked the Atlantic Charter. This historic document consisted of the following eight points: (1) there would be no territorial or other aggrandizement by the United States or Britain; (2) in the future, territorial changes would be by self-determination only; (3) every people would have a right to choose its own government; (4) there would be freedom of trade after the war; (5) there would be improved and more equalized standards of existence after the war; (6) there would be freedom from fear and want; (7) there would be freedom of the seas; and (8) the use of force in international relations would forever be abandoned.

On Sept. 4, a German submarine fired a torpedo at the American destroyer, "Greer," in the waters off Iceland and missed. One week later, President Roosevelt issued orders to the navy to "shoot first" at axis sea raiders. Shortly afterwards, the navy instituted full-fledged convoys as far as Iceland. Allied sinkings correspondingly took a big drop. On October 17, the new U.S. destroyer "Kearney" was torpedoed 350 mi. southwest of Iceland. One day previous, in Japan, the comparatively moderate cabinet of Prince Konoye fell. It was replaced by the war-hungry government of General Tojo. With Konoye out the brakes were now released. The military group was in full power in Japan, demanding that "the orient be purged of the United States."

With these two events—the deliberate torpedoing of the "Kearney," and the ascension of the Japanese militarists—the United States faced its greatest crisis since World War I. Obviously America was being squeezed from both ends of the axis. From this point on, the road ran downhill to war.

On Oct. 27 in a Navy day address, President Roosevelt answered the axis by saying "Damn the torpedoes; full speed ahead!" Up until that time, 11 American-owned ships had been sunk. An undeclared sea war now raged, and ship sinkings increased, but all signs pointed to the fact that the north Atlantic was being swept clear of axis submarines.

The first week in November saw the march of events approaching landslide proportions.

The United States and the axis clung to peaceful relations by a shred. Maxim Litvinov was appointed soviet ambassador to the United States, presaging close co-operation between America and the Union of Soviet Socialist Republics.

Japan demanded that the United States withdraw unconditionally from the far east to allow a final solution of the "China incident."

Finally Saburo Kurusu was sent to Washington to discuss "the possibilities for a peaceful settlement."

The second week in November, congress repealed the Neutrality act by a vote of 212 to 194. This provided for the arming of U.S. merchant ships, and allowed U.S. vessels to sail into any part of the world. The situation became more and more tense. Kurusu arrived in Washington, and began an endless series of conferences with the state department. Japan demanded (1) no obstruction of the Japanese effort in China, (2) the lifting of the Anglo-American blockade, and (3) no spread of the European war to east Asia. These terms were irreconcilable with the American basic demands. While desiring peace, America insisted on the territorial and political integrity of China, and was determined to prevent further Japanese aggression. In the midst of the negotiations, a tremendous number of Japanese troops were landed in French Indo-China. The United States demanded to know the reason for this move. Japan replied that the troops were in limited numbers, and were to be used in punitive actions against south China. The negotiations continued at a stalemate.

Then, without warning, on the peaceful Sunday morning of Dec. 7, 1941, the blow struck. The United States was at war.

XVII. THE FAR EAST

During the greater portion of 1941, the undeclared far eastern war between Japan and the nationalist government of China continued, apparently apart from the European conflict. The Japanese, with the concurrence of the Vichy government of France, took over important bases in French Indo-China and, later, to all intents and purposes, completed the investment and occupation of that rich dominion. In China itself, the Japanese operations were limited to minor campaigns in Hunan province, and to extensive aerial activity. Continuous heavy bombing attacks were made on Chungking, the capital of nationalist China, and on the Burma road, which was becoming increasingly important as a supply route from the United States and Great Britain.

Then, on Dec. 7, 1941, in the midst of peace discussions with the United States, Japan struck at widely separated vital points. Japanese bombing planes scored heavily in a surprise attack on Pearl Harbor, the great United States base, nearly 4,000 miles to the east of Japan. At the same time, Japanese naval forces attacked Guam, Midway and Wake—U.S. island stepping stones in the line of communications to the far east; and Japanese troops launched a series of invasion moves against Hongkong, Thailand, Malaya and the Philippine islands of Luzon and Mindanao.

In one day, the European and far eastern conflicts had merged into one world war. The United States, Great Britain, the Netherlands East Indies, the British dominions and several Latin-American nations entered the war against Japan. A few days later, Germany and Italy, together with their satellite nations, came in on the side of Japan. All over the globe, the lines were now sharply drawn.

Japan's first blows were effective. At Pearl Harbor, the United States suffered heavy losses in damage to land and naval installations. One battleship, one target ship, three destroyers, and one mine layer were lost, together with many aircraft. Guam fell and a short time later Wake was occupied, after a gallant stand by a small defending garrison of 400 United States marines. On Christmas day, 1941, Hongkong surrendered to the Japanese after relentless pressure for more than two weeks. Thailand capitulated almost immediately, and Japan used that country as a base of operations against Malaya. In Malaya the Japanese moved swiftly. The British air base at Kota Bharu fell, and soon afterwards, Penang, the big naval base commanding the Straits of Malacca, on the west coast of Malaya. The Japanese then began a systematic advance down both sides of the Malayan peninsula. At the end of the year, Ipoh had been taken, and Kuantan and Kuala Lumpur were threatened. Sizable landings had also been made on the Dutch island of Sumatra, and in British North Borneo and Sarawak.

Possibly the heaviest Japanese blows were struck in the Philippines. Landing some 200,000 troops at several beach-heads on the island of Luzon, the Japanese converged rapidly on Manila. The fall of that capital appeared imminent at the close of the year, although the small defending forces of United States and Filipino troops seemed capable of further resistance for some time. The occupation of the island of Mindanao was completed by the Japanese against comparatively weak resistance.

As the year 1941 ended, the air and naval forces of the Netherlands East Indies and the United States had done appreciable damage to Japanese warships and transports, but on the whole, the Allies were still gathering strength for defensive and offensive action in the far east.

XVIII. THE WAR AT SEA

World War II up to Jan. 1, 1942 had seen conflict on the surface, under the surface and above the surface of nearly all the ocean highways travelled by the ships of all the nations of the world.

Sea power, the predominant force in determining so many of the great struggles in history, still remained a vital and unsolved problem. In the great world conflict between dictatorships and democracies, the democracies controlled the seas, although they were subject to severe challenge in the Atlantic and in the far east at the close of 1941. The British empire, with a powerful fleet, had strong naval forces based upon the British Isles, the Mediterranean sea—both in the east and in the west—and at Singapore in the far east. Other additional strong units were operating along west African shores covering routes to south Africa and to India, as well as additional forces operating along the Red sea and Suez routes. The British had approximately 20,000,000 tons of merchant shipping when the war began in 1939. From various countries defeated by Germany she acquired additional tonnage available outside the European continent. Purchases from neutrals and her own shipbuilding program increased the grand total available for the prosecution of the war. Estimates place the grand total tonnage at about 26,000,000 tons. In these respects, naval strength and merchant tonnage, the British had a decided advantage in the conduct of the war at sea. In addition, the royal navy was operating with an efficient air arm, which, as the war progressed, proved itself to be absolutely vital and essential to all large-scale fleet operations.

The British plan of operation included the protection first of the mainland of the home country, and with this, the protection of the merchant fleet bringing war supplies to the home front and to other fronts. It followed that the converse action for the British naval forces was the denial of free access to the merchant shipping lanes of the world to the opponents; and whenever the opportunity arose, direct naval action against enemy naval forces, and the support of the empire land and air forces in operations against the enemy.

The circumstances of World War II contrast sharply with those of World War I in so far as the war at sea is concerned. In World War II, Italy was an axis partner and had to be dealt with in the Mediterranean sea and in the Red sea and Suez areas. Japan was an enemy and seriously threatened the security of the empire in the far east. While the Dutch East Indies were allies, the source of vital supplies in this area and the security of the commonwealth of Australia and of New Zealand became new responsibilities of the British naval forces. In addition, British naval bases in the far east at Hongkong and at the formerly friendly ports controlled by the French were in Japanese hands. The area to be denied to the enemy by blockade was enormously increased. Germany controlled the western European coastline from Narvik to Spain. From a hundred land bases for planes and dozens of excellent harbours for surface raiders and submarines the enemy could launch strong and continuous attacks against the blockade forces and against the merchant shipping lanes. The Vichy French government was in a doubtful position in so far as the eventual control and use of the remainder of the defeated French fleet was concerned.

To the naval craft and surface raider and the ever-present submarines had been added the powerful effect of the air arm. Geography, air power, the loss of allies, increased demands for supplies . . . these appeared to be the principal characteristics of the conduct of the war at sea for the British in World War II.

The axis powers, increased late in 1941 by the addition of the Japanese, had considerable strength for the conduct of warfare at sea. If Germany was short on battleships, she had considerable strength in submarines and employed available new Atlantic bases to full capacity. Italy had a Mediterranean fleet which might be defeated before the Mediterranean would be free for the movement of vital supplies of men and materials. In the far east, Japan had a powerful fleet not fully tested in modern warfare, but demanding the full attention of the British and United States forces engaged in that theatre. To all this axis naval strength must be added the new and powerful air arm which appeared to be more useful to the axis than to the Allies so far as the development until the close of the year 1941 indicated.

Naval Action During 1939 and 1940.—From the close of the Polish campaign on Oct. 5, 1939, up until the German invasion of Norway, the war at sea constituted the major action in the struggle between Germany and the Allies. Independent German surface raiders and submarines played havoc with Allied merchant shipping, while the overwhelming Allied surface strength maintained a ring of steel around Germany's sea outlets and engaged German naval units wherever they could be met.

Early in the war, the British aircraft carrier "Courageous" was sunk by submarine attack at sea, and shortly afterwards a German undersea craft nosed its way inside Scapa Flow naval base and sent the anchored 29,150-ton battleship "Royal Oak" to the bottom. On Nov. 23, 1939, the British armed merchant cruiser "Rawalpindi" met the German pocket battleship "Deutschland" and was destroyed in a gallant action which saw her firing her feeble six-inch guns at the enemy until decks were awash.

On Dec. 13, 1939, the first decisive engagement of the war took place when another German pocket battleship, the "Admiral Graf Spee," was attacked by three British cruisers, the "Ajax," the "Exeter" and the "Achilles," off the coast of Uruguay. Deploying themselves with extreme skill, the less-powerfully armed British cruisers damaged the "Admiral Graf Spee" which ran for Montevideo harbour and then scuttled itself on Dec. 17, supposedly on orders from Hitler. In the meantime, further British successes were announced by the government in London.

Up until the Norwegian campaign, at least 40 German submarines were sunk, one-tenth of the German merchant marine had been destroyed or captured and the rest driven from the seas.

In the Norwegian campaign, sea power again played a major part. On April 8, the British destroyer "Glowworm" was sunk by two German destroyers while engaged in laying mines off the coast of Norway. On the day the campaign began, the German cruisers "Karlsruhe" and "Bluecher" were destroyed by Norwegian coast defenses, and shortly afterwards, the German battleship "Scharnhorst" was damaged in a long-range action with the British battle cruiser "Renown." During the violent running action in the Skagerrak and Kattegat, several German transports were reported sunk. The battle of Narvik was fought in two separate engagements. On April 10, 1940, a flotilla of British destroyers swept into Narvik harbour to engage strong German destroyer forces there. Two British destroyers were lost and two others damaged in this action, while the German losses were one destroyer sunk, three destroyers badly damaged and seven supply ships sunk. After breaking contact with the enemy, the British withdrew. Some days later, however, they reappeared, this time escorting the battleship "Warspite." The "Warspite" slashed its way into the harbour, all guns blazing. The remaining German units were wiped out. In the last days of the Norwegian campaign, the British and French lost several small units and the aircraft carrier "Glorious."

During the battle of western Europe, sea power played a less important role, except in the historic evacuation of Dunkirk (see *The Battle of Flanders*). It was after the fall of France that the greatest naval engagement, up until that time, was fought. When the French began to demobilize their fleet in accordance with the Franco-German and Franco-Italian armistices, the British took over all French naval vessels in British ports. At the same time they requested Admiral Marcel-Bruno Gensoul to accept internment or surrender for a considerable French squadron based at Oran in Algeria. Gensoul refused, and on July 3, 1940, a British fleet under Vice-Admiral Somerville opened fire. The French losses were heavy. The battleship "Bretagne" was sunk, and the battleships "Provence" and "Dunkerque" were severely damaged and driven ashore. In addition, the destroyer "Mogador" was damaged. The battleship "Strasbourg" managed to escape with an escort of five destroyers and reached Toulon, but only after several hits were scored on it by units of the British fleet air arm.

During the week of July 20, 1940, units of the British and Italian fleets closed in action off the island of Crete in the Mediterranean. The principals in this clash were the Italian cruiser "Bartolomeo Colleoni," known as the fastest warship in the world, and the Australian cruiser "Sydney." In an engagement which consisted mostly of pursuit, the "Bartolomeo Colleoni" was overtaken by the "Sydney" and sunk. A few weeks later, British planes discovered an important part of the Italian fleet in the inner harbour of Taranto. Striking by the light of a full moon, British "Swordfish" torpedo planes launched a devastating attack shortly afterwards, sinking one 35,000-ton Italian battleship and damaging two 23,600-ton battleships, two cruisers and two supply ships.

Further damage was done to Italian naval strength by innumerable attacks on Mediterranean convoys by British surface craft, planes and submarines.

During the Italo-Greek war, the British fleet steamed unimpeded through the Strait of Otranto and bombarded Valona, on the Albanian coast, with 100 tons of shells.

The battle of the Atlantic continued to be the most vital theatre of sea combat throughout the year, as Britain fought desperately to maintain her life lines from America and the empire. On Nov. 5, an epic of the sea was written when a 38-ship British convoy, protected only by the armed merchant cruiser "Jervis Bay," was attacked by the powerful German pocket battleship, "Luetzow." The "Jervis Bay" heroically committed suicide by engaging the "Luetzow" with her six-inch guns until she was blasted into a flaming, sinking wreck. In the meantime, however, 32 of the 38 ships of the convoy escaped.

Such actions characterized the supreme British effort in the battle of the Atlantic.

Naval Action During 1941.—During 1941 the battle of the Atlantic, the battle of the Mediterranean and the battle of the far east were the leading events in naval warfare. In the battle of the Atlantic, Germany announced a war zone including the British Isles and Iceland and extending to the three-mile limit around Greenland and south to the French coast. From the western coastline of Europe, German attacks were launched against the British naval forces. The object of these attacks was to cut the vital lines of supply bringing war materials to the British. A secondary, but included, objective was to reduce the strength of the British naval forces whenever opportunity permitted. Surface raiders ranged throughout the north and south Atlantic waters, attacking and sinking merchant ships, avoiding, if possible, any action with naval forces. Submarines in large numbers, frequently on individual missions, but often in packs of six or more, slipped through blockade lines to wait for their prey along the shipping routes to the British Isles. Overhead the large seaplanes carried death and destruction to both ships and crews by bombing raids against supply ships and by acting as scouts for the submarine packs waiting for the kill. Reports indicate that, during 1940, British weekly losses were around 70,000 tons due to this type of war at sea. In Jan., 1941, the British claimed a new low in shipping losses when they put the total for one seven-day period at 37,000 tons. Losses increased in February and in March, 1941, a new high was reached when figures released by the British admitted a total of tonnage lost for one week at 148,000. Shortly afterwards the British admiralty announced that totals would not be published in the future, and it appeared the Germans had begun to succeed in the war at sea in the Atlantic.

The introduction of the convoy system, the acquisition by the United States of new bases in the north Atlantic, the improvement of antiaircraft defense within the British Isles, the prompt destruction of German naval units seeking battle and the wide extension of British air power in offensive action against German bases on the continent resulted in the reduction of these shipping losses. In addition, both the British and the United States shipyards established new records for speed in turning out new units for the maintenance of vital supply lines. These factors helped during the period from April to Dec. 1941, when the entrance of Japan into the conflict introduced the possibility of serious change. All British and United States forces removed from the Atlantic to the far east would reduce the effectiveness of their joint resistance against Germany in the Atlantic area. At the close of the year 1941 the war at sea in the far east had not developed sufficiently to warrant an analysis of these effects.

On May 27, 1941, the German battleship "Bismarck" was sunk in the north Atlantic after a spectacular naval engagement with units of the British fleet. Reports indicate that the German battleship left the Norwegian coast from a naval base at Bergen on May 22, crossed the north Atlantic to the vicinity of Greenland and was sighted by British naval forces near Iceland on May 23. Apparently the objective of the "Bismarck" was to attack and destroy British naval units operating merchant-ship convoys in these waters. On May 24, British and German naval forces engaged in battle in this area. The scene of the first action was in the body of water known as the Denmark strait between Iceland and Greenland. The "Bismarck" was slightly damaged during this encounter. However, the British battle cruiser "Hood" was sunk and the "Prince of Wales" damaged. The "Bismarck" disengaged from this combat and the pursuit was undertaken by several units of the British home fleet. Air attacks were delivered by planes based on the aircraft carrier "Victorious" before all sight of the "Bismarck" was lost. On the morning of May 26, an American-built naval patrol plane with the British fleet sighted the "Bismarck" en route to the shelter of the French coast. Several large British units, as well as other vessels, closed in for battle. Torpedo bombers from the carrier, "Ark Royal," severely damaged the "Bismarck" and the battleship was forced by this action to reduce its speed. Destroyer units launched attacks which rendered the enemy steering action useless, and the warships "Rodney" and "King George V" silenced the "Bismarck" guns. On the morning of the 27th, the British vessel "Dorsetshire" sank the "Bismarck" off the French coast by torpedo attack. This engagement in the war at sea indicated the two principal types of naval action in modern warfare. The first was the ship-versus-ship action during which the battle cruiser "Hood" was lost and the "Bismarck" damaged. The second was the discovery and the attack upon the "Bismarck" by patrol and torpedo planes. The first type of action is the classical tradition of naval warfare. The second is comparatively new, and while at this time not decisive, the air action contributed considerably to the final destruction of the opponent. The loss of the battle cruiser "Hood" was a severe blow to the British. However, the loss of the new battleship "Bismarck" represented a greater loss of strength to the German fleet in comparison between the relative strengths of the two navies. No decisive answer had been made to the erroneous but persistent question of the battleship versus the aeroplane.

The balance of the war at sea in the Atlantic was concerned with the operation of convoys, the occasional excursion on raids against the European coast and protection of the home front and coast lines against invasion.

In the Mediterranean sea the British were faced with a different, but equally important, task in the war at sea. The British control of Gibraltar and of the Suez was essential to the conduct of the war. These entrances into the Mediterranean had to be in British hands if the Italian naval forces were to be denied the use of the Atlantic and if the British were to continue to use this area as a supply route for the home front. The narrow channel between Sicily and Tunisia, about 90 miles in width, offered the Italians opportunities to launch attacks upon forces moving along the east-west routes between Gibraltar and the Suez. This geographical factor meant that the whole Mediterranean area was divided into two theatres of action. In the western theatre the fall of France meant the loss of Toulon, Corsica, Bizerte, Algiers and Oran as naval bases for joint British and French use. It will be recalled that the existence of France and Italy as allies during World War I made all these circumstances aids to the British rather than danger zones. Far from controlling this area, the British faced a constant struggle to maintain themselves in the war in the Mediterranean sea.

In Jan., 1941, the British aircraft carrier "Illustrious" was crippled by air attacks, while the cruiser "Southampton" was so badly damaged by an air attack it was beyond salvage value and was sunk. In this action, at least one destroyer, the "Gallant," was seriously damaged. These attacks from the air were launched in the narrow channel between Sicily and Tunisia. The fact that they could be launched and could result in such extensive damage indicated the strong challenge to continued British use of the east-west route through the Mediterranean.

In February, the British fleet made raids along the eastern Adriatic coastline off the shores of Albania and also attacked the naval base at Genoa. Earlier raids had already been made against the base at Taranto in 1940. These raids were combined with air attacks to reduce the possibilities of continued Italian naval action.

In March, the British fleet engaged a strong Italian force in the vicinity of Cape Matapan. These Italian forces, moving east in two columns, approached the island of Crete from the west. The British forces moving west from Alexandria and Suda bay in Crete attacked the southern column of the Italian force. One Italian battleship, the "Vittorio Veneto," was badly damaged, three heavy cruisers were lost and two destroyers were also sunk. The British reports indicated no losses in this action. This engagement went far toward establishing the British control in the eastern Mediterranean.

During the Libyan campaigns and also during the campaigns in Greece and Crete, the various elements of the British fleet took part. These actions were not considered to be limited solely to naval forces and are described in the analysis of the military operations.

In the far east the war at sea was confined for the most part to occasional surface-raider attacks upon shipping, and to the limited action of the Japanese naval units against stray Chinese merchant vessels. These circumstances obtained until the entrance of Japan into the war in December. The Japanese war at sea was not confined alone to the operation of naval units. The attacks upon Pearl Harbor in the Hawaiian group, and upon Guam, Midway and Wake islands were combined naval and air actions. In addition, the attacks upon the Philippines, upon the Malayan coast and the East Indies were the result of combined action. The most spectacular naval action was the result of the engagement between the British battle cruiser "Repulse" and the British battleship "Prince of Wales" with Japanese air forces. Without adequate air protection these vessels were attacked and sunk by Japanese air forces. This action appeared to be the only outstanding plane versus ship operation during the year in the war at sea.

In considering the old question of the plane versus the battleship, this action should prove at least one point, which is that the question in itself is irrelevant. Battleships without adequate air support are subject to attack and destruction. It follows that there must be unity of command wherever air and other units are employed in the same action. These forces are complementary in their efforts and must be balanced and controlled as the separate instruments in an orchestra and harmonized and led by a single conductor.

XIX. THE WAR IN THE AIR

Every major air action during 1939, 1940 and 1941 supported the belief that air power is essential to the conclusion of all decisive operations in modern warfare. However, although during the principal military campaigns air power played a decisive role in co-ordinated operations with ground and naval forces, air warfare over England and the continent did not in itself produce decisive results. The conclusion to be drawn appears to be that the surface forces, both ground and naval, cannot secure decisive results without securing equality, or temporary superiority, in the air. In Britain, and also on the continent, air forces alone had been unable to secure decisive results. This necessity for adequate air strength acting in concert with other forces in the conduct of operations is further dependent upon the adoption of unity of command. These are not new lessons of warfare. The number of operations in the war in the air and the magnitude of World War II emphasize their importance.

Aside from the use of air forces in the separate campaigns discussed under military operations, the principal war in the air was concerned with the battle of Britain and the subsequent opening of the battle

of Germany. Early in the year 1941, Lord Beaverbrook, the British minister for air, stated in effect that Britain had more aeroplanes of every type in operation than ever before in her history. During Jan., 1941, the British made the first mass air raid on German bases on the continent. After Dec. 29, 1940, when German air raids over London had been most severe, the axis planes appeared to have reduced the number and the intensity of their attacks. Britain meanwhile had adopted the offensive and was gradually extending the radius of distant attacks on Germany. The lull in German attacks continued in February and many estimates were made as to the disposition and probable employment of the German air forces. Some British estimates placed the German air force combat-plane strength at 19,000 ships. A United States estimate suggested that Germany had about 18,000 first-line planes, with another 18,000 for replacement, available for attack on England. No large-scale attack of this character developed during the year 1941.

It was apparent that the British plan for the conduct of the battle of Britain in 1940 had been changed for 1941. In 1940 the British had fought savagely to maintain air equality over the islands and to attempt occasional air raids over the channel. Now the British extended offensive air action in attempts to destroy invasion bases and to reach far inland to destroy the German capacity to concentrate and support a large-scale invasion. In addition, the British extended the use of the air arm to assist naval and ground forces in some of the operations in the Mediterranean. It was reported that British parachute troops had been dropped in southern Italy during February. In March the British claimed extensive air raids over the continent as far to the east as Cracow. The loss of life due to air raids over Britain dropped to a new low of 1,500 per month compared with the tragic high figure of some 6,900 for the month of Sept. 1940. It appeared that the British air strength had increased to warrant full support of the new British plan for the conduct of the war in the air during the early months of 1941.

During April, furious German air raids began again over widespread areas in England. Despite heavy losses, these raids continued during April and May. In mid-June, after a period of relative quiet, the British initiated the first of their large-scale daylight raids over the channel coast and the German bases. The opening of the German war against Russia and the acquisition of the Iceland base by the United States combined to offer new opportunities to the British in the conduct of the war in the air. New supplies and ships could be expected from the United States. German air forces would be engaged in the Russian war. Britain swiftly improved its air equipment, developed its air defense and air offense tactics and launched repeated attacks against the continent. In July Germany launched no reprisal raids. Scattered German attacks were made over England during August and September. During September, the German air forces appeared to be concentrating on shipping, both along the sea lanes and also against the ports of entry on the coast. British claims in October 1941, indicated that the Germans were dropping large land mines which might have caused the extensive damage to Coventry and to other English towns in earlier raids. The intensity of the British raids over the continent continued during the balance of 1941. Ports were bombed, industrial areas were destroyed, Berlin was under frequent attack and at times both the British and the Russian forces combined in launching raids over the German cities. The full extent of the British raids had to be reduced during a part of November because of poor weather, and also because the German antiaircraft defenses had been improved. This increased resistance resulted in heavy losses of pilots and planes for a short period during this month.

The year 1941 closed with the British definitely equal in strength, and frequently superior in strength, to the German air forces. Complete air superiority appears to be an impossibility. Temporary air superiority may be secured for a short period of time and as a result of large concentrations for operations frequently resulting in large losses of men and materials. Regardless of the excellence of the modern air defenses, some planes will get through to launch at least minor attacks which are not designed to bring about decisive results.

The war in the air developed within the German air forces a system of close co-ordination with ground and naval forces. Unity of command appeared to be the rule. While a separate air force existed in Germany, complete co-ordination appeared to be secured at all times. The British developed a satisfactory type of plane detection for use during day and night, organized fighter commands and coastal commands of great strength and flexibility, and despite occasional heavy losses, adopted extensive offensive actions over the continent. British air co-operation with ground and naval forces was erratic, but showed improvement.

Considerable improvement could be expected as soon as the principle of unity of command in operations became the rule instead of the exception. (H. A. Dr.)

XX. WAR IN THE PACIFIC, 1942–43

The Japanese attack on Pearl Harbor extended World War II, theretofore confined to the continents of Europe and Africa, to the western hemisphere, Asia, Australia and Oceania—the entire globe.

At the outset of this global conflict, the axis powers had the advantages of interior positions, shorter supply lines, better-trained and larger armies, and total mobilization of their peoples in the war effort. As a counterbalance to their inferior military position in Dec. 1941, the United Nations had one great and definite advantage: the virtually limitless industrial potential of the United States, whose giant production facilities were harnessed to the war effort immediately after Japan's new aggression in the Pacific.

This aggression started on Dec. 7, 1941, when Tokyo's war lords set in motion a synchronized land, sea and air blitzkrieg in an effort to make all Asia tributary to Japan. Among their objectives were conquest of Malaya and Burma on the Asiatic mainland, and the countless islands in the southwest Pacific. A summary of Japanese military operations in Asia and the southwest Pacific follows:

1. Malaya.—The immediate goal of the Japanese campaign in Malaya was the capture of Singapore, keystone of British naval power in the far east. As long as this mighty base remained in Allied hands, the combined Anglo-American fleets could prevent Nippon's projected moves to the south. The British command in Malaya based its strategy on the assumption that should war start, Singapore would become the chief Allied base from which the Anglo-American fleet would seize the initiative to strike at the Japanese heartland itself. This strategy was severely jolted by the Pearl Harbor attack. An even more serious blow to Singapore itself was the sinking on Dec. 10, 1941, of the "Prince of Wales" and the "Repulse," the loss of which deprived the fortress of its chief weapons for offensive operations. As a result, the great British naval base was stripped of its power almost overnight and reduced to a land base of dubious defensive strength.

The Japanese opened their drive with invasions of both the western and eastern shores of Malaya. Operating from bases in Thailand, one Japanese column struck across the Kra isthmus, severing communications between Malaya and Burma. Another force landed on the east coast at Kota Bharu, a few miles south of the Thai frontier, capturing the airfield there on Dec. 9, 1941. Simultaneous with the land attacks, Japanese bombers severely damaged the principal Malayan airfields, destroying more than half of the R.A.F. aircraft, which were surprised on the ground. The Japanese thus rapidly won air superiority at a low cost and then intensified their drives down both coasts. British efforts to stem the Japanese torrent were unsuccessful. By Jan. 15, 1942, the British imperial armies had been thrown out of Kuala Lumpur and Port Swettenham and all British hopes of holding any portion of the mainland vanished. Australian and British troops retreated rapidly toward Singapore and on Jan. 31, they crossed the Straits of Johore and blew up the causeway linking Singapore island with the mainland behind them.

Numbering about 60,000 men, the British army was exhausted by seven weeks of constant fighting. After a week's respite, the Japanese force, estimated at 100,000 men, swarmed across the Straits of Johore and overran the Singapore defenses. On Feb. 15, the British surrendered unconditionally. The Japanese, who reduced the "impregnable" fortress of Singapore in two weeks, had won one of the most impressive victories in their history.

2. The Battle of the Philippines.—The paralyzing blow dealt to American naval power at Pearl Harbor, Dec. 7, 1941, immobilized the United States Pacific fleet and dashed all hopes of getting reinforcements and supplies to the Philippines. As a result of this attack and the destructive raids on the American airfields in the Philippines, Japan immediately won both air and naval supremacy. Now practically immune from aerial or naval attack, the Japanese started to invade the Philippines and poured troops onto the island of Luzon. By the end of Dec. 1941, two large Japanese armies, which had been landed on Luzon, were converging on Manila in a move to encircle the defending American-Filipino units. Gen. MacArthur, however, eluded the trap, evacuated Manila, which fell on Jan. 2, 1942, and withdrew to the rugged and difficult terrain of the Bataan peninsula. Although MacArthur's armies were outnumbered by five to one, they held the Japanese at bay on the Bataan battleground for three months.

But 12 weeks of constant fighting with no air support and against heavy odds exhausted the American-Filipino army. Gen. Wainwright, who replaced MacArthur after the latter was sent to Australia, held firm until March 31 when Japanese infantry covered by shell-fire from warships offshore, forced a breach in the Bataan lines. Waves of Japanese shock troops poured through the crumbling defenses and on April 9, the Japanese overran the entire Bataan sector.

Of Wainwright's entire force of 43,000, some 36,000 were captured, killed or wounded in this battle. Wainwright with a force of 7,000 soldiers, marines and sailors and some 3,000 civilians escaped from Bataan and fled to Corregidor. This island fortress, however, was completely cut off from outside aid. Japanese units stormed the "Rock" and took it in an all-out assault on May 6. With the fall of Corregidor the Japanese had conquered the last principal point of resistance in the Philippines, although American and native guerrillas still fought in the remote islands.

3. Netherlands Indies.—In the carefully designed pattern of Japan's strategy to establish a "co-prosperity sphere" in Asia, the East Indies were a major objective. This rich archipelago possessed abundant oil, rubber, quinine, copra, spices, coffee, rice, timber and other tropical products. Japan launched its invasion of the outer rim of the East Indies archipelago on Dec. 17, 1941, with landings on Sarawak, a British protectorate in northwestern Borneo. The Japa-

nese then invaded Tarakan, Dutch island and oil refining centre off the east coast of Borneo, and the Minahassa peninsula of Celebes. Both areas fell under their control by mid-January 1942. After securing a foothold on Celebes, the Japanese troops struck to the east and landed on New Guinea, New Britain and the Bismarck archipelago on Jan. 23. They seized Rabaul in New Britain and Kavieng in New Ireland, thus winning strategic bases on the eastern perimeter of the East Indies. Their efforts to drive a wedge through the centre were temporarily halted when an Allied naval force smashed a large convoy in the Strait of Makassar, sinking at least one-third of the Japanese ships, Jan. 24–26.

Despite this setback, the Japanese continued their infiltration southward, occupying strategic points on Borneo and Celebes, and by Feb. 12 they had won complete control of the Strait of Makassar and established airfields within bomber range of Surabaya. The Japanese then invaded the southern tip of Sumatra, separated by a narrow neck of water from Java itself, and on Feb. 20, they occupied Portuguese Timor. With the fall of Bali on Feb. 23, Java was completely encircled in the jaws of a Japanese vise. The Japanese then proceeded to mop up Dutch forces on Sumatra, Borneo and Celebes.

At this critical point, the American and Dutch commands decided to risk their combined fleets in a desperate gamble to break the enemy ring around Java. On Feb. 27, a small Allied fleet challenged a large convoy of Japanese troopships escorted by strong naval detachments in the Java sea. After a two-day running battle, nearly the entire Allied force was destroyed. This staggering defeat sealed the doom of Java. The enemy convoy got through safely and the Japanese invaded Java on the night of Feb. 28. Batavia fell on March 5 and the defenses of Bandoeng collapsed two days later. By March 10, Surabaya had fallen and virtually all resistance in Java had ceased. The Japanese claimed that 98,000 Allied troops, including about 5,000 American, British and Australians, were taken prisoner on Java.

4. Burma.—The Japanese invasion of Burma did not get under way until five weeks after the Pearl Harbor attack. Although the position of Burma was a potential threat to the Japanese flank in Malaya, the British were unable to mass enough men and material to exploit this situation. When it became evident to the Japanese that their forces in Malaya were adequate to bring that campaign to a successful conclusion, they turned the bulk of their reserve divisions in Thailand against Burma.

On Jan. 15, 1942, a Japanese land column moving from Thailand struck across the frontier, penetrating Tenasserim province, the narrow "appendix" of southern Burma. Another column crossed into central Burma and drove toward the Salween river area north of Moulmein. Their common objective was to converge on Rangoon. British opposition to these drives was weak. British regulars fought with skill and courage but the colonial levies and native troops, wanting in experience and morale, could not cope with the superior jungle tactics of the Japanese. By Jan. 31, the southern column drove up the Gulf of Martaban, occupied Moulmein, and effected a junction with the army to the north. Both forces then broke the British defense line on the Salween and occupied Rangoon on March 8.

The fall of Rangoon jeopardized the Allied hold on the Burma road over which flowed the major portion of Allied war supplies to China. The Chinese, whose appeals to participate in the fighting were hitherto ignored, were now "allowed" to share in the defense of Burma. But the delay was fatal and liaison between the British and Chinese was faulty. The Japanese armies, functioning swiftly and smoothly, were quick to exploit this chaotic situation and drove ahead with great rapidity. One Japanese column reached Lashio, the Burma road terminus, on April 28; another entered Mandalay on May 1. The British fled to India, their retreat covered by the Chinese armies, and Burma fell to the Japanese.

Indications that the British were preparing a full-dress offensive for the reconquest of Burma were seen in the appointment of Lord Louis Mountbatten in Aug. 1943 as supreme Allied commander for southeast Asia.

5. Battles of the Coral Sea and Midway.—On May 4, 1942, U.S. carrier-based planes attacked a Japanese task force headed toward New Caledonia and New Hebrides and opened a naval battle unique in history in that it was the first major sea engagement fought entirely by planes based on aircraft carriers. Surface ships of the opposing forces apparently never came within gun range of each other and the only broadsides fired were at attacking planes. This unusual contest ended on May 7 in a Japanese defeat. The American bombers had repulsed the Japanese force, sinking seven warships, including a carrier, and several transports. American losses were a carrier and two other vessels.

The American forces scored another great naval victory a month later at the battle of Midway, June 4–7, when both land and carrier-based planes repulsed a Japanese naval armada of some 80 ships that attempted to attack the island. When this engagement ended after four days of furious fighting between rival air forces, the Japanese armada limped to its home bases, minus four aircraft carriers, two cruisers and three destroyers which had been sunk by the American bombing and torpedoplanes. U.S. losses were a carrier and a destroyer. The battle of Midway, which was similar to the Coral sea battle in that it was almost exclusively an air action, was a decisive victory since it halted a major Japanese effort to capture Midway and Hawaii.

6. New Guinea.—New Guinea and the nearby islands of New Britain, New Ireland and the Solomons held a prominent position in Japanese strategy as stepping stones for a possible thrust into Australia and as bases from which Japanese warships could attack U.S. convoys bearing war supplies to the far east.

The first enemy thrust into this island cluster was launched on Jan. 23, 1942, when Japanese transports landed troops on New Britain, New Ireland and the Solomons. The invaders rapidly consolidated their newly won positions, repaired harbours and constructed airfields. The Japanese then invaded New Guinea, landing troops on March 8 at Salamaua, Lae and Finschhafen, small neighbouring ports on the island's northeast coast. After seizing Buna and Gona, two tiny shore settlements farther down the coast, a Japanese column drove inland and was less than 35 mi. from Port Moresby, chief Allied base on New Guinea's southern coast by Sept. 1942.

But these advance units had pushed ahead too quickly for their slower-travelling supply carriers. Australian forces took advantage of the precarious Japanese position with a surprise offensive launched on Sept. 25. Gen. MacArthur, who planned the tactics for this campaign, was determined not to commit the error of over-extending his supply lines. His forces pressed forward cautiously and drove the Japanese back to their north coast bases. Thousands of American soldiers then joined the Australians and aided by a smoothly functioning land-and-air transport system, the combined armies closed in on Buna and Gona. The Australians captured Gona on Nov. 24, while the Americans took Buna on Dec. 15. Both forces then mopped up enemy units still holding out in nearby Buna Mission. On Jan. 22, 1943, the Allies captured Sanananda Point, thus closing the first phase of the New Guinea campaign, in which a Japanese army estimated at 15,000 men was virtually annihilated. Allied casualties were approximately half that figure.

In an attempt to redress their weakening position in New Guinea, the Japanese dispatched a dozen troop transports, protected by a destroyer flotilla, into the Bismarck sea. Allied scouting planes, however, sighted the convoy as it sneaked along the New Britain coast and a huge force of Allied bombers attacked and destroyed the entire Japanese convoy of 10 warships and 12 transports. Some 15,000 Japanese aboard the vessels met their death either by drowning or by the murderous strafing from Allied planes. The battle of the Bismarck sea, March 2–5, 1943, was a decisive victory of land-based aeroplanes over warships.

These successes in New Guinea and the simultaneous victories in the Solomons gave the Allies a firm foothold in the southwest Pacific islands. On June 30, 1943, the Allies opened a major offensive in both New Guinea and the Solomons to extend their grip on the island chain circling Australia's north coast. In New Guinea, an Allied amphibious force landed at Nassau bay in an offensive aimed at Salamaua and Lae. Two months later another amphibious unit landed behind both of these Japanese bases and the enemy garrisons in this area were completely landlocked. The Allies then launched a drive which resulted in the capture of Salamaua, Sept. 12, and Lae, Sept. 16, 1943.

The capture of Salamaua and Lae enabled the Allies to extend the target area of their long-range fighter planes and to give more adequate protection to their troops battling along New Guinea's northern coastline. Meanwhile, medium and long-range bombers continued to hammer the New Guinea bases of Sattelberg, Wewak and Madang, facilitating the Australian drive that resulted in the occupation on Oct. 2, 1943, of Finschhafen. Capture of this stronghold gave Gen. MacArthur complete control of the Huon Gulf and provided him with new airfields closer to the Japanese base of Rabaul on New Britain island. In the Japanese-held outer island defenses in the southwest Pacific, Rabaul was second only to Truk in importance.

Rabaul was then hammered incessantly by Allied air raiders. Their objectives were (1) destruction of Japanese airpower in the vast New Guinea-Solomons zone of operations and (2) the cutting of Japanese supply lines. On Oct. 12, 1943, an Allied air fleet attacked the base in force, destroying at least 177 planes and sinking or damaging 123 ships and harbour craft. Continuing throughout the autumn of 1943, the raids on Rabaul were so effective that an estimated 500 Japanese aircraft were destroyed between Oct. 12 and 30.

7. The Solomon Islands.—On Aug. 7, 1942, United States marines landed in the southern Solomon islands in the first genuine Allied offensive in the Asiatic theatre of operations after the outbreak of war. Protected by air and naval barrage, a division of marines rapidly secured a beachhead on Guadalcanal island, captured an almost completed Japanese airfield there, and seized the smaller islands of Tulagi, Gavutu and Tanombogo.

The marines won their initial footholds with relative ease and at low cost in casualties, but the Japanese did not intend to relinquish their grip on the Solomons without a struggle. On the night of Aug. 8–9, a Japanese cruiser force slipped into the channel between Guadalcanal and Tulagi, caught Allied naval patrols off guard, and sank four cruisers. The Japanese then launched a spirited land, sea and air offensive to dislodge the marines from the Solomons. Although the marines clung tenaciously to their Guadalcanal beachhead, Japan's numerical superiority in men and ships began to tell. By mid-October, Japanese forces landed in broad daylight for the first time on Guadalcanal, only 15 mi. from the American lines, and toward the end of the month

the position of the marines became critical. Although they had received small reinforcements of regular army troops, replenishment of supplies was uncertain in view of the constant Japanese naval and air patrol.

In November, the Japanese launched a land and sea offensive to smash the American grip on Guadalcanal. This drive reached its climax in the naval battle of the Solomons, Nov. 13–15. After three days of violent fighting, the Japanese were decisively defeated and the crisis had passed. The American ground force then launched an offensive which drove the Japanese out of Guadalcanal by Feb. 10, 1943.

By June 30, four months after conquest of Guadalcanal, the Allies opened a new offensive to destroy Japanese forces in the Solomons and New Guinea. While Gen. MacArthur's troops pressed forward on the New Guinea coast, the American forces under Adm. Halsey's command invaded new island groups in the Solomons north of Guadalcanal. The Americans quickly seized Trobriand and Woodlark islands, wiped out the Japanese garrison on Rendova and then crossed over to nearby New Georgia island where they established secure beachheads under protection of a barrage from shore and naval guns. The Munda air base on New Georgia was the immediate American objective. Capture of this important base would give them an airfield from which to attack Japanese strongholds at Rekata bay, Bougainville and the great base at Rabaul, New Britain.

The battle for control of the Munda air base followed closely the pattern of fighting on Guadalcanal. The Japanese fleet attempted to block the American offensive but was soundly thrashed in the two battles of Kula gulf, July 6 and July 12. While warships, shore batteries and bombers laid down a heavy curtain of fire over the enemy lines, the American forces inched their way toward the Munda air strip. Japanese resistance was stubborn in the initial phases of the New Georgia campaign, but weakened under the constant pressure brought to bear by the attacking force. By Aug. 5, the Americans seized the coveted air strip. A few disorganized Japanese units, all that was left of the Munda garrison, fled to the hills. On Aug. 26, the Allies announced that the Japanese had fled from Bairoko Harbour, their last foothold on New Georgia.

Bitter fighting then ensued for possession of another island cluster—Arundel, Kolombangara, Vella Lavella and Santa Isabel. After clamping a tight air and sea blockade to the approaches of these isles, American troops cleared all enemy forces from them by Oct. 15.

After the conquest of the central Solomons, Adm. Halsey lost no time in preparing an invasion of the northern Solomons where the bulk of Japanese strength was concentrated. The airdromes of Kieta, Kahili, Buin on Bougainville and the airfield on Buka were systematically plowed by Allied bombers, and when Japanese air power was regarded as sufficiently weakened, American marines landed on Oct. 27, on tiny Mono and Stirling islands in the Treasury group. The following day, a larger force invaded Choiseul, but the Japanese withdrew rapidly without giving battle.

The Choiseul landing set the stage for a larger operation—the invasion of Bougainville, where the Japanese at one time reportedly had a garrison of 40,000 men. On Oct. 31, a force of U.S. marines landed at Empress Augusta bay on Bougainville. Here Japanese resistance was strong and the marines had to battle desperately for 10 days before they could announce that they had a clear claim to the disputed coastal strip. Slowly, the Americans widened the beachhead and by mid-November, the marines were solidly entrenched on Bougainville. Similar in purpose to the New Guinea drive, the Allied objective behind the Bougainville offensive was to win new airfields and move closer to Rabaul. Construction of an airfield at Empress Augusta bay would move the right wing of Allied air forces 200 mi. nearer to Rabaul. The success of Allied operations in both New Guinea and the Solomons opened the way for an attack farther north to flank Truk island, Japan's major naval base in the south Pacific. The hub and heart of a concentric system of island bases, Truk was the Japanese equivalent of Pearl Harbor and guarded the Pacific sea lanes to the Japanese mainland. In a move intended apparently to neutralize the effectiveness of both Truk and Rabaul, a larger force of U.S. marines launched a successful but bitterly contested invasion of Makin, Tarawa and Apamama atolls in the Gilbert Islands, Nov. 20, 1943.

8. China.—After Pearl Harbor, war supplies that normally would have gone to the Chinese armies were siphoned off to the Allied forces desperately striving to halt the Japanese tide of conquest in the Pacific. The Chinese thus could make no basic changes in their strategy to fight a grim war of attrition, but their stubborn fighting spirit continued to be a great contribution to the Allied cause. Their refusal to admit defeat after five years of war compelled the Japanese to tie up at least one-third of their forces in China. Despite their lack of equipment, China's armies proved at the battle of Changsha in Jan. 1942, that they could still win battles on a shoestring. In this engagement, Chinese armies repulsed a mechanized Japanese force of 100,000 men that attempted to lay siege to this Chinese bastion astride the Hankow-Nanking railway. The Japanese lost an estimated 57,000 casualties in this ill-starred operation. But Chinese elation over the victory at Changsha was dampened by the fall of Burma which gave Japan control of the Burma road and virtually isolated China; the few alternate roads to India were mere camel paths in comparison.

In May 1942, the Japanese started an offensive designed to eliminate American airfields which, they believed, were in the still unconquered provinces of southeastern China. They occupied some important cities in the initial phases of this drive but were later forced to relinquish most of them to counterattacking Chinese armies.

In 1943, the Chinese were still faced with a desperate supply problem. Although they had reoccupied many areas formerly held by the enemy, their arms and equipment were running dangerously short. One cheering prospect, however, was the extensive activity of the U.S. bomber force which ranged far and wide over China to hammer Japanese military objectives.

9. Battle for the Aleutians.—In June 1942, a Japanese force invaded the outermost islands of the Aleutian chain, the first enemy landing on North American soil. The assault on the Aleutians was launched simultaneously with the abortive Japanese naval attack on Midway Island. While the Midway operation ended in failure, the Aleutian invasion was temporarily successful.

The Japanese opened their Aleutian drive on June 3, when carrier-based planes raided Dutch Harbor, an American naval post on Unalaska island. Enemy forces then landed on Attu, Agattu and Kiska islands. The United States made no serious effort to dislodge the Japanese during 1942, as it appeared unlikely that the enemy could extend its conquest to the Alaskan mainland. However, a substantial force of U.S. warships, submarines and planes constantly harried the Japanese when the weather over the fog-bound islands would permit and in October the invaders abandoned Agattu.

The United States decided in 1943 to clear the Aleutians and on Jan. 12, established a base on Amchitka island, only 70 mi. from Kiska. Four months later, on May 11, American ground forces landed on barren Attu island and annihilated the entire Japanese garrison there after a 19-day battle.

American planes and warships then softened Kiska, the largest and most important island, with furious air and naval bombardments. A strong force of American and Canadian troops landed on Kiska on Aug. 15. They met no opposition as all the Japanese had evacuated the island some time before rather than run the risk of annihilation.

XXI. THE RUSSIAN THEATRE OF WAR

In Jan. 1942, the Russian armies were on the offensive all along a snowbound battlefront 2,000 mi. long. The Germans, who had seriously underestimated the Red army's fighting ability and the quality and quantity of its equipment, were not prepared for a winter campaign. The reich's mechanized war machine stalled in the first snows while the Russian army was adapted for winter fighting. The German retreat, however, was not a rout, but a deliberate withdrawal to a winter line, which had been decided upon after the reich command recognized that a winter offensive was impossible. The invaders, holding the bulk of their territorial gains, established an elaborate system of "hedgehog" defenses, behind which a railway network constituted their supply routes to the rear. The key points in this defense system were generally the railway junction cities interconnecting German lines from Leningrad to the Black sea.

The big Russian offensive started in Nov. 1941. The German armies which had occupied Rostov, gateway to the Caucasus, were thrown out of the city by Marshal Timoshenko's forces. This successful operation was followed by similar Red army offensives all along the front. By March 1942, the Russians had reconquered about 100,000 of the 500,000 sq.mi. they had yielded to the nazis and had inflicted on the wehrmacht its first major defeat in World War II.

But as the winter wore on, German resistance wore down the power of the Russian offensive, and by March 15, the Red army advance had virtually ceased. The German hedgehog system had successfully absorbed the shock of the soviet drives, and an important chain of rail centres running from Velikie Luki, on the north, to Kharkov, on the south, were still in German hands.

In the summer of 1942, the Germans were poised for a new offensive. Hitler's principal objective was the Caucasus, whose rich oil fields produced over 80% of Russia's total output of crude oil. Move no. 1 in the Nazi grand strategy for conquest was a heavy attack on Russian forces holding Kerch and Sevastopol in the Crimea, potential threats to the German southern flank. German troops overran Kerch on May 23, and two weeks later, they opened a massive assault against Sevastopol, which had been under land siege since Nov. 1941. Although the defenders of Sevastopol fought back with incredible ferocity, German and Rumanian forces stormed this Soviet citadel on July 1 and mopped up the remnants of the Russian garrison.

While the fighting in Sevastopol was still underway, Hitler opened his drive to the Caucasus attacking in great force in June 1942. German tank columns split Russian lines on the Donets river southeast of Kharkov and bludgeoned their way east to the Volga and south into the Caucasus. On July 27, German armoured divisions operating below the Don bend had marched into Rostov. These armies then fanned southward into the Caucasus, seizing railway junctions, ports and naval bases. Although the Russians fought a stubborn delaying action, and skilfully avoided encirclements, they were unable to halt the German armoured columns. By Oct. 1, the Germans were in control of a great triangular-shaped segment of the Caucasus and were in possession of the oil city of Maikop. At this critical stage of the campaign, fierce Russian counterattacks halted the German push into the Caucasus and thwarted the nazi strategy to march straight through to Baku before winter.

Meanwhile, Russian armies to the north in the big Don bend refused to give battle in this area, which was a natural pocket and therefore adaptable to panzer tactics, and withdrew toward Stalingrad. By mid-August, the Germans were in complete possession of the Don bend and moved in on Stalingrad. The reich strategy was to capture the city, sever the last Russian rail link with the Caucasus, separate the Russian armies in the Caucasus from those in the north and prevent the Russians from using the Volga for river traffic. For the final onslaught against Stalingrad the Germans massed an estimated 40 divisions, strongly bolstered by tank units and a huge air fleet. The Russians, deciding to make a firm stand behind Stalingrad's protective chain of fortifications, depended on their great quantity of heavy artillery to repel the invaders.

The Germans opened a massive plane-tank assault on Stalingrad's outer defenses in late August. Dive-bombers poured tons of explosives on the defense belt. Tanks bludgeoned their way through softened spots in the city's defenses and were followed up by droves of infantry units. Sheer weight of numbers finally enabled the Germans to conquer several districts on both the north and south sides of the city. The luftwaffe deluged the city with bombs. Few buildings were left standing, but the defenders fighting with unprecedented stubbornness held their ground and stopped the Germans in their tracks by the end of October. Thus, the German summer offensive of 1942 was brought to a halt at Stalingrad and failed in its main purpose—destruction of the Red army and the conquest of the Caucasus.

On Nov. 22, 1942, the Russians again launched a great winter counter-offensive. The Red army broke through many strongly fortified points in the German winter line and by Feb. 2, 1943, they had either killed or captured the entire nazi garrison of 330,000 men trapped in the Stalingrad area. Driving ahead on a great front extending from Moscow to the towering Caucasus mountains, the Russians relentlessly pounded the tired wehrmacht. The Red army recaptured the German hedgehog points of Velikie Luki, Kursk and Kharkov and had cleared the entire Caucasus, save for a small German bridgehead on the Kuban peninsula. In March, the Russian armies in the Kharkov sector had over-extended their supply lines and counterattacking Germans recaptured Kharkov on March 14, and Belgorod a week later. Heavy rains then slowed down military operations. After conclusion of their winter drive of 1942–43, the Russians had reconquered 185,000 sq.mi. of territory.

The German armies launched their third major offensive of the war on the eastern front on July 5, 1943. They attempted to pierce the Russian defenses along a 165-mi. front running from Orel through Kursk and to Belgorod. But the Red army, which had achieved parity with the wehrmacht in planes, tanks and guns, stopped the German offensive and developed a powerful counterdrive of its own on July 12.

The Russians opened their offensive, aimed at the German fortified base of Orel, with a tremendous artillery barrage that crushed the German defenses. Russian tank columns then spearheaded a general advance and by Aug. 5 the German strongholds of Orel and Belgorod fell to the Russians. By Oct. 1, the Russians had retaken Bryansk, Smolensk, Kharkov (the fourth time this city had changed hands) and scores of other cities, and were crowding the nazis all along a 600-mi. front from Smolensk on the north to the Sea of Azov. The Germans, driven back to the Dnieper river, were desperately fighting to prevent the Red army from crossing the stream and surging toward the frontiers of Poland and Rumania.

By Oct. 1943, the reconquest of the Ukraine by the soviet armies was within sight. The battered German forces were in retreat and their vaunted Dnieper line was broken in an early test of strength. Nevertheless, the German retreat was not a rout and the wehrmacht armies retired in good order. The German strategy was to fall back to a shorter line which the high command hoped to hold without excessive strain on dwindling reserves, already dangerously drained by three years of titanic battle in Russia.

On the other hand, Russian strategy was to attack continuously and give the enemy forces no rest. Stalin's major objectives were (1) to destroy the nazi armies and (2) to drive them from soviet soil.

By Oct. 15, Russian spearheads had crossed the Dnieper at several points. Great battles were in progress for possession of Melitopol, Dnepropetrovsk, Perekop and Kiev. Melitopol was taken by the Russians on Oct. 23, Dnepropetrovsk fell two days later, and on Nov. 1, the Red army seized Perekop, thus bottling up a large German force in the Crimea. The fighting for Kiev was furious, but the Russians finally stormed into the city on Nov. 6. Standing on the left bank of the Dnieper, Kiev is the gateway to a corridor, flanked by the Pripet marshes on the north and the Carpathian mountains on the south, leading directly to the heart of central Europe. Its capture was a grave blow to the Germans, and Russian occupation on Nov. 13 of the railway hub of Zhitomir brought the Red army to within 60 mi. of the old Polish frontier. Determined to cork up the corridor leading to Poland, the Germans launched strong counterattacks.

The Russians, their lines overextended, prudently retired, and the nazis recaptured Zhitomir on Nov. 15. Despite this temporary setback, the Russians continued to bludgeon their way through German defenses in neighbouring sectors.

Both German and Russian casualties in the first two years of fighting were heavy. In June 1943, the Russians claimed that their own losses in dead and wounded were 4,200,000 and put German casualties in dead and captured at 6,400,000. In November, the Russians asserted that the Germans had lost an additional 2,700,000 casualties in the four months of fighting that started with the Russian offensive in July 1943. German claims of Russian casualties, issued periodically by the reich propaganda ministry, soared extravagantly. One German claim placed Russian losses at 20,000,000 men dead, wounded or captured.

XXII. AIR WAR OVER EUROPE

In early 1942, the R.A.F., strengthened by increased production and by aircraft sent from the United States, launched a sustained aerial offensive on the reich. The first R.A.F. raids of importance in 1942 were destructive bombardments in March of industrial targets in the Paris suburb of Billancourt and nearby Poissy. Intensifying their air offensive, R.A.F. bombers hammered objectives in axis Europe with great frequency. The length of the air raids was extended, more bombers participated in night attacks and there was an increasing proportion of heavy bombers to fighters. The R.A.F. concentrated on mass attacks on a single target rather than disperse its bomber strength over scattered objectives.

Examples of the destructive power of mass bombings were the R.A.F. raids on Luebeck and Rostock. On March 26, R.A.F. planes shattered the Baltic port of Luebeck with 340 tons of bombs in a three-hour raid. A month later, British bombers devastated the port of Rostock, in four successive night raids, virtually razing the city with 800 tons of bombs.

The R.A.F.'s offensive in 1942 reached its peak on May 30 when 1,130 planes of all types dropped 3,000 tons of bombs on Cologne. Forty-eight hours later, an armada of 1,036 planes bombed Essen, home of the famous Krupp armaments works, setting huge fires in the industrial regions circling the city. Although less spectacular, many of the raids on German cities in the late summer and fall of 1942 were nearly as effective in destructive power as the Cologne and Essen raids.

The participation of the United States air force in the aerial offensive against Germany and the occupied countries widened the scope and variety of Allied raids. The R.A.F. bombers concentrated on night mass bombings while the Flying Fortresses and Liberators were initially employed for daylight precision raids.

By the summer of 1943, the combined Allied air force based in England rained an ever-increasing tonnage of explosives on war plants, railway centres and other vital military objectives in Germany and occupied Europe. Flights of 700 planes, or more, sweeping over the channel to strike at axis targets were nearly a daily—or nightly—occurrence. Britain alone was producing more planes than the reich and in the 20-month period from Jan. 1942 to July 1943, the U.S. produced 110,000 planes, the greater part of which was sent to the European theatre of war. The once mighty luftwaffe, now helplessly outnumbered, was fighting for its very life as one of the major objectives in Allied air strategy was destruction of the German air force.

Chief target of the American and British bombers was the Ruhr valley, industrial arsenal of the reich. Allied bombers hit the cities of the Ruhr with terrible force. More than 1,000 ac. of Düsseldorf were devastated in a single raid on June 11, 1943. The giant Krupp munitions works in Essen were paralyzed by repeated Allied aerial blows. Bombs rained with monotonous regularity on Cologne, Dortmund, Stuttgart, Mülheim, Krefeld, Duisburg and Hamm. During a 30-day period in May and June 1943, the R.A.F. alone unloosed 10,000 tons of bombs on the heart of the Ruhr area. This terrific pounding had such a tremendous effect that an estimated 3,000,000 persons fled from the Ruhr valley.

The Allied raids were not confined exclusively to the Ruhr. Industrial and military establishments throughout axis Europe were battered by Allied raiders. Long-distance bombers struck objectives as far distant as Trondhjem in Norway and Crete in the Mediterranean. Industrial cities in Italy were also heavily bombed. Russian air fleets from bases to the east hammered East Prussian targets while American Flying Fortresses repeatedly raided the U-boat shipyards and ports of Kiel, Bremen, Emden, Wilhelmshaven, Flensburg and Lorient.

The great summer offensive was climaxed by the raids on Hamburg, which started July 24. R.A.F. and U.S. bombers subjected the city to eight raids in six days. At least 8,000 tons of bombs were dropped on Hamburg during this period. The city was left in ashes and Swedish dispatches reported that thousands had been killed in the raids.

An Allied announcement that similar bombing expeditions were in store for Berlin, led nazi authorities to evacuate all those residents of the capital considered nonessential to the war effort. In the late summer, the R.A.F. night bombers had delivered three heavy blows on Berlin. In each raid, 1,000 or more tons of bombs rocked the German capital. Berlin was now getting a bitter dose of the treatment handed out to London in the battle of Britain in 1940, but the British night fliers had to go longer distances and their losses to enemy planes and antiaircraft guns were heavy. From the start of the war through June 1943, announced British losses over Europe were 5,736 planes.

In the autumn of 1943, the Allied air offensive over Germany had grown to sizable proportions and had become a definite menace to reich industry. In an effort to counter these air blows, Hitler first

diverted large numbers of aircraft from the eastern front to protect the homeland and then ordered a speed-up in production of fighter planes. Thus augmented, the luftwaffe became a powerful defensive force; its fighter craft frequently shot as many as 60 to 70 of the Allied heavy bombers out of the skies at one time. The Allies in turn countered with the use of long-range fighter aircraft to convoy their daylight bombers and with more effective use of radar on the night missions. As a result the luftwaffe defenses were largely neutralized; the attacks on the reich increased both in the number of heavy bombers employed on a single mission and in the tonnage of bombs dropped. In late 1944 and in 1945, flights of 1,300 Flying Fortresses, accompanied by nearly as many long-range fighter planes, were not uncommon occurrences. The R.A.F. sent equally large numbers of night bombers over the reich. As much as 3,000 tons of bombs were dropped in a single raid on German cities by the U.S. daylight raiders; the maximum tonnage of explosives unleashed on a single raid by the British night bombers, which sacrificed armour to increase their bomb capacity, was about 4,500 tons.

It was obvious that this aerial blitzkrieg in reverse, which repaid Germany a thousandfold for the destruction of London and Coventry, could not be turned back by the luftwaffe. Consequently, the Germans decided to renew their bombing attacks on England and developed several novel long-range bombardment weapons for this purpose. One, labelled by the Germans as V-1, was a pilotless flying bomb which carried in its warhead an explosive equivalent to a one-ton bomb. This projectile was capable of attaining a speed of nearly 400 m.p.h. The second weapon, called V-2, was a long-range rocket which reached a height of 60 or 70 mi. and a speed that was faster than sound. The Germans used both of these missiles to bomb England, particularly London. The V-1 bombings lasted 80 days (June 13 to Aug. 31, 1944) and killed 5,479 people. The V-2 attacks were more sporadic.

While the effects of these revolutionary weapons were damaging, they could not match the giant Allied bomber fleets in destructive power. Toward the close of the war, the Germans had developed several jet-propelled fighter aircraft that were held in great respect by the Allied airmen. These, however, were not produced in sufficient quantity to demonstrate their maximum effectiveness.

XXIII. WAR IN THE MEDITERRANEAN, 1942–45

The Mediterranean was the scene of many bitter campaigns from 1942 to the end of the war. In that arena, Hitler had nearly won Egypt, only to lose it by a hair's breadth in 1942. The Mediterranean was also the scene of the first successful Allied ground offensive of the war.

In Jan. 1942, British imperial armies advanced steadily across Cyrenaica's desert sands in a drive which started (Nov. 18, 1941) from the Egyptian-Libyan border. They succeeded in pushing Marshal Erwin Rommel's German-Italian forces beyond the port of Derna; then the British, their communications overextended, halted. Rommel counterattacked and drove them back to the El Gazala-Bir Hacheim line. Here a stalemate occurred which was broken with lightning suddenness by Rommel on May 26. His Afrika Korps first ambushed and destroyed more than 80% of the British tank force, then in a bold and daring thrust swept up to El Alamein. Fighting with desperation, the British held firmly at El Alamein. Rommel, himself plagued by supply difficulties, was forced to come to a halt at that point only 70 mi. from Alexandria. He failed to reach the Suez canal, his announced goal.

During the quiet that prevailed on this front from July to Oct. 1942, Marshal Sir B. L. Montgomery, then a general, re-organized and re-equipped his British 8th army with materials and munitions poured into Egypt by Allied convoys. Montgomery then broke the lull with a powerful offensive, Oct. 23, 1942. Surprised by the unexpected strength of the British attack, Rommel's armies broke off battle after two weeks of extremely hard fighting and were in full retreat by Nov. 7. The following day (Nov. 8), a large force of British and United States troops, led by Gen. Dwight D. Eisenhower of the U.S. army, landed on the coasts of Morocco and Algeria, and sped toward Tunisia. Pinned between the converging Allied armies, Rommel's Afrika Korps hastily abandoned all Tripolitania and withdrew to Tunisia where it was joined by new axis forces. The Germans, however, could not extricate themselves from this trap. Sensing disaster, Hitler recalled Rommel in March 1943 to preserve intact the reputation of his foremost general, and Col. Gen. Jürgen von Arnim was made commander of axis armies in Africa. German opposition crumbled soon thereafter and by May 12, Gen. von Arnim was forced to surrender with most of his troops.

After conquering North Africa, the Allied armies in the Mediterranean, under the over-all command of Gen. Eisenhower, prepared to invade Italy. They first seized the fortified Italian island outpost of Pantelleria (June 11, 1943) and then invaded Sicily on July 10, winning the entire island by Aug. 17.

The loss of North Africa and the invasion of Sicily so undermined Italian confidence in Mussolini that he was deposed as premier of Italy (July 25, 1943) and was replaced by Marshal Pietro Badoglio. On Sept. 3, as British troops were invading Italy, Badoglio agreed to cease fighting. Five days later (Sept. 8), he accepted Eisenhower's terms for unconditional surrender. Hitler, however, was determined to hold Italy and he poured troops into the narrow peninsula.

Thenceforth the length and breadth of Italy was turned into a battleground. The terrain favoured the defense, and the Allies were compelled to fight for every inch of ground gained. At Salerno, and later at Anzio, they were nearly driven into the sea and suffered heavy losses in the grim battles to retain these beachheads. After the capture of Rome, June 4, 1944, the Allies made several sensational advances, but by October the Germans had again stabilized their lines. Thereafter, Allied gains of more than 2,000 yd. per day were the exception rather than the rule until the end of the war. On April 16, 1945, Gen. Mark Wayne Clark opened a strong Allied offensive. After the fall of Bologna, April 21, the position of the axis armies in northern Italy was untenable, and at a secret meeting with Allied officers in Caserta, April 29, the Germans agreed to surrender unconditionally; three days later (May 2) all German and Italian-fascist troops in northern Italy and western Austria laid down their arms.

XXIV. THE INVASION OF FRANCE

Throughout 1942 and 1943, the Russians persistently demanded the opening of a "second front" in western Europe to relieve the pressure on the eastern front where Hitler had committed the bulk of his armies. The Allies promised an invasion of Europe, but with the stipulation that the offensive would not be undertaken until their armies had been fully prepared for this gigantic task. By the summer of 1944, sufficient men and material had been accumulated in England to make the venture feasible, and on June 6 the Allies struck. A parachute force led the attack, landing behind the enemy lines to sever communications and seize key defense posts. Very shortly thereafter an armada of 4,000 ships, protected by a great canopy of aircraft, started to disgorge troops on the Normandy beachheads between Cherbourg and Le Havre. The German reaction was immediate but not adequate. The nazis had expected additional landings in the Pas-de-Calais area and consequently dispersed their forces. Their failure to assess correctly the Allied strategy enabled Eisenhower, supreme commander of the Allied invasion forces, to establish a 60-mi. beachhead extending from Caen to the Cotentin peninsula and to win the port of Cherbourg in the following three weeks.

Entrenched behind the Norman hedgerows, the Germans contained the Allies in their cramped beachhead until July 26 when a U.S. armoured column burst through the nazi lines at St. Lo. This unleashed an Allied offensive of tremendous power. Additional U.S. armoured forces widened the gap and were soon running wild throughout France. Three weeks later, another army of U.S. and French troops landed on the Mediterranean coast of France (Aug. 15) and pushed rapidly northward.

Driving toward the Seine, Allied armoured forces captured Paris (Aug. 25) and raced toward the German frontier. The British-Canadian forces at Caen, which heretofore had been acting as the pivot of a great wheeling movement, also broke through the German lines and advanced toward Belgium. By Sept. 15, Eisenhower had six armies drawn up along Germany's western borders. His blitzkrieg had chased the wehrmacht out of all but a small section of eastern France. The Allies also had penetrated Belgium and the southern part of the Netherlands.

XXV. THE BATTLE FOR GERMANY

On reaching the Franco-German frontier, the Allies were halted by the Siegfried line, or Westwall defenses. On Sept. 17, the Allies attempted to flank the line by landing parachute troops behind the Rhine in the Netherlands, but this effort failed. In mid-November, Eisenhower made another attempt to break through the Westwall. Allied progress in this drive was slow but substantial. Suddenly, however, Eisenhower saw his plans disrupted by a startling counterattack launched in the Ardennes forest Dec. 17, by Marshal Karl Rudolf Gerd von Rundstedt, who had taken over command of the German armies on the west. Von Rundstedt's armies succeeded in carving out a 60-mi. gap in the Allied lines; Eisenhower's forces soon recovered and by the end of Jan. 1945 regained most of the territory lost in the Ardennes battle.

Meanwhile, the Russian armies to the east were reaping a great harvest of victories. They forced Finland, Rumania and Bulgaria out of the war and recovered all of White Russia, Bessarabia, Bukovina and most of the Baltic states. They also made deep penetrations into Poland, Czechoslovakia and Hungary. After this strenuous campaign, the Russians reorganized their forces for a large-scale drive into Germany proper. This offensive opened Jan. 12, 1945, and by April 1 the Red army had overrun all of Poland and the remainder of the Baltic states. In addition, the soviet forces had conquered East Prussia, had reached the Oder river at Kuestrin, only 30 mi. east of Berlin, and had seized a large part of German Silesia.

The Russian offensive on the east was in large part co-ordinated with a similar Allied offensive on the west that started Feb. 23, 1945. Driving toward the Rhine river, some eight Allied armies swept up all the industrial cities and towns on the west bank of the Rhine and, on March 7, one column crossed the river over a railroad bridge at Remagen, which the Germans had somehow failed to destroy.

Subsequently, Eisenhower's armies made additional crossings of the river; German resistance had become ineffectual and the wehrmacht appeared thoroughly demoralized and disorganized.

As a result the Allied armies raced almost at will through the reich, meeting only scattered opposition. Exploiting this chaotic situation in the west, the Russians opened their march on Berlin on April 19. The Russian and Allied armies met at Torgau, April 26, while other soviet columns to the north had already broken into Berlin on April 21.

The furious Allied blows from the west and the east precipitated the collapse of Germany. The end of the war was in sight and the sun was setting on the fascist dictatorships. On April 28, Benito Mussolini was executed by Italian anti-fascists. Three days later (May 1), the German radio announced that Hitler had died in action in Berlin, but there was no real evidence that he was dead. On May 2, the Russians captured Berlin. Five days later (May 7), the Germans surrendered unconditionally. The following day, May 8, the war in Europe ended.

XXVI. VICTORY OVER JAPAN, 1944–45

At the start of 1944, the U.S. armed forces in the Southwest and Central Pacific were of sufficient strength to set in motion the offensive designed to carry the war to Japan itself. While the burden of the fighting in the Pacific was borne by the United States, it received substantial help from British imperial and other Allied forces as the campaigning progressed. The Pacific area was divided into two commands, with the Central Pacific under Adm. Chester W. Nimitz and the Southwest Pacific under Gen. Douglas MacArthur. Lord Louis Mountbatten headed the Southeast Asia command, which embraced the Burma-India sector, while Generalissimo Chiang Kai-shek headed the Chinese forces.

Despite Allied supremacy in manpower and material the road to Tokyo in 1944 seemed to be beset with overwhelming barriers. The Japanese clung tenaciously to their island outposts; they fought with fury and fanatical disregard for death. In addition, the terrain favoured the defenders. Thus, because of the geography and the temperament of the Japanese fighting man, each island gained by the Allies, particularly in the Central Pacific, was won only at a terrible cost in casualties and after battles of incredible ferocity. In the Central Pacific, Nimitz launched his campaign to secure stepping-stone bases closer to the Japanese isles with the invasion of the Gilbert Islands (Nov. 20, 1943). The U.S. marines won strategic outposts after three days of fighting but not until the entire enemy garrisons were wiped out. The marines, too, sustained heavy casualties. Following the Gilberts campaign, Nimitz' forces invaded the major islands and atolls in the Marshalls group, Jan. 31, 1944. Then they landed on Saipan, June 14, and soon afterward on the neighbouring islands of Guam and Tinian in the Marianas group. That few prisoners were taken in this and subsequent campaigns on the Marianas was indicative of the fierce temper and fighting spirit of the enemy. Again the Americans were compelled to fight to the finish. They killed more than 45,000 of the foe, by far the greater part of the Japanese garrisons, and their own losses were more than 25,000 in dead, wounded and missing. Later, the Marianas were converted into bases for Superfortress squadrons. Before this the Superfortress command had only remote bases in China and India.

In addition to the Marianas, Nimitz' armies also invaded (Sept. 14) and captured the Palau Islands, midway between New Guinea and Manila.

As Nimitz' troops conquered island bases in the Central Pacific, MacArthur's forces drove up the northern coast of New Guinea. Employing new amphibious warfare techniques, the Allied forces leapfrogged from point to point on the island's rugged coastline. By Aug. 1, 1944, MacArthur's forces reached Sansapor on the extreme northwestern tip of New Guinea and were only 600 mi. from their ultimate objective—the Philippines.

After 11 weeks of preparation, during which time Allied air and naval units constantly attacked strategic Japanese defenses, MacArthur's troops invaded Leyte in the Philippines (Oct. 20), occupying the entire island by Christmas day of 1944. MacArthur's next step was the invasion of Luzon (Jan. 9, 1945). His forces landed at Lingayen gulf, the exact spot chosen by the Japanese to invade the island three years earlier. Outmanoeuvred and lacking adequate air and naval support, the Japanese fell back to Manila. The U.S. troops entered the capital Feb. 3, and after hard fighting entirely liberated the city by Feb. 24. Thereafter, the U.S.-Filipino forces invaded and eliminated Japanese resistance in scores of key islands in the Philippines. By July 5, MacArthur announced that the entire archipelago had been liberated, save for isolated Japanese guerrilla bands in some remote areas.

Toward the end of the Philippines campaign, MacArthur dispatched Australian and Dutch forces to invade Tarakan and Borneo. While these operations were in progress, British imperial forces in Burma climaxed their long and arduous campaign by driving the Japanese eastward across the Sittang river.

Combined, the successful operations in the Philippines, Burma and Borneo reduced Japanese power in the outlying island empire they had seized at the beginning of the war. The next Allied move was to seize bases needed for airfields and staging purposes close to Japan. The difficult task of securing these essential areas fell upon Adm. Nimitz. His first objective was Iwo Jima, some 400 mi. from Kyushu, southernmost of the Japanese home islands. U.S. marine forces landed on Iwo Feb. 19, 1945. After a gruelling and exhausting battle they won the island (March 16). As on Tarawa and Saipan, the garrison had to be routed out and destroyed man by man. Japanese losses were 20,000 dead; U.S. marine casualties were more than 4,000 dead and 15,000 wounded.

After Iwo came the invasion of Okinawa (April 1) by the U.S. 10th army. Here too, Japanese resistance was stubborn and the early phase of the fighting was even more sanguinary than it had been on Iwo. At Okinawa, the Japanese used the Kamikaze (suicide) planes effectively, damaging a substantial number of Allied warships supporting the invasion forces. Nevertheless, the U.S. troops won the island (June 21) at a cost of 45,000 casualties compared with Japanese losses of more than 115,000 in dead and captured.

While the conquest of Iwo and Okinawa gave the U.S. the bases required for the final great assault on Japan, the heavy casualties involved in securing them indicated that forces invading the Japanese homeland could expect an even heavier loss of life. Preparations for the invasion by United States forces went on apace.

However, as the Allied land, air and sea forces were girding for the invasion of the Japanese home islands, three startling developments occurred which suddenly altered the entire course of the war. One was the dropping of the first atomic bomb on the Japanese city of Hiroshima, Aug. 6, 1945; the second was the Russian declaration of war (Aug. 8) against Japan, followed immediately by the invasion of Manchuria by the Red army; the third was another atomic attack, this time against the city of Nagasaki, Aug. 9. In the Hiroshima bombing, 78,150 people were killed (according to a report issued by Allied headquarters in Japan on Feb. 3, 1946).

The employment of the atomic bomb and the entry of the soviet union into the war brought home to Japan's militarists the realization that continuation of the conflict was futile. Thus, after several days of deliberation with his cabinet ministers and war leaders, Emperor Hirohito made a broadcast to his people, Aug. 15, 1945, that he would accept the Allied surrender terms.

The same day, Gen. MacArthur was made supreme commander of all Allied forces in the Pacific to receive the Japanese surrender. MacArthur gave the Japanese complete instructions on surrender procedure and ceremony and then proceeded to Tokyo bay aboard the battleship U.S.S. "Missouri."

On Sept. 2, 1945, a Japanese delegation headed by Mamoru Shigemitsu, the foreign minister, and Gen. Yoshijiro Umezu, of the imperial general staff, boarded the "Missouri" and there signed the document that officially ended World War II, six years and one day after it had started. Thereafter, Emperor Hirohito issued a proclamation declaring that he had ordered the signing of the surrender document, and U.S. armed forces began to land on the Japanese home islands to assume their occupation duties.

WORM, a term used popularly to denote almost any kind of elongated, apparently limbless creature, from a lizard, like the blindworm, to the grub of an insect or an earthworm. In old usage it sometimes denoted a mythical dragon. The Latin term for worms, *Vermes,* was employed as a taxonomic unit to include practically all invertebrates by Linnaeus in his system of classification of animals. Although later zoologists, like Lamarck and Cuvier, working in the early 19th century, realized the unsatisfactory nature of Linnaeus' Vermes and restricted it somewhat, the term Vermes continued to be applied off and on during much of the 19th century to a heterogeneous assemblage of vermiform invertebrates. Although still having some vogue in Europe, the concept of a phylum Vermes has been abandoned by most modern zoologists as an impossibility because the animals termed worms belong to many different groups and have widely varied anatomical construction and life histories.

Worms in the zoological sense include the following main groups: flatworms (*see* PLATYHELMINTHES), elongated flattened animals of solid construction and soft consistency, divided into the *Turbellaria* (*q.v.*), including planarians, the flukes (*see* TREMATODES) and the tapeworms (*q.v.*) or *Cestoda;* the roundworms or *Nematoda* (*q.v.*), slender elongated worms of cylindrical form with tapering ends and clothed in a smooth tough cuticle; the nemertine worms (*see* NEMERTINEA), marine worms common along ocean shores, often of very great length, and notable for a long protrusible proboscis; the spiny-headed worms (*see* ACANTHOCEPHALA), intestinal parasites with an eversible spiny head; the gordian worms (*see* NEMATOMORPHA), very long slender worms found in wet places and popularly called horsehair worms from a myth that they originate from horsehairs dropped in water; and the segmented worms (*see* ANNELIDA), worms with elongated jointed bodies including the earthworms (*q.v.*), leeches (*q.v.*) and

a variety of marine and fresh-water types. Other minor groups of less typical worm shape but allied to the above groups are the *Rotifera, Gastrotricha, Kinorhyncha, Echiuroidea, Priapuloidea, Sipunculoidea* and *Phoronidea* (*qq.v.*).

Many of the groups of worms are wholly or partly parasitic during all or part of their life cycles and have therefore secured a large measure of attention from zoologists and physicians. In the groups of the flukes, tapeworms and roundworms are included many important parasites of man, some of which, as for instance the hookworm, a roundworm and the oriental blood fluke (*Schistostoma*), constitute health problems of vast proportions. It is characteristic of parasitic worms that they have complicated life cycles involving a succession of larval stages in hosts different from those that harbour the adult worm. The working out of these life cycles and identification of larval stages have required the earnest labours of a succession of zoologists and still constitute an active branch of zoological research. (L. H. H.)

WORM, a screw which touches tangentially and which rotates a toothed wheel (the worm-wheel), and gives a very smooth drive. Among many other uses it is largely applied to the transmission of power from electric motors, and to the axles of road vehicles. Ball or roller bearings are fitted to the shafts, to take the journal running, and the end thrust, and, in good practice, the worm and wheel are submerged in an enclosed oil-bath. The worm is best made of steel, hardened and ground accurately on the threads, and the wheel of phosphor-bronze. In order to save expense, it is usual to make the wheel in the shape of an annular ring, and bolt it to an iron hub or rim. If increase in speed of rotation of the wheel is required for a given speed of worm, the latter is made with double or triple threads instead of a single helix. What is termed a *drop-worm* is extensively employed in machine-tools and other machines. Its bearings are hinged so that when the limit of desired travel has been reached, an automatic knock-off device allows the worm to fall out of mesh with the wheel. A conveyor worm is a helix surrounding a shaft (*see* CONVEYORS IN MASS PRODUCTION). A worm condenser consists of a coil of piping (*see* CONDENSER).

WORMS, a city of Germany, in the *Land* of Hesse. It is situated on the left bank of the Rhine, 25 mi. S. of Mainz, 20 mi. N.W. of Heidelberg and 9 mi. by rail N.W. of Mannheim. Pop. (1939) 50,157.

History.—Worms was known in Roman times as Borbetomagus, which in the Merovingian age became Wormatia. The town had before Caesar's time become the capital of a German tribe, the Vangiones. Drusus is said to have erected a fort there in 14 B.C. In 413 the emperor Jovinus permitted the Burgundians under their king Guntar or Guntiar to settle on the left bank of the Rhine between the Lauter and the Nahe. There they founded a kingdom with Worms as its capital. Adopting Arianism they came into conflict with the Romans, and under their king Gundahar or Gundicar (the Gunther of the *Nibelungenlied*) rose in 435 against the Roman governor Aetius, who called in the Huns against them. The destruction of Worms and the Burgundian kingdom by the Huns in 436 was the subject of heroic legends afterwards incorporated in the *Nibelungenlied* (*q.v.*) and the *Rosengarten* (an epic probably of the late 13th century). Worms was rebuilt by the Merovingians, and became an episcopal see, first mentioned in 614, although a bishop of the Vangiones had attended a council at Cologne as early as 347. There was a royal palace from the 8th century, and in it the Frankish kings, including Charlemagne, occasionally resided.

Under the German kings the power of the bishops of Worms gradually increased. Otto I granted extensive lands to the bishop, and in 979 Bishop Hildbold acquired comital rights in his city. Burchard I (bishop, 1000–25) destroyed the castle of the Franconian house at Worms, built the cathedral and laid the foundations of the subsequent territorial power of the see. There were frequent struggles between the bishops and the citizens, who espoused the cause of the emperors against the church, and were rewarded by privileges which fostered trade. The city retained its freedom until 1801, in spite of the bishops, who ruled a small territory south of the city, on both sides of the Rhine, and resided at Ladenburg near Mannheim till 1622.

The city of Worms was frequently visited by the imperial court. The concordat of Worms closed the investiture controversy in 1122. The "perpetual peace" (*ewiger Landfriede*) was proclaimed by the emperor Maximilian I at the diet of 1495, and Luther appeared before the famous diet of 1521 to defend his doctrines in the presence of Charles V. Four years later, Worms formally embraced Protestantism, and religious conferences were held there in 1540 and 1557. It suffered severely during the Thirty Years' War. The French under Mélac burned the city almost entirely in 1689, and it only fully recovered from this blow in recent years. Thus the population, which in its prosperous days is said to have exceeded 50,000, had sunk in 1815 to 6,250. By the treaty of Worms in 1743 an offensive alliance was formed between Great Britain, Austria and Sardinia. The city was annexed to France at the peace of Lunéville in 1801, together with the bishop's territories on the left bank of the Rhine. The remaining episcopal dominions were secularized in 1803 and given to Hesse-Darmstadt, which acquired the whole by the Vienna congress in 1815.

Antiquities.—Some parts of the ancient walls and towers still remain. The cathedral of SS. Peter and Paul ranks beside those of Spires and Mainz among the noblest Romanesque churches of the Rhine. This basilica, built of red sandstone, with a choir at each end, has an imposing exterior. Only the ground plan and the lower part of the western towers belong to the original building consecrated in 1110; the remainder was mostly finished by 1181, but the west choir and the vaulting were built in the 13th century, the elaborate south portal was added in the 14th century, and the central dome has been rebuilt. The baptistery contains five remarkable stone reliefs of the late 15th century. The church of Our Lady (*Liebfrauenkirche*) is a handsome Gothic edifice outside the town, finished in 1467. The principal Protestant place of worship is the Trinity church, built in 1726. Second in interest to the cathedral is the church of St. Paul, also in the Romanesque style, and dating from 1102–16, with a choir of the early 13th century, cloisters and other monastic buildings. This church has been converted into a museum. The late Romanesque church of St. Andrews is not used. The old synagogue, an unassuming building erected in the 11th century and restored in the 13th, is completely modernized. The Jewish community of Worms claims to be the most ancient in Germany and to have existed continuously since the very early Christian era, though the earliest authentic mention of it occurs in 588.

The old Bischofshof, in which the most famous Diet of Worms (1521) was held, has been replaced. The Luginsland is an old watch-tower of the 13th century. The Lutherplatz contains a group of statuary commemorating the Protestant reformers and their forerunners. Extensive burial-grounds, ranging in date from neolithic to Merovingian times, have been discovered near the city. Worms is the centre of a vine-growing country. The manufactures include patent leather, machinery, cloth, chemicals, paints, cork, furniture, slates, etc.

Worms possesses a good river harbour, and carries on a considerable trade by water.

WORMSEED, the name given to various plants whose seeds are used as vermifuges. Among the best known is the Levant wormseed (*Artemisia santonica*), from whose dried flower-heads is extracted the drug santonin, very efficacious in expelling round worms.

The American wormseed (*Chenopodium anthelminticum*), called also Mexican tea, yields wormseed oil, an officinal vermifuge. (*See* ARTEMISIA; CHENOPODIUM.)

WORMWOOD, the popular name for any aromatic herb of the genus *Artemisia,* a member of the family Compositae. The best known is *A. absinthium,* one of the ingredients of absinthe. It grows from 1 to 3 ft. high and is silkily hairy; the leaves are small and much cut, and the flowers are small yellow hemispherical heads among the leaves at the end of the branches. It is a native of Europe, grows in waste places in the British Isles, is widely naturalized in eastern North America, and is cultivated for use in domestic medicine. *A. pontica* is Roman wormwood;

A. stelleriana, a dusty miller, is sometimes called beach wormwood, etc. (*See* MUGWORT.)

WORSHIP (*i.e.,* "worth-ship"), honour, dignity, reverence, respect. The word is used in a special sense of the service, reverence and honour paid, by means of devotional words or acts, to God, to the gods, or to hallowed persons, such as the Virgin Mary or the saints, and hallowed objects, such as holy images or relics. It must, however, be borne in mind that the Roman Catholic Church distinguishes three kinds of worship: (1) *latria,* the worship due to God alone (from Gr. λατρεία, service, esp. the service of the gods, worship), and (2) *hyperdulia,* the worship or adoration due to the Virgin Mary as the Mother of God (from Gr. ὑπέρ, above, and δουλεία, service) and (3) *dulia,* that due to the saints.

The public service of God in church is known as "divine worship" or "divine service."

WORSTED MANUFACTURE. Straightness of fibre is the essential feature of worsted yarn. Originally, hand twisting and the use of long fibres made for straightness of fibre, but necessity for machine volume production has made complicated the machinery used in operations preceding spinning. The manufacture of worsted yarn in the United States rests basically on two systems: the English and the French. They are rarely found in the same mill. The former more adequately processes the longer and coarser wools, the latter is more suitable for medium and short wools (2½ in. or less). The basic drawing and combing principles are similar in both systems, although the machinery used differs. The English system necessitates fewer operations, produces more and is used more in the United States. The French system is more expensive and produces a softer, finer and less hairy yarn. The differences appear at first in the woollen carding. Ordinarily the wool is first scoured, dried and prepared by dusting, shaking and teasing. It is then ready to be carded (exceptionally long wools such as mohair are fed into sheeter gill boxes for straightening and disentanglement—a process of five or six operations which takes the place of carding; these long wools are not generally prepared in the United States). After carding, the usual operations are backwashing, gilling, combing, drawing, spinning, finishing and weaving.

Carding.—Worsted carding straightens, parallelizes, cleans and blends the fibres, so as to make a sliver of uniform quality, thickness and weight. This uniformity is necessary for a yarn of strength and fineness; hence great care is exercised. Long fibres must be whole, short ones must not curl up even though they are later combed out. Extraneous substances must be removed since they interfere with the operations. Worsted carding, unlike woollen carding, is done on one long card. In the United States three different types of cards are used: (1) single-cylinder with four licker-ins, (2) double-cylinder with two licker-ins and dividers, (3) double cylinder with burr breast workers and strippers; the latter card is preferred for all systems. Metallic cards are available that have no licker-ins and increase production.

Modern cards are divided into three parts, feeding, carding and delivery, and consist primarily of sets of rollers moving in different directions at varied speeds. Automatic feeders have spiked lattices that pull loose wool from hoppers at a regular pace to be beater combed and form a uniform sliver; these are adjustable to form any sliver weight. The spikes deposit the wool on an apron whence it passes onto the card covering which opens and uniformly deposits the wool on an automatically weighing feed apron and from there it moves to the card proper. The latter has feed rolls, licker-ins (breast works), main cylinders, fancies and doffers. The feed rolls, inserted with saw tooth wire or intersecting rings and pins, control the feeding of stock. Three feed rollers and a brush or wire stripper suffice for even fine wool. The licker-ins or breast works are the chief stock opening machinery. Cylindrical in shape, from 20 to 30 inches in diameter, they are studded with garnet wire and angular flattened saw teeth to keep burrs, etc., on top so that bladed beaters can remove them. For the removal of burrs the United States mills use a chemical treatment or burr breast works set close to high speed revolving burr knives; in England a burr crusher is also used. When the wool is freed of burrs and opened up it passes onto cylinders and strippers for carding. Thence it passes to the fancies and doffer dickeys, which latter, facing and running against the doffer, are small cylinders covered with flexible-tooth card clothing for raising any stock missed by the beater comb. The stock is delivered from the card by any one of four types of heads depending on the type of wool used, (1) can coiling, (2) railway balling, (3) centre balling, (4) side drawing balling; the object of all these heads is to put the sliver in a convenient form. The centre balling head is generally used in the United States.

Backwashing.—There being concealed impurities not removed by scouring and numerous impurities acquired in preparing or carding (such as oil, dust or dirt) the carded (or sheeter gilled mohair) wool is backwashed. Backwashing always just precedes combing. Many balls or cans of card slivers are fed to the back-

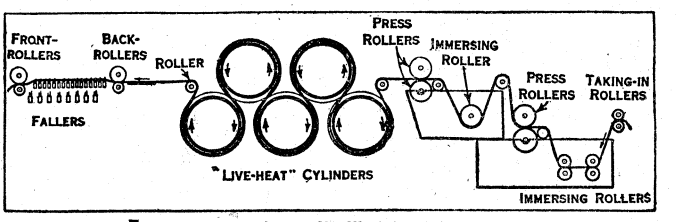


FIG. 1.—SECTIONAL VIEW OF BACKWASHER

washing machine at once. These machines have from one to four bowls for washing and have can or hot air dryers. Coloured slivers get no more than four bowl washings—white slivers get three or less. The bowls contain olive or olein soap full of suds; at least one bowl contains warm rinsing water to which is added, on occasion, blueing or ammonia. The slivers are squeezed and then dried; in the United States a hot air dryer is preferred. Because backwashing and drying tend to make the fibre brittle, wool oil is added at this point. Some simple machinery is used, usually, in the United States, being a series of rollers over an oil pan.

Gilling (preparing).—After backwashing, drying and oiling the slivers pass into a giller to be combed out by steel pins

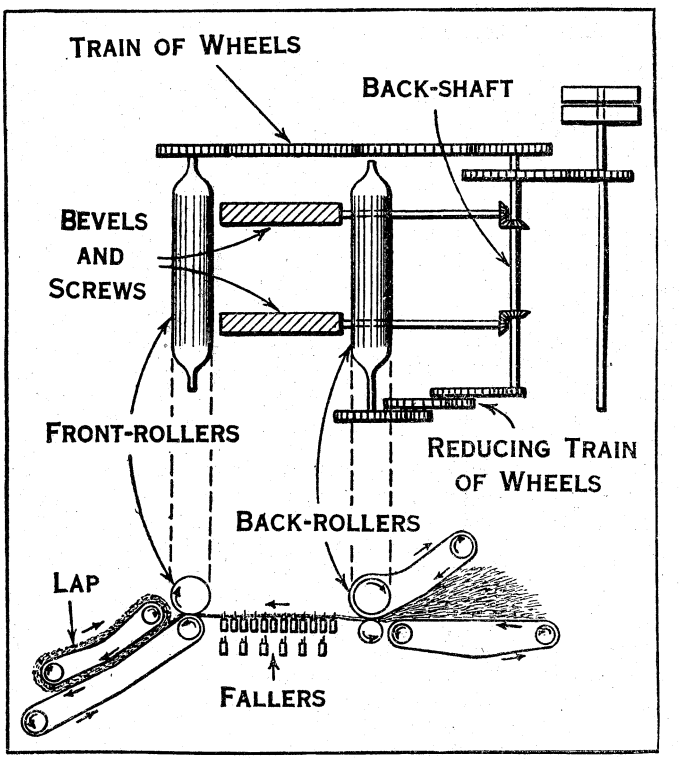


FIG. 2.—PLAN AND SECTION OF A PREPARING BOX

and to be straightened by other pins. The sliver is delivered from the gill boxes faster than it enters, the ratio of delivery to speed of entering is termed the draft. The sliver enters be-

tween rollers and passes over strong steel pins (fallers) which move in the same direction as the sliver but at a faster rate, giving a combing and straightening action. The wool is then passed through delivery rollers to calender rollers (to prevent any bunching) and into a can (or from the delivery rollers to an apron for coiling). There are various types of mechanical drafts in gill boxes—front, back and total. The front (delivery) rollers move faster than the fallers and the fallers move faster than the back (entering) rollers. The ratio of surface speed of the front rollers to the fallers is the front draft; the ratio of the fallers to the back rollers is the back draft, and that of the back rollers to the front rollers is the total draft. These drafts, differing with different types of wool and gilling operations, are important. There is also a material draft which is the weight per unit of the sliver entering the back rollers compared with the sliver weight leaving the front rollers. The mechanical ratio is the product of multiplying the surface speed of all the increasing rollers divided by the product of the surface speeds of all the decreasing rollers. Today, the rollers (back and front) are fluted spirally to grip but not break the fibres and keep them straight; obviously these flutes affect the draft. In the English system a simple measuring device is used in the gill box to keep the length of the slivers uniform. Usually, particularly in the English system, two more gillings may occur; these additional gillings vary from the first gilling only in the number of teeth per faller and the speed of the rollers. They present an opportunity for thickening the sliver and making it more uniform in weight and stock by doubling (doubling is merely the combining of different slivers into one, the combined slivers are then thinned out in the gill boxes and the result is a more uniform sliver).

Combing.—The purpose of combing is to eliminate short fibres of a given length as well as to further straighten the fibres and eliminate impurities. There are four types of combs, the Noble, Lister, Holden (square motion) and French (rectilinear). The first two are used in the English system and the latter two in the French system.

(a) *The English System.*—In the United States the Noble circular comb, imported from England, is most widely used. It is most productive and has a good length of fibre range. The Lister comb, while used somewhat, requires longer fibres and gives a smoother, straighter yarn. Preparation varies—the Noble comb has a ball winder attachment which makes a tight ball out of four slivers, each ball weighing about 20lb., 18 of these balls fill a Noble comb. The Lister comb takes the wool in long slivers much as a gill box does. The Noble comb, requires a good deal of moisture in the wool; this is left in from backwashing and by having the humidity high where the work is done. Rings of pins of varied number and sizes are used in Noble combing, the size and number depending on the wool used. Very important is the dabbing of the wool into the pins; the dabbers being of varied types, the most common is an Indian hog bristle brush. The dabbing must coincide with the rotating of the cylinders which separates the long wool. The drawing-off rollers are set close to the pins, and draw the long fibres from them. The delivery rollers are fluted and covered with leather which cushions the roller flutes and delivers the newly made twisted sliver to a sliver funnel. The sliver funnel takes the twist out and deposits the sliver in a coiling can. Generally speaking, about 9% of the combed wool is noil. One carding machine supplies one comb, and one backwash machine supplies three combs.

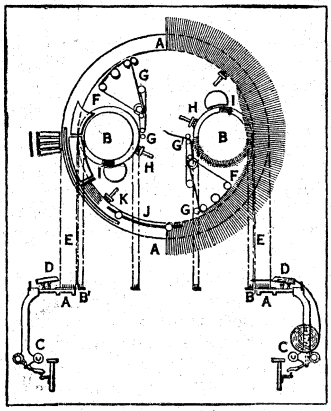


FIG. 3.—PLAN AND SECTION OF NOBLE COMB

Top Gilling.—To furnish a good English system worsted top two more gillings are given after combing; these are to insure uniformity of blend, weight, and length, to keep the fibres straight and to add water. The first of these gillings is like the backwash gilling except that the faller pins are finer. The condition of the latter is most important. The sliver is delivered into cans (or balls) in uniform lengths; usually many slivers are joined to form a heavy well blended sliver that will not break. Water is added, between the front and calender rollers, to compensate for evaporation—oil is added for dyed slivers. The second gilling box differs from the first in that it turns out a weighed definite length ball of worsted top which is made on a balling head. The sliver, as it leaves the front rollers, is passed over a straightening plate which evens up the fibres, and thence to a folder which folds the sliver over on itself whence it is wound onto a ball. As each top is produced it is weighed and checked. The top is then stored in moist cellars for settling.

(b) *The French System.*—The Heilman comb is used in the French system. It is good for long and short wools (and rayon staple fibre), is nearly as productive as the Noble comb, occupies much less room, uses 20% of the power, and needs only half of the supervision—it is a straight comb. It is fed by groups of slivers (8) placed side by side. The wool, drawn off in tufts, is pressed into slivers and passes through feed rolls and a feeding gill onto nipper jaws that hold the sliver while it is combed by a circular comb which has 18 pin bars with needles of varying density. As the nippers open another comb comes over the uncombed part of the sliver, and as the drawing off rollers remove the wool it is completely combed. A brush removes the noil from the combs while the usable wool is being delivered in overlapping tufts onto an apron and thence to a can. Burrs are removed by special blades.

Recombing.—This is done on special occasions, usually where dyed slivers are used because dyeing often causes the fibres to curl. Often it is used where blending of different coloured slivers is desired although such blending is reputedly best done in the gill boxes.

Drawing.—The theory of drawing in the English and French systems is to create a fine roving that can be spun into an even yarn. Drafting is used to thin out the sliver, doubling to make it uniform, and care is exercised to continue straightness and parallelism of the fibres. All systems use drafting rollers and a winding up of the reduced sliver. In the United States the English, French and cone systems are generally used. The English system is used on long coarse lustre and crossbred wools; the French system on unoiled tops of short fine wools, of from 1½in. to 4in.; and the cone system uses oiled tops. A fourth system is

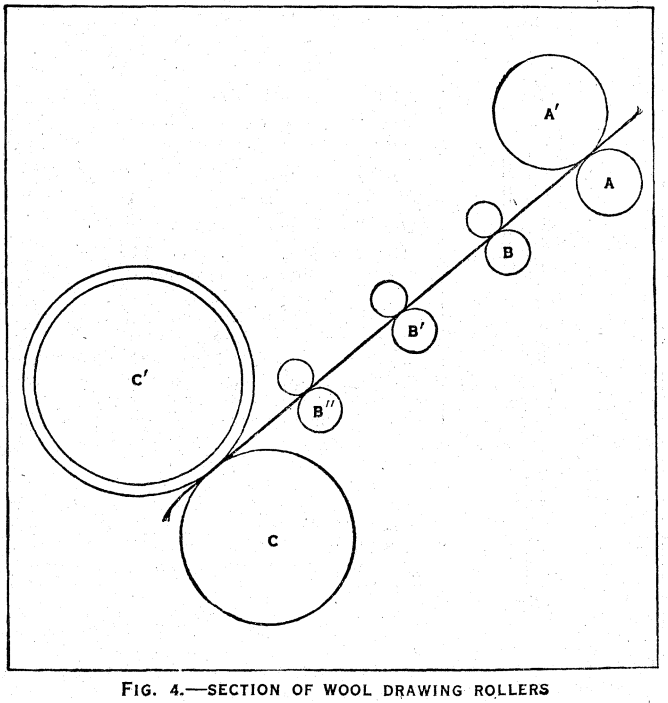


FIG. 4.—SECTION OF WOOL DRAWING ROLLERS

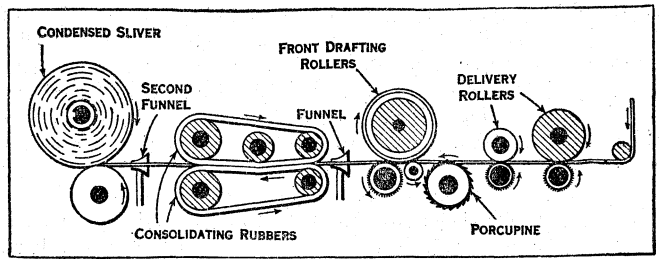


FIG. 5.—SECTION OF FRENCH DRAWING-BOX

patented by an English organization and combines the English and French systems, allowing oiled tops to be used on the French system. In the United States there are approximately twice as many mills using the English system as the French.

(a) *The English System.*—The English system can be used on almost any type of wool, although not so readily on the short fine Merino and crossbred stocks. An oiled top is essential, no other moisture is necessary. Drawing requires five to nine operations. Gilling, drawing, finishing, reducing, and roving are employed. Usually there are two or three gilling operations and from three to five drawing operations; the finer the wool is the more operations are necessary. The gilling machines are similar to and finer than the backwash gilling machines. The last gilling operation, however, is in a spindle gill which imparts a twist to the sliver making it a slubbing and feeds the slubbing onto a wooden spool (bobbin) by a "flyer." It is essential that the exact amount of strengthening twist be given. The slubbing now moves on to the drawing frames which are similar to the spindle gilling machines except that they are reduced in size. The drawing machines double, reduce, twist, and package (wind on spools) the slubbing; the draft exceeds the doubling in order to reduce the thickness of the slubbing. The drawing machine feed rolls are placed four high to get a sufficient hold on the slubbing, the carrier rollers are steel (top rollers are wood) and the delivery rollers are fluted cast iron (top rollers are leather covered). Finishers are in reality types of drawing boxes. The reducers and rovers number from one to three and are similar to drawing boxes set with fast moving spindles. Recently American mills have turned to ring rovers which permit great spindle speed at lower costs, although requiring a great deal of figuring due to twisting difficulties. Whereas slivers are figured in weight at ounces per ten yards, rovings and slubbings, being finer, are figured at drams per 40 yards. It can be readily perceived that careful calculating must be used in determining the draft and doubling so that the required weight rover is produced. As the slubbing and rover become finer the bobbin sizes decrease.

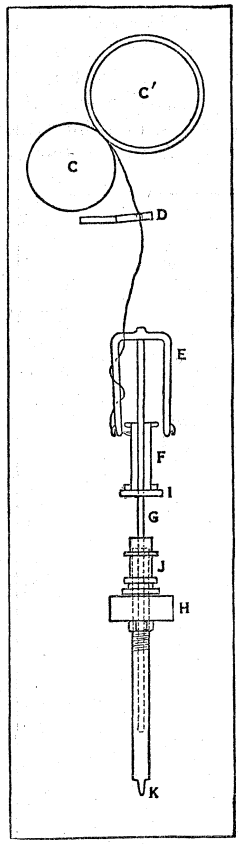


FIG. 6.—SECTION OF FLYER SPINDLE

(b) *The French System.*—The French system requires more operations (9 to 11) than the English and is more costly. It differs from the latter in that no real twist is imparted to the slubbing, drafting is always of four and is gauged by mechanical means, moisture is necessary; there are only two bobbin sizes; the slubbing or sliver is quickly reduced; the yarn produced is of short stock, smooth, soft and extremely fine, and the gill boxes are intersecting. The intersecting gill boxes have two sets of fallers, one over the other, and the teeth intersect each other and withdraw alternately, thus giving the sliver a double faller action. Three slivers are combined into one in the gill box. They are delivered by fluted delivery rolls and calender rolls through a false twisting funnel onto a balling head. These balling heads can be made to give two types of bobbin deliveries, either a single or double meche (one or two slubbings to the bobbin). The French drawing machines vary in fineness of operation, and hold the slubbing and roving together by rubbing rather than twisting. Doubling, drafting, condensing and winding are the main operations as in the English system. The machines have a "porcupine" roller which is studded with steel pins angled back and away from the rotation curve. The wool moves over the porcupine, which moves faster than the back rollers but slower than the front rollers, and the short fibres are controlled by the porcupine as the front rollers pull the long fibres. The slubbing passes onto leather aprons covering fluted revolving rollers which have a horizontal motion and rub the slubbing into a compact strand. The roving is then wound on bobbins by passing through a modern slubbing guide.

Cone Drawing.—Cone drawing follows closely the English system, it is costlier but permits of greater production and is widely used in the United States. The main difference is that the slubbing is wound onto the English system bobbin by being dragged around while the bobbin is free to move; as the bobbin gets filled it becomes more difficult to wind and the slubbing must be twisted hard to withstand the strain; in the cone system the bobbin is driven independently of the spindle and flyer and there is a constant tension on the slubbing that makes for a uniform and accurate twist on the roving with a consequent more even roving. Bobbins are larger and production greater, and since the twist is less the roving is softer and more like the French roving.

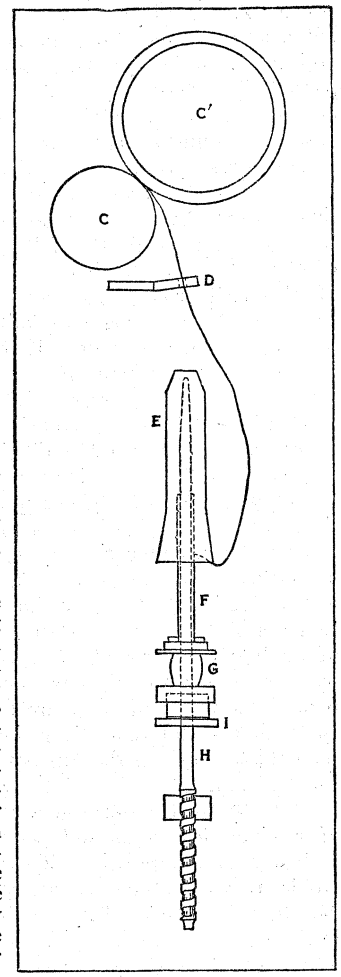


FIG. 7.—SECTION OF CAP SPINDLE

Patented Drawing. — This new English method does away with the English system drawing frames and substitutes the pin control method, thereby using short hair stock as well as long hair stock. It can be used with the English system roving and spinning sets and it can take oiled or dry tops or a blend of both. Since great competition is being given the English system by the French system in America, mills using the former are putting in the patented drawing machines to get the French soft roving without replacing their roving and spinning machinery.

Spinning.—Having obtained the roving by any one of the systems described, the next step is to spin the roving into yarn. There are four methods of spinning—flyer, cap, ring and mule. The English system uses ring, cap and flyer spinning. While most American mills using the English system use cap spinning there is a definite trend toward ring spinning. Flyer spinning is used on mohairs and carpet wools. About 85% of the American mills operating under the French system use mule spinning although ring spinning is increasing. In all systems there are three steps to spinning: (1) final drafting, (2) twisting the roving, (3) packaging—these are continuous operations except in worsted mule spinning.

Flyer Spinning.—Invented by Richard Arkwright in 1769 and known in England as the "throstle," the flyer spinner gives its yarns smoothness and lustre. The flyer frame is similar to the English system drawing frame with front, back and carrier rollers to thin the roving. The flyers which impart the twist are at the top of spindles, revolving at 2,500 to 3,000 revolutions per minute. The yarn is automatically wound onto bobbins or tubes. Production is low, but the flyer is necessary for spinning mohair and does a good job. The yarn is laid on the bobbins in horizontal layers by use of friction drag—automatic doffing is common. Amount of twist depends on the speed of the flyer.

Cap Spinning.—Invented by Charles Danforth, an American, in 1828, cap spinning is the most common spinning method used in the United States for English system worsteds. The spindles are stationary and the method of inserting twist and the bobbin winding differ from the flyer frames. The bobbin rotates at 6,000 to 9,000 r.p.m. by the lifting of a tube fitted with a whorl which is placed over the spindle; a twist is imparted to the yarn as the bobbin revolves and the spindle and cap do not. Weaknesses of this system are roughness and hairiness of yarn due to the great speed. Calculating the amount of twist

is complicated; the number of twists varies according to type of wool, from 3 to 20 per inch, equalling the number of revolutions of the bobbin per inch of delivery.

Ring Spinning.—Recently the use of ring spinning, formerly used for cotton has become widespread in the worsted field. The benefits of this type of spinning are quality yarns at low cost. The most prominent feature is the large size of the bobbin which holds many times that held by the ordinary one. Very few knots are found in the yarn and it is superior to cap spun yarn. The yarn is fed through an eye, and onto a traveller which is dragged around a ring, lubricated to reduce friction, which in turn is fastened to a stationary ring rail. The yarn goes at right angles from the traveller to the bobbin. The bobbin motion inserts the twist and the traveller runs slower than the bobbin to ensure tension. Spindle speed is variated to compensate for loss of tension due to the filling up of the bobbin, hence the smaller the bobbin load the greater the spindle speed.

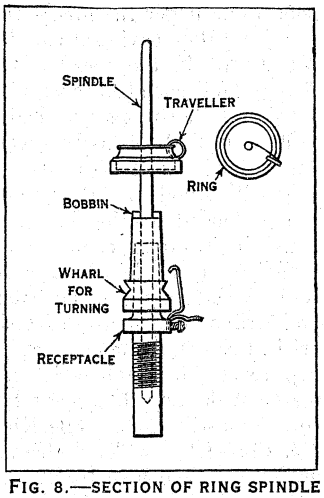


FIG. 8.—SECTION OF RING SPINDLE

Mule Spinning.—Mule spinning, being replaced in the United States by ring spinning, produces an exceptionally fine, soft yarn with short wools. The operations are performed intermittently rather than continuously, and the process is used only in the French system. Twist is put into the flat yarn by using cylinder driven tapered spindles on a carriage which runs about five feet. When the carriage reaches the end of its run the yarn is completed and removed from the top of the spindles; the carriage then travels back and the yarn is again wound on the bobbin.

Doubling, etc.—It is often necessary to double or further thicken the yarns; this is done on the spinning frames. Similarly, fancy twists are often desired and these are imparted by numerous attachments on ring frames. Since yarns are available in many forms, spools, bobbins, etc., the buyer has a broad choice.

Weaving, Finishing.—The principles of weaving apply generally to worsted weaving (*see* WEAVING) except in a few cases. Generally, the processes used in finishing worsteds are similar to those used in woollens except that the worsted is more nearly a completed fabric when it leaves the looms; hence though similar operations are required for finishing they are more lightly applied and the change from the unfinished to the finished worsted is not so noticeable. Worsteds may be crossed with other fabrics to form hybrids; generally the usages are increasing. (*See* also WOOLLEN MANUFACTURE.)

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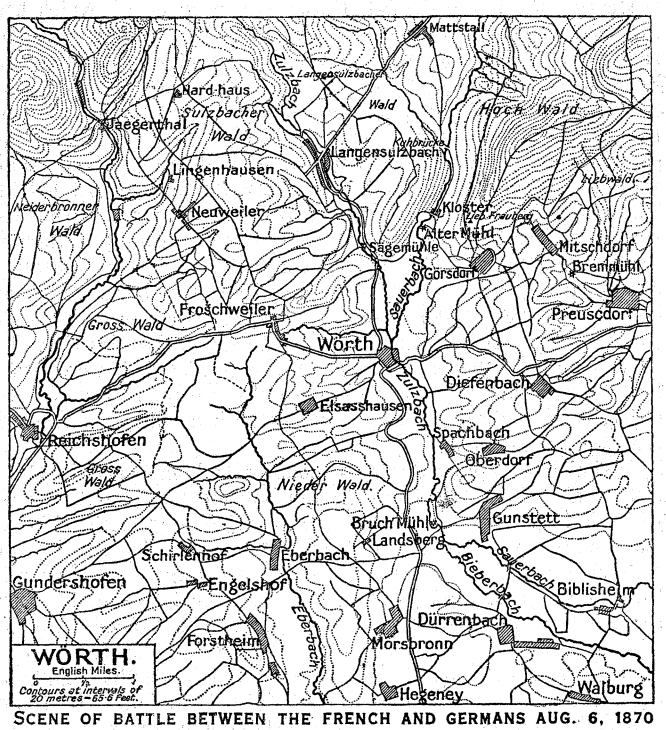
WORTH, CHARLES FREDERICK (1825–1895), the famous dressmaker, was born at Bourne, Lincolnshire, in 1825 and was sent to London as an apprentice to Swan & Edgar, drapers. In 1846, he went to Paris, without capital or friends, and after 12 years in a wholesale silk house he began business as a dressmaker in partnership with a Swede named Dobergh. He won the patronage of the empress Eugénie, and, through her, of fashionable Paris. After the Franco-German War Worth continued the business with his two sons John and Gaston—both naturalized Frenchmen. For more than 30 years he set the taste and ordained the fashions of Paris.

WÖRTH, a village of Alsace, on the Sauer, 6mi. N. of Hagenau, which gives its name to the battle of Aug. 6, 1870, fought between the Germans under the crown prince of Prussia and the French under Marshal MacMahon. The battle is also called Reichshoffen and Fröschweiler. Pop. (1936) 1,141.

The events which led up to the engagement, and the general situation on the 6th are dealt with under FRANCO-GERMAN WAR. During Aug. 5 the French concentrated in a selected position running nearly north and south along the Sauer Bach on the left front of the German III Army, which was moving south to seek them. The position is marked from right to left by Morsbronn, the Niederwald, the heights west of Wörth and the woods north-east of Fröschweiler. East of the Sauer the German III Army was moving south, when their cavalry found the French position about noon. Thereafter the German vedettes held the French under close observation, while the latter moved about within their lines and as far as the village of Wörth as if in peace quarters.

About 5 P.M. some horses were being watered at the Sauer, when a sudden swoop of the enemy's hussars drove the party back to camp. The alarm was sounded, tents were struck and the troops fell in and remained under arms until the confusion died down, when orders were sent to fall out, but not to pitch the tents. The army there bivouacked, and but for this incident the



SCENE OF BATTLE BETWEEN THE FRENCH AND GERMANS AUG. 6, 1870

battle of the next day might not have been fought. A sudden storm broke over the bivouacs, and when it was over, many of the men, wet and restless, broke out of camp and went into Wörth, which was unoccupied, though Prussians were only 300yd. from the sentries. These fired, and the officer commanding the Prussian outposts, hearing the confused murmur of voices, ordered up a battery, and as soon as there was light enough dropped shells into Wörth. The stragglers rushed back, French lines were again alarmed, and batteries on their side took up the challenge.

The Prussian guns, as strict orders had been given to avoid all engagement that day, soon withdrew and were about to return to camp, when renewed artillery fire was heard from the south and presently also from the north. In the latter direction, the II Bavarian Corps had bivouacked along the Mattstall-Langensulzbach road with orders to continue the march if artillery were heard to the south. This order was contrary to the spirit of the III Army orders, and, moreover, the V Prussian Corps to the south was in ignorance of its having been given.

The outpost battery near Wörth was heard, and the Bavarians at once moved forward. The leading divisional commander, anxious to prove his loyalty to his new allies—his enemies in 1866—ordered his troops to attack, giving the spire of Fröschweiler, which was visible over the woods, as the point of direction. The French, however, were quite ready and a furious fusillade broke out, which was multiplied by the echoes of the forest-clad hills out of all proportion to the numbers engaged. The Prussian officers of the V Corps near Diefenbach, knowing nothing of the orders the Bavarians had received, were amazed; but when about 10.30 A.M. their comrades were seen retiring, part in disorder, the corps commander, Kirchbach, decided that an effort must be made to relieve the Bavarians. He communicated his intention of attacking to the XI Corps (Bose) on his left and asked for all available assistance. A report was also despatched to the crown prince at Sulz, 5mi. away.

Meanwhile the XI. Corps had become involved in an engagement. The left of the V. Corps' outposts had over night occupied Gunstett and the bank of the Sauer, and the French shortly after daylight on the 6th sent down an unarmed party to fetch water. As this appeared through the mist, the Prussians naturally fired upon it, and the French General Lartigue (to whose division the party belonged), puzzled to account for the firing, brought up some batteries in readiness to repel an attack. These fired a few rounds only, but remained in position as a precaution.

Hearing the firing, the XI. Corps' advanced guard, which had marched up behind in accordance with the general movement of the corps in changing front to the west, promptly came up to Spachbach and Gunstett. In this movement across country to Spachbach some bodies appear to have exposed themselves, for French artillery at Elsasshausen suddenly opened fire, and the shrapnel bursting high, sent showers of bullets on to the house roofs of Spachbach, in which village a battalion had just halted. The major in command thereupon ordered the march to be resumed, and as he gave the order, his horse ran away with him towards the Sauer. The leading company, seeing the battalion commander gallop, moved off at the double, and the others of course followed. Under the impression that they were intended to attack, they deployed and crossed the river. By this time the French outposts lining the edge of the Niederwald, were firing heavily. The line of smoke was naturally accepted by all as the objective, and the German companies with a wild rush reached the edge of the wood.

A similarly unpremeditated encounter had happened at Gunstett and both sides brought up reinforcements. The Prussians, with all their attention concentrated on the wood in their front, and having as yet no superior commanders, soon exhibited signs of confusion, and thereupon Gen. Lartigue ordered a counter attack towards the heights of Gunstett, when all the Prussians between the Niederwald and the Sauer gave way. The French followed with a rush, and, fording the Sauer opposite Gunstett, for a moment placed the long line of German guns upon the heights in considerable danger. At this crisis a fresh battalion arrived and attacked the French on one flank whilst the guns swept the other. The momentum of the charge died out, and the French retired.

In the centre the fight had been going badly for the V. Corps. As soon as Kirchbach's 84 guns between Dieffenbach and Spachbach opened fire the French disappeared from sight. There was no longer a target, and, perhaps to compel his adversary to show himself, Kirchbach ordered four battalions to cross the river. These, however, were overpowered and driven back by infantry fire. But, once more, the dashing counter-attack of the French was thrown into confusion by the Prussian shell fire, and as the French fell back the Prussian infantry, now reinforced, followed them up (about 1 P.M.). The commander-in-chief of the German III. Army (the crown prince Frederick) now appeared on the field and ordered Kirchbach to stand fast until the pressure of the XI. Corps and Württemberg Division could take effect against the French right wing. The majority of these troops had not yet reached the field. Bose, however, seeing the retreat of the troops of the V. Corps, had independently determined to renew the attack against the Niederwald, and had ordered Schkopp's brigade, which was then approaching, to join the troops collecting to the east of Gunstett. Schkopp, however, seeing that his present line of advance led him direct on to the French right about Morsbronn and kept him clear of the confusion to be seen around Gunstett, disregarded the order and continued to advance on Morsbronn. This deliberate acceptance of responsibility really decided the battle, for his brigade quietly deployed as a unit and compelled the French right wing to fall back.

To cover the French retreat Michel's brigade of cavalry was ordered to charge. Without reconnoitring or manoeuvring for position, the French cavalry rode straight at the first objective which offered itself. Hence the charge was costly and only partly successful. However, the Prussians' attention was sufficiently absorbed while the French infantry rallied for a fresh counter-stroke. This was made, about 1.20 P.M., with the utmost gallantry, and the Prussians were driven back. But the counter-attack soon came under the fire of the great artillery mass above Gunstett, and Bose having at length concentrated the main body of the XI. Corps in the meadows between the Niederwald and the Sauer, the French had to withdraw. Their withdrawal involved the retreat of the troops who had defended Niederwald all day.

By 3 P.M. the Prussians were masters of the Niederwald and the ground south of it on which the French right wing had originally stood, but they were in indescribable confusion after the prolonged fighting in the dense undergrowth. Before order could be restored came another fierce counterstroke. As the Prussians emerged from the northern edge of the wood, the French reserves suddenly came out from behind the Elsasshausen heights, and striking due south drove the Prussians back. It was a grave crisis, but at this moment Schkopp, who throughout all this had kept two of his battalions intact, came round the north-west corner of the Wald, and these fresh battalions again brought the French to a standstill. Meanwhile Kirchbach, seeing the progress of the XI. Corps, had ordered the whole of his command forward to assault the French centre, and away to the right the two Bavarian corps moved against the French left, which still maintained its original position in the woods north-east of Fröschweiler.

MacMahon, however, was not beaten yet. Ordering Bonnemains' cavalry division to charge by squadrons to gain time, he brought up his reserve artillery, and sent it forward to case-shot range to cover a final counter-stroke by his last intact battalions. But from his position near Fröschweiler he could not see into the hollow between Elsasshausen and the Niederwald. The order was too late, and the artillery unlimbered just as the counter attack on the Niederwald alluded to above gave way before Schkopp's reserve. The guns were submerged in a flood of fugitives and pursuers. Elsasshausen passed into the hands of the Germans. To rescue the guns the nearest French infantry attacked in a succession of groups, charging home the bayonet with the utmost determination. Before each attack the Prussians immediately in front gave way, but those on the flanks swung inwards, and under this converging fire each French attempt died out, the Prussians following up their retreat. In this manner, step by step, in confusion which almost defies analysis, the Prussians conquered the whole of the ground to the south of the Fröschweiler-Wörth road, but the French still held on in the village of Fröschweiler itself and in the woods to the north of the road, where throughout the day they had held the two Bavarian corps in check with little difficulty. To break down this last stronghold, the guns of the V. and XI. Corps, which had now come forward to the captured ridge of Elsasshausen, took the village as their target; and the great crowd of infantry, now flushed with victory but in the direst confusion, encouraged by the example of two horse artillery batteries, which galloped boldly forward to case-shot range, delivered one final rush which swept all resistance before it.

The battle was won and cavalry only were needed to reap its consequences, but the Prussian cavalry division had been left behind without orders and did not reach the battlefield till late at night. Under cover of darkness the French escaped, and on the following day the cavalry division was quite unable to discover the direction of the retreat.

MacMahon received no support from the neighbouring French troops (*see* FRANCO-GERMAN WAR). The battle was won by overpowering weight of numbers. The Prussian general staff were able to direct upon the field no fewer than 75,000 infantry, 6,000 cavalry and 300 guns, of which 71,000 rifles, 4,250 sabres and 234 guns came into action against 32,000 rifles, 4,850 sabres and 101 guns on the French side. The superiority of the French chassepot to the needle guns may reasonably be set against the superior number of rifles on the German side, for though the Germans were generally, thanks to their numbers, able to bring a converging fire upon the French, the latter made nearly double the number of hits for about the same weight of ammunition fired, but the French had nothing to oppose to the superior German artillery, and in almost every instance it was the terrible shell fire which broke up the French counter attack. All of these attacks were in the highest degree honourable to the French army, and many came nearer to imperilling the ultimate success of the Germans than

is generally supposed even by students of military affairs.

The losses of the Germans were 9,270 killed and wounded and 1,370 missing, or 13%; those of the French were about 8,000 killed and wounded, and perhaps 12,000 missing and prisoners, representing a total loss of about 41%.

See the French and German official histories of the war; H. Bonnal, *Fröschwiller* (1899); H. Kunz, *Schlacht von Wörth* (1891) and *Kriegsgesch, Beispiele,* Nos. 13–18; R. Tournès, *De Gunstett au Niederwald* and *Le Calvaire;* and Commandant Grange, "Les Réalités du champ de bataille," *Revue d'infanterie* (1908–10). (F. N. M.)

WORTHING, a municipal borough and seaside resort mainly in the Horsham and Worthing parliamentary division of Sussex, England, 61 mi. S.W. from London by the S. railway. Pop. (est. 1938) 59,080. Area, 13.5 sq.mi. It has a fine marine parade and a promenade pier, and there is a long range of firm sands. The mother parish of Worthing is Broadwater, the church of which, 1 mi. N. of Worthing, is a cruciform building, and a fine example of transitional Norman work. A Roman villa, evidence of a pottery works, and a "mile-stone," have been discovered here. The town was incorporated in 1890. A modern and important industry is the raising of flowers and fruit, especially tomatoes, in glass houses. A new town hall was opened in 1933 and the corporation owns over 1,000 ac. of downlands, besides a marine estate and public gardens. During World War II 3,000 houses were damaged in the German air raids of 1940–41. The area of the borough was more than doubled in 1929, and portions of the parishes of Findon and Sompting were added in 1933.

WORTHINGTON-EVANS, SIR LAMING (1868–1931), British statesman, was born Aug. 23, 1868. In 1910 he was elected Conservative M.P. for Colchester, and in 1918 for the Colchester division of Essex, which he represented in succeeding parliaments. In 1916 he entered the Coalition government as parliamentary secretary to the ministry of munitions. He left the ministry of munitions in 1918 to become minister of blockade, and afterwards filled the following offices under Lloyd George and Baldwin: minister of pensions, 1918–20; minister without portfolio, 1920–21; secretary for war, 1921–22; postmaster-general, 1923–24; and again secretary for war, 1924–29. He wrote books on company law. He died Feb. 14, 1931.

WOTTON, SIR HENRY (1568–1639), English author and diplomatist, son of Thomas Wotton (1521–1587) and grandnephew of Nicholas Wotton, was born at Bocton Hall in the parish of Bocton or Boughton Malherbe, Kent. He was educated at Winchester school and at New college and Queen's college, Oxford. At Oxford he was the friend of Albericus Gentilis and of John Donne. While at Queen's he wrote a play, *Tancredo,* which has not survived, but his chief interests appear to have been scientific. About 1589 Wotton went abroad, probably in preparation for a diplomatic career, and his travels appear to have lasted for about six years. At Altdorf he met Edward, Lord Zouch, to whom he later addressed a series of letters (1590–93) which contain much political and other news. These (*Reliquiae Wottonianae,* pp. 585 *et seq.* 1685) provide a record of the journey. He travelled by way of Vienna and Venice to Rome, and in 1593 spent some time at Geneva in the house of Isaac Casaubon. Wotton returned to England in 1594, and in 1595 was admitted to the Middle Temple. While abroad he had provided Robert Devereux, second earl of Essex, with information, and he now entered his service as one of his agents or secretaries to supply intelligence of affairs in Transylvania, Poland, Italy and Germany. Wotton was not actually involved in Essex's downfall, but he left England, and within 16 hours of his patron's apprehension he was safe in France, whence he travelled to Venice and Rome. In 1602 he was resident at Florence, and a plot to murder James VI of Scotland having come to the ears of the grand duke of Tuscany, Wotton was entrusted with letters to warn him of the danger, and with Italian antidotes against poison. As "Ottavio Baldi" he travelled to Scotland by way of Norway. He remained three months at the Scottish court, retaining his Italian incognito. He then returned to Florence, but on receiving the news of James's accession hurried to England. James knighted him, and offered him the embassy at Madrid or Paris; but Wotton, knowing that both these offices involved ruinous expense, desired rather to represent James at Venice. He left London in 1604 accompanied by Sir Albertus Morton, his half-nephew, as secretary, and William Bedell, the author of an Irish translation of the Bible, as chaplain.

Wotton spent most of the next twenty years, with two breaks (1612–16 and 1619–21), at Venice. He helped the Doge in his resistance to ecclesiastical aggression, and was associated with Paolo Sarpi, whose history of the Council of Trent was sent to King James as fast as it was written. In 1611 Caspar Schoppe, whom Wotton had offended, wrote a scurrilous book against James entitled *Ecclesiasticus,* in which he fastened on Wotton a saying which he had incautiously written in a friend's album years before. It was the famous definition of an ambassador as an "honest man sent to lie abroad for the good of his country." Wotton was at the time on leave in England, and made two formal defences of himself, one a personal attack on his accuser addressed to Marcus Welser of Strasbourg, and the other privately to the king. He seems to have won back James's favour by obsequious support in parliament of his claim to impose arbitrary taxes on merchandise. In 1614 he was sent to the Hague and in 1616 he returned to Venice.

In 1620 he was sent on a special embassy to Ferdinand II. at Vienna, to do what he could on behalf of James's daughter Elizabeth, queen of Bohemia. Wotton's devotion to this princess, expressed in his exquisite verses beginning "You meaner beauties of the night," was sincere and unchanging. At his departure the emperor presented him with a jewel of great value, which Wotton received with due respect, but before leaving the city he gave it to his hostess, because, he said, he would accept no gifts from the enemy of the Bohemian queen. After a third term of service in Venice he returned to London early in 1624 and in July he was installed as provost of Eton College. This office did not relieve him from his pecuniary embarrassments, and he was even on one occasion arrested for debt, but he received in 1627 a pension of £200, and in 1630 this was raised to £500 on the understanding that he should write a history of England. He did not neglect the duties of his provostship, and was happy in being able to entertain his friends lavishly. His most constant associates were Izaak Walton and John Hales. A bend in the Thames below the Playing Fields, known as "Black Potts," is still pointed out as the spot where Wotton and Izaak Walton fished in company. He died at the beginning of December 1639 and was buried in the chapel of Eton College.

Sir Henry Wotton was not an industrious author, and his writings are very small in bulk. Of the twenty-five poems printed in *Reliquiae Wottonianae* only 15 are Wotton's. But of those 15 two have obtained a place among the best known poems in the language, the lines already mentioned "On his Mistris, the Queen of Bohemia," and "The Character of a Happy Life."

During his lifetime he published only *The Elements of Architecture* (1624), which is a paraphrase from Marcus Vitruvius Pollio, and a Latin prose address to the king on his return from Scotland (1633). In 1651 appeared the *Reliquiae Wottonianae,* with Izaak Walton's *Life.* An admirable *Life and Letters,* representing much new material, by Logan Pearsall Smith, was published in 1907. *See* also A. W. Ward, *Sir Henry Wotton, a Biographical Sketch* (1898).

WOUND, a solution in the continuity of the soft parts of the body. Contused wounds, or bruises, are injuries to the cellular tissues in which the skin is not broken. In parts where the tissues are lax the signs of swelling and discoloration are more noticeable than in the tenser tissues. The discoloration is caused by haemorrhage into the tissues (*ecchymosis*), and passes from dark purple through green to yellow before it disappears. If a considerable amount of blood is poured forth into the injured tissues it is termed a *haematoma.* The treatment of a bruise consists in the application of cold lotion, preferably an evaporating spirit-lotion, to limit the subcutaneous bleeding. The haemorrhage usually becomes absorbed of its own accord even in haematomata, but should suppuration threaten an incision must be made and the cavity aseptically evacuated.

Open wounds are divided into incised, lacerated, punctured and gunshot wounds. *Incised* wounds are made by any sharp instrument and have their edges evenly cut. In these wounds there is usually free haemorrhage, as the vessels are cleanly divided.

Lacerated wounds are those in which the edges of the wound are torn irregularly. Such injuries occur frequently from accidents with machinery or blunt instruments, or from bites by animals. The haemorrhage is less than from incised wounds, and the edges may be bruised. *Punctured* wounds are those in which the depth is greater than the external opening. They are generally produced by sharp-pointed instruments. The chief danger arises from puncture of large blood-vessels, or injury to important structures such as those in the thorax and abdomen. The great danger of all open wounds is that pathogenic micro-organisms will be introduced at the time of injury.

The treatment of incised wounds is to arrest the bleeding (*see* HAEMORRHAGE), cleanse the wound and its surroundings, removing all foreign bodies (splinters, glass, etc.), and obtain apposition of the cut surfaces. This is usually done by means of sutures or stitches of silk, catgut, silkwormgut or silver wire. If the wound can be rendered aseptic, incised wounds usually heal by first intention. In lacerated wounds there is danger of suppuration, sloughing, erysipelas, while if soil, particularly cultivated and heavily manured soil, be carried into the tissues during the injury there is risk of gas-gangrene, malignant oedema or tetanus. These wounds do not heal by first intention, and there is consequently considerable scarring. The exact amount of time occupied in the repair depends upon the presence or not of septic material, as lacerated wounds are very difficult to cleanse properly. Carbolic acid lotion should be used for cleansing, while torn or ragged portions should be cut away and provision made for free drainage. It is not always possible to apply sutures at first, but the wound may be packed with antiseptic gauze, and later, when a clean granulating surface has been obtained, skin-grafting may be required. In extensive lacerated wounds, especially in conjunction with comminuted fractures, amputation of a limb may be called for. Punctured wounds should be syringed with carbolic lotion, and all splinters and foreign bodies removed. The location of needles and other bodies opaque to the rays is facilitated by the use of the Röntgen rays; the wound can then be packed with gauze and drained. If a large vessel should have been injured, the wound may have to be laid open and the bleeding vessel secured. Should paralysis indicate that a large nerve has been divided, the wound must also be laid open in order to suture the injured structure.

It is only possible here to mention some of the special characteristics of *gunshot* wounds. A remarkable collection, largely added to during the World War, is contained in the Museum of the Royal College of Surgeons of England and smaller collections are to be found in some other great centres. With the modern small-bore rifle of high velocity, machine guns and Lewis guns the aperture of entry is small and the aperture of exit larger and more slit-like. There is usually but little haemorrhage. Should no large vessel be torn, and should no portion of septic clothing be carried in, the wound may heal by first intention. Such bullets may be said to disable without killing. They may drill a clean hole in a bone without a fracture, but sometimes there is much splintering. Abdominal wounds may be so small that the intestine may be penetrated and adhesions of neighbouring coils of intestine cover the aperture. Martini-Henry bullets make larger apertures, while soft-nosed or "dum-dum" bullets spread out as soon as the bullet strikes, causing great mutilation and destruction of the tissues. Shell wounds cause extensive lacerations. Small shot may inflict serious injury should one of the pellets enter the eye. In gunshot wounds at short distance the skin may be blackened owing to the particles of carbon lodging in it. The chief dangers of gunshot wounds are haemorrhage, shock and the carrying in of septic material or clothing into the wound.

WOUWERMAN, PHILIP (1619–1668), Dutch painter of battle and hunting scenes, was born at Haarlem, where he was baptised on May 24, 1619. He learned the elements of his art from his father, Paul Joosten Wouwerman, a painter from Alkmaar. He then became a pupil of Frans Hals and probably of J. Wynants and of Pieter Verbeek, a painter of horses. He became a member of the guild of painters at Haarlem in 1642, and there he died on May 19, 1668. About 800 pictures were enumerated in John Smith's *Catalogue raisonné* (1840) as the work of Philip Wouwerman, and in C. Hofstede de Groot's enlarged *Catalogue,* vol. ii. (1909), the number exceeds 1,200; but probably many of these are the productions of his brothers Pieter (1623–1682) and Jan (1629–1666), and of his many other imitators. His authentic works are distinguished by great spirit and are infinitely varied, though dealing recurrently with cavalry battle-pieces, military encampments, cavalcades, and hunting or hawking parties. He is equally excellent in his vivacious treatment of figures, in his skilful animal painting, and in his admirable and appropriate landscape backgrounds. Horses were his favourite study, and a white horse is generally introduced. Three different styles have been observed as characteristic of the various periods of his art. His earlier works are marked by the prevalence of a foxy-brown colouring, and by a tendency to angularity in draughtsmanship; the productions of his middle period have greater purity and brilliancy; and his latest and greatest pictures possess more of force and breadth, and are full of a delicate silvery-grey tone.

See H. de Groot, *Catalogue of Dutch Painters* (1909).

WRAITH, a general term in popular parlance for the appearance of the spirit of a living person. (*See* PSYCHICAL RESEARCH: *Spontaneous and Experimental Phenomena.*)

WRANGEL, FRIEDRICH HEINRICH ERNST, COUNT VON (1784–1877), Prussian general field marshal, was born at Stettin, on April 13, 1784. He entered the Prussian army in 1796 and distinguished himself in the campaigns against Napoleon. He was in command of the 13th Division, with headquarters at Münster, in Westphalia, in 1834, when riots occurred owing to differences between the archbishop of Cologne and the crown, and the determination and resolution with which he treated the clerical party prevented serious trouble. He was promoted lieutenant-general, received many honours from the court, enjoyed the confidence of the Junker party, and commanded successively at Königsberg and Stettin. In 1848 he commanded the II. Corps of the German Federal army in the Schleswig-Holstein campaign, was promoted general of cavalry, and won several actions. In the autumn he was summoned to Berlin to suppress the riots there. As governor of Berlin and commander-in-chief of the Mark of Brandenburg (appointments which he held till his death) he proclaimed a state of siege, and ejected the Liberal president and members of the Chamber. Thus on two occasions in the troubled history of Prussian revival Wrangel's uncompromising sternness achieved its object without bloodshed. In 1856 he was made a field marshal. At the age of eighty he commanded the Austro-Prussian army in the war with Denmark in 1864. The prestige of his name, and the good work of his subordinates, made the campaign a brilliant success. After the capture of Düppel he resigned the command, was created a count, and received other honours. In 1866 "Papa" Wrangel assisted in the Bohemian campaign, but without a command on account of his great age. He took a keen interest in the second reorganization of the cavalry arm 1866–1870, and in the war with France in 1870–71. He died at Berlin on Nov. 2, 1877.

See supplement to *Militär. Wochenblatt* (1877), and lives by von Köppen and von Maltitz (Berlin, 1884).

WRANGEL, KARL GUSTAV VON (1613–1676), Swedish soldier, was descended from a family of Estonian origin, branches of which settled in Sweden, Russia and Germany. His father, Hermann von Wrangel (1587–1643), was a Swedish field marshal in Gustavus Adolphus's wars. Karl Gustav was born near Uppsala on Dec. 23, 1613, and at the age of twenty distinguished himself as a cavalry captain in the war against the Army of the League. Three years later he was colonel, and in 1638 major-general, still serving in Germany. In 1644 he commanded a fleet at sea, which defeated the Danes at Fehmarn on the 23rd of October. In 1646 he returned to Germany as a field marshal and succeeded Torstensson as commander-in-chief of the Swedish army in Germany, which post he held during the last three campaigns of the Thirty Years' War. Under Wrangel and Turenne the allied Swedish and French armies marched and fought in Bavaria and Württemberg. At the outbreak of a fresh Polish

war in 1655 Wrangel commanded a fleet, but in 1656 he was serving on land again and commanding, along with the Great Elector of Brandenburg, in the three days' battle of Warsaw. In 1657 he invaded Jutland and in 1658 passed over the ice into the islands and took Kronborg. In 1657 he was appointed admiral and in 1664 general of the realm, and as such he was a member of the regency during the minority of Charles XI. But his last campaign was unfortunate. Commanding, ineffectively owing to his broken health, in the war against Brandenburg, he was recalled after his stepbrother Waldemar, Freiherr von Wrangel (1647–1676), had been defeated at Fehrbellin. He died at Rügen on July 5, 1676.

WRANGEL, PETER NICHOLAIEVICH, Baron (1878–1928), Russian general, was born at St. Petersburg (Leningrad) on Aug. 15, 1878, of a noble family of Swedish descent. After experience in the ranks of the horse guards and as a mining engineer in Siberia, he served as an officer in a Cossack regiment, transferring after the Russo-Japanese War to the horse guards as a captain. During the World War he commanded successively a squadron, a regiment and a division of Cossacks. He was one of the first officers to join Kaledin against the Bolsheviks. After Kaledin's suicide Wrangel allied himself to Alexeyev and Denikin, distinguishing himself particularly by his defence of Tsaritsyn in the summer of 1919. On April 4, 1920, after Denikin's retreat, Wrangel was appointed commander-in-chief of the volunteer army. He was in Constantinople when the summons came. He arrived in the Crimea to find a force completely disorganized. In a very short space of time he had turned it into an effective force with which he held the Bolsheviks in check, and indeed made some advance. But after the signing of a peace treaty between Poland and the Bolsheviks the tide turned. On Nov. 15 Sebastopol was lost and the evacuation of the army carried out. Wrangel embarked with about 130,000 refugees, who were dispersed in the Balkans and other parts of Europe. He kept a staff for some time in Belgrade, from which centre he tried to organize the settlement of his soldiers. After a time he took a post as mining engineer in Brussels, where he died on April 25, 1928.

WRANGEL ISLAND, in the Arctic sea, 85 m. N.E. of Cape Billings, eastern Siberia, extends between 176° W. and 179° E. in about 71° N. It is 80 m. long and 18–30 m. wide and has an area of about 2,000 sq.miles. The mountainous interior rises to 2,500 ft. in Berry Peak, but there is much low land on the south and north. Shoals and sandspits project to sea on the north and south-west. The west and east coasts are steep and lofty. The small Rodgers harbour is on the south-east. There are no true glaciers. Tundra covers many parts. Polar bears and foxes are numerous. Walrus and seals frequent the shores. In summer there are duck, geese, gulls and other birds. Driftwood is abundant. Mammoth tusks have been found. No minerals of value occur. Herald island lies 40 m. E. of Wrangel island. It is 5 m. long and 900 ft. high. The shores are mostly steep. There are no resources. Both islands are generally surrounded by pack-ice. Hunters do not visit them and there has never been a native population. Reports of land seen to the north by natives of eastern Siberia were investigated by F. von Wrangel in 1824, but he failed to reach the island. In 1849 Captain H. Kellett, R.N., discovered and landed on Herald island, from which he reported lands to the west, Plover and Kellett's Lands, thought to be parts of an Arctic continent. Commander J. Rodgers, U.S.N., landed on Herald island in 1855, and the American whaler T. Long sailed along the south of Wrangel island and gave it its name in 1867. The first certain record of landing is by Capt. C. L. Hooper, U.S.N., in 1881. The same year Captain R. M. Berry, U.S.N., explored the island and dispelled the idea of extensive land in that region. Russians first landed in 1911 when the "Taimir" and "Vaigach" erected a beacon. The survivors of V. Stefansson's "Karluk" lived on the island from March to Sept. 1914 (*see* Arctic Regions); in 1921 Stefansson sent another party of five under A. Crawford to establish a Canadian claim by occupation in view of the use of the island as a base in transpolar aerial trade routes. The party perished through accident with the exception of the Eskimo seamstress. In 1923 a party of Eskimos under an Alaskan trapper was established with the same end in view, but Russia, laying stress on a claim made in 1916, removed the colony in Aug. 1924 and shortly afterwards brought 50 Chuckhee to form a settlement under Soviet officials. The Soviet flag was also hoisted on Herald island in 1926. The colony was visited by Russian aeroplanes in 1927. These claims were not officially disputed by Britain, Canada or the United States.

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(R. N. R. B.)

WRASSE, a name given to the fishes of the family Labridae. They are abundant in the tropical zone, less so in the temperate, and disappear altogether in the Arctic and Antarctic. Their body is compressed, like that of a carp, and covered with smooth scales; they possess one dorsal fin only, the anterior portion of which consists of numerous spines. Many wrasses are recognized by their thick lips, the inside of which is sometimes curiously folded. The dentition consists of strong conical teeth, of which some are larger than others. But the principal organs with which they crush shell-fish, and other hard substances are the solid and strongly-toothed pharyngeal bones, of which the lower are coalesced into a single flat triangular plate. All wrasses are surface fishes. Rocky parts of the coast overgrown with seaweed are their favourite haunts in the temperate, and coral-reefs in the tropical seas. Some 450 species of wrasses (including parrot-fish, *q.v.*) are known, chiefly from the tropics.

Of the British wrasses the ballan wrasse (*Labrus maculatus*) and the striped or red or cook wrasse (*L. mixtus*) are the most common. The goldsinny or corkwing (*Crenilabrus melops*) is much more frequent on the southern coasts of England and Ireland than farther north. It rarely exceeds 10 in. in length. The commonest temperate American species is the tautog.

WRECK, a term which in its widest sense means anything without an apparent owner that is afloat upon, sunk in, or cast ashore by the sea; in legal phraseology, it has a narrower meaning. Formerly an appreciable source of revenue to the Crown, afterwards a valuable addition to the income of a landowner on the sea-coast, wreck has almost within modern times ceased to be a perquisite of either, or to enrich the casual finder at the expense of its rightful owner.

History.—The general rule in the civilized maritime countries of Europe was that the right to wreck belonged to the sovereign, and formed part of the royal revenue. This was so under the Roman, French and feudal law; and in England the common law set out in the statute *De praerogativa regis* (17 Edw. II., 1324) provided that the king has wreck of the sea, whales and sturgeons taken in the sea and elsewhere within the kingdom, except in certain places privileged by the king. This right, which it is said had for its object the prevention of the practice of destroying the property of the shipwrecked, was, however, gradually relaxed; and the owner of wreck was allowed to recover it if he made claim to it, and gave proof of his ownership within a certain time —fixed at a year or a year and a day alike by a decree of Antonine the Great, the feudal law, the general maritime law, the law of France and English law. Early in the 15th or at the close of the 14th century, it became usual for the Crown to grant to the lord-admiral by his patent of appointment, amongst other *proficua et commoditates* appertaining to his office, wreck of the sea; and when, early in the reign of Henry VIII., vice-admirals of the coast were created, the lord-admiral by patent under his own hand delegated to them his rights and duties in the several counties, including those in connection with wreck. He did not, however, part with the whole of his emoluments; his vice-admirals were required to render an account of the proceeds of wreck, and to hand over to him a part, usually one-half, of their gains. This system lasted until 1846 when an act (9 & 10 Vict. c. 99) was passed forbidding the vice-admirals to intermeddle with wreck, and it required the receivers of droits of admiralty to receive all wreck from the finders and to detain it for 12 calendar months; at the end of that period it was to be sold and the proceeds carried to the credit of the consolidated fund. The

ancient law by which the unfortunate owner was deprived of his property, if no living thing escaped from the wreck, had during the 16th and 17th centuries been gradually but tacitly relaxed; it required, however, a decision of Lord Mansfield and the king's bench in 1771 to settle the law definitely that, whether or no any living creature escaped, the property in a wreck remains in the owner. In Scotland it seems that the same law had been laid down in 1725, and there are indications that upon the continent of Europe there had before this date been a relaxation of the old law in the same direction. In the 17th century working salvors established the right to a lien upon property saved as a security for adequate remuneration of their exertions in saving it; and if the vice-admirals restored to its owners wreck that had come to their hands, they did so only upon payment of extravagant demands for salvage, storage, and often legal expenses. Stories of wilful wrecking of ships and of even more evil deeds are probably exaggerations, but modern research has authenticated sufficient abuses to show that further legislation was necessary to regulate the taking possession of wreck and ships in distress by "sea-coasters." Previously to the passing of the Act of 1846 the only substantial protection against plunder which owners of a wrecked ship could get was to apply to the admiralty judge for a commission enabling them or their agents to take possession of what came ashore, but to obtain such a commission took time and cost money, and before the commissioners arrived at the scene of the wreck a valuable cargo would have disappeared and been dispersed through the country. Plunder of wrecks was common, and the crowds that collected for the purpose set law at defiance. The vice-admirals, even if they had been able, did little to protect the ship wrecked. Many of the vice-admirals' accounts of the 17th and following centuries are extant. Most of them are for trifling sums, but occasionally the amounts are considerable. At the close of the 17th century the vice-admirals were required to make affidavits as to the amount of their gains; in 1709 20 of them swore that their office was worth less than £50 in the year.

The right of the warden of the Cinque Ports to wreck was derived from charters granted to the ports by Edward I. and his successors; many other seaports enjoyed a similar right under early charters. It would seem that these rights were of some value, for in 1829 the little towns of Dunwich and Southwold litigated at a cost of £1,000 the question whether a tub of whisky picked up at sea belonged to the admiralty jurisdiction of the one town or the other; and the town of Yarmouth is said to have spent no less than £7,000 upon a similar question. The Municipal Corporations Act of 1835 put an end to all dealings with wreck by local admiralty courts, except those of the Cinque Ports.

Grants of wreck to individuals are earlier than those to towns. Even before the Conquest it seems to have been not unusual for grantees from the Crown of lands adjoining the sea to get the franchise of wreck included in their grants. The lords of counties palatine had *wreccum maris* within their areas as part of their *jura regalia,* but yet inferior lords might prescribe for wreck belonging to their several manors within a county palatine.

From early times a distinction was made in English law between wreck cast ashore and wreck that is floating or sunken below low-water mark. Wreck proper, or common law wreck, *ejectum maris,* is what is cast by the sea upon the shore; for "nothing shall be said to be *wreccum maris,* but such goods as are cast or left upon the land" (*Sir H. Constable's Case,* 1599, 5 Rep. 106), and this belonged to the king *jure coronae,* and was dealt with by the common law. Floating and sunken wreck belonged to the Crown as *inter regalia,* but was granted to the lord-admiral *jure regis.* Even when the office of lord high admiral is in abeyance, and the duties are performed by commissioners, as now, these rights are distinguished from the other royal revenues as belonging to the Crown in its office of admiralty, or, as they are commonly known, droits (*q.v.*) of the Admiralty. From early times the lord-admiral tried to usurp, and there are several instances of his actually usurping jurisdiction over wreck proper; and in the reign of Richard II. special statutes (which were only declaratory of the common law) were passed for the purpose of confining his jurisdiction to its proper limits. Droits are flotsam, jetsam, lagan, derelict. In Lord Coke's words, flotsam is "when a ship sinks or otherwise perishes, and the goods float on the sea"; jetsam is "when goods are cast out of a ship to lighten her when in danger of sinking, and afterwards the ship perishes"; and ligan, or lagan, is "when heavy goods are, to lighten the ship, cast out and sunk in the sea tied to a buoy or cork, or something that will not sink, in order that they may be found again and recovered." Derelict is a ship or cargo, or part of it, abandoned by its master and crew *sine spe recuperandi et sine animo revertendi.* "None of these goods," adds Coke, "which are so called, are called wreck so long as they remain in or upon the sea; but if any of them by the sea be put upon the land then they shall be said to be wreck" (*Sir H. Constable's Case,* 1599, 5 Rep. 106; and 2 Inst. 167). Contrary to the opinion of Hale, Lord Stowell held that what is found anywhere derelict on the seas is acquired beneficially for the sovereign, if no owner shall appear. It seems that this was also Coke's view (2 Inst. 168).

The provisions of the Merchant Shipping Act, 1894, mentioned below, upon the subject of droits of admiralty are not clear. In practice the only droits of the admiralty that are commonly dealt with are anchors that have been slipped or parted from in heavy weather. In the Downs and other roadsteads these are "swept" for by creepers towed over the sea bottom, and in former days sweeping for anchors was a common industry. In the Downs large sums have been made after gales in this way. In the 17th century it became customary to obtain from the Crown grants of the right to fish for sunken wreck and treasure not only upon English coasts but all over the world.

The method of dealing with wreck outside territorial waters (which does not come within the scope of the act) is governed by the previous general law relating to droits of admiralty. The Board of Trade, and receiver-general, in its instructions to receivers, directs that wreck picked up at sea out of the limits of Great Britain, or brought to it by British ships, is to be taken possession of by the receiver and held by him on behalf of the owners, or, if the owners do not claim it, on behalf of the Crown. Derelict ships picked up at sea outside territorial limits and brought into British ports must be delivered to the receiver and kept by him until the owner can be found (but not longer than a year and a day). Wreck picked up out of territorial limits by a foreign ship need not be interfered with by the receiver, unless upon application by a party interested.

Although a ship on board which, or by means of which a man was killed, might be a deodand (*q.v.*), yet *qua* wreck she was not subject to forefeiture as deodand.

Present British Law.—The Merchant Shipping Act, 1894, contains the whole of the existing statute law upon the subject of wreck within the territorial waters of Great Britain, and under the Sea Fisheries Act, 1883, it applies to fishing boats. For its purposes wreck includes jetsam, flotsam, lagan and derelict, found in or on the shores of the sea or any tidal water. The term does not extend to a barge adrift in the Thames, nor a raft of timber adrift; it must be the hull, cargo or appurtenances of a vessel.

The provisions of the Merchant Shipping Act dealing with wreck are of a detailed and administrative character and are concerned with the duties of the Board of Trade, receivers of wreck, finders of wreck and other matters. They will be found in part IX. of the act and are included in ss. 510–537.

The owner of a wrecked ship, sunk by his negligence in a navigable highway, so as to be an obstruction to navigation, if he retains the ownership of her, is liable in damages to the owner of any other ship which without negligence runs into her, unless he has taken steps to indicate her position, or the harbour authority at his request has undertaken to do so. He may, however (whether the sinking was due to his negligence or not), abandon the ship, and can thus free himself from any further liability in respect of her. If he abandons her to any other person—*e.g.*, an underwriter—who pays for her as for a total loss, that person does not become liable for her unless he takes possession or control in any way. Harbour authorities generally have under the Merchant Shipping Act, 1894, or by local statute, as they have by the general Harbours, Docks and Piers Clauses Act, 1847 (if incor-

porated in their own act), the power of removing the wreck in such a case, and recouping themselves for their expenses from its proceeds. The general act also gives a personal right of action against the owner for any balance of expense over the value of the wreck; but if the owner has abandoned it, and no one else has taken it, neither he nor anyone else is liable. A particular or local act (as *e.g.*, one of the State of Victoria) may, however, fasten this liability on the person who is owner at the time when the ship is wrecked, and then he cannot free himself of it. A harbour authority is not obliged to remove a wreck because it has power to do so, unless it takes dues from vessels using the harbour where the wreck lies, or in some way warrants that the harbour is safe for navigation, in which case it is under an obligation to do so. Further statutory provision is now made in this respect by the Merchant Shipping Act, which empowers harbour authorities to raise, remove or destroy (and meantime buoy or light), or to sell and reimburse themselves out of the proceeds of any vessel or part of a vessel, her tackle, cargo, equipment and stores, sunk, stranded or abandoned in any water under their control, or any approach thereto, which is an obstruction or danger to navigation or lifeboat service. They must first give due notice of such intention, and must allow the owner to have the wreck on his paying the fair market value. The act gives similar powers to lighthouse authorities, with a provision that any dispute between a harbour and lighthouse authority in this respect is to be determined finally by the Board of Trade.

By an Act of 1896 it is now the duty of the master of a British ship to report to Lloyd's agent, or to the secretary of Lloyd's, any floating derelict ship which he may fall in with at sea. By the Merchant Shipping Convention Act, 1914, a master must on finding a wreck communicate with the shore. But the operation of the act was suspended by order in council till Jan. 1, 1929. It will supersede previous acts when it comes into force. Under the Merchant Shipping Act it is a felony to take wreck found in territorial limits to a foreign port, and it is punishable by fine to interfere with a wreck. The receiver has power, by means of a search warrant from a justice, to search for wreck which he has reason to believe is concealed. By the law of Scotland plundering wreck is punishable at common law; and in England and Ireland it is a felony to plunder or steal any wreck or part thereof, to destroy any wreck or part thereof, to prevent or impede any person on board a wreck from saving himself, and to exhibit any false signal with the intent of endangering any ship, or to do anything tending to the immediate loss or destruction of a ship for which no other punishment is provided.

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WREN, SIR CHRISTOPHER (1632–1723), English architect, the son of a clergyman, was born at East Knoyle, Wiltshire, on Oct. 20, 1632; he entered at Wadham College, Oxford, in 1646, took his degree in 1650, and in 1653 was made a fellow of All Souls. While at Oxford Wren distinguished himself in geometry and applied mathematics, and Newton, in his *Principia,* p. 19 (ed. of 1713), speaks very highly of his work as a geometrician. In 1657 he became professor of astronomy at Gresham College, and in 1660 was elected Savilian professor of astronomy at Oxford. It is, however, as an architect that Wren is best known, and the great fire of London, by its destruction of the cathedral and nearly all the city churches, gave Wren a unique opportunity. Just before the fire Wren was asked by Charles II. to prepare a scheme for the restoration of the old St. Paul's. In May 1666 Wren submitted his report and designs (in the All Souls collection), for this work; the old cathedral was in a very ruinous state, and Wren proposed to remodel the greater part, as he said, "after a good Roman manner," and not, "to follow the Gothick Rudeness of the old Design." According to this scheme only the old choir was left; the nave and transepts were to be rebuilt after the classical style, with a lofty dome at the crossing—not unlike the plan eventually carried out.

In September of the same year (1666) the fire occurred, and the old St. Paul's was completely gutted. From 1668 to 1670 attempts were being made by the chapter to restore the ruined building; but Dean Sancroft was anxious to have it wholly rebuilt, and in 1668 he had asked Wren to prepare a design for a wholly new church. This first design, the model for which is preserved in the South Kensington Museum, is very inferior to what Wren afterwards devised. In plan it is an immense rotunda surrounded by a wide aisle, and approached by a double portico; the rotunda is covered with a dome taken from that of the Pantheon in Rome; on this a second dome stands, set on a lofty drum, and this second dome is crowned by a tall spire. But the dean and chapter objected to the absence of a structural choir, nave and aisles, and wished to follow the mediaeval cathedral arrangement. Thus, in spite of its having been approved by the king, this design was happily abandoned—much to Wren's disgust; and he prepared another scheme with a similar treatment of a dome crowned by a spire, which in 1675 was ordered to be carried out. Wren apparently did not himself approve of this second design, for he obtained the king's permission to alter it as he liked, without showing models or drawings to any one, and the actual building bears little resemblance to the approved design, to which it is superior in almost every point.

Wren's earlier designs have the exterior of the church arranged with one order of columns; the division of the whole height into two orders was an immense gain in increasing the apparent scale of the whole, and makes the exterior of St. Paul's very superior to that of St. Peter's in Rome, which is utterly dwarfed by the colossal size of the columns and pilasters of its single order. The present dome and the drum on which it stands, masterpieces of graceful line and harmonious proportion, were very important alterations from the earlier scheme. As a scientific engineer and practical architect Wren was perhaps more remarkable than as an artistic designer. The construction of the wooden external dome, and the support of the stone lantern by an inner cone of brickwork, quite independent of either the external or internal dome, are wonderful examples of his constructive ingenuity. The first stone of the new St. Paul's was laid on June 21, 1675; the choir was opened for use on Dec. 2, 1697; and the last stone of the cathedral was set in 1710.

Wren also designed a colonnade to enclose a large piazza forming a clear space round the church, somewhat after the fashion of Bernini's colonnade in front of St. Peter's, but space in the city was too valuable to admit of this. Wren was an enthusiastic admirer of Bernini's designs, and visited Paris in 1665 in order to see him and his proposed scheme for the rebuilding of the Louvre. Bernini showed his design to Wren, but would not let him copy it, though, as he said, he "would have given his skin" to be allowed to do so.

After the destruction of the city of London Wren was employed to make designs for rebuilding its fifty burnt churches, and he also prepared a scheme for laying out the whole city on a new plan, with a series of wide streets radiating from a central space. Difficulties arising from the various ownerships of the ground prevented the accomplishment of this scheme.

Among Wren's city churches the most noteworthy are St. Michael's, Cornhill; St. Bride's, Fleet Street, and St. Mary-le-Bow, Cheapside, the latter remarkable for its graceful spire; and St. Stephen's, Walbrook, with a plain exterior, but very elaborate and graceful interior. In the design of spires Wren showed much taste and wonderful power of invention. He was also very judicious in his expenditure; he did not fritter away his limited resources in an attempt to make the whole of a building remarkable, but devoted it chiefly to one part or feature, such as a spire or a rich scheme of internal decoration. Thus he was in some cases, as in that of St. James's, Piccadilly, content to make the exterior of an almost barnlike plainness.

Wren's buildings were very numerous. Among the principal

ones are:—the Custom House, the Royal Exchange, Marlborough House, Buckingham House, and the Hall of the College of Physicians—now destroyed; others which exist are—at Oxford, the Sheldonian theatre, the Ashmolean museum, the Tom Tower of Christ Church, and Queen's College chapel; at Cambridge, the library of Trinity College and the chapel of Pembroke, the latter at the cost of Bishop Matthew Wren, his uncle. The western towers of Westminster Abbey are usually attributed to Wren, but they were not carried out till 1735–1745, many years after Wren's death, and there is no reason to think that his design was used. Wren (D.C.L. from 1660) was knighted in 1673, and was elected president of the Royal Society in 1681. He was in parliament for many years, representing Plympton from 1685, Windsor from 1689, and Weymouth from 1700. He occupied the post of surveyor of the royal works for fifty years, but by a shameful cabal was dismissed from this office a few years before his death. He died on Feb. 26, 1723, and is buried under the choir of St. Paul's; on a tablet over the inner north doorway is the well-known epitaph—*Si monumentum requiris, circumspice.* At the bi-centenary of his death on Feb. 26, 1923, a memorial service was held in St. Paul's Cathedral.

For further information the reader should consult the *Parentalia,* published by Wren's grandson in 1750, an account of the Wren family and especially of Sir Christopher and his works; also the two biographies of Wren by Elmes and Miss Phillimore; Milman, *Annals of St. Paul's* (1868); and Longman, *Three Cathedrals dedicated to St. Paul in London* (1873), pp. 77 *seq. See* also Clayton, *Churches of Sir C. Wren* (1848–1849); Taylor, *Towers and Steeples of Wren* (London, 1881); Niven, *City Churches* (London, 1887), illustrated with fine etchings; A. H. Mackmurdo, *Wren's City Churches* (1883); A. Stratton, *The Life, Work and Influence of Sir Christopher Wren* (1897); Lena Milman, *Sir Christopher Wren* (1908). The proceedings and publications of the Wren Society, incl. the vol. of drawings (1923); Sir Laurence Weaver K.B.E., *Sir Christopher Wren* (1923); *Letters (Tom Tower) to Fell, Bishop of Oxford* (Oxford, 1923); and the bi-centennial memorial volume published by the Royal Institute of British Architects (1923). In the library of All Souls at Oxford are preserved a large number of drawings by Wren, including the designs for almost all his chief works, and a fine series showing his various schemes for St. Paul's Cathedral. (J. H. Mi.)

WREN, the popular name for birds of the Passerine family *Troglodytidae,* of which the best known is *Troglodytes troglodytes,* the little brown bird with its vigorous song and its short tail cocked on high, that braves the winter of the British islands, and even of the European continent, and figures largely in folklore. In St. Kilda, isolation has brought about the evolution of a distinct sub-species.

The better known forms in the United States are the house-wren, common in the eastern states but in bad odour for its egg-eating proclivities; the winter-wren, remarkable for its resonant and brilliant song; the Carolina wren, also a fine singer; and the marsh-wren, besides the cactus-wrens and the cañon-wrens of the western States.

Wrens have the bill slender and arched: their food consists of insects, larvae and spiders, but they will also take any small creatures, such as worms and snails, and occasionally eat seeds. The note is shrill. The nest is usually a domed structure of ferns, grass, moss and leaves, lined with hair or feathers, and from three to nine eggs are produced, in most of the species white.

The headquarters of the wrens are in tropical America, but they reach Greenland in the north and the Falkland Islands in the south. Some genera are confined to the hills of tropical Asia, but *Troglodytes,* the best known, ranges over North and South America, Asia and Europe.

The *Troglodytidae* by no means contain all the birds to which the name "wren" is applied. Several of the *Sylviidae* bear it, especially the little golden-crested wren (*see* GOLDCREST), and the group forming the genus *Phylloscopus* (*see* WARBLER), habitual summer visitants. The largest *P. sibilatrix,* is called the wood-wren. The willow-wren *P. trochilus,* is in many parts of Great Britain the commonest summer bird, and is the most generally dispersed. The third species, *P. collybita,* is the chiffchaff.

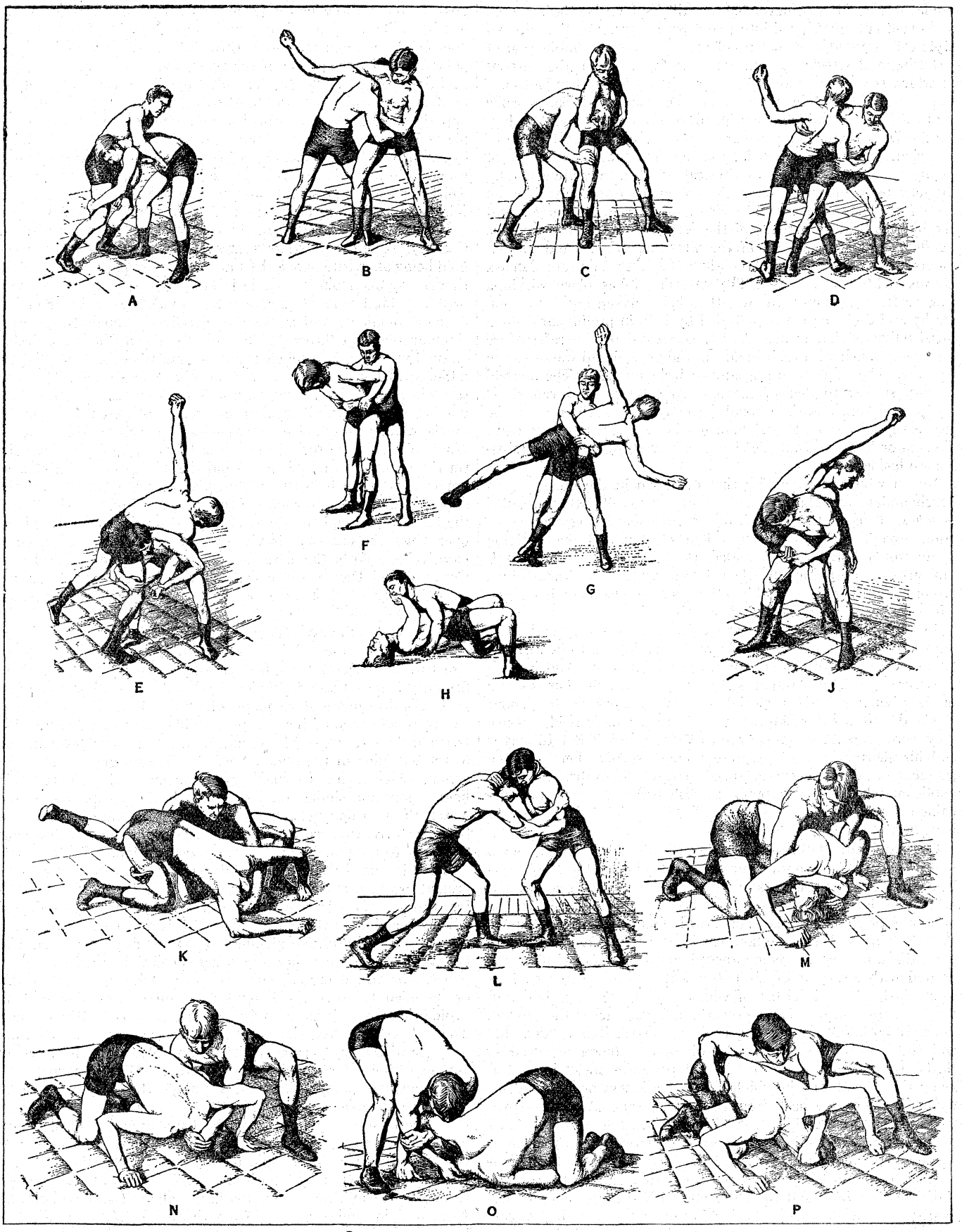
WRENCH: *see* SPANNER.

WRESTLING, a sport in which two persons strive to throw each other to the ground. It is one of the most primitive and universal of sports. Upon the walls of the temple-tombs of Beni Hasan, near the Nile, are sculptured many hundreds of scenes from wrestling matches, depicting practically all the "holds" and "falls" known at the present day, thus proving that wrestling was a highly developed sport at least 3,000 years before the Christian era. The description of the bout between Odysseus and Ajax in the 23rd book of the Iliad, and the evolutions of the classic Greek wrestlers, tally with the sculptures of Beni Hasan and Nineveh. The sport, in an organised and scientific form, may have been introduced into Greece from Egypt or Asia, though Greek tradition ascribed its invention and original rules to the legendary hero, Theseus. In Homer's celebrated description of the match between Ajax and Odysseus the two champions wore only a girdle, which was, however, not used in the classic Greek games. Neither Homer nor Eustathius, who also minutely depicted the battle between Ajax and Odysseus, mentions the use of oil, which, however, was invariably used at the Olympic games, where wrestling was introduced during the 18th Olympiad (about 704 B.C.). Wrestling contests for boys were added later. The Greek wrestlers, after the application of the oil, were rubbed with fine sand, to afford a better hold.

Wrestling was a very important branch of athletics in the Greek games, since it formed the chief event of the *pentathlon,* or quintuple games. (*See* GAMES, CLASSICAL.) All holds were allowed, even strangling, butting, and kicking. Crushing of the fingers was used, especially in the *pancration,* a combination of boxing and wrestling. Wrestlers were taught to be graceful in all their movements, in accordance with the Greek ideas of aesthetics. There were two varieties of Greek wrestling, the *πάλη ὀρθή,* or upright wrestling and the *ἀλίνδησις* (*κύλισις, lucta volutatoria*) which included ground wrestling after the contestants had fallen, the struggle continuing until one acknowledged defeat. This was the variety employed in the *pancration,* and was an "all in" struggle, no "fouls" being recognised. The upright wrestling was very similar to the catch-as-catch-can style, though leg holds were infrequent. In this, three falls out of five decided a contest; a variation of this style was that in which one of the contestants stood within a small ring and resisted the efforts of his adversary to pull or push him out of it. Other local varieties existed in the different Greek states. The most celebrated wrestler of ancient times was Milo of Croton (*c.* 520 B.C.), who scored thirty-two victories in the different national games, six of them at Olympia. Greek athletic sports were introduced into Rome in the last quarter of the 2nd century B.C., but they never attained to the popularity they had enjoyed in Greece.

In Switzerland and some of the Tirolese valleys a style of wrestling flourishes under the name of *schwingen* (swinging). The wrestlers wear *schwinghosen* or wrestling breeches, with stout belts, on which the holds are taken. Lifting and tripping are prevalent, and the first man down loses the bout. In Styria wrestlers stand firmly on both feet with right hands clasped. When the word is given, each tries to pull or push the other from his stance, the slightest movement of a foot sufficing to lose. In Russia, belt wrestling, and in Iceland, the glima, are popular styles. Both require the wearing of a kind of harness about the loins and thighs, and otherwise are similar to *schwingen.* In the Balkan states, the favourite style is catch-as-catch-can.

The popularity of wrestling has survived in many Asiatic countries, particularly in Japan, where the first match recorded took place in 23 B.C., the victor being Sukune, who has ever since been regarded as the tutelary deity of wrestlers. In the 8th century the emperor Shômu made wrestling one of the features of the annual harvest "Festival of the Five Grains," the victor being appointed official referee and presented with a fan bearing the legend, "Prince of Lions." In 858 the throne of Japan was wrestled for by the two sons of the emperor Buntoku, and the victor, Koreshito, succeeded his father under the name of Seiwa. Imperial patronage of wrestling ceased in 1175, after the war which resulted in the establishment of the shogunate, but continued to be a part of the training of the *samurai,* or military caste. About 1600, professional wrestling again rose to importance, the best men being in the employ of the great *daimios* or



SOME OF THE HOLDS USED IN WRESTLING

(A) Double leg hold, (B) Chancery back heel, (C) Side chancery, (D) Cross buttock and waist hold, (E) Near leg hold and arm lock, (F) Waist lock secured from rear and breaking the hold, (G) Ready to secure fall with waist hold secured from front, (H) Fall imminent from waist lock, (J) Leg hold and inside back-heel, (K) Half Nelson and further leg hold, (L) Referee's hold, (M) Full Nelson, (N) Three-quarter Nelson, (O) Quarter Nelson, (P) Half Nelson

feudal nobles. It was, nevertheless, still kept up by the *samurai,* and eventually developed into two separate systems, the national style called *Sumo,* and that peculiar and scientific combination of wrestling and self-defense known as *ju-jutsu* (*q.v.*), the purpose of which is to disable an adversary. The national championships were re-established in 1624, when the celebrated Shiganosuke won the honour, and have continued to the present day. The Japanese (*Sumo*) wrestlers place great reliance upon weight, some of the champions scaling 300 lb. and upward; and as a result of highly specialized methods of physical training, they are generally of huge bulk and great strength, although surprisingly light on their feet. They form a guild which is divided into several ranks, the highest being composed of the *joshiyori,* or elders, in whose hands the superintendence of the wrestling schools and tournaments lies. The badges of the three highest ranks are damask aprons richly embroidered. The wrestling takes place within a ring 12 ft. in diameter, the wrestlers being naked but for a loincloth; and each contest is preceded by certain preliminaries of a quasi-religious significance. At the command of the referee the wrestlers crouch with their hands on the ground and watch for an opening. The contests are usually of brief duration. The method is very similar to that of the modern catch-as-catch-can style, except that touching the ground with any part of the person, the feet excepted, after the first hold has been taken, loses the bout. To step or be forced outside the actual wrestling circle is equivalent to losing a fall.

Indian wrestling resembles that of Japan in the great size of its champions and the number and subtlety of its attacks, called *penches.* It is of the "loose" order, the men facing each other nude, except for a loincloth, called *chaddi,* and manoeuvring warily for a hold. Both shoulders placed on the ground simultaneously constitute a fall, which is seldom gained without much ground wrestling. It is highly scientific, though including many tricks that western rules exclude as "fouls."

In Great Britain wrestling was cultivated at a very early age, both Saxons and Celts having always been addicted to it, with the men of Cornwall always holding a special eminence; and English literature is full of references to the sport. On St. James's and St. Bartholomew's days special matches took place throughout England, those in London being held in St. Giles's field, whence they were afterwards transferred to Clerkenwell. The lord mayor and his sheriffs were often present on these occasions, but the frequent brawls amongst the spectators eventually brought these public matches into disrepute. English monarchs have not disdained to patronize the sport, and Henry VIII is known to have been a powerful wrestler.

Cumberland Style.—This style prevails chiefly in the north of England (except south Lancashire) and in the south of Scotland. In this the wrestlers stand chest to chest, each grasping the other with locked hands round the body, each one's chin on the other's right shoulder. The right arm is below and the left above the adversary's. When the hold has been firmly taken the umpire gives the word and the bout proceeds until one man touches the ground with any part of his person except his feet, or he fails to retain his hold, in either of which cases he loses. If both fall together, the one who is underneath, or first touches the ground, loses. If both fall simultaneously side by side, it is a "dogfall," and the bout begins anew. The different manoeuvres used to throw the adversary are called "chips," the most important being the "backheel," in which a wrestler gets a heel behind his opponent's opposite heel, from the outside, and forces him over backwards; the "outside stroke," in which, after a sudden twist of his body to one side, the opponent is struck with the edge of the opposite foot on the outside of the ankle; the "hank," or locking a leg and lifting the opponent with a sudden turn to the right, so that both fall together, but with the opponent underneath; the "inside click," the locking of an opposite leg applied after jerking the opponent forward, the pressure then being straight back; the "outside click," a backheel applied by the defender as he is on the point of being lifted from the ground—it prevents this and often results in oversetting the opponent; the "cross-buttock," executed by turning the left hip under the opponent's body, throwing the leg across both his and striking backwards, while partially lifting and throwing him forward; the "buttock," in which the hip is thrust still farther under the opponent, who by the action of the arms is thrown right over one's back; the "hipe" or "hype," executed by lifting the opponent off his feet, and while carrying him to the right or left, placing the opposite knee under one of his legs and raising it as high as possible before throwing him sideways to the ground; the "swinging hype," in which the opponent is lifted and swung nearly or quite round before the knee stroke is made; and the "breast stroke," which is a sudden powerful twist, first to one side, then the other, followed by a throw. There is but a single "foul"—direct kicking.

West Country Style.—In the Cornwall and Devon or "West Country" style the wrestlers wear stout, loose canvas jackets, the hold being anywhere above the waist or by any part of the jacket, though any manipulation of the jacket collar to strangle an opponent is forbidden. A fall is gained when both hips and a shoulder, or both shoulders and a hip (three points), touch the ground simultaneously. A throw that does not secure a fall is a "hitch." Ground wrestling is forbidden, and a man, when he feels himself falling, will try to turn and land on his side or chest. Many of the "chips" used by Cumberland and Westmorland wrestlers are possible in this style, with slight differences of execution required by the different method of taking hold and under other names—"forehip" (cross-buttock); "inside lock" (hank), etc. More distinctive throws are the "heave," and the "flying mare," a chip of universal use in which the opponent's wrist is grasped with the opposite hand, the upper part of the same arm by the other hand, the back turned and the captured limb drawn across a shoulder, over which the opponent is vigorously shot forward. Until comparatively recently there was a difference between the styles of Cornwall and Devon, the wrestlers of the latter county having worn heavily soled shoes, with which it was legitimate to kick the adversary's shins.

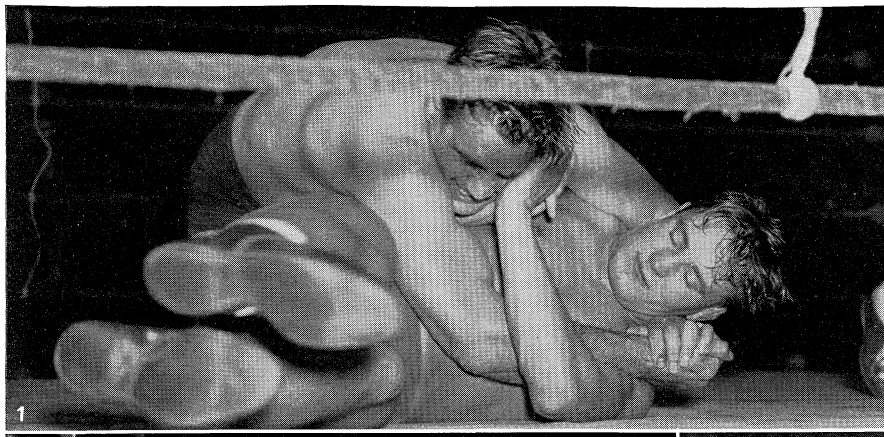
Catch-as-catch-can.—The Lancashire style, generally known as "catch-as-catch-can," is practised in Lancashire, throughout Great Britain generally, and is the most popular style in the United States, Canada, Australia, Switzerland and some other countries. It is the legitimate descendant of the ancient Greek upright wrestling combined with ground struggling, but minus the "all-in" freedom the Greeks permitted, and undoubtedly is representative of the wrestling of the middle ages. It allows a great amount of action, which includes struggling on the mat, tripping, catching hold of legs and similar tactics. At the beginning of a wrestling match the two opponents face each other, and at the signal to begin each tries to secure a hold that will enable him to throw his opponent to the mat in an advantageous position.

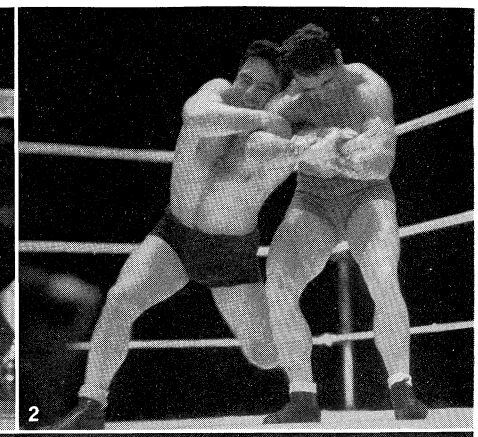
A fall is gained when both shoulders of one wrestler touch the ground together, and very seldom are falls registered from standing throws. This necessitates most contests being completed while struggling on the mat. Much of this down wrestling is admittedly very skilful. No kicking, striking or other foul practices are permitted. Strangle holds or others designed to cut off an opponent's breathing and grips or forms of attack causing acute pain or intended to force the defender to roll on his shoulders to avoid injury by dislocation or fracture are considered illegal holds. The style contains practically all the manoeuvres known to other methods with many peculiar to itself; and because of its freedom and opportunity for the display of strategy, skill and strength, is, when upstanding wrestling and tripping—the very essence of wrestling—are not neglected, the most preferable.

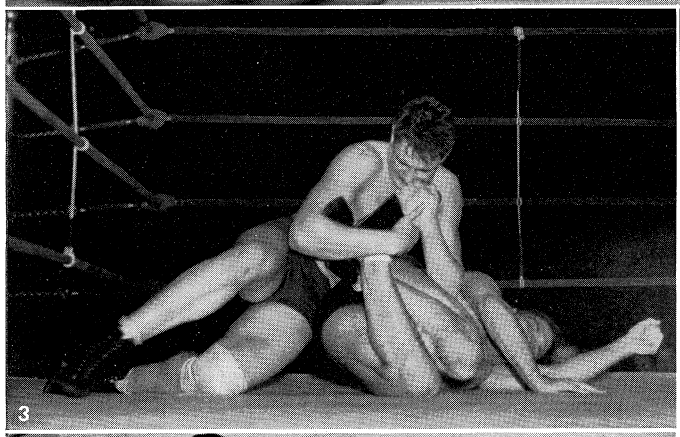
In Scotland a combination of the Cumberland and Westmorland and catch-as-catch-can style is sometimes practised, the contest commencing in the first named style and continued on the ground if a direct fall on both shoulders does not result from a throw. In Ireland, the national style is called "collar and elbow" (practised in America also), from the holds taken by the two hands, and first down, any part (in America, any three points) is loser.

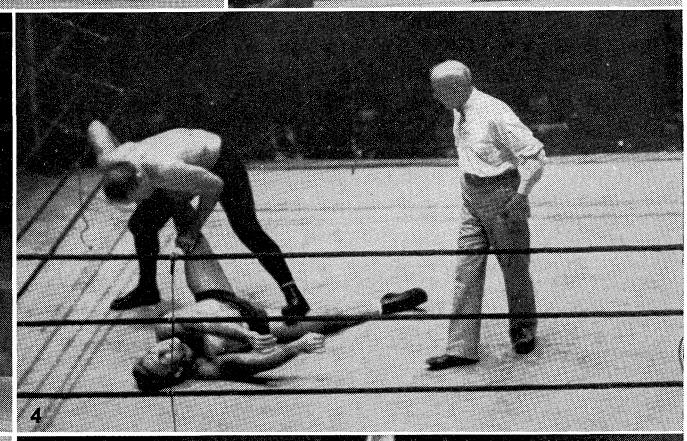
Graeco-Roman Style.—The style chiefly affected by the continental European wrestlers is the Graeco-Roman (so-called, though it bears almost no resemblance to classic wrestling), which arose

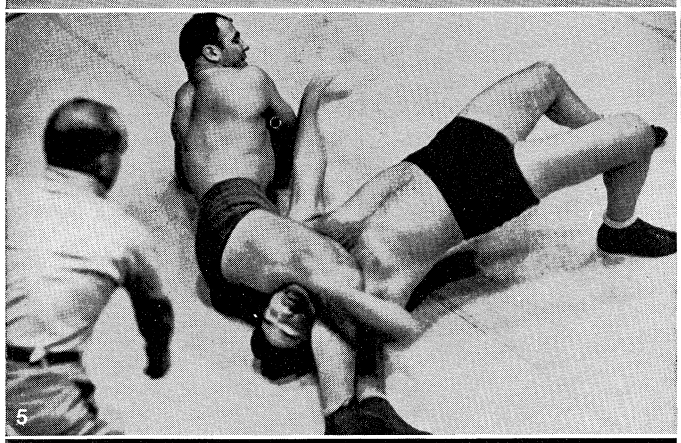
WRESTLING

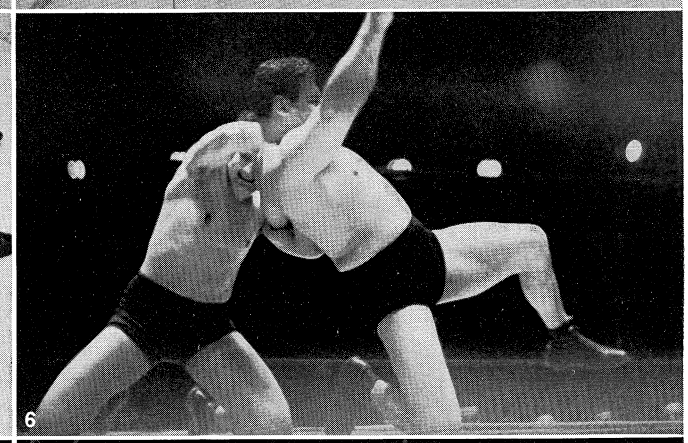


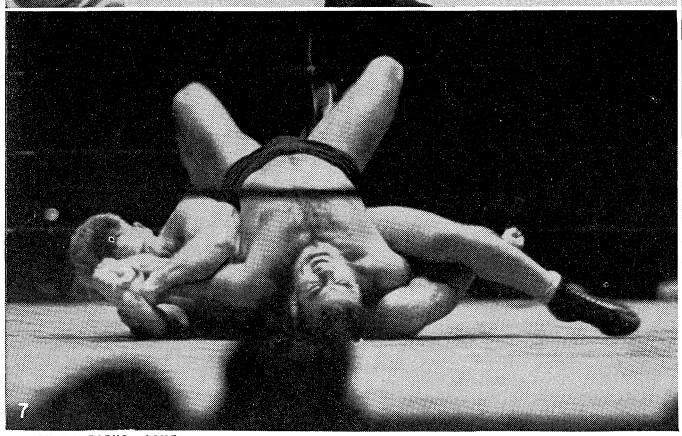


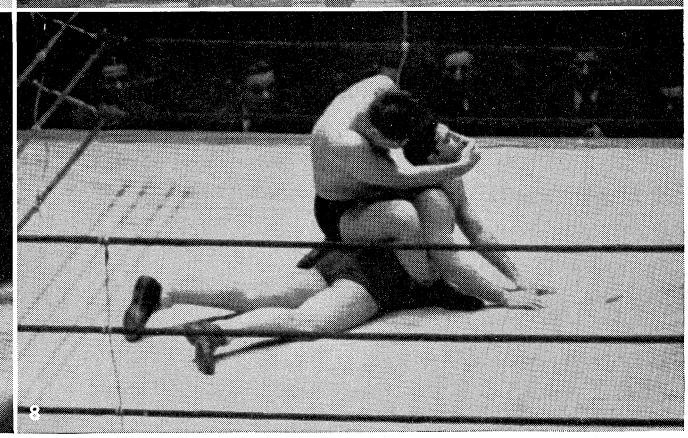








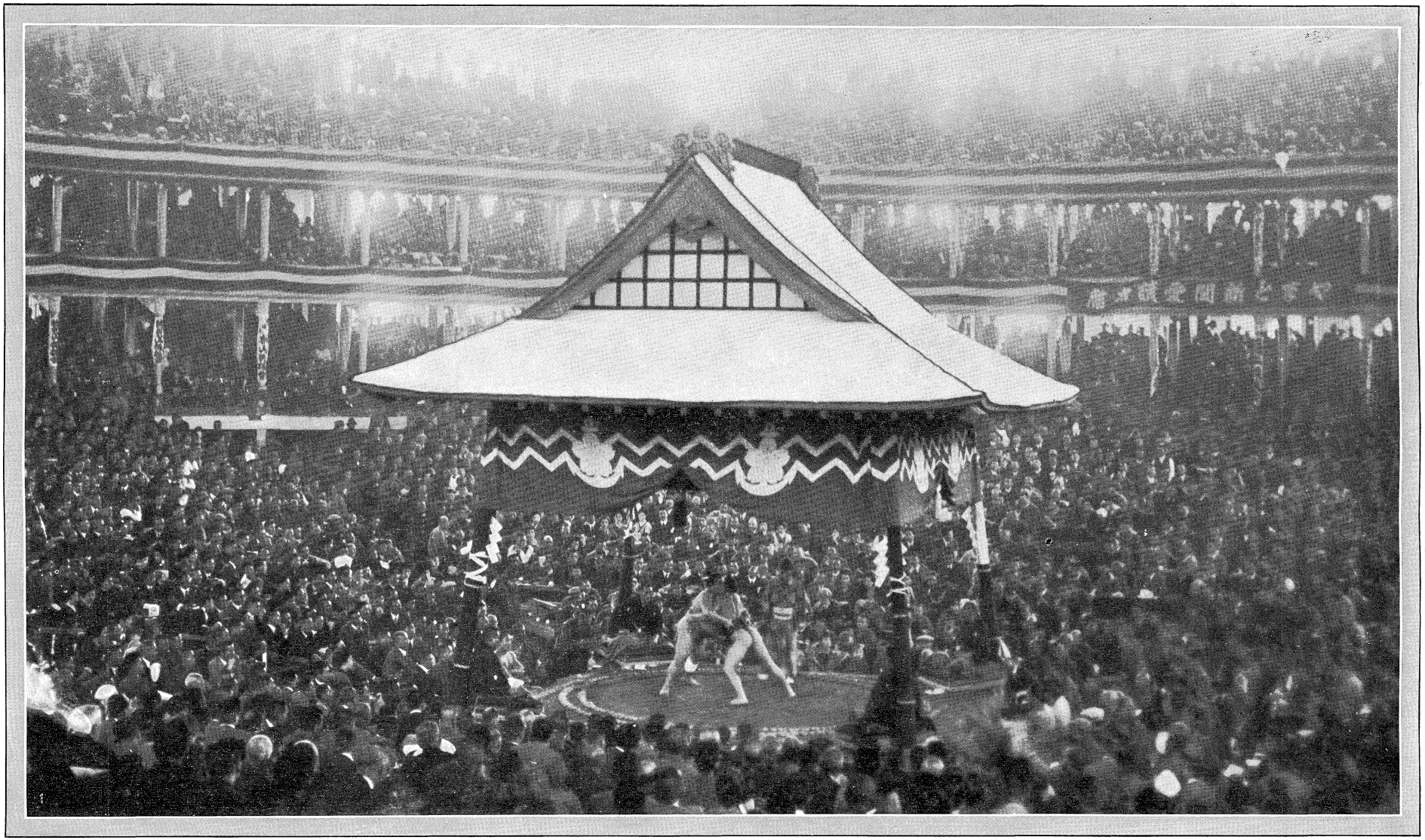




PHOTOGRAPHS, ACME

WRESTLING HOLDS

1. Jim Browning (top) with a headlock on Danno O'Mahoney
2. Joe Savoldi (right) applying a wristlock on Jim Londos
3. O'Mahoney (top) with a toehold on Browning
4. Dick Shikat applying a leg spread on Everett Marshall
5. Savoldi using a head scissors on Sammy Stein
6. O'Mahoney (left) applying an armlock on Ed George
7. Londos (top) in an arm and leg hold by Marshall
8. Browning getting a chin hold on Stein



BY COURTESY OF THE JAPANESE CONSULATE, NEW YORK

WRESTLING MATCH IN JAPAN

Japanese wrestlers struggling in a 12 ft. ring. Contests are usually of brief duration. Great reliance is placed upon weight, some champions scaling 300 lb. and upward. After taking the initial hold whichever contestant touches the ground with any part of his person, except his feet, loses the match. A cloth around the loins is the only covering for the body

about 1860, and is a product of the French wrestling schools. It is a very restricted style, neither tripping nor any hold below the hips being allowed, the result being that the bouts consist chiefly of ground struggling. When no time limit is enforced, contests are usually tediously long. British and American wrestlers, accustomed to their own freer styles, seldom compete under Graeco-Roman rules. These, however, have been revised by the governing body of international wrestling, the International Amateur Wrestling federation (inaugurated 1921), with the result that the character and quality of this style of wrestling have greatly altered and improved. The pre-eminence that French wrestlers formerly held has been transferred to the Scandinavian countries. The Finnish wrestlers show a marked advance. Finland shared with Sweden the wrestling championships at the Olympic games of 1912, held at Stockholm, repeated the success at Antwerp in 1920, and won four of the six weights at Paris, in 1924. A wide distribution of the honours in 1928 was followed by a decided victory for Sweden in 1932 with 77 points to 47 for Finland and 30 for the U. S. A.

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THE UNITED STATES

Wrestling in America is considered second in importance to boxing in the category of individual sports of a bodily combat nature. Although professional wrestlers attract greater audiences than amateurs, the participation of high school, college and athletic club performers has perhaps brought the sport into more popular favour. In professional contests, as with amateurs, the catch-as-catch-can style of wrestling is preferred to the Graeco-Roman style.

Among professional heavyweights, Frank Gotch is considered the peer of all time because of the science he imparted to the sport. As undisputed world's champion he successfully defended his title against Hackenschmidt in 1908; Mahmont, the Turk, in 1911; Hackenschmidt again in 1912; and in many other contests, and retired undefeated. In the following years there were many so-called championship matches, but no contestant won a clear title to a world's championship. Ben. F. Roller of Seattle won the American championship in 1912 by defeating C. Cutler of Chicago, after the latter had beaten Ordeman in Minneapolis. After Americus had defeated Beel, Roller won from Americus at Springfield in 1913. Ed. ("Strangler") Lewis defeated Roller in New York in 1915 and Earl Caddock in 1921. Munn beat Lewis in Kansas City in 1923; Stanislaus Zbyszko defeated Munn in Philadelphia in 1924; Joe Stecher beat Zbyszko in 1925; Lewis defeated Stecher in 1928; Gus Sonnenberg defeated Lewis in Boston in 1929, winning the world's championship. Rival authorities have been unable to agree on rules; as many as six "champions" in 1933 were reduced to but two by 1934, Jim Londos in New York and Don George in New England, with no hope for a final issue. (J. B. P.; X.)

Professional wrestling has so degenerated for the most part that it is now little more than a prearranged farce, performed with gruesome gestures by weirdly costumed clowns, and in 1943 there were some 15 claimants to the world's heavyweight championship.

Amateur wrestling in the United States is governed by the National Collegiate Athletic association and the Amateur Athletic Union of the United States. The National Collegiate Athletic association's wrestling rules committee, under the chairmanship of Dr. R. G. Clapp, University of Nebraska, formulates the set of rules which governs collegiate wrestling. They also formulate a set of rules which they recommend for the governing of high school contests. In 1928 the National Collegiate Athletic association started sponsoring a national championship tournament each year (after the first year of entrance of the United States into World War II excepted) at which individual championships are contested in eight weight classes and a team championship is recognized. Several states have high school wrestling tournaments sponsored by their high school athletic association or invitational tournaments sponsored by one of the state's colleges. In the states where the recommended rules of the National Collegiate Athletic association are followed the tournaments are contested in ten individual weight classes and a team championship is recognized.

Amateur wrestling meets and tournaments sponsored by Y.M.C.A.s athletic clubs, state and national amateur athletic unions are governed by a set of rules formulated by the Amateur Athletic Union of the United States.

Since the turn of the century amateur wrestling has steadily progressed in popularity in the United States. In 1942 some 10,000 boys participated in supervised wrestling as members of a junior high school, high school, college, Y.M.C.A. or an athletic club team. The National Collegiate tournament of 1942 was held at Michigan State college in East Lansing, Mich., with 94 contestants representing 23 colleges and universities from 14 states of the union.

Oklahoma amateur wrestlers have dominated the sport in the United States since 1925. Edward Clark Gallagher (1887–1940) coached wrestling at Oklahoma A. & M. college from 1916 to 1940, and his teams established one of the finest records in sports history. Gallagher's teams were undefeated in 17 dual-meet seasons in 21 years, winning 70 consecutive dual-meet victories from 1921 through 1932. His teams won 11 of the 13 National Collegiate team championships contested from 1928 to 1940, and 6 National Amateur Athletic Union team titles. He coached 64 men to National Collegiate and National A.A.U. individual championships. Fifteen of his men were members of the U.S. Olympic wrestling teams of 1924, 1928, 1932 and 1936. He coached 3 men to world's amateur championships of catch-as-catch-can wrestling: Bobby Pearce (123 lb.) and Jack Van Bebber (155 lb.) champions in the 1932 Olympics and Frank Lewis (155 lb.) champion of the 1936 Olympics. After the death of Gallagher (Aug. 28, 1940), the Oklahoma "Aggies" continued to dominate the United States' amateur wrestlers with coach Art Griffith leading the "Aggies" to the National Collegiate team title in 1941 and 1942.

Wrestling has been added to college and university intercollegiate athletic programs in many of the Eastern, Southeastern, Midwestern, Rocky Mountain and Pacific Coast Conference schools, and it also has played an important part in physical fitness programs for conditioning men for military service in World War II. (R. Py.)

WREXHAM (Welsh *Gwrecsam,* in the Anglo-Saxon Chronicle *Wrightesham*), a market town and municipal borough of Denbighshire, Wales, 12 mi. S.W. of Chester, with stations on the G.W.R. and L.N.E.R. Pop. (1938) 25,740, largest in North Wales. Area 4.6 sq.mi. Wrightesham was of Saxon origin, and lying east of Offa's Dyke, was yet reckoned in Mercia. It was given (with Bromfield and Yale, or *Iâl*) by Edward I to Earl Warenne. St. Giles's church is of the 14th, 15th and 16th centuries, with a panelled tower; the interior is Decorated. West of the tower is the tomb of Eliugh, or Elihu, Yale (1721), first donor of Yale university. The Wrexham tower in the memorial quadrangle at Yale is a copy of the tower of Wrexham church. Wrexham is the seat of the Roman Catholic bishop of Menevia, whose diocese includes all Wales except Glamorganshire. With the development of the north Wales coal field in the 19th century Wrexham grew in importance and has interests in the by-product industries. It was incorporated in 1857.

WRIGHT, SIR ALMROTH EDWARD (1861–), British bacteriologist, was born at Middleton Tyas, Yorks., on Aug. 10, 1861. He was educated at Dublin university, subsequently obtaining his scientific and medical training at the universities of Leipzig, Strasbourg and Marburg. In 1887 he became a demonstrator of pathology at Cambridge, in 1889 a lecturer in physiology at Sydney, and from 1892 to 1902 professor at the army medical school at Netley, being then appointed professor of experimental pathology in the University of London. He was, in addition, principal of the institute of pathology and research at St. Mary's hospital. He was knighted and elected F.R.S. in 1906.

Sir Almroth Wright became prominent by his researches in parasitic diseases. He introduced antityphoid inoculation and did much valuable work on the preparation of other vaccines and

toxins. He carried out many important experiments in bacterial infection and in measuring the protective matter of human blood. He acted as consulting physician to the army in France from 1914–1919 and was in 1919 created K.B.E. He was a member of many learned societies and received numerous British and foreign awards and honours including the gold medal of the Royal Society of Medicine in 1920. He published a short treatise on *Anti-Typhoid Inoculation* (1904), *Principles of Microscopy* (1906) and *Studies in Immunisation* (1909) besides many papers. In 1913 appeared *The Unexpurgated Case against Woman Suffrage* which provoked much discussion. (*See* IMMUNITY.)

WRIGHT, CARROLL DAVIDSON (1840–1909), American statistician, was born at Dunbarton, N.H., on July 25, 1840. Paying his way by teaching, he became a lawyer although his studies were interrupted by service in the Civil War, in which he advanced from private to colonel and assistant adjutant-general in the Shenandoah valley campaign. In 1872–73 he served in the senate of Massachusetts, and from 1873 to 1888 he was chief of the Massachusetts bureau of statistics of labour. He was U.S. commissioner of labour from 1885 to 1905. Avoiding polemics, he directed the energies of the national bureau into investigation of the economic conditions surrounding labour and study of the methods for promoting the welfare and uplift of the working classes. He was a persistent advocate of the principle of collective bargaining and of the sliding-scale method of wage adjustment. In 1902 he was chosen president of Clark college, Worcester, Mass., where he was also professor of statistics and social economics from 1904 until his death on Feb. 20, 1909. Among his works of general interest are *The Industrial Evolution of the United States* (1895), *Outline of Practical Sociology* (1899), *Some Ethical Phases of the Labor Question* (1902) and *The Battles of Labor* (1906).

See the article on him by S. N. D. North (Amer. Statist. Assoc., *Pub.*, new ser. 86, 1909) and the bibliography (*ibid.*, 87, Sept., 1909).

WRIGHT, ORVILLE (1871–), American inventor, was born at Dayton, Ohio, on Aug. 19, 1871. He early became associated with his brother, Wilbur (*q.v.*), in the bicycle repair business, and from the first shared his interest in mechanical flight. Shop experiments led to the development of a power driven heavier-than-air machine which was piloted by Orville Wright on its first successful flight made on Dec. 17, 1903 at Kitty Hawk, N.C. Further experiments led to the development of an aeroplane which established a new record on Sept. 12, 1908 by remaining in the air one hour and 15 minutes. An accident on Sept. 17 terminated his experiments for that year but on July 27 and 30, 1909, his demonstrations at Ft. Meyer, Va., satisfied the tests, and secured the acceptance of his machine by the U.S. Government. Numerous demonstrations made in Europe during 1908 and 1909 caused many honours to be bestowed on the two brothers. In Dec. 1928, the 25th anniversary of the first successful flight was celebrated at Kitty Hawk.

WRIGHT, SILAS (1795–1847), American political leader, was born at Amherst, Mass., on May 24, 1795. He graduated at Middlebury college, Vermont, in 1815, was admitted to the bar in 1819, and began practice at Canton, in northern New York. He was appointed surrogate of St. Lawrence county in 1820, and was successively a member of the state Senate in 1824–26, a member of the national House of Representatives in 1827–29, comptroller of the state in 1829–33, U.S. senator in 1833–44, and governor of New York in 1844–46. During his public life he had become a leader of the Democratic party in New York, Martin Van Buren being his closest associate. He was an influential member of the so-called "Albany regency," a group of Democrats in New York, including such men as J. A. Dix and W. L. Marcy, who for many years virtually controlled their party within the state. He died at Canton on Aug. 27, 1847.

The best biography is that by J. D. Hammond, *Life and Times of Silas Wright* (Syracuse, N.Y., 1848), which was republished as vol. iii. of that author's *Political History of New York*.

WRIGHT, WILBUR (1867–1912), American inventor, son of Milton and Susan Catharine (Koerner) Wright, was born near Millville, Ind., on April 16, 1867. When Wilbur Wright was one month old his father was elected editor of the official organ of the Church of the United Brethren in Christ, necessitating moving his family to Dayton, O.; and eight years later he was elected a bishop of that denomination requiring other changes of residence. As a result Wilbur Wright received his education in the public schools of Dayton, Ohio, Richmond, Indiana, and Cedar Rapids, Iowa. Just when he was expecting to enter college, an accident, while playing in a game of ice hockey, disabled him for some six or eight years for active work. These years of poor health he devoted to the care of his invalid mother and to assisting his father in legal matters connected with the church. In 1890 he joined his brother, Orville, who was publishing a small weekly newspaper.

Experiments in Gliding.—Reading of the experiments of Otto Lilienthal in Germany, Wilbur and his brother became intensely interested in gliding as a sport. Lilienthal's experiments were suddenly ended in 1896 by his death, resulting from an accident due to insufficient control of the equilibrium of his glider. Lilienthal had balanced his machine by shifting the weight of his body. The brothers, believing this method incapable of expansion to meet the requirements of flight, set about to develop a more effective system. They developed a system in which the centre of gravity remained constant and the equilibrium was maintained by varying the air pressures on different parts of the machine through adjustments of the angles of the wings and auxiliary surfaces. This system, patented by them, is now generally known as aileron control.

Although Wilbur and his brother had taken up aeronautics merely as a sport, their chief interest soon turned to its more scientific aspects. Having found in their experiments that the existing scientific data was almost altogether untrustworthy, they cast it all aside and began investigations of their own, using methods which avoided many of the errors in the work of their predecessors. In 1901 they set up a small wind tunnel in their work-shop at Dayton in which they made measurements of the lift and drag of a great number of different-shaped aerofoils at angles from zero to 45 degrees. The results derived from this tunnel so stimulated their interest that often they worked into the early hours of the morning. Measurements also were made to determine the position of the centre of pressure on cambered surfaces and to determine the effect on the lift and drag when one surface was placed above another or when one surface followed another.

The First Motor-driven Aeroplane.—With this mass of data in their possession they thought it now possible to predict from calculation the performance of a flying machine; they thought they could design a machine which would require not over one-half to one-fourth of the power that would have been necessary for any of the earlier proposed machines. Accordingly in Oct. 1902, they began the design of a motor-driven aeroplane. When completed the machine including the pilot weighed 750 lb. and was propelled by a four cylinder petrol motor of 12 horse power. Tested at Kitty Hawk, N.C., on Dec. 17, 1903, the machine carrying a man made four sustained free flights. The longest of these had a duration of 59 seconds and a speed of 30 m. an hour. This machine is now exhibited in the Science museum at South Kensington, London.

Experiments were continued in 1904, but it was not until Sept. 1905, that they learned to avoid the "tail-spin" in making short turns. The flights then rapidly increased in length, and on Oct. 5 Wilbur Wright flew for 38 min. over a small circular course covering a distance of 24 miles. Believing the machine now to be developed to a stage of practical usefulness, the Wrights spent several years in finding a market for the invention. Wilbur Wright went to Europe in 1908 to make the tests required in the sale of the French rights to a syndicate. While there, his flights at Le Mans and Pau, France and at Rome, attracted world-wide attention and the kings of England, Spain and Italy went to see them. In recognition of his pioneer work he received many honours and medals in European countries and in America.

During the last three years of his life he served as president of the Wright Company, which had taken over the patent rights for

America. Much of this time he devoted to upholding the Wright aeroplane patents in law courts of America and Europe. He died of typhoid fever at Dayton, O., on May 30, 1912. (O. W.)

WRIST, in anatomy, the carpus or carpal articulation in man, the joint by which the hand is articulated with the forearm (*see* ANATOMY: *Superficial and Artistic;* and SKELETON: *Appendicular*).

WRIT, in law, is a species of formal order from the Crown or a delegated officer to an inferior officer or to a private person, enjoining some act or omission. The word represents the Latin *brevis* or *breve* (sometimes Englished into "brief" in the older authorities), so called from its "shortly" expressing the intention of the framer (*quia breviter et paucis verbis intentionem proferentis exponit*).

History.—The writ in English law still occupies a very important position, which can scarcely be understood without a sketch of its history. The whole theory of pleading depended in the last resort upon the writ, the plaintiff's claim simply expanding its terms.

The *breve* can be traced back as far as Paulus (about A.D. 220), who wrote a work *Ad edictum de brevibus,* cited in the Vatican Fragments, § 310. In the *Corpus iuris* the word generally means a note-book or list. The *interdictum* of Roman law sometimes represents the writ of English law; *e.g.,* there is considerable likeness between the Roman *interdictum de libero homine exhibendo* and the English writs of *habeas corpus* and *de homine replegiando.* From Roman law the *breve* passed into the *Liber feudorum* and the canon law, in both in a sense differing from that at present borne by the writ of English law. The *breve testatum* of the *Liber feudorum* was an instrument in writing evidencing the transfer of land.

The *breve testatum* in England developed into the deed of grant; in Scotland into the charter, and later into the disposition. In canon law *breve* or *brevilegium* denoted a letter from the pope, sealed with the seal of the fisherman and less formal than a bull. In old English ecclesiastical law a brief—still named in one of the rubrics of the Book of Common Prayer—meant letters patent to church-wardens or other officers for the collection of alms. (For counsel's brief *see* BRIEF.)

The origin of the writ is disputed, but its development was clearly influenced by both Anglo-Saxon and Norman law before the Conquest. The Anglo-Saxon contribution appears in the shape of diffuse royal charters, which were used to express the king's commands or wishes. Next, the form of these charters was infected by royal letters employed primarily for the publication of new laws, which were communicated by such letters to the shire-moots and, presumably, to the hundred-moots and important persons. These documents, cross-bred between charter and writ, show progress, but fall far short of the pure writ, which was concise, secular, practical and implicit with power. Writ-charters similar to those in England existed in Normandy before the Conquest. After that event, the chancery, or royal office which in England framed the king's orders, had some counterpart in Normandy, which did the like. The exact stages by which the writ disembarrassed itself of the charter element are not certain, but at any rate the process was a rapid one. The distinction between the two is known to have existed as early as 1071. The growth of a more robust Central Government hastened the separation, and in Glanvill's book (1187–89) not only are many writs included, but the idea has become so common that the author does not take the trouble to explain it. The writ, as thus developed, was of supreme importance in the growth of law and government. From the latter part of the 13th century to the early 18th century, if a man had no legal remedy he had no legal right. Without a writ he could not, in general, begin an action, and if there were no writ that covered his complaint he had no remedy. Nor was the writ confined to the initiation of litigation. It was also a machine for hosts of executive acts which never passed to the law courts at all. The chancery from which writs were issued was styled *officina brevium,* or "writ-shop." Writs had to be paid for, though occasionally poor men might get them free. Nor did Magna Carta c. 40, make any difference in this respect, except to forbid prohibitive charges for writs in common form ("de cursu," or "of course"). At first new writs could be used freely, but in the Provisions of Oxford, 1258, the chancellor swore that he would seal no writs except those "of course" without the command of the king and his council; and the statute of Westminster II, 1285, while it recognized the power of the chancery clerks to make writs for cases similar (*in consimili casu*) to those already covered by existing writs, impliedly forbade them to create new writs, that being the province of parliament. But this statute did not seriously hamper the chancery, for the clerks showed great dexterity in varying existing writs to meet new circumstances.

Collections of writs were made at an early period. They were entitled *Registra Brevium,* and the oldest one extant is dated 1227. These collections were unofficial, though of course the writs embodied in them originated in the chancery. For three centuries *Registrum Brevium* continuously multiplied in copies and swelled in bulk. The mss. of it are at present beyond computation. Their number and increasing length testify to the industry of the chancery and to the striking import of the writ as one of the modes of keeping law and government reasonably abreast of the needs of the community. *Registrum Brevium* was first printed in 1531. After that it practically ceased to grow, for it was being outgrown by the law itself, which needed something more elastic.

The chief reason why the writ fell into the background as an agency in the growth of our law is that the centre of gravity in legal procedure shifted from the writ to the plaintiff's written "declaration," which specified the details of his claim. It was this rather than the writ which came to determine the form of action. The correct form of action was vital to success in litigation. If the plaintiff chose the wrong one, he was, in general, without a remedy. True, a selection of the wrong writ was, even till the 19th century, equally disastrous, but then, in most cases, it had ceased to be compulsory on a plaintiff to begin his action by an original writ, though its existence was always assumed. There were many other ways in which litigation could be begun, and there is reason to think that they were usually preferred to the original writ, which was neither cheap nor convenient. The transference of energy from the writ to the declaration was a gradual process. So long as the pleadings in an action were oral, the writ must of necessity have attracted to itself all the weight which the written word carries as against the spoken word. But by degrees litigants adopted the practice of exchanging written pleadings. This was well recognized in the 16th and 17th centuries, though the seeds of it are traceable some time before. The multiplicity of writs and of other devices for commencing a common law action was remedied with respect to personal actions by the Uniformity of Process in Personal Actions Act, 1832 (2 Will. IV. c. 39), which substituted for these methods a simple, uniform, writ of summons. Further amendments were made in 1833, by 3 and 4 Will. IV. c. 27, s. 36, which abolished writs in real actions with the exception of those relating to dower, *quare impedit,* and ejectment, and by 3 and 4 Will. IV. c. 42, in connection with the writs of debt and of detinue. The Common Law Procedure Act, 1852, s. 3, dispensed with the need of mentioning any form of action in the writ on a personal action, and the Judicature Acts, 1873–75, contain the complete remodelling of procedure under which English civil law is administered in the Supreme Court of Judicature. The Rules of the Supreme Court, 1883, made in pursuance of this legislation, now require every action in the High Court to be commenced by a writ of summons, indorsed with a statement of the nature of the claim made, or of the relief or remedy required in the action. The writ, therefore, nowadays differs considerably in form from its ancient predecessor. And an equally striking distinction is to be found in its much narrower scope as compared with the writs of *Registrum Brevium.* They dealt with almost every conceivable matter of executive government as well as with legal procedure. But now the province of writs has shrunk to the institution of litigation except in the realm of constitutional law, where writs still issue for the election of members to the House of Commons and for the attendance of individual members in the House of Lords. Elsewhere, more

convenient methods of expressing the will of the executive have ousted the writ; such are Orders in Council, Royal Proclamations, Letters Patent, and regulations made by various Government departments.

The writ, though issuing from the king's chancery, did not, where it was concerned with litigation, necessarily direct the trial of the question in the king's court. In whatever court it was returnable, it frequently called in the aid of the sheriff as executive officer. In such cases, it was either addressed to him or, if addressed to the party alleged to be in default, it concluded with a threat of constraint by the sheriff in the event of disobedience, generally in these terms, *et, nisi feceris, vicecomes de N. faciat ne amplius clamorem audiamus pro defectu iustitiae.* If the writ was returnable in the county court or the lord's court, the sheriff or the lord sat as the deputy of the king; he did not sit by virtue of his own inherent jurisdiction. The writ was not necessary for the initiation of proceedings there or before the justices in eyre.

There are several divisions of writs (excluding those purely financial and political), the most important being that into original and judicial, the former (tested in the name of the king) issued to bring a suit before the proper court, the latter (tested in the name of a judge) issued during the progress of a suit or to enforce judgment. The nature of a third class, *magistralia,* is an unsolved puzzle. Bracton regarded them as writs which were capable of variation in order to meet the plaintiff's grievance; Coke considered them to be a variety of original writs which generated actions upon the case. Possibly the later writers attached more technicality to Bracton's expressions than they were meant to bear, and in any event the use of *magistralia* for purposes of classification was of little import by the time that *Registrum Brevium* was printed, for the primary division there is only twofold, original and judicial.

No ms. register known to the author of this article contains even this twofold division. Coke and other authorities mention numerous other divisions, but those which have been named appear to be the principal, of writs.

Writs of Historical Interest.—A great number of the older writs are now obsolete. The details relating to them can be found in the printed *Registrum Brevium* and in Sir Anthony Fitzherbert's "New Natura Brevium," a work of the highest authority which ran into 18 editions, or reprints, between 1534 and 1794. Some of these ancient writs had such a great influence on the history of English law that they need brief descriptions here. The *prerogative writs* are treated in the paragraph on "Writs at the present day"; historically they had a large share in securing the administration of justice, and the personal freedom of the subject. In the domain of private law, the *writ of right* (*breve de recto*) was styled by Fitzherbert "the highest writ in law," and *Registra Brevium* invariably commence with it. It was employed for the recovery of real estate. The principle that no man need answer for his freehold without a royal writ was laid down in Henry II.'s reign. This compelled everyone who demanded freehold land from another person to obtain a writ, in effect the writ of right, if he were asserting title to the land. The insistence on the writ of right had political significance, for it furthered the centralization of justice. The procedure upon it became intolerably clumsy and tedious, and this led first to its disuse and finally to its abolition. No writ had wider effect than the *writ of trespass.* In origin, the word "trespass" covered nearly every wrongful act or default, whether it be what we should now call a crime or a tort. In that sense, it is traceable as early as John's reign, but the writ of trespass did not become a writ "of course" until the latter part of Henry III.'s reign, just after the conclusion of the Barons' war. Very likely it was one of the agencies in clearing up the litter of disorder left by civil strife. The action which the writ of trespass *vi et armis* originated was quasi-criminal. It was aimed at serious and forcible breaches of the king's peace. Though it was begun by the injured individual, it ended in the punishment of the defendant as well as in compensation to the plaintiff. It was more popular than the "appeal of felony" because the same precision in pleading was not required and the trial was not by the detested method of battle. Its scope was also wider, and damages were obtainable. Later, trespass developed on one side into misdemeanours (now one branch of criminal law) and on the other into the law of torts, or civil injuries. In the 14th and 15th centuries, statutes often fixed the action of trespass as an appropriate remedy for the offences created by them, because criminal "appeals" were falling into disuse, there was no organized police, the judges were often corrupt, except in the central courts, and were not always pure even there. The three chief kinds of the writ of trespass *vi et armis,* were for assault and battery, for injury to land (*quare clausum fregit*), and for taking away goods (*de bonis asportatis*). The writ could therefore be employed by any landholder for the recovery of damages done to his possession, but not, at first, for the recovery of possession itself. This extension was not recognized till the middle of the 15th century, and it resulted in the writ of trespass, *de ejectione firmae,* which appears first as a remedy enabling the termor, or lessee for years, to sue anyone who had ejected him, whether his lessor or another person, and then becomes the best remedy of the ejected freeholder. He borrowed this "action of ejectment" from the termor, because his own proprietary and possessory remedies had become so inadequate. A cloud of legal fictions veiled the borrowing, but in spite of the duration of some of these till the Common Law Procedure Act, 1852, the action of ejectment was greatly superior to the dilatory remedies which it thrust in the background. The law of torts, as it is now called, also owes a heavy debt historically to writs of *trespass upon the case,* which were adaptations of the writ of trespass made to meet special cases. The same object was achieved by means of the statute of Westminster II, 1285 (*supra*), for the clerks of the chancery were required by it to issue modified writs *in consimili casu.* It is not clear whether writs of trespass upon the case ought, as a matter of history, to be regarded as springing from this statute or as of independent origin. Certainly, in later law, the sources seem to be distinct. However that may be, trespass upon the case, or "case," was an excellent machine for redressing most civil injuries, nor have judges ceased to speak of "action on the case" even at the present day. Nor was its influence confined to the law of torts. The most notable offshoot of "case" was the variety of it styled *assumpsit,* which became the general form of action by which damages could be recovered for breach of a contract not made under seal. If one undertook (*assumpsit*) to do something and did it ill, he was liable. Gradually it was held that even if he did nothing, he was still liable. This was recognized very early in the 16th century, and the shaping of this action of *assumpsit* by the judges of this and the succeeding century resulted in the curious spectacle of an action upon contract modelled upon an action of pure tort.

Freedom from unwarrantable arrest or imprisonment of the person was secured by the writs *de odio et atia, de homine replegiando, de manucaptione* and *mainprise.* These have long been superseded by the more efficient writs of *habeas corpus,* though, it may be added, these latter also are themselves of very ancient origin.

Writs at the Present Day.—The vast majority of writs at the present day deal with the initiation, progress, or results of litigation; but purely administrative writs still exist, such as those for summoning representatives to parliament, or for assembling an ecclesiastical convocation. Writs are now issued from the central office of the Supreme Court, which was created by the Supreme Court of Judicature (Officers) Act, 1879, and thereby absorbed the Crown office of the Queen's Bench Division. The Crown office is an institution of the greatest antiquity, and the clerk of the Crown in Chancery has important duties relating to parliamentary writs, which are noticed below. Some writs require the Great Seal, *e.g.,* those for summoning new parliaments; writs of summons in actions are under the seal of the court, and are tested in the name of the lord chancellor, but writs issuing from the Crown office side are tested in the name of the lord chief justice of England. Instead of the Great Seal, the Crown Office Act, 1877, allows wafer great seals made on embossed paper, wax, wafer, or any other material, in accordance

with rules drawn up by a committee of the Privy Council, to be attached to documents authorized by such rules to be thus validated. As to writs connected with litigation, the commonest type is the writ of summons which originates a civil action in the High Court of Justice. Indeed, it is now the only way in which such an action can be commenced. It is a formal document by which the king commands the defendant to "enter an appearance" within eight days, if he wishes to dispute the plaintiff's claim, and notifying him that, in default, judgment will be signed against him. It must be indorsed with a statement of the nature of the claim made. It may be issued either from the central office of the Supreme Court in London, or from one of the district registries which exist in many of the large provincial towns. Issue consists in taking two copies of the proposed writ to the writ department of the central office or to a district registry, signing one copy and paying 30s., whereupon the official impresses a 30s. stamp on the signed copy, files it, stamps the other with a "seal," and hands it back to the applicant. This then becomes the writ in the action. Technical defects in the writ are no longer fatal, for the plaintiff can amend them with the leave of the practice master in the King's Bench Division or of the chief clerk of the writ in the Chancery Division. Bracton's statement nearly 700 years ago, *non potest quis sine brevi agere,* is true of procedure in the High Court even now, but the great difference between the writs of his day and those of our own is the elasticity of claim which the latter allow. We are not limited to a certain number of actions, each with its appropriate writ, to be chosen rightly at the plaintiff's peril; the writ is always the same except for its indorsement, and, in effect, any claim which it is probable that the courts will enforce can be indorsed on it. If the plaintiff lose his case, it will be either because he has not evidence to support it, or because he fails to satisfy the requirements of the substantive law, and not because he has selected the wrong form of writ. After issue of the writ, it must be served on the defendant. This is done by showing him, or his solicitor, the original, and then leaving with either of them a correct copy of it. As a rule, the writ cannot be served on a Sunday. The entry of appearance by the defendant does not involve his personal presence. This, and all other proceedings on the writ, prior to the trial of the action, can be, and usually are, conducted on behalf of the parties by their respective solicitors. The officials who deal with these preliminary proceedings are the masters of the Supreme Court. No leave for the issue of the writ is necessary, unless the defendant be out of England, or the plaintiff seek to join on his writ causes of action for the joinder of which leave is required. Proceedings in the county court, in which most civil actions for claims of small amount are tried, are begun by the entry of a plaint, followed by a summons to the defendant.

Besides the writ commencing an action, there are others which facilitate it, or give effect to its result. Attendance of witnesses is secured by the writ of *subpoena.* Redress for contempt of court may be effected by writ of *attachment.* The writs employed for the execution of judgment against an unsuccessful defendant are *fieri facias* against his goods, *elegit* against his lands, *possession* for the recovery of land adjudged to be the plaintiff's, and *delivery* or *attachment,* or *sequestration* for the recovery of any property other than land or money. The writ of attachment also applies where a judgment directs the performance of any specific act other than the payment of money, *e.g.,* the removal of a nuisance, or requires anyone to abstain from doing a thing; and the writ of sequestration also extends to cases in which a person wilfully disobeys an order or judgment which directs him to pay money into court or to do any other act within a limited time; the writ enables his property to be seized.

The *prerogative writs* deserve special notice both for their historical interest and their practical utility. They are extraordinary remedies issued upon cause shown in circumstances where the ordinary legal remedies are inapplicable or inadequate. The most important of those now in use are *certiorari, habeas corpus, mandamus, procedendo,* and *prohibition.* They usually issue from the Crown office side of the central office of the Supreme Court, and, in general, they are not obtainable as a matter of course. Some probable cause must be shown why such extraordinary remedies should be invoked. A rule *nisi* is issued in the first instance by the court calling upon the party to whom the writ is addressed to show cause why he should not comply with the writ. If he shows sufficient cause, the rule is discharged, otherwise it is made absolute and the party must obey the writ. But in urgent cases, the rule may be made absolute from the first in some of the writs, *e.g., habeas corpus.* The writ of *certiorari* proceeds from a superior court and directs an inferior court, whether civil or criminal, to transmit to the superior court the record of proceedings pending before the inferior court, in order to ensure speedier and better justice to the applicant for the writ. Its object is to give relief against inconvenience arising from the likelihood that the lower court will not dispose of the case as effectually as will the superior. The procedure by this writ must be distinguished from appeals by dissatisfied litigants. These come after judgment, whereas *certiorari* generally deals with cases still pending and, even where it is used for the purpose of getting a conviction quashed, it does not enable the superior court to review the case on its merits, but to deal with some matter like lack of jurisdiction. There are several writs of *habeas corpus,* but the best known variety is the *habeas corpus ad subiiciendum,* which provides for the personal freedom of the subject. (*See* HABEAS CORPUS.) *Mandamus* directs a person, a corporation, or an inferior court of judicature, within the king's dominions, to do some particular thing which appertains to the office or duty of any of them. (*See* MANDAMUS.) The writ of *procedendo* is a possible sequel to *certiorari,* for it applies where the superior court considers it expedient or necessary to restore the record to the inferior court whose proceedings are in question. The writ commands the lower court to proceed with the case. The writ of *prohibition* forbids an ecclesiastical or inferior temporal court to continue proceedings therein in excess of its jurisdiction or in contravention of the laws of the land. (*See* PROHIBITION.) Another prerogative writ has taken the place of the writ *de excommunicato capiendo;* this is *de contumace capiendo* for compelling persons duly cited to appear in the ecclesiastical courts and for enforcing compliance with their orders and punishing contempts in the face of such courts. As to writs relating to the assembly of parliament, the king, on the advice of the Privy Council, issues a proclamation expressing the royal pleasure to call a new parliament and announcing an Order in Council to the lord chancellor to issue the necessary writs on the authority of the proclamation. In practice, the clerk of the Crown in Chancery does not receive direct authority from the chancellor for the issue of the writs, but regards the proclamation itself as sufficient for that purpose. Parliament must meet at any time not less than 20 clear days after the proclamation. Individual writs of summons are sent to those who are entitled to sit in the House of Lords; but for the election of members to the House of Commons the writs are sent to the returning officers of the various constituencies. The writs of summons issued to peers of the United Kingdom are of historical note, for adjudication of disputed peerage claims has often centred in the validity or scope of the writ. Even now, though such a peerage is invariably created by letters patent, these are accompanied by a writ of summons, and it rests with the committee for privileges of the House of Lords to decide whether the writ is valid, or indeed whether it can be issued at all; a familiar recent instance was their refusal to issue the writ to a peeress in her own right (*Viscountess Rhondda's Claim,* Law Reports [1922] 2 Appeal Cases, 339).

Scotland.—"Writ" is a more extensive term than in England. Writs are either judicial or extrajudicial, the latter including deeds and other instruments—as, for instance, in the Lord Clerk Register (Scotland) Act, 1879, and in the common use of the phrase "oath or writ" as a means of proof. In the narrower English sense both "writ" and "brieve" are used. The brieve was as indispensable a part of the old procedure as it was in England, and many forms are given in *Regiam Maiestatem and Quoniam Attachiamenta.* It was a command issued in the king's name, addressed to a judge, and ordering trial of a question stated therein. It was drawn by the writers to the signet, originally

clerks in the office of the secretary of State. Its conclusion was the will of the summons. In some cases, proceedings which were by writ in England took another form in Scotland. For instance, the writ of attaint was not known in Scotland, but a similar end was reached by trial of the jury for wilful error. Most proceedings by brieve, being addressed to the sheriff, became obsolete after the institution of the court of session, when the sheriffs lost much of that judicial power which they had enjoyed to a greater extent than the English sheriff. (*See* SHERIFF.) An English writ of execution is represented in Scotland by diligence, chiefly by means of warrants to messengers-at-arms under the authority of signet letters in the name of the king. The only brieves in practical use are those for serving a tutor-at-law, for kenning to the terce, and for cognition of insane persons. The two former are rare; the third was substituted by the Court of Session (Scotland) Act, 1868, for the old brieves of furiosity and idiotry. Other kinds of brieve have been superseded by simpler procedure, *e.g.*, the brieve of service of heirs, representing the older *breve de morte antecessoris*, by a petition to the sheriff under the Titles to Land Consolidation (Scotland) Act, 1868, and the brieve of perambulation by action of declarator. Writs *eo nomine* have been the subject of much modern legislation. The writs of *capias, habeas, certiorari* and extent were replaced by other proceedings by the Exchequer Court Act, 1856. The writs of *clare constat*, resignation and confirmation (whether granted by the Crown or a subject superior) were regulated by the Titles to Land Act (*supra*). By the same act Crown writs are to be in the English language and registered in the register of Crown writs. Writs need not be sealed unless at the instance of the party against whom they are issued. Writs of progress (except Crown writs, writs of *clare constat* and writs of acknowledgment) were abolished by the Conveyancing (Scotland) Act, 1874. The *clare constat* writ is one granted by the Crown or a subject superior for the purpose of completing title of a vassal's heirs to lands held by the deceased vassal.

(P. H. W.)

United States.—The system of original writs seems never to have obtained in the United States. From the earliest colonial times actions were begun by the issuance of a writ of summons directed to a sheriff or constable, briefly setting forth the character of the claim, and directing that official to summon the defendant. This writ of summons as distinguished from the early English chancery writs was a judicial and not an executive writ. Its issuance was simply a means for securing the presence of the defendant before the court, not as in England giving the court jurisdiction to hear the particular claim. The form of the writ of summons followed in the main the old English writ, briefly stating the cause of action. Probably because of this similarity, despite the absence of original writs, the common law forms of action continued to survive in the United States. Until the adoption of procedural reforms by the codes during the middle of the 19th century, they persisted with all their common law vigour. Under the codes there is usually but one form of action, which is begun by the issuance of a summons prepared by the plaintiff's attorney and served by any one not a party to the suit. The summons is brief, does not disclose the nature of the action, though a copy is commonly attached to and served with the summons.

Writs in the Federal courts are by Act of Congress to be tested in the name of the chief justice of the United States. By State law writs in the State courts are generally bound to be in the name of the people of the State, in the English language, and tested in the name of the chief justice of the State. The common law prerogative writs such as *mandamus*, prohibition, *certiorari, quo warranto* and *habeas corpus* are well known in the United States. The Constitutions or statutes of the several States confer upon their courts power to issue these writs. The cases in which they may issue are generally governed by statute, and the courts issue them as a matter of sound discretion and not as a matter of right. In trying questions of title to real property, writs of entry and other real actions, which before the settlement of the colonies had become nearly obsolete in England, were until the middle of the 19th century the common remedies in the U.S. courts. They were, however, stripped of the cumbrous feudal appendages which made them intolerable in England. The action of ejectment begun by summons in the manner of any personal action has now supplanted them. Two prerogative writs have much importance in the Federal courts. These are the writ of error (now abolished in England) and the writ of *certiorari*. From 1879 until 1914, writ of error was the only means by which a decision of a State court could be reviewed in the Supreme Court of the United States. In that year *certiorari* was added as another method for review, having been available since 1891 as a method for reviewing decisions of the inferior Federal courts in the Supreme Court. In 1928 the writ of error was abolished and appeal substituted in its place. The writ of assistance has its interest in constitutional history. Before the War of Independence it was issued to revenue officers to search premises for smuggled goods. It was on this writ that it was first contended in 1761 that a colonial court had jurisdiction to examine the constitutionality of a legislative Act authorizing the issue of the writ. (*See Quincy's Massachusetts Rep.*, app., I. 520.)

(J. M. LA.)

BIBLIOGRAPHY.—For the history of the writ see *Registrum Brevium* and Sir Anthony Fitzherbert, *La nouvelle Natura Brevium* (1534 or 1537; Eng. trans., 1652, 9th ed., 1794), both noticed above; *Natura Brevium*, which changed its name to *Old Natura Brevium* after Fitzherbert's book was published; it exists in a great number of editions, the earliest of which is about 1516, the last 1584; *Novae narrationes; Articuli ad novas narrationes; Returna Brevium;* Simon Theloall, *Le digest des briefs originals* (1579); *Thesaurus brevium* (*c.* 1661); R. Brownlow, *Brevia judicialia* (1662); *Officina brevium* (1679); Sir E. Coke, *Institutes* (1628, many later editions); C. Dufresne du Cange, "Brevis" in *Glossarium* (Leyden, 1688; best ed. Henschel 1840–1850); G. Booth, *Real Actions* (1701); W. Tidd, *Practice* (1790–97); H. J. Stephen, *Pleadings* (1824; 7th ed., 1868); R. J. and A. B. Corner, *Practice of the Crown Side* (1844); M. M. Bigelow, *History of Procedure in England* (1880); F. Pollock and F. W. Maitland, *History of English Law before the time of Edward I.* (1895); W. S. Holdsworth, *History of English Law* (1903, etc., especially vols. ii. and iii.); W. S. McKechnie, *Magna Carta* (1905; 2nd ed., 1914); T. A. Street, *Foundations of Legal Liability*, vol. iii. (1907); F. W. Maitland, *Equity, also the Forms of Action at Common Law* (edit. A. H. Chaytor and W. J. Whittaker, 1909); also *Collected Papers*, vol. ii. (edit. H. A. L. Fisher, 1911); W. Stubbs, *Select Charters* (9th ed., 1913); P. H. Winfield, *Chief Sources of English Legal History* (1925); and E. Jenks on "Prerogative Writs" in *The Yale Law Journal* (April 1923).

For current law, there is no book which deals with writs both exclusively and completely. Taken in the aggregate, the following books cover the topic: *The Annual Practice;* W. G. Clay, *The Law and Practice relating to Writs of Summons* (1894); F. H. Short and F. H. Mellor, *Practice on the Crown Side of the King's Bench Division* (2nd ed., 1908); E. R. Daniell, *Chancery Practice* (8th ed., S. E. Williams and F. Guthrie Smith, 1914), and *Chancery Forms* (6th ed., R. White, F. E. W. Nicholls and H. G. Garrett, 1914); T. E. May, Baron Farnborough, *Parliamentary Practice* (13th ed., T. L. Webster, 1921); W. B. Odgers, *Pleading and Practice* (10th ed., 1926); Alduson, *Judicial Writs and Process* (1895); and *see* "Writ" in index to the Earl of Halsbury, *The Laws of England* (31 vols., 1907–17, with supplement, 1910, etc.).

(P. H. W.)

WRITERS TO THE SIGNET, in Scotland, a society of law agents who, along with others, correspond to solicitors in England. They were originally clerks in the secretary of State's office and prepared the different writings passing the signet. They have no charter but are usually considered a corporation by long custom; they have office-bearers and are members of the College of Justice.

WRITING. The earlier history of writing is dealt with in the articles ALPHABET, PALAEOGRAPHY, PICTOGRAPHY. The subject of the present article is handwriting in its common uses in Europe since the period when the invention of printing superseded its employment for the making of books.

Speaking broadly, the ordinary handwritings of modern Europe result from the competition and interaction of two contrasted forms of script which existed side by side in most countries for many generations, and which still maintain an independent existence in Germany. These are the Italian, or Roman, and the national, not very accurately called Gothic, current hands. In England the most important type of native current hand was known in the 16th century as Secretary. The acute stage of the rivalry here may be said to last from about 1480 till the reign of Charles I., whose own hand is not a bad example of the compromise which shows the resultant of the two forces. Endymion Porter's hand

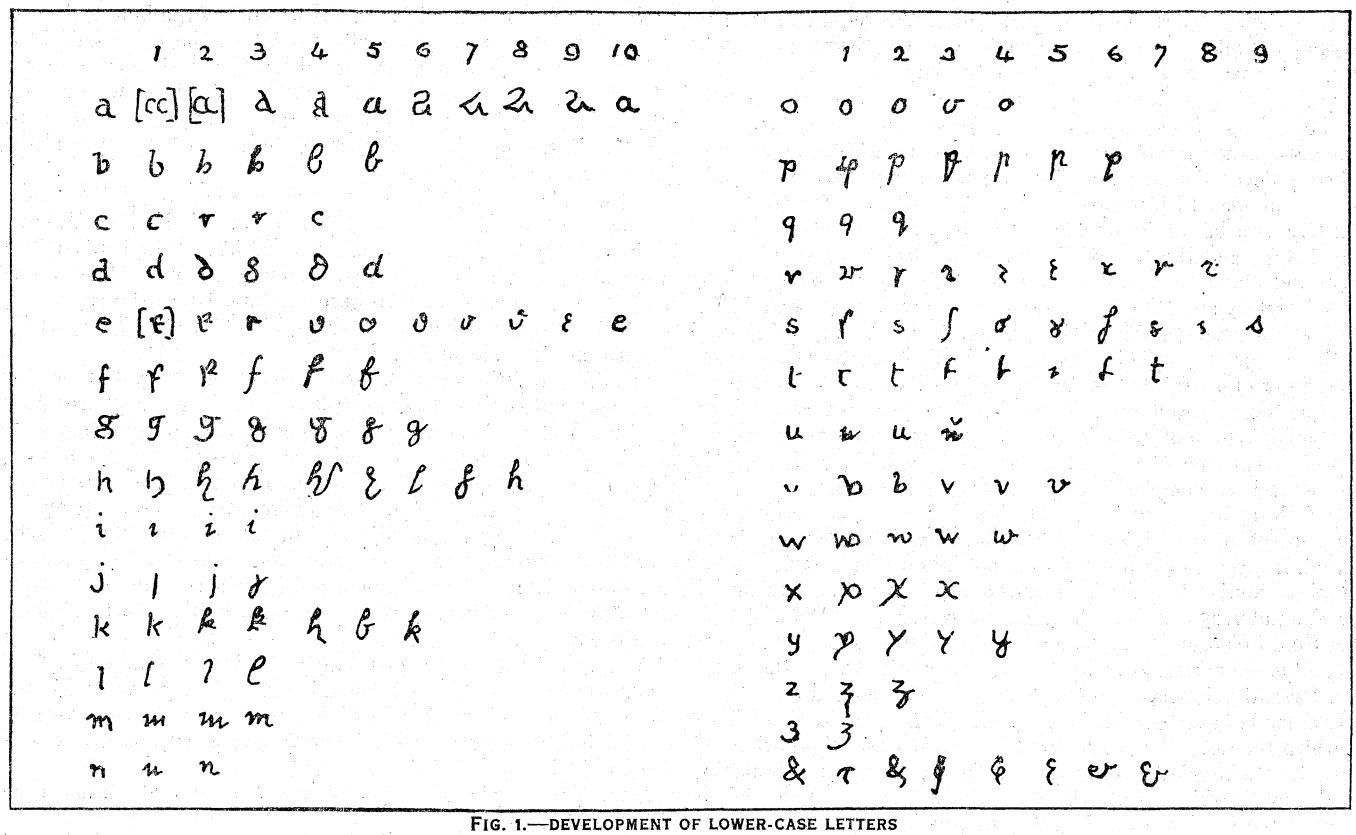

FIG. 1.—DEVELOPMENT OF LOWER-CASE LETTERS

gives an even better specimen.

The Italian Hand.—The great and singular achievement of the Italian renaissance in the matter of hand writing, the creation or revival of what is known as humanistic script (*see* art. PALAEOGRAPHY) might seem, since that hand was properly a book-hand, to lie outside our present subject. This, however, would not be altogether true. If the type used in this Encyclopædia follows so closely the forms of letters evolved 11 centuries ago that a Latin book printed in it would have been easily read by a scholar of Charlemagne's court, it is because the Caroline hand set up a standard of legibility and simplicity from which other beautiful scripts were felt to fall away. As cheapened and, as it were, stereotyped by its adoption for printing, it has retained the same compelling power in a higher degree. To make one's hand "as plain as print" has been and is an aim the effects of which recur again and again in the history of writing. Before, however, it could have any direct influence on ordinary handwriting the humanistic script had to submit to certain changes, the general tendency of which can be gathered by comparing the printers' Roman with the printers' Italic type. This more cursive type of Italian script is seen in the hand of Petrus Carmelianus, tutor to the children of Edward IV., which serves also to show that the script had made its way into England before 1483.

Its rapid spread in England, perhaps, owed something to Royal patronage, for although Henry VIII. did not write it himself, he had it taught to his children, but through the 15th and first half of the 16th centuries a very large proportion of educated Englishmen both could and did write both in Italian and Secretary hand.

The different uses to which men put the two hands indicate that the superior legibility of the Italian was recognized, for in a letter or tract written mainly in Secretary it is common practice to write sub-headings, proper names, foreign words and the like in Italian script, in fact to use it much as we do italic print or leaded type.

Before we compare the merits and defects of the Italian current script with the fully-developed Secretary hand it is necessary to say something further concerning the scripts from which the latter had evolved.

Sources of Secretary Hand.—A critical study of the development of popular current script in England in the 14th–15th century is still a desideratum. Insufficient attention seems to have been paid to the needs which it rose to meet. Collections of specimens of writing from the beautiful book-hands of monastic scriptoria, or the workshops of artist-illuminators fail to illustrate it, and so, to a great degree, do collections of official writings from the administrative offices of State, written by clerks trained in their particular departments, a conservative class given to a professional pride in writing unlike the general public. Secretary hand, it is true, is considerably influenced by a type of script used in the chancery for documents intended to be read by laymen, an example of which may be taken from a formulary of Henry IV. It was influenced likewise by a type of vernacular book-hand, of which a specimen may be taken from a mid-15th century ms. of Occleve's poems. And it was influenced also by a form of script the origin of which seems to be French or Flemish, though it was popular in England. An illustrative example is from a book which was written in France for presentation by the earl of Salisbury to Queen Margaret at or immediately after her marriage to Henry VI. in 1445.

This is apparently the script known to French writers of the time as "lettres bastardes," to indicate its intermediate position between the stiff precision of the "lettres de forme" of the most expensive mss. and informal current or court hand called "lettre de cour." In the main, however, "Secretary" derives from none of these styles so much as from the styleless writing of the ordinary man of the 14th century, and its first beginnings are to be seen as soon as the need for any large amount of writing by the ordinary man began to be felt. Many circumstances combine to fix this at about the 50 years 1260–1310. Great monasteries began late in Henry III.'s reign to keep elaborate court-rolls and account-rolls of their manors. Changes in land tenure under Edward I. led to a vast output of deeds dealing with little bits of land. A little later allusions to the "paper of the market" show a new and cheap writing material fostering the growth of ephemeral business records. And lastly, legal documents were coming to be written in French and English, and by persons unskilled in the elaborate system of abbreviations which learned Latinists had devised to

shorten their labour. In these conditions, the requirements for a popular hand were speed and simplicity rather than beauty, and even at the cost of a high degree of legibility.

Analysis of Letters.—The subjoined table of lower case alphabets (fig. 1) is meant to illustrate, by reference to the numerals at the top, the forms of letters mentioned in the remarks which follow. Forms in brackets do not belong to our period, but are alluded to historically. The alphabets are far from exhaustive as a list of forms admissible or usual in 15th–18th century hands, and the facsimiles should be studied to supplement them and illustrate the mode of use of the letters. In what follows Secretary and Italian hands will be referred to as *Sec.* and *It.*

a. The normal form in both *Sec.* and *It.* is a^5. Formed in one stroke, its greater rapidity caused it to displace the Carolingian (or printer's) *a* (a^3) though the latter with its variant a^4 survived in some legal as well as book hands; a^5 may be regarded either as a simplification of a^3, by neglect of the top hook, or as a revival of the precaroline a^2 (the earlier type of which was a^1), which had never been completely driven out by a^3. a^5–a^9 are characteristic 16th–17th century forms developed from an overhead fore-link, but often used initially and where no link was needed; a^7 indeed, has ceased to function as a link altogether and become a senseless flourish like the long up-stroke often prefixed to initial *m*; a^8, a not very common form, has received a good deal of attention from its occurrence in one of the Shakespeare signatures.

b. b^1 is the normal *It.*, with b^2 and b^3 as variations, b^4 the usual *Sec.* form, developing at an early date into the modern b^5.

c. c^2 made in one stroke, had replaced in *Sec.* the mediaeval c^1, in which the downward curve was written first and the horizontal top added afterwards. It thus avoided the disastrous similarity of c^1 and t^1, which makes the two letters as often as not indistinguishable in mediaeval documents. But it became too like an ill-formed *e* (e^3 or e^7). *It.* did good service in restoring the simple curve (c^4), the ultimate victory of which was assured.

d. Of the two forms d^1 and d^2, about equally frequent in 12th century use, d^2 had gradually driven out d^1 in 15th century England, and, with the addition of a loop for after-link, established itself in *Sec. It.* partially reintroduced d^1, and the two forms have been alternatives ever since. In the 16th century the ambiguity of d^4 with the e^4 of *Sec.* more than counterbalanced the ambiguity of d^5 with *cl.* d^3 is an abnormal, but not rare, form of d^2 fore-linked and written the wrong way round.

e, the letter of most frequent occurrence, whether in Latin or the vernacular, has perhaps undergone more changes than any other. The early mediaeval e^1 is formed in three pieces, beginning with the downward curve; e^2 is a modification written in two motions. The gradual development of the characteristic *Sec.* form e^6 through the stages e^4 and e^5 was the work of the 14th century. Its ambiguity with d^4 was perhaps the cause of a marked tendency in the 16th century to lift the pen before forming the final loop (as in e^8), or to reduce the loop to its smallest size as in e^7. In well-formed *It.* it had practically the modern shape e^{10}, but English writers show a strong inclination to revert to other forms. (*See*, for example Plate I*b* line *e* in the same plate. 1, *quietness*, where the second *e* exactly resembles c^3, and *d*, where Elizabeth prefers the *Sec.* e^6, whereas Burleigh uses something resembling e^2.) The eventual victory of e^{10} was assured in the 17th century, though e^6 lingered on well into the 18th, and not only in legal hands. Final *e*, like final *s*, is always specially liable to slurring. The epsilon form e^9 occurs fairly often from Elizabethan *It.* onwards, but is somewhat indicative of academic education.

f in *Sec.* is analogous in formation to *e*, starting with the middle of the shaft downwards and completing the top in one or two motions, f^1 and f^2. The *It.* f^3 is a simple two-piece letter, but needs adaptation to make it current. If the fore-link was added on the *r*, and the after-link on the *l*, as in f^4, it is too like h^7 and s^6. The difficulty is eventually solved by the form f^5.

g, rather a complicated letter throughout the middle ages, tending continually to diverge from, and return to the figure-of-8 form of the minuscule, never attained in *Sec.* a form of satisfactory simplicity. In g^1 and g^2 after writing the *y* part of the letter the pen was carried far to the left below the line, and must be lifted to make the horizontal top-stroke. The *It.* g^3 links well but the bottom loop, made large and far to the right, was rather cumbrous. An alternative g^5 was liable to confusion with h^7 and other letters, and many 16th–17th century writers used the complicated g^4. Eventually the modern g^6 begins to take shape about Charles I.'s reign.

h. The mediaeval form h^1 as a letter ending to the left below the line early acquired a curved link to carry it back to the line in the form of the *Sec.* h^2, often extended in Elizabethan use into an overhead link as in h^4. Even without this, it was a long letter, in which the angles tended to become slurred into the shapes h^5, h^6 and h^7, the last being too close to f^4 and s^6. The *It.* h^3 easily changed into the modern h^8.

i and *j* need little comment, except that their distinctive use for the vowel and consonant (though a few mediaeval instances may be found) is an innovation belonging rather to the history of printing than of writing, and was little observed even by printers till the 17th century. Previous to this, lower case *j* occurs as the last rather than the first of two or more *i*'s coming together, especially in numerals, as xiij., and in Latin words like *conijcio.* Dotting of these letters, though well known to mediaeval scribes and obviously useful to distinguish *i* from a part of *m, n,* or *u,* was also not an obligatory process in good writing till the printer set the example.

k, if not much wanted in Latin or Italian is common in Germanic tongues and the continental form k^1 competed with the more complicated *Sec.* k^2 and k^3. More current shapes k^4 and k^5 were liable to confusion with *h* and *b,* and k^6 is a natural development.

l, m, n, nearly identical in ordinary *Sec.* and *It.* forms, need no comment, and of

o we need only remark the ambiguity of the negligently formed o^3, with open loop, and e^6 and e^7.

p has the characteristic form p^1 in Elizabethan *Sec.*, later slurred into p^6, resembling x^1. The *It.* p^2, in the effort to write it currently sometimes took the form p^3, but a simpler change, by slight opening of the loop, led through p^4 to p^5.

q needs no comment, but

r is another letter of complicated history, and an illustration of the way in which alternative forms have arisen and maintained themselves for centuries. The modern alternatives r^7 and r^8 have a story reaching back more than a thousand years, the latter originating in the ligature of the uncial letters OR in the shape ꝛ and thence introduced into minuscule writing, particularly in the common Latin genitive termination orum, written as (oꝛ), but admissible anywhere where *r* follows *o*. From about the 12th

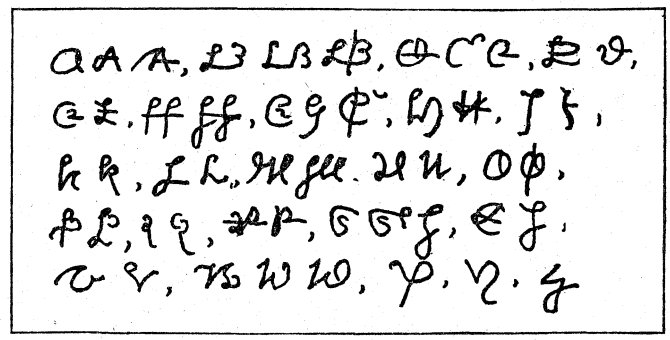

FIG. 2.—SOME FORMS OF CAPITAL LETTERS

century the use of this 2-shaped *r* was extended to cases where it followed the letters *p* and *b,* the last curve of which is similar to that of *o*. In the course of the 13th century the analogy of the masculine orum seems to have brought the 2-shaped *r* into the feminine arum, and in the 14th and 15th century it slowly creeps in after *i, e, u* and other letters, and last of all as an initial. Normally however, when not following *o* the form r^2 (with longer or shorter shaft) is retained in English as well as *It.* hands until early in the 16th century, when a short horizontal stroke on the line is introduced, making the typical *Sec.* form r^1. From the

short-shafted variety of r^2 is developed r^6, and from the 2-shape r^3 come r^4, and r^5, all characteristic of 16th-17th century hands. Several other varieties could be noted if space allowed.

s is another letter of two forms (*s* and *f*) the use of which in writing as in print (until about 1800) depended on the position of the letter in a word. From aesthetic motives apparently scribes of the 10th–12th century gradually discarded the use of the minuscule or long *s* in a final position and substituted the short or uncial *s*, which was slowly modified first into a shape like a Greek final sigma *s* then into something like a medial sigma *σ*, *viz.*, s^4 or s^5. The use of s^4 in an initial position is one of the earliest signs of the popular current hand of about 1300. In Italy the current hand, abandoning the minuscule long *s* of the formal humanistic script, reverted to the old Roman cursive s^3, which it used along with the uncial short s^2. We have therefore in Elizabethan hands the four forms s^1–s^4 in regular use medially or initially together with the final forms s^5 or s^2. The addition of fore- and after-links convert s^2 and s^3 into s^7 and s^6 respectively, but in 17th century hands the one is often shortened or the other lengthened so as to become hardly distinguishable. Slurring of the upper loop converts s^2 into s^8, but the further development into the modern s^9 is scarcely recognized as a copybook form till the 18th century.

t in the regular mediaeval shape t^1 had been barely distinguished from c^1. The writers of *Sec.* therefore, influenced, perhaps, by the form in Bastard hand, preferred t^3, while t^2 is the normal *It.* In cursive writing and especially in a final position, where slurring is most prevalent, it took the shapes t^4, t^5, and t^6. t^7 is the later development of its medial use.

u needs little comment, except that a practice of distinguishing it from *n* by adding a curved mark over it, u^3, is a fairly sure sign, if not of German or Netherlands, then of Scottish influence.

With regard to the use of *u* and *v* the case is similar to that of *i* and *j*. Until about 1600, *v* is merely the initial form of the letter written medially as *v*. *v, w*. v^1 v^2, w^1 w^2 are the *Sec.* forms.

x. The *Sec.* form x^1 closely resembles p^6; x^2 is the usual *It.*, but x^3 occurs before 1600.

y, z. y^1 is the *Sec.* form. *z* nearly always has a tail.

Of the two surviving extra letters of the Anglo-Saxon (runic) alphabet, the thorn þ disappears about the beginning of our period (*circ.* 1460), being replaced by *y* in the abbreviations y^e and y^t for *the* and *that*. *yok* survives a little longer but is often written like *z*.

The last line of our table shows a few forms of the ampersand, or abbreviation for *and* (or *et*). Of other abbreviations common in Elizabethan English few will give much trouble to the reader. The stroke above the line for *m* or *n, r* above the line in such words as your (yor) and after (aft^r, *p* for per or par, and the stroke above for *i* in the termination cion (our tion), *e.g.*, devocon, deserve notice, as also the sweeping curve for *es* or *s*, as in the words *lands* and *ends* in the example of Burleigh's hand.

Capital letters have so many forms depending on individual taste, that a detailed analysis in the space at command would be impossible. The very small selection given includes some of the Elizabethan forms which are most different from modern usage. For bibliography *see* CALLIGRAPHY.

WROUGHT IRON: *see* IRON AND STEEL.

WRYNECK, a bird, *Jynx torquilla*, so called from its way of writhing its head and neck. It is a summer visitant to most parts of Europe, generally arriving a few days before the cuckoo, and is often known as "cuckoo's leader" and "cuckoo's mate."

The unmistakable note of the wryneck is merely a repetition of what may be syllabled *que, que, que,* many times in succession, rapidly uttered at first, but gradually slowing and in a continually falling key. This is only heard during a few weeks, and for the rest of the bird's stay in Europe it seems to be mute. It feeds mainly on insects, especially on ants. It is larger than a sparrow with beautifully variegated plumage of black, brown, buff and grey. The wryneck lays its translucent white eggs on the bare wood of a hole in a tree, and it is one of the few wild birds that can be induced to go on laying by abstracting its eggs day after day, and thus upwards of forty have been taken from a single hole—but the proper complement is from six to ten. When disturbed on the nest, the female writhes and hisses like a snake. As regards Britain, the bird is most common in the south-east, its numbers decreasing rapidly towards the west and north.

Other species of the genus are found in various parts of Africa. The wrynecks (*see* WOODPECKER) form a subfamily *Jynginae* of the *Picidae,* from the more normal groups of which they differ in coloration and in having the tail-quills not stiffened to serve as props as in the climbing *Picinae*.

WRY-NECK (Lat. *Torticollis*), a congenital or acquired deformity, characterized by the affected side of the head being drawn downwards towards the shoulder together with deviation of the face towards the sound side. There are various forms. (1) The congenital, due to a lesion of the sterno-mastoid muscle. (2) The rheumatic, due to exposure to a draught or cold. This is commonly known as "stiff-neck." (3) The nervous or spasmodic, the result of (*a*) direct irritation of the spinal accessory nerve or its roots, or (*b*) the result of cerebral irritation. Many cases are also due to hysteria and some to spinal caries. When wry-neck is congenital, massage and manipulation may be tried and some form of apparatus. Failing this, division of the muscle surgically may be practised. In the spasmodic forms, anti-neurotic treatment is recommended. In rheumatic torticollis the spasm is usually overcome by the application of hot compresses and appropriate anti-rheumatic treatment.

WUCHANG: *see* HANKOW.

WUCHOW, former treaty port, Kwangsi province, China, on left bank of the Sikiang at its junction with the Fu or Kwei-kiang (Cassia) river. It is 220 mi. above Canton and the river is navigable the whole distance for vessels drawing up to 8 ft. of water. The situation of Wuchow makes it the distributing centre between Kweichow, Kwangsi and Canton. Imports from Canton were chiefly cotton and cotton goods, kerosene oil, woollens, etc., while sugar, oils, hides and aniseed were the chief exports. During summer floods the water pent up by the gorges rises 50–60 ft. at Wuchow. Because of the variation of river level the principal offices and shops are built upon pontoons which are moored along the river bank. The city, renamed Tsangwu, and located on the Canton-Kweichow road system, was repeatedly bombed by the Japanese since 1938. Pop. (est. 1931) 90,000.

WUHU, an important port in Anhwei province, China, on the south bank of the Yangtze river about 50 mi. above Nanking. It is directly connected by rail and road eastward with Nanking, southward with Suancheng (Ningkwo), and beyond, and from the north bank of the river by rail with Hofei (Luchow) and Tienchiaan. Ocean freighters and river steamers freely reach the port. Canals brought silk, rice, cotton, wheat, tea, feathers to Wuhu for export. It was marked out as a treaty port in 1858, opened for trade in 1877, and from 1905 on had a steady increase in prosperity. The large, modern, cotton-spinning factory and the power and light works were taken over by the Japanese in 1937, who also built large military establishments there and mined coal and iron nearby. Pop. (est. 1931) 135,385.

WULFENITE, a mineral consisting of lead molybdate, $PbMoO_4$, crystallizing in the hemimorphic-tetartohedral class of the tetragonal system. Crystals usually have the form of thin square plates bevelled at the edges by pyramidal planes. They have a brilliant resinous to adamantine lustre, and vary in colour from greyish to bright yellow or red: the hardness is 3, and the specific gravity 6·7. Small amounts of calcium are sometimes present isomorphously replacing lead. The mineral occurs in the oxidation zone of veins containing lead and molybdenum. Good yellow crystals come from Bleiberg in Carinthia and bright red ones from Arizona. The mineral has been produced on a commercial scale, as an ore of molybdenum, at the Mammoth mine, Arizona.

WULFHERE (d. 675), king of the Mercians, a younger son of King Penda, was concealed for some time after his father's death in 655, but in 658 or 659, when the Mercians threw off the supremacy of Oswio, king of Northumbria, Wulfhere became king. He did much to spread Christianity inside and outside his kingdom. In 657 he gained Lindsey from Northumbria, and he was successful against Wessex, extending his borders in all directions.

Wulfhere married Eormenhild, a daughter of Erconberht, king of Kent, and was succeeded by his brother Aethelred. His only son, Coenred, became king in 704, in succession to Aethelred, and his daughter, St. Werburga or Werburh, was abbess of Ely.

See Bede, *Historia ecclesiastica,* edit. C. Plummer (Oxford, 1896); and J. R. Green, *The Making of England* (1897–99).

WULFSTAN, archbishop of York from 1003 until his death in May 1023, and also bishop of Worcester (1003–16), is generally held to be the author of a remarkable homily in alliterative English prose. Its title, taken from a ms., is *Lupi sermo ad Anglos, quando Dani maxime prosecuti sunt eos, quod fuit anno 1014.* It is an appeal to all classes to repent in the prospect of the imminent day of judgment, and gives a vivid picture of the desperate condition of England in the year of King Aethelred II.'s flight (1014). Of the many other homilies ascribed to Wulfstan very few are authentic. Subsequent legislation, especially that of Canute, bears clear traces of his influence.

See the edition of his homilies by A. Napier (Berlin, 1883); the same writer's *Über die Werke des altenglischen Erzbischofs Wulfstan* (Göttingen dissertation, 1882), and his paper in *An English Miscellany* (Oxford, 1901, pp. 355 f.); also A. Brandl in H. Paul's *Grundriss der germanischen Philologie* (2nd ed., 1901–09), ii., pp. 1110–1112.

WULFSTAN, ST. (*c.* 1012–1095), bishop of Worcester, born at Little Itchington near Warwick and educated in the monastic schools of Evesham and Peterborough, became a monk at Worcester, and schoolmaster and prior in the cathedral monastery there. Chosen bishop of Worcester in 1062, he accepted with some reluctance, and was consecrated at York in September. Wulfstan submitted to William the Conqueror, and helped to check the rebellious barons during the revolt of 1075. He was equally loyal to William II. in his struggle with the Welsh. Wulfstan's relations with his ecclesiastical superiors were not so harmonious, and at one time both Lanfranc of Canterbury and Thomas of York unsuccessfully demanded his removal. He died on Jan. 18, 1095. In 1203 he was canonized by Pope Innocent III. By his preaching at Bristol Wulfstan is said to have put an end to the kidnapping of English men and women and selling them as slaves. He rebuilt the cathedral church of Worcester, and some parts of his building still remain. Lives of St. Wulfstan by Hemming and Florence of Worcester are in H. Wharton's *Anglia sacra* (1691). *See* also E. A. Freeman, *Norman Conquest* (1867–79).

WUNDT, WILHELM MAX (1832–1920), German physiologist and philosopher, was born on Aug. 16, 1832 at Neckarau, in Baden. He studied medicine at Tübingen, Heidelberg and Berlin, and in 1857 began to lecture at Heidelberg. In 1864 he became assistant professor there, and in 1866 was chosen to represent Heidelberg in the Baden Chamber, but soon resigned. In 1875 he became professor of philosophy at Leipzig, where he founded an institute for experimental psychology, the precursor of many similar institutes. The list of Wundt's works is long and comprehensive, including physiology, psychology, logic and ethics. He died near Leipzig on Aug. 31, 1920.

WUNTHO, a native state of Upper Burma annexed by the British and incorporated in the district of Katha in 1892. When the British annexed Upper Burma in 1885 the state became a refuge for rebels. Finally in 1891 it broke into open rebellion, the sawbwa was deposed, and a force of 1,800 troops under General Sir George Wolseley occupied the town of Wuntho and reduced the state to order.

WU PEI-FU (1873–1939), Chinese general, was born in Shantung. He joined the Third Army Division, commanded by Tsao Kun, distinguished himself in several minor campaigns, and was rewarded by Tsao Kun in 1916 with the command of a division. By 1917 he was the Peking Government's chief bulwark against the Monarchists, Sun Yat-sen's independent republic at Canton and the ambitions of Marshal Chang Tso-lin, the governor general of Manchuria. Sun Yat-sen was not in a position to take the offensive, but Chang Tso-lin invaded Chihli in the spring of 1922 and, being defeated by the forces of Wu Pei-fu, launched another attack in 1924. Wu Pei-fu was defeated in a great battle near Tientsin in Oct. and fled, after which he remained in retirement at Yochow.

WUPPERTAL, Germany: *see* BARMEN; ELBERFELD.

WÜRTTEMBERG, a *Land,* and a component State of the German Reich, forming a tolerably compact mass in the south-west angle of Germany. In the south it is cleft by the long narrow territory of Hohenzollern, belonging to Prussia; and it encloses several small enclaves of Baden and Hohenzollern, while it owns some small exclaves within the limits of these two states. It lies between 47° 34′ 48″ and 49° 35′ 17″ N., and between 8° 15′ and 10° 30′ E. Its greatest length from north to south is 140 m.; its greatest breadth is 100 m.; its boundaries, almost entirely arbitrary, have a circuit of 1,116 m.; and its total area is 7,530 sq.m. It is bounded on the east by Bavaria, and on the other three sides by Baden, with the exception of short distances on the south, where it touches Hohenzollern and the lake of Constance.

Physical Features.—The undulating fertile terraces of Upper and Lower Swabia may be taken as the characteristic parts of this agricultural country. The usual estimates return one-fourth of the entire surface as "plain," less than one-third as "mountainous," and nearly one-half as "hilly." The average elevation above the sea-level is 1,640 ft.; the lowest point is at Böttingen (410 ft.), where the Neckar quits the country; the highest is the Katzenkopf (3,775 ft.), on the Hornisgrinde, on the western border.

The chief mountains are the Black Forest (*q.v.*) on the west, the Swabian Jura or Rauhe Alb stretching across the middle of the country from south-west to north-east, and the Adelegg Mountains in the extreme south-east, adjoining the Algau Alps in Bavaria. The Rauhe Alb or Alp slopes gradually down into the plateau on its south side, but on the north it is sometimes rugged and steep, and has its line broken by isolated projecting hills. The highest summits are in the south-west, viz., the Lemberg (3,326 ft.), Ober-Hohenberg (3,312 ft.) and Plettenberg (3,293 ft.). To the south of the Rauhe Alb the plateau of Upper Swabia stretches to the lake of Constance and eastwards across the Iller into Bavaria. Between the Alb and the Black Forest in the north-west are the fertile terraces of Lower Swabia, continued on the north-east by those of Franconia.

About 70% of Württemberg belongs to the basin of the Rhine, and about 30% to that of the Danube. The principal river is the Neckar, which flows northward for 186 m. through Württemberg to join the Rhine, and with its tributaries the Rems, Kocher, Jagst, Ens, etc., drains 57% of the country. The Danube flows from east to west across the south half of Württemberg, a distance of 65 m., a small section of which is in Hohenzollern. Just above Ulm it is joined by the Iller, which forms the boundary between Bavaria and Württemberg for about 35 m. The Tauber in the north-east joins the Main; the Argen and Schussen in the south enter the lake of Constance. The lakes of Württemberg, with the exception of those in the Black Forest, all lie south of the Danube. The largest is the Federsee (1 sq.m.), near Buchau. About one-fifth of the lake of Constance is reckoned to belong to Württemberg. Mineral springs are abundant; the most famous spa is Wildbad, in the Black Forest.

The climate is temperate, and colder among the mountains in the south than in the north. The mean temperature varies at different points from 43° to 50° F. The abundant forests induce much rain, most of which falls in the summer.

Population.—The population of the four divisions (*Kreise*) into which the kingdom was divided is shown below:—

Division (*Kreis*)	Area in sq.m.	Pop. 1900	Pop. 1933	Density 1933
Neckar	1,285	745,669	1,035,951	806·1
Black Forest (Schwarzwald)	1,844	509,258	620,476	336·4
Jagst	1,984	400,126	430,202	216·8
Danube (Donau)	2,417	514,427	609,313	252·0
Total	7,530	2,169,480	2,695,942	358·0

The population in 1939 was 2,907,131, being particularly dense in the Neckar valley. The people of the northwest belong to the Alamannic stock, those of the northeast to the Franconian, and those of the centre and south to the Swabian.

The largest towns in the kingdom are Stuttgart (with Cannstadt), Ulm, Heilbronn, Esslingen, Reutlingen, Ludwigsburg,

Göppingen, Gmünd, Tübingen, Tuttlingen and Ravensburg.

Agriculture.—Württemberg is essentially an agricultural State; 64% of its total area is under cultivation, while 31% is under forest. It possesses rich meadowlands, cornfields, orchards, gardens, and hills covered with vines. The chief agricultural products are oats, spelt, rye, wheat, barley, hops. To these must be added wine (mostly of excellent quality), peas and beans, maize, fruit, chiefly cherries and apples, beets and tobacco, and garden and dairy produce. Of live stock, cattle, sheep and pigs are reared in considerable numbers, and attention is paid to horse-breeding.

Mining.—The salt industry was developed at the beginning of the 19th century. The iron industry is of great antiquity, but it is hampered by the absence of coal. Other products are granite, limestone, ironstone and fireclay.

Manufactures.—Linen, woollen and cotton fabrics are made at Esslingen and Göppingen, and paper at Ravensburg, Heilbronn and other places in Lower Swabia. The manufacturing industries assisted by the government developed rapidly during the later years of the 19th century, notably metal-working, especially such branches of it as require exact and delicate workmanship. Of particular importance are iron and steel goods, locomotives (Esslingen), machinery, motor-cars, bicycles, small arms (in the Mauser factory at Oberndorf), all kinds of scientific and artistic appliances, pianos (at Stuttgart), organs and other musical instruments, photographic apparatus, clocks (in the Black Forest), electrical apparatus, and gold and silver goods. There are also extensive chemical works, potteries, cabinet-making workshops, sugar factories, breweries and distilleries. Water-power and petrol largely compensate for the lack of coal.

Commerce.—The principal exports are cattle, cereals, wood, pianos, salt, oil, leather, cotton and linen fabrics, beer, wine and spirits. The chief commercial cities are Stuttgart, Ulm, Heilbronn and Friedrichshafen. The book trade of Stuttgart, called the Leipzig of South Germany, is very extensive.

Communications.—In 1939 Württemberg had 802 mi. of full gauge railways. The Neckar, the Schussen and the lake of Constance are all navigable for boats; the Danube begins to be navigable at Ulm. The roads of Württemberg are fairly good; the oldest of them are Roman.

Government.—The republican constitution of Sept. 25, 1919, provided for a Landtag of 80 members elected for 4 years by universal suffrage. This was superseded after 1933 by a totalitarian regime in the hands of Wilhelm Murr, a national socialist district leader (*Gauleiter*) and federal governor (*Reichsstatthalter*) appointed by Hitler.

For administrative purposes the country is divided into the City of Stuttgart, 62 districts (Oberämter), and 1,887 communes (Gemeinden).

Religion.—At the census of 1933 the various creeds numbered as follows:—Protestants, 1,810,000; Roman Catholics, 839,678; Jews, 10,023; and others 34,826. At the head of the Evangelical (Protestant) Church stands a president, who with a church council is responsible for its administration. The Roman Catholic Church is subject to the bishop of Rottenburg, in the archdiocese of Freiburg.

Education.—The higher branches of learning are provided in the university of Tübingen, in the technical high school (with academic rank) of Stuttgart, the veterinary high school at Stuttgart, the commercial college at Stuttgart, and the agricultural college of Hohenheim. There are gymnasia and other schools in all the larger towns, while every commune has a school. There are numerous schools and colleges for women. There is also a school of viticulture at Weinsberg.

HISTORY

Origins.—The origin of the name Württemberg is uncertain. Early forms of it are Wirtenberg, Wirtembenc, Wirtenberc, Wirtemberg and Würtemberg. In 1806 Württemberg was adopted as the official spelling.

As far as we know, the first inhabitants of the country were the Celts, and then the Suebi. In the 1st century A.D. the Romans included it in the area defended by the *Limes Germanicus* (*q.v.*). Early in the 3rd century the Alamanni drove the Romans beyond the Rhine and the Danube, but in their turn they were conquered by the Franks under Clovis, the decisive battle being fought in 496. In the 9th century it was incorporated with the German duchy of Swabia.

The duchy of Swabia was ruled by the Hohenstaufen family until the death of Conradin in 1268, when a considerable part of it fell to the count of Württemberg, the representative of a family first mentioned about 1080, a certain Conrad von Beutelsbach, having called himself after his ancestral castle of Württemberg. The earliest count about whom anything is known is Ulrich, who ruled from 1241 to 1265. Under his sons, Ulrich II. and Eberhard I., and their successors the power of the family grew steadily. Eberhard (d. 1325) doubled the area of his county and transferred his residence from Württemberg to Stuttgart. His successors all added something to the area of Württemberg. The lands of the family were several times divided, but in 1482 they were declared indivisible and were united under Count Eberhard V. In 1495 the county was raised to the rank of duchy.

The long reign (1498–1550) of Duke Ulrich I., who succeeded to the duchy while he was still only a child, was a most eventful period for the country. His extortions excited a rising known as that of the *arme Konrad* (poor Conrad) and in 1514 by the treaty of Tübingen the people undertook to pay the duke's debts in return for various political privileges, which in effect laid the foundation of the constitutional liberties of the country. A few years later Ulrich quarrelled with the Swabian league, and its forces expelled him and sold his duchy to the Emperor Charles V. Charles handed over Württemberg to his brother, the German king, Ferdinand I., but discontent caused by the oppressive Austrian rule, disturbances in Germany leading to the Peasants' War and commotions aroused by the Reformation gave Ulrich an opportunity to recover it. Aided by Philip, landgrave of Hesse, and other Protestant princes, he fought a victorious battle against Ferdinand's troops at Lauffen in May 1534, and then by the treaty of Cadan he was again recognized as duke, but was forced to accept his duchy as an Austrian fief. He now introduced the reformed doctrines and proceeded to endow Protestant churches and schools throughout his land. Ulrich's connection with the league of Schmalkalden led to another expulsion, but in 1547 he was reinstated by Charles V., although on somewhat onerous terms.

Ulrich's son and successor, Christopher (1515–68), completed the work of converting his subjects to the reformed faith. He introduced the system of church government known as the *Grosse Kirchenordnung*. Frederick I. (1557–1608) by paying a large sum of money, induced the emperor Rudolph II. in 1599 to free the duchy from the suzerainty of Austria. Thus once again Württemberg became a direct fief of the empire. Under the reign of the next duke, John Frederick (1582–1628), Württemberg suffered severely from the Thirty Years' War. His son and successor Eberhard III. (1614–74) plunged into the war as an ally of France and Sweden in 1633, but after the battle of Nördlingen in 1634 the duchy was occupied by the imperialists and he himself was for some years an exile. He was restored by the peace of Westphalia to a depopulated and impoverished country. During the reign of Eberhard IV. (1676–1733), Württemberg suffered from French invasions.

Alexander, who became duke in 1733, embraced the Roman Catholic faith. His favourite adviser was the Jew Süss Oppenheimer, and it was thought that master and servant were aiming at the suppression of the diet and the introduction of the Roman Catholic religion. The sudden death of Charles Alexander in March 1737 put an abrupt end to these plans, and the regent, Charles Rudolph, had Oppenheimer hanged.

Frederick Eugene (d. 1797) educated his children in the Protestant faith. Thus when his son Frederick II. became duke in 1797, the ruler of Württemberg was again a Protestant and the royal house adhered to this faith since that date. During Frederick Eugene's short reign the French invaded Württemberg, compelled the duke to withdraw his troops from the imperial army and to pay a sum of money.

French Wars.—Frederick II. (1754–1816) took part in the

war against France against the wishes of his people, and when the French again invaded and devastated the country he retired to Erlangen, where he remained until after the conclusion of the peace of Lunéville in 1801. By a private treaty with France (March 1802) he ceded his possessions on the left bank of the Rhine, receiving in return nine imperial towns, among them Reutlingen and Heilbronn, and some other territories, amounting altogether to about 850 sq.mi. and containing about 124,000 inhabitants. He also accepted from Napoleon the title of elector. In 1805 Württemberg took up arms on the side of France, and by the peace of Pressburg in Dec. 1805 the elector was rewarded with various Austrian possessions in Swabia and with other lands in the neighbourhood. On Jan. 1, 1806, Frederick assumed the title of king and abrogated the constitution.

In 1806 he joined the Confederation of the Rhine and received further additions of territory containing 160,000 inhabitants; a little later, by the peace of Vienna in Oct. 1809, about 110,000 more persons were placed under his rule. In return for these favours Frederick joined Napoleon in his campaigns against Prussia, Austria and Russia. After the battle of Leipzig he deserted the French emperor, and by a treaty made with Metternich at Fulda in Nov. 1813 secured the confirmation of his royal title and of his recent acquisitions of territory, while his troops marched with those of the allies into France. In 1815 the king joined the Germanic Confederation. He died on Oct. 30, 1816.

The new king, William I, granted a new constitution in Sept. 1819. A democratic constitution, proclaimed during the revolution of 1848, was abrogated as soon as the movement had spent its force and the constitution of 1819 was restored.

Charles I. (1823–1891) succeeded his father William as king in July 1864. In 1866 Württemberg took up arms on behalf of Austria, but three weeks after the battle of Königgrätz its troops were decisively beaten at Tauberbischofsheim, and the country was at the mercy of Prussia. The Prussians occupied the northern part of Württemberg and peace was made in Aug. 1866; Württemberg paid an indemnity of 8,000,000 gulden and concluded a secret offensive and defensive treaty with Austria's conqueror.

On the outbreak of the Franco-Prussian War in 1870 its troops took a creditable part in the battle of Wörth and in other operations of the war. In 1871 Württemberg became a member of the new German empire, but retained control of its own post office, telegraphs and railways. It had also certain special privileges with regard to taxation and the army. On Oct. 6, 1891, King Charles died suddenly, and was succeeded by his cousin William II (b. 1848), who continued the policy of his predecessor. The reform of the constitution continued to be discussed, and the election of 1895 was memorable because of the return of a powerful party of democrats.

Later Politics.—Between 1900 and 1910 the political history of Württemberg centred round the settlement of the constitutional question. The constitution was revised in 1906. No further changes were made until Oct. 1918, when the Weizsäcker ministry, which held office during World War I, resigned, and revolution broke out on Nov. 9. For two days the direction of affairs was exclusively in Socialist hands, but on Nov. 11 a coalition was formed, from which the Spartacists were excluded, and representatives of the bourgeois parties admitted. The king abdicated on Nov. 30. The Spartacist rising of Jan. 1919, had its echo in Württemberg chiefly in the form of industrial disturbances, after which the Independent Social Democrats left the ministry. A new republican constitution was adopted in 1919, but this (*see* above) was superseded in 1933 by a national socialist regime.

Owing to the relatively happy economic balance in Württemberg between agriculture and industry, the country suffered less from the economic crisis after World War I, and was less afflicted with violent partisan politics than were most other parts of Germany.

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WURTZ, CHARLES ADOLPHE (1817–1884), French chemist, was born at Wolfisheim, near Strasbourg, on Nov. 26, 1817. When he left the Protestant gymnasium at Strasbourg in 1834 his father wished him to study theology, he wished to become a chemist, so medicine was the compromise. In 1839 he was appointed "Chef des travaux chimiques" at the Strasbourg faculty of medicine. In 1842 he studied at Giessen under Justus von Liebig (*q.v.*). He graduated in medicine in 1843, and then worked in Caillot's laboratory. He went to Paris in 1844 and after a period, under Balard, in 1845 he became assistant to J. B. A. Dumas (*q.v.*) at the Ecole de Médecine. In 1849 he lectured on organic chemistry. In 1852 Wurtz was appointed to the combined chairs of organic chemistry and of mineral chemistry and toxicology at the faculty of medicine as successor to Dumas. In 1875 he became the first occupant of the chair of organic chemistry which he had induced the government to establish at the Sorbonne. He died in Paris on May 12, 1884. He was buried in Pere-Lachaise cemetery.

Wurtz's first published paper was on hypophosphorous acid (1842), and the continuation of his work on the acids of phosphorus (1845) resulted in the discovery of phosphorus oxychloride, as well as of copper hydride. His original work was mainly in the domain of organic chemistry. Investigation of the alkyl isocyanates (1848) led him to the discovery of the amines (1849), and later (1851) the compound ureas. In 1855 he showed that the combination between two hydrocarbon radicles could be brought about by the action of sodium on the alkyl iodides; this important reaction is known by his name. Electrolysis of mixed salts of aliphatic acids produced new radicles both simple and mixed. About the same time he reached the conclusion that glycerol is a body of alcoholic nature formed on the type of three molecules of water, as common alcohol is on that of one, and was thus led (1856) to the study of the glycols, bodies similarly related to the double water type. The name indicates the relation to both glycerol and alcohol. The oxidation of the glycols led him to homologues of lactic acid, and a controversy about the constitution of the latter with A. W. H. Kolbe (*q.v.*) resulted in a better understanding of the relations between the hydroxy- and the amino-acids. He was the first to teach Charles F. Gerhardt's (*q.v.*) views in France. In 1867 Wurtz prepared neurine synthetically by the action of trimethylamine on glycol-chlorhydrin. In 1872 he discovered aldol, pointing out its double character as at once an alcohol and an aldehyde. He discovered the aldol condensation. In addition reference may be made to his work, published from 1865 onward, on abnormal vapour densities. While on the olefines he noticed that a change takes place in the density of the vapour of amylene hydrochloride, hydrobromide, etc., as the temperature is increased, and in this he saw a powerful argument in favour of the view that abnormal vapour densities, such as are exhibited by ammonium chloride or phosphorus pentachloride, are to be explained by dissociation.

From 1852–72 Wurtz published in the *Annales de chimie et de physique* abstracts of chemical work done out of France. After 1868 he was one of the editors of this important journal. He was the author of the official report of the famous international chemical congress at Karlsruhe in 1860. The publication of his great *Dictionnaire de chimie pure et appliquée*, in which he was assisted by many other French chemists, was begun in 1869 and finished in 1878; two supplementary volumes were issued 1880–86, and a second supplement was completed in 1908. His introductory statement "Chemistry is a French science, founded by Lavoisier of immortal memory" aroused violent contention. He later regretted this unfortunate phrase.

Among his books are *Chimie médicale* (1864), *Leçons de philosophie chimique* (1864). *Leçons élémentaires de chimie moderne, La Théorie atomique* (1879), *Progrès de l'industrie des matières colorantes artificielles* (1876) and *Traité de chimie biologique* (1880–85).

For his life and work, with a list of his publications, *see* Charles Friedel's memoir in the *Bulletin de la Société Chimique* (1885); also A. W. von Hofmann in the *Ber. deut. chem. Ges.* (1887), reprinted in vol. iii of his *Zur Erinnerung an vorangegangene Freunde* (1888); G. Bugge, in *Das Buch der grossen chemiker* (1930); G. Urbain, *Bulletin de la societé chimique de France* (1934).

WÜRZBURG, a university town and episcopal see of Bavaria, Germany, capital of the province of Lower Franconia, situated on the Main, 60 mi. by rail S.E. from Frankfort and at the junction of main lines to Bamberg and Nürnberg. Pop. (1939) 108,617. The site of the Leistenberg was occupied by a Roman fort, and was probably fortified early in the 13th century. *Wircebirgum* is the old Latin form of the name of the town; *Herbipolis* (herb town) first appears in the 12th century. The bishopric was probably founded in 741, but the town appears to have existed in the previous century. About the 12th century the bishops had ducal authority in Eastern Franconia. Quarrels broke out between the bishops and the citizens, and, after long struggles, the citizens submitted in 1400. Several imperial diets were held in Würzburg,

chief among these being the one of 1180 when Henry the Lion was placed under the ban. By the peace of Lunéville the bishopric was secularized, and in 1803 Würzburg passed to Bavaria. The peace of Pressburg in 1805 transferred it to Ferdinand, formerly grand-duke of Tuscany, who joined the confederation of the Rhine and took the title of grand-duke of Würzburg. In 1815 the congress of Vienna restored Würzburg to Bavaria. The bishopric of Würzburg at one time embraced an area of about 1,900 sq.m. and had about 250,000 inhabitants. A new bishopric of Würzburg was created in 1817.

An ancient stone bridge (1474–1607), 650 ft. long and adorned with statues of saints, and two modern bridges connect the two parts of the town on each side of the river. On the Leistenberg stands the fortress of Marienberg, which from 1261 to 1720 was the residence of the bishops. Many of the houses are interesting specimens of mediaeval architecture; and the numerous old churches recall the fact that it was long the capital of an ecclesiastical principality. The principal church is the imposing Romanesque cathedral, a basilica with transepts, begun in 1042 and consecrated in 1189. The four towers, however, date from 1240, the (rococo) façade from 1711–19, and the dome from 1731. The transepts terminate in apses. The exterior was restored in 1882–83. Other interesting buildings are the Marienkapelle, the Haugerstifts church, the Neumünster church, the church of St. Burkhard, the palace, formerly the residence of the bishops and grand-dukes of Würzburg, and the Julius hospital, and the town hall dates in part from 1456. Walter von der Vogelweide is buried in the cloisters adjoining the Neumünster church.

A university was founded at Würzburg in 1403, but it only existed for a few years. The present university was founded by Bishop Julius in 1582. Here W. K. Röntgen discovered the "Röntgen rays" in 1896. Würzburg was long the Jesuit stronghold in Germany, and the Roman Catholic theological faculty attracted large numbers. The university in 1938 had about 150 on its teaching staff and was attended by 1,500 students.

Würzburg is surrounded by vineyards, which yield some of the best wine in Germany. Its principal industries are the manufacture of tobacco, furniture, machinery, scientific instruments and railway carriages. It has also breweries, and produces bricks, marmalade, pianos, sugar, malt and chocolate.

See S. Göbl, *Würzburg, Ein Kulturhistorisches Städtebild* (Würzburg, 1896); F. X. von Wegele, *Geschichte der Universität Würzburg*, (Würzburg, 1882); *Geschichte des Bischofstums Würzburg* (Würzburg, 1899–1901).

WURZEN, a town of Germany in the *Land* of Saxony, on the Mulde, 15½ mi. by rail E. of Leipzig on the main line (via Riesa) to Dresden. Pop. (1939) 19,755. Wurzen was founded by the Sorbs, and was a town early in the 12th century, when the bishop of Meissen founded a monastery here. In 1581 it passed to the elector of Saxony. It has a cathedral dating from the 12th century and a castle, at one time a residence of the bishops of Meissen and now utilized as law courts.

WYANDOTTE, a city of Wayne county, Michigan, U.S.A., on the Detroit river and the Dixie highway, 8 m. S. by W. of Detroit. It is served by the Detroit and Toledo Shore line, the Detroit, Toledo and Ironton, the Michigan Central and the New York Central railways. The population was 13,851 in 1920 (29% foreign-born white), 28,368 in 1930, 30,618 in 1940, by federal census. Beneath the city, from 790 to 1,200 ft. deep, lie four vast salt beds (from 25 to 90 ft. thick) containing originally more than 400,000,000 tons. Limestone also is abundant. Chemical plants which convert the salt into soda ash, caustic soda, bicarbonate of soda, and other products, and make bleaching powders out of the limestone, are the city's principal manufacturing industries. Many of the passenger boats plying the Great Lakes were built in the Wyandotte shipyards. Wyandotte was settled in 1820, incorporated as a village in 1854, and as a city in 1866.

WYANDOTTE CAVE, a cave in Crawford county, southern Indiana, U.S.A., 38° 14′ N. lat. and 86° 18′ W. longitude. It is but one of the many caves of southern Indiana dissolved and eroded in the relatively pure, massive, horizontally bedded Mississippian limestones that extend southward into the cave-bearing regions of Kentucky and Tennessee. Like Mammoth cave of Kentucky, Wyandotte cave owes its early history tc the demand for nitre for gunpowder in the War of 1812, the nitrate industry beginning in that year and terminating in 1817. The environs of the mouth of the cave afford a scene of sedate quiet, the narrow valley of the Blue river stretching across from the entrance to Greenbrier mountain, with its sharp conical crest and steep slopes, belted with massive cliffs of rock and set with tapering cedars. The entrance is about 200 ft. above Blue river. The cave has been as accurately mapped as cave conditions permit, but the aggregate length of its passages can only be estimated, for some have not been explored; the total probably exceeds 25 miles. The "old cave" constitutes that portion of the cave discovered before 1850. In that year the new cave was discovered, a long extension with many passages and chambers that add materially to the beauty and interest of the cave. The mouth of the old cave is 20 ft. wide and 6 ft. high. One hundred feet within the entrance the gallery widens into a spacious corridor known as Faneuil Hall, whence issues the Columbian Arch, a semi-cylindrical tunnel 75 ft. long, which in turn opens into Washington Avenue, a grand passageway, 275 ft. long, 30 ft. wide, and 40 ft. high. This passage terminates in a low gallery which expands into Banditti Hall, the common entry into both the old and new caves. The old cave ends in the Senate Chamber, an imposing rotunda like, but not quite so large as, Rothrock's cathedral with its magnificent Wallace's Grand Dome rising above Monument mountain, beyond Rothrock's Straits in the new cave.

The Senate Chamber, one of the most picturesque features of Wyandotte cave, is a vast elliptical amphitheatre, 145 ft. long and 56 ft. wide, converging upward to a gigantic dome. In the centre of the chamber a mass of fallen rock constitutes Capitol Hill, 32 ft. high, out of the centre of which rises the grandest spectacle of the cave—the massive, fluted column of satin-spar, or calcite, known as the "Pillar of the Constitution." Quite cylindrical, 25 ft. in diameter, this majestic column of spectral white calcite extends from the peak of Capitol Hill to the centre of the dome far above. Tiny streamlets of water trickle down its fluted sides, evaporating and leaving their burdens of calcium carbonate crystallized upon the ever-growing column. A relatively sparse cave fauna and a few evidences of Indian activity are found in the cave. The temperature of the cave is uniformly 53° F and the air is sweet and pure.

See list of 22 titles referring to Wyandotte and other Indiana caves given on pp. 210–212, of the 21st *Annual Report* of the Department of Geology and Natural Resources of Indiana (1896). (W. E. E.)

WYANT, ALEXANDER H. (1836–1892), American artist, was born at Port Washington (O.), on Jan. 11, 1836. He was a pupil of Hans Gude in Carlsruhe, Germany. A trip with a government exploring expedition in the west of America undermined his health and he painted mainly in the high altitudes of the Adirondack mountains. He was elected a full member of the National Academy of Design, New York, in 1869 and died in New York city on Nov. 29, 1892. His fame was deferred until after his death.

WYAT, SIR THOMAS (1503–1542), English poet and statesman, elder son of Henry Wyat, or Wiat, afterwards knighted, and his wife Anne, daughter of John Skinner of Reigate, Surrey, was born at Allington Castle, near Maidstone, Kent, in 1503. His father (1460–1537) belonged to a Yorkshire family, but bought Allington about 1493. He was an adherent of the Lancastrian party, and was imprisoned and put to the torture by Richard III. The family records (in the possession of the earl of Romney) relate that during his imprisonment he was saved from starvation by a cat that brought him pigeons. At the accession of Henry VII. he became knight of the Bath (1509), knight banneret (1513) and held various offices at court. His son, Thomas Wyat, was admitted at St. John's College, Cambridge, when about twelve years of age, took his B.A. degree in 1518, and proceeded M.A. in 1522. An early marriage with Elizabeth Brooke, daughter of Lord Cobham, proved unhappy, for a letter from the Spanish ambassador Chapuys to Charles V. (Feb. 9, 1542) speaks of her having been repudiated by her

husband. As early as 1516 Wyat was server extraordinary to the king, and in 1524 he was at court as keeper of the king's jewels. He was one of the champions in the Christmas tournament of 1525. His father had been associated with Sir Thomas Boleyn as constable of Norwich Castle, and he had thus been early acquainted with Anne Boleyn. He appears to have been generally regarded as her lover. He was employed on missions to Francis I. (1526), to the papal court (1527), and from Rome was sent to Venice. From 1528 to 1530 he was acting as high marshal at Calais.

During the following years he was constantly employed in Henry's service, and was apparently high in his favour. He was, however, sent to the Tower in 1536, perhaps because it was desired that he should incriminate the queen. His father's correspondence with Cromwell does not suggest that his arrest had anything to do with the proceedings against Anne Boleyn, but the connection is assumed (*Letters and Papers of Henry VIII.* vol. x. No. 919) in the letters of John Hussey to Lord Lisle, deputy of Calais. Nicholas Harpsfield makes a circumstantial statement (*Pretended Divorce . . .* Camden Soc. p. 253) that Wyat had confessed his intimacy with Anne to Henry VIII. and warned him against marrying her; but this, in view of his continued favour, seems highly improbable. He was released after a month's imprisonment, and in the autumn of that year took part in the suppression of the Lincolnshire rising. In March 1537 he was knighted, and a month later was sent abroad as ambassador to Charles V. In 1538 he was joined by Edmund Bonner, then a simple priest, who wrote to Cromwell (2nd Sept. 1538) a long letter (Petyt MS. 47, Middle Temple; first printed in the *Gentleman's Magazine,* June 1850) in which he accused Wyat of disloyalty to the king's interests, and of many personal slights to himself. So long as Cromwell ruled no notice was taken of Bonner's allegations. He was recalled in April 1539, but later in the same year he was employed on another embassy to the emperor. After Cromwell's death Wyat's enemies renewed their attacks, and he was imprisoned (Jan. 17, 1541) in the Tower on the old charges, with the additional accusation of treasonable correspondence with Cardinal Reginald Pole. He was released at the intercession of the queen, Catherine Howard, on condition that he confessed his guilt and took back his wife, from whom he had been separated for fifteen years, on pain of death if he were thenceforth untrue to her (*see* Chapuys to Charles V., March 1541). He received a formal pardon on March 21, and received during the year substantial marks of the king's favour. In the summer of the next year he was sent to Falmouth to meet the ambassadors of the emperor. The heat brought on a fever to which he succumbed at Sherborne, Dorset, on Oct. 11. A Latin elegy on his death was written by his friend John Leland, "Naenia in mortem Thomae Viati equitis incomparabilis"; and Henry Howard, earl of Surrey, celebrated his memory in some well-known lines beginning "Wyat resteth here, that quick could never rest," and in two sonnets.

Wyat's work falls readily into two divisions: the sonnets, rondeaus, and lyric poems dealing with love; and the satires and the version of the penitential psalms. The love poems probably date from before his first imprisonment. A large number were published in 1557 in *Songes and Sonettes* (*Tottel's Miscellany*). Wyat's contributions number 96 out of a total of 310. These have been supplemented from mss. He was the pioneer of the sonnet in England. Wyat wrote in all thirty-one sonnets, ten of which are direct translations of Petrarch. The sentiment is strained and artificial. Wyat shows to greater advantage in his lyrical metres, in his epigrams and songs, especially in those written for music[1], where he is less hampered by the conventions of the Petrarchan tradition, to which his singularly robust and frank nature was ill-fitted. Wyat wrote three excellent satires—"On the mean and sure estate," dedicated to John Poins, "Of the Courtier's Life," to the same, and "How to use the court and himself." They are written in *terza rima* and in form and matter owe much to Luigi Alamanni. In the "Penitential Psalms" each is preceded by a prologue describing the circumstances under which the psalmist wrote, and the psalms themselves are very freely paraphrased, with much original matter from the author. They were published in 1549 by Thomas Raynald and John Harrington as *Certayne Psalmes . . . drawen into English meter by Sir Thomas Wyat Knyght.*

[1]One of the most musical of the pieces printed in his works, however, "The Lover complayneth the unkindnes of his Love," beginning "My lute, awake," is sometimes attributed to George Boleyn, Lord Rochford (*see* E. Bapst, *Deux Gentilshommes poètes de la cour de Henri VIII.*, p. 142).

None of Wyat's other poems were printed until fifteen years after his death, in *Songes and Sonettes.* There are editions of his *Works* by G. F. Nott (1816); of the *Songes and Sonnettes* by E. Arber (1870); and of the *Poems* (2 vols.) by A. K. Foxwell (1913). *See* A. K. Foxwell, *Study of Wyat's Poems* (1911). *See* also Brewer and Gardiner, *Letters and Papers of Henry VIII.* (especially from 1534 to 1542).

WYAT, SIR THOMAS (The Younger) (d. 1554), English conspirator, son of the preceding, was over 21 in 1543, but the date of his birth is uncertain. He is said to have accompanied his father on his mission to Spain, and to have been turned into an enemy of the Spaniards by the menaces of the Inquisition. In 1542 he inherited the family property of Allington castle and Boxley abbey on the death of his father.

In 1554 he joined with the conspirators who combined to prevent the marriage of Queen Mary with Philip, the prince of Spain. On January 22, 1554, he summoned a meeting of his friends at his castle of Allington, and the 25th was fixed for the rising. On the 26th Wyat occupied Rochester, and issued a proclamation to the county. Lord Abergavenny and Sir Robert Southwell, the sheriff of Kent, were deserted by their men, who either disbanded or went over to Wyat. A detachment of the London train-bands sent against him by Queen Mary, under the command of the duke of Norfolk, followed their example. The rising now seemed so formidable that a deputation was sent to Wyat by the queen and council to ask his terms. He insisted that the Tower should be surrendered to him, and the queen put under his charge. The insolence of these demands caused a reaction in London, where the reformers were strong and were at first in sympathy with him. When he reached Southwark on Feb. 3, he found London Bridge occupied in force, and was unable to penetrate into the city. He was driven from Southwark by the threats of Sir John Brydges (or Bruges), afterwards Lord Chandos, who was prepared to fire on the suburb with the guns of the Tower. Wyat now marched up the river to Kingston, where he crossed the Thames, and made his way to Ludgate with a part of his following. Some of his men were cut off. Others lost heart and deserted. His only hope was that a rising would take place, but the loyal forces kept order, and after attempting to force the gate Wyat surrendered.

He was brought to trial on March 15, and could make no defence. Execution was delayed, in the hope that in order to save his life he would compromise the queen's sister, the Princess Elizabeth. He was executed on April 11, and on the scaffold expressly cleared the princess of all complicity in the rising. His estates were afterwards partly restored to his son George, the father of the Sir Francis Wyat (d. 1644) who was governor of Virginia in 1621–26 and 1639–42.

See G. F. Nott, *Works of Surrey and of Sir Thomas Wyat* (1815); and Froude, *History of England.*

WYCHERLEY, WILLIAM (*c.* 1640–1716), English dramatist, was born about 1640 at Clive, near Shrewsbury, where for several generations his family had been settled on a moderate estate of about £600 a year. Like Vanbrugh, Wycherley spent his early years in France, whither, at the age of fifteen, he was sent to be educated in the very heart of the "precious" circle of Mme. de Montausier, on the banks of the Charente. This lady effected the first of his successive conversions from Protestantism to Catholicism. Later at Oxford, Bishop Barlow reclaimed him, and under James II. he returned to Catholicism once more. In fact, the deity he worshipped was the deity of the "polite world" of his time—gentility. Moreover, as a professional fine gentleman, at a period when, as the genial Major Pack says, "the amours of Britain would furnish as diverting memoirs, if well related, as those of France published by Rabutin, or those of Nero's court writ by Petronius," Wycherley was obliged to be a loose liver.

As a fellow-commoner of Queen's College, Oxford, Wycherley lived (according to Wood) in the provost's lodgings, being entered as "Philosophiae Studiosus" in July 1660. And he does not seem to have matriculated or to have taken a degree. He left Oxford and settled in the Inner Temple; but not, naturally, to engage seriously in the study of the law. Pleasure and the stage were alone open to him, and probably early in 1671 was produced, at the Theatre Royal, *Love in a Wood.* It was published the next year. With regard to this comedy Wycherley told Pope that he wrote it the year before he went to Oxford. But we need not believe him: the worst witness against a man is mostly himself. To pose as the wicked boy of genius has been the foolish ambition of many writers, but on inquiry it will generally be found that these inkhorn Lotharios are not nearly so wicked as they would have us believe. It is not so much that, as Macaulay insists, "the whole air and spirit of the piece belong to a period subsequent to that mentioned by Wycherley," but that "the whole air and spirit of the piece" belong to a man—an experienced and hardened young man of the world—and not to a boy who would fain pose as an experienced and hardened young man of the world. The real defence of Wycherley against his foolish impeachment of himself is this, that *Love in a Wood,* howsoever inferior in structure and in all the artistic economies to *The Country Wife* and *The Plain Dealer,* contains scenes which, not for moral hardness merely, but often for real dramatic ripeness, are almost the strongest to be found amongst his four plays. The play was dedicated to Charles II.'s mistress, the duchess of Cleveland, whose favours Wycherley forthwith enjoyed. His fortune as a dramatist was made. Voltaire (in his *Letters on the English Nation*) has a picturesque description of the duchess's visits to Wycherley's chambers in the Temple.

Whether Wycherley's experiences as a naval officer, which he alludes to in his lines "On a Sea Fight which the Author was in betwixt the English and the Dutch," occurred before or after the production of *Love in a Wood* is a point upon which opinions differ, but on the whole we are inclined to agree with Macaulay, against Leigh Hunt, that these experiences took place not only after the production of *Love in a Wood* but after the production of *The Gentleman Dancing Master,* in 1673. We also think, with Macaulay, that he went to sea simply because it was the "polite" thing to do so—simply because, as he says in the epilogue to *The Gentleman Dancing Master* "all gentlemen must pack to sea."

This second comedy was published in 1673, but was probably acted late in 1671. It is inferior to *Love in a Wood.* In *The Relapse* the artistic mistake of blending comedy and farce damages a splendid play, but leaves it a splendid play still. In *The Gentleman Dancing Master* this mingling of discordant elements destroys a play that would never in any circumstances have been strong—a play nevertheless which abounds in animal spirits, and is luminous here and there with true dramatic points.

It is, however, on his two last comedies—*The Country Wife* and *The Plain Dealer*—that must rest Wycherley's fame as a master of that comedy of repartee which, inaugurated by Etheredge, and afterwards brought to perfection by Congreve and Vanbrugh, supplanted the humoristic comedy of the Elizabethans. *The Country Wife,* produced in 1672 or 1673 and published in 1675, is so full of wit, ingenuity, animal spirits and conventional humour that, had it not been for its motive, it would probably have survived as long as the acted drama remained a literary form in England. So strong, indeed, is the hand that could draw such a character as Marjory Pinchwife (the undoubted original not only of Congreve's Miss Prue but of Vanbrugh's Hoyden), such a character as Sparkish (the undoubted original of Congreve's Tattle), such a character as Horner (the undoubted original of all those cool impudent rakes with whom our stage has since been familiar), that Wycherley is certainly entitled to a place alongside Congreve and Vanbrugh.

Scarcely inferior to *The Country Wife* is *The Plain Dealer,* produced probably early in 1674 and published three years later,—a play of which Voltaire said, "Je ne connais point de comédie chez les anciens ni chez les moderns où il y ait autant d'esprit." This comedy had an immense influence, as regards manipulation of dialogue, upon all subsequent English comedies of repartee, and he who wants to trace the ancestry of Tony Lumpkin and Mrs. Hardcastle has only to turn to Jerry Blackacre and his mother, while Manly (for whom Wycherley's early patron, the duke of Montausier, sat), though he is perhaps overdone, has dominated this kind of stage character ever since.

It was after the success of *The Plain Dealer* that the turning-point came in Wycherley's career. The great dream of all the men about town in Charles's time, as Wycherley's plays all show, was to marry a widow, young and handsome, a peer's daughter if possible—but in any event rich, and spend her money upon wine and women. While talking to a friend in a bookseller's shop at Tunbridge, Wycherley heard *The Plain Dealer* asked for by a lady who, in the person of the countess of Drogheda, answered all the requirements. An introduction ensued, then love-making, then marriage—a secret marriage, probably in 1680, for, fearing to lose the king's patronage and the income therefrom, Wycherley still thought it politic to pass as a bachelor. But the news reached the royal ear, and Wycherley lost the royal favour for ever. He never had an opportunity of regaining it, for the countess seems to have really loved him, and *Love in a Wood* had proclaimed the writer to be the kind of husband whose virtue prospers best when closely guarded at the domestic hearth. Wherever he went the countess followed him, and when she did allow him to meet his boon companions it was in a tavern in Bow Street opposite to his own house, and even there under certain protective conditions. In summer or in winter he was obliged to sit with the window open and the blinds up, so that his wife might see that the party included no member of a sex for which her husband's plays had advertised his partiality. She died, however, in the year after her marriage and left him the whole of her fortune. But the title to the property was disputed; the costs of the litigation were heavy—so heavy that his father was unable (or else he was unwilling) to come to his aid; and the result of his marrying the rich, beautiful and titled widow was that the poet was thrown into the Fleet prison. There he remained for seven years, being finally released by the liberality of James II.—a liberality which, incredible as it seems, is too well authenticated to be challenged. James had been so much gratified by seeing *The Plain Dealer* acted that, finding a parallel between Manly's "manliness" and his own, such as no spectator had before discovered, he paid off Wycherley's execution creditor and settled on him a pension of £200 a year. Other debts still troubled Wycherley, however, and he never was released from his embarrassments, not even after succeeding to a life estate in the family property. In coming to Wycherley's death, we come to the worst allegation that has ever been made against him as a man and as a gentleman. At the age of seventy-five he married a young girl, and is said to have done so in order to spite his nephew, the next in succession.

Wycherley wrote verses, and, when quite an old man, prepared them for the press by the aid of Alexander Pope, then not much more than a boy. But, notwithstanding all Pope's tinkering, they remain contemptible. Pope's published correspondence with the dramatist was probably edited by him with a view to giving an impression of his own precocity. The friendship between the two cooled, according to Pope's account, because Wycherley took offence at the numerous corrections on his verses. It seems more likely that Wycherley discovered that Pope, while still professing friendship and admiration, satirized his friend in the *Essay on Criticism.* Wycherley died on Jan. 1, 1716, and was buried in the vault of the church in Covent Garden.

Wycherley's complete works were edited by M. Summers in 4 vols. (Nonesuch Press, 1924). *See* C. Perromat, *William Wycherley, sa vie, son oeuvre* (1921). (T. W.-D.; X.)

WYCLIFFE (or WYCLIF), **JOHN** (*c.* 1320–1384), English reformer, was born, according to John Leland, at Ipreswel (evidently Hipswell), in Yorkshire[1]. The Wycliffes were connected

[1]The form of spelling of the name Wycliffe adopted in this article is that of the village Wycliffe-on-Tees, from which Leland says that he "drew his origin" (*Collectanea* ii. 329); it is also preferred by the editors of the Wycliffe Bible, by Milman and by Stubbs. "Wyclif" has the support of Shirley, of T. Arnold and of the Wyclif Society; while "Wiclif" is the popular form in Germany.

with Balliol College, Oxford, which had been founded by their neighbours, the Balliols of Barnard Castle; John Wycliffe went there, and some time after 1356 was elected master. Confusion with contemporaries makes it not easy to trace his Oxford life; it has been said that he was a fellow of Merton College in 1356. In 1361 he accepted the living of Fillingham in Lincolnshire. In the same year a "John de Wyclif of the diocese of York, M.A." was a suppliant to the Roman Curia for a provision to a prebend, canonry and dignity at York (*Cal. of Entries in the Papal Registries,* ed. Bliss, Petitions, i. 390). This was not granted, but Wycliffe received instead the prebend of Aust in the collegiate church of Westbury-on-Trym. In 1365 one "John de Wyclif" was appointed by Simon Islip, archbishop of Canterbury, to the wardenship of Canterbury Hall, which the archbishop founded for a mixed body of monks and secular clergy, and then filled exclusively with the latter. In 1367, his successor, Simon Langham, replaced the intruded seculars by monks. The displaced warden and fellows appealed to Rome, and in 1371 judgment was given against them. The question of the identity of the warden of Canterbury Hall with the reformer is still a matter of dispute. It may have been referred to by Wycliffe himself (*De ecclesia,* cap. xvi. pp. 370 *sq.*), and was assumed by the contemporary monk of St. Albans (*Chron. Angl.* "Rolls" ser. p. 115) and by Wycliffe's opponent William Woodford (*Fasc. Zizan.* p. 517), who found in Wycliffe's resentment at this treatment the motive for his attacks on the religious orders; it has likewise been assumed by a series of modern scholars, including Loserth (*Realencyklopädie,* 1908 ed., vol. xxi. p. 228, § 35), who only denies the deductions that Woodford drew from it. Dr. Rashdall, following Shirley, brings evidence to show that the Wycliffe of Canterbury Hall was the same person as the fellow of Merton, this being the strongest argument against the identification of the latter with the reformer.

Long before Wycliffe had become a power outside Oxford his fame was established in the university. He was acknowledged supreme in the philosophical disputations of the schools, and his lectures were crowded, but it was not until he was drawn into the arena of the politico-ecclesiastical conflicts of the day that Wycliffe became of world-importance. It has been assumed that this happened first in 1366, and that Wycliffe published his *Determinatio quaedam de dominio* supporting parliament in refusing the tribute demanded by Pope Urban V.; but Loserth has shown that this work must be assigned to a date some eight years later. Wycliffe, in fact, for some years to come had the reputation of a good "curialist." Had it been otherwise, the pope would scarcely have granted him (January 1373) a license to keep his Westbury prebend even after he should have obtained one at Lincoln (*Cal. Papal Letters,* ed. Bliss and Twemlow, iv. 193). Moreover, it is uniformly asserted that Wycliffe fell into heresy after his admission to the degree of doctor (*Fasc. Ziz.* p. 2), and the papal document above quoted shows that he had only just become a doctor of theology, that is in 1372.

But Wycliffe's tendencies may already have called attention to him in high places as a possibly useful instrument for the anti-papal policy of John of Gaunt and his party. On the 7th of April 1374, he was presented by the crown to the rectory of Lutterworth in Leicestershire, which he held until his death; and on the 26th of July he was nominated one of the royal envoys to Bruges to confer with the papal representatives on the long vexed question of "provisions" (*q.v.*). He may have been attached to this mission as theologian—a proof that he was not yet considered a *persona ingrata* at the Curia. His name stands second, next after that of the bishop of Bangor, and he was paid at the princely rate of twenty shillings a day. The commission was appointed because of repeated complaints from the Commons; but the king was interested in keeping up the papal system of provisions and reservations, and the negotiations were practically fruitless.

After his return Wycliffe lived chiefly at Lutterworth and Oxford, making prolonged visits to London, where his fame as a popular preacher was established. It is from this period that dates the development of his systematic attack on the established order in the church. It was not at first the dogmatic, but the political elements in the papal system that provoked his censure. The negotiations at Bruges had strengthened his sympathy with the anti-curial tendencies in English politics from Edward I.'s time onwards, and a final impulse was given by the attitude of the "Good Parliament" in 1376; in the autumn of that year he was reading his treatise on civil lordship (*De civili dominio*) to his students at Oxford. Of its propositions some, according to Loserth, were taken bodily from the 140 titles of the bill dealing with ecclesiastical abuses introduced in the parliament; but it may perhaps be that Wycliffe inspired the bill rather than the bill Wycliffe. For the first time he now publicly proclaimed the doctrine that righteousness is the sole indefeasible title to dominion and to property, that an unrighteous clergy has no such title, and that the decision as to whether or no the property of ecclesiastics should be taken away rests with the civil power.

If the position at which Wycliffe had now arrived was originally inspired, as Loserth asserts, by his sympathy with the legislation of Edward I., *i.e.,* by political rather than theological considerations, the necessity for giving to it a philosophical and religious basis led him to criticism of the doctrinal standpoint of the church. As a philosopher Wycliffe was no more than the last of the conspicuous Oxford scholastics, and his philosophy is important in so far as it determined his doctrine of *dominium,* and the direction in which his political and religious views were to develop. In the controversy between Realism and Nominalism he was on the side of the former, though his doctrine of universals showed the influence of Ockham and the nominalists. To Wycliffe the doctrine of arbitrary divine decrees was anathema. The will of God is his essential and eternal nature, by which all his acts are determined; God created all things in their primordial causes, as genera and species, or else in their material essences, *secundum rationes absconditas seminales* (*ibid.* p. 66). The world is therefore not merely one among an infinity of alternatives, but is the only possible world; it is, moreover, not in the nature of an eternal emanation from God, but was created at a given moment of time—to think otherwise would be to admit its absolute necessity, which would destroy free-will and merit. Since, however, all things came into being in this way, it follows that the creature can produce nothing save what God has already created. This leads to predestination and free-will. Wycliffe takes a middle position. God does not will sin, for He only wills that which has being, and sin is the negation of being; He necessitates men to perform actions which only become right or wrong through man's free agency. All human lordship is derived from the supreme overlordship of God and is inseparable from it, since whatever God gives is part of himself. But, in giving, God does not part with the lordship of the thing given; whatever lordship the creature may possess is held subject to due service to the supreme overlord. Thus, as in feudalism, lordship is distinguished from possession. Property is the result of sin; Christ and his apostles had none. The service by which lordship is held of God is righteousness and its works; it follows that the unrighteous forfeit their right to exercise it, and may be deprived of their possessions by competent authority.

The question follows as to what this authority is, and this Wycliffe sets out to answer in the *Determinatio quaedam de dominio* and the *De civili dominio.* Briefly, his argument is that the church has no concern with temporal matters at all, that for the clergy to hold property is sinful, and that it is lawful for statesmen (*politici*)—who are God's stewards in temporals—to take away the goods of such of the clergy as no longer render the service by which they hold them. That the church was actually in a condition to deserve spoliation he refused to affirm; but his theories fitted in too well with the notorious aims of the duke of Lancaster not to rouse the bitter hostility of the endowed clergy.

Hitherto Wycliffe had made no open attack on the doctrinal system of the church. Early in 1377, however, Archbishop Sudbury summoned him to appear before the bishop of London, and on Feb. 19 Wycliffe made his appearance at St. Paul's, accompanied by the duke of Lancaster, by Lord Percy, marshal of England, and by four doctors of the four mendicant orders. Before Wycliffe could open his mouth, the court was broken up by a rude brawl between his protectors and Bishop Courtenay,

the affair developing into a general riot.

Wycliffe had escaped for the time, but probably before this his enemies had set their case before the pope; and on the 22nd of May five bulls were issued by Gregory XI., condemning eighteen of Wycliffe's "conclusions." All the articles but one are taken from his *De civili dominio*. The bulls truly stated Wycliffe's intellectual lineage; he was following in the error of Marsilius of Padua; and the articles laid against him are concerned entirely with questions as to how far ecclesiastical censures could lawfully affect a man's civil position, and whether the church had a right to hold temporal endowments. The bulls were addressed to the archbishop of Canterbury and the bishop of London, the university of Oxford, and the king. The university was to send Wycliffe to the prelates, who were to examine the truth of the charges and to report to the pope, Wycliffe being meanwhile kept in confinement. The execution of the papal bulls was impeded by three separate causes—the king's death on the 21st of June; the tardy action of the bishops, who enjoined the university to make a report; and the unwillingness of the university to admit the pope's right to order the imprisonment of any man in England. The convocation of the university merely directed Wycliffe to keep within his lodgings at Black Hall for a time.

As soon as parliament met in the autumn of 1377, Wycliffe was consulted by it as to the lawfulness of prohibiting that treasure should pass out of the country in obedience to the pope's demand. Wycliffe's affirmative judgment is contained in a state paper still extant; and its tone is plain proof that his views on the main question of church and state had the support of the nation. He had laid before this same parliament his answer to the pope's bulls, with a defence of the soundness of his opinions. His university, moreover, confirmed his argument; his tenets, it said, were orthodox though their expression might admit of a wrong interpretation. Early in 1378 Wycliffe appeared at Lambeth Palace to clear himself before the prelates who had summoned him. A more cautiously worded defence was laid before the council; but its session was rudely interrupted, not only by a crowd of citizens, but also by a messenger from the princess of Wales enjoining them not to pass judgment against Wycliffe; and thus a second time he escaped. Meanwhile his "protestatio" was sent on to Rome, but before any further step could be taken Gregory XI. died.

In the autumn of this year Wycliffe was once more called upon to prove his loyalty to John of Gaunt, who had violated the sanctuary of Westminster by sending armed men to seize two squires who had taken refuge there. One of them was murdered, together with a servant of the church. The bishop of London excommunicated all concerned in the crime (except only the king, his mother and his uncle), and preached against the culprits at Paul's Cross. At the parliament held at Gloucester in October, in the presence of the legates of Pope Urban VI., Wycliffe read an apology for the duke's action, pleading that the men were killed in resisting legal arrest. The paper, which forms part of the *De ecclesia*, maintains the right of the civil power to invade the sanctuary to bring escaped prisoners to justice.

The schism in the papacy, owing to the election of Clement VII. in opposition to Urban VI., accentuated Wycliffe's hostility to the Holy See and its claims. He did not object to a visible head of the church so long as this head possessed the essential qualification of righteousness. It was later that Wycliffe definitely branded the pope, *qua* pope, as Antichrist. (*See* vol. ii. of the *Sermones*. Book iii. of his *Opus evangelicum* is entitled *De Antichristo*.) Wycliffe's criticism of the established order and of the accepted doctrines he now determined to carry into the streets. For this purpose he instituted "simple" priests to preach his doctrines throughout the country; and, secondly, he translated the Vulgate into English, with the aid of his friends Nicholas Hereford and John Purvey. (*See* BIBLE, ENGLISH.) This version of the Bible, and still more his numerous sermons and tracts, established Wycliffe's position as the founder of English prose writing.

Wycliffe had been on good terms with the friars, whose ideal of poverty appealed to him but he had come to recognize that all organized societies within the church were liable to the same corruption, while he objected fundamentally to a special standard of morality for the "religious." His itinerant preachers were meant to supplement the services of the church by religious instruction in the vernacular, and among them were men who held or had held respectable positions at Oxford. The common people were rejoiced by their plain and homely doctrine which dwelt chiefly on the simple "law" of the gospel, while they no doubt relished the denunciation of existing evils in the church. The feeling of disaffection against the rich and careless clergy, monks and friars was widespread but undefined. Wycliffe turned it into a definite channel.

In addition, Wycliffe was appealing to the world of learning in a series of Latin treatises, which followed each other in rapid succession, and collectively form his *summa theologiae*. J. Loserth, in his paper "Die Genesis von Wiclifs Summa Theologiae" (*Sitzungsber. der k. Akad. der Wissensch.*, Vienna, 1908, vol. 156) gives proofs that the *Summa* was written to provide weapons in the controversies of the time. During the years 1378 and 1379 Wycliffe produced his works on the truth of Holy Scripture, on the church, on the office of king, on the papal power. The *De officio regis* is practically a declaration of war against the papal monarchy, an anticipation of the theocratic conception of national kingship as established later by the Reformation. (See *De officio regis* ed. A. W. Pollard and Charles Sayle, from Vienna mss. 4514, 3933, Wyclif Soc. 1887—cap. vi. p. 119.) Wycliffe now passed from an assailant of the papal to an assailant of the sacerdotal power. In 1379 or 1380 Wycliffe began a formal public attack on what he calls the "new" doctrine in a set of theses on the Eucharist propounded at Oxford. (1381 is the date given in Shirley's edition of the *Fasciculi Zizaniorum*. F. D. Matthew, in the *Eng. Hist. Rev.* for April 1890, v. 328, proves that the date must have been 1379 or 1380.) There followed sermons, tracts, and, in 1381, his great treatise *De eucharistia*. Finally, at the close of his life, he summed up his doctrine in the *Trialogus*.

The language in which he denounced transubstantiation anticipated that of the Protestant reformers; it is a "blasphemous folly," philosophically it is nonsense, since it presupposes the possibility of an accident existing without its substance; it overthrows the very nature of a sacrament. Yet the consecrated bread and wine are the body and blood of Christ, for Christ himself says so (*Fasc. Zizan.* p. 115); we do not, however, corporeally touch and break the Lord's body, which is present only *sacramentaliter, spiritualiter et virtualiter*—as the soul is present in the body. The real presence is not denied; what Wycliffe "dares not affirm" is that the bread is after consecration "essentially, substantially, corporeally and identically" the body of Christ. His doctrine approximates to the Lutheran doctrine of consubstantiation, as distinguished from the Zwinglian teaching accepted in the xxviii. Article of Religion of the Church of England.

The theologians of the university were at once aroused. The chancellor, William Barton, sat with twelve doctors (six of whom were friars), and solemnly condemned the theses. Wycliffe appealed, not to the pope, but to the king. But the lay magnates, who were perfectly ready to help the church to attain to the ideal of apostolic poverty, shrank from the responsibility of supporting obscure propositions, which involved undoubted heresy and the pains of hell. John of Gaunt hastily sent a messenger enjoining the reformer to keep silence. The rift thus created between Wycliffe and his patrons in high places was widened by the Peasants' Revolt of 1381, the result of which was to draw the conservative elements in church and state together.

With the Peasants' Revolt it has been supposed that Wycliffe had something to do. One of its leaders, John Ball, when condemned, confessed that he learned his subversive doctrines from Wycliffe. We have, however, not only the repeated testimony of Knyghton that he was a "precursor" of Wycliffe, but also documentary evidence that he was excommunicated in 1366, long before Wycliffe exposed himself to ecclesiastical censure. Wycliffe's communistic views are theoretical and confined to his Latin scholastic writings. They could not reach the people directly. Possibly his followers translated them in their popular discourses, and thus fed the flame that burst forth in the rebellion.

In the spring after the Revolt his old enemy, William Courtenay, who had succeeded the murdered archbishop Sudbury as archbishop of Canterbury, resolved to stamp out Wycliffe's crowning heresy. He called a court of bishops, theologians and canonists at the Blackfriars' convent. This proceeding was met by a manifestation of university feeling on Wycliffe's side. The chancellor, Robert Rygge, though he had joined in the condemnation of the theses, stood by him, as did also both the proctors. The Council decided that out of 24 articles extracted from Wycliffe's works, ten were heretical and fourteen erroneous. The reply of the chancellor was to deny the archbishop's jurisdiction within the university, and to allow Philip Repington, disciple of Wycliffe, to preach before the university. The chancellor and proctors were now summoned to appear before the Blackfriars' court on the 12th of June. Though they were, with the majority of regent masters at Oxford, on the side of Wycliffe, the main question was for them one of philosophy rather than faith, and they made formal submission to the authority of the Church.

Wycliffe himself remained at large and unmolested. That his strength among the laity was undiminished is shown by the fact that an ordinance passed by the House of Lords alone, in May 1382, against the itinerant preachers was annulled on the petition of the Commons in the following autumn. The reformer, however, was growing old and now occupied himself in writing numerous tracts and two of his most important works. The *Trialogus* is a summing up of his arguments and conclusions on philosophy and doctrine. It was the most influential of all Wycliffe's works, and was the first to be printed (1525). All the only four known complete mss. of the work, preserved in the Imperial Library at Vienna, are of Hussite origin. The note of both the *Trialogus* and of the unfinished *Opus evangelicum,* Wycliffe's last work, is their insistence on the "sufficiency of Holy Scripture."

In 1382, or early in 1383, Wycliffe was seized with a paralytic stroke. On the 28th of December 1384, he had a final stroke, from the effects of which he died on the New Year's eve. He was buried at Lutterworth; but by a decree of the council of Constance, May 4, 1415, his remains were ordered to be dug up and burned, an order which was carried out, at the command of Pope Martin V., by Bishop Fleming in 1428.

A sober study of Wycliffe's life and works justifies a conviction of his complete sincerity and earnest striving after what he believed to be right. When he conceives the Church as consisting exclusively of the righteous, he may seem to have gone the whole length of the most radical reformers of the 16th century. And yet, powerful as was his influence in England, his doctrines in his own country were doomed to become for a century and a half the creed only of obscure sectaries. (*See* LOLLARDS.) It was otherwise in Bohemia, whither his works had been carried by the scholars who came to England in the train of Richard II.'s queen, Anne of Bohemia. Here his writings were eagerly read and multiplied, and here his disciple, John Huss (*q.v.*) raised Wycliffe's doctrine to the dignity of a national religion. Extracts from the *De ecclesia* and the *De potestate Papae* of the English reformer made up the greater part of the *De ecclesia* of Huss, a work for centuries ascribed solely to the Bohemian divine, and for which he was condemned and burnt. It was Wycliffe's *De sufficientia legis Christi* that Huss carried with him to convert the council of Constance; of the fiery discourses now included in the published edition of Wycliffe's *Sermones* many were likewise long attributed to Huss. Finally, it was from the *De eucharistia* that the Taborites derived their doctrine of the Lord's Supper, with the exception of the granting of the chalice to the laity. To Huss, Luther and other continental reformers owed much, and thus the spirit of the English reformer had its influence on the reformed churches of Europe.

BIBLIOGRAPHY.—The documentary materials for Wycliffe's biography are to be found in John Lewis's *Life and Sufferings of J. Wiclif* (new ed., Oxford, 1820), which contains a valuable appendix; Foxe's *Acts and Monuments,* vol. iii., ed. 1855, with app.; Forshall and Madden's preface to the Wycliffe Bible, p. vii. note, Oxford, 1851; W. W. Shirley's edition of the *Fasciculi Zizaniorum,* a collection of contemporary documents (1858); and H. T. Riley's notices in the appendices to the *Second* and *Fourth Reports* of the Historical Manuscripts Commission. The narrative of a monk of St. Albans published under the title of *Chronicon Angliae,* by Sir E. Maunde Thompson (1874), and in a modified version in Walsingham's *Historia Anglicana* (ed. H. T. Riley, 1863, 1864). Knyghton's chronology in *De eventibus Angliae* is faulty (ed. J. R. Lumby, 1889–95). There are valuable notices in the *Eulogium historiarum* (vol. iii., ed. F. S. Haydon, 1863), in the *Chronicle* of Adam of Usk (ed. E. M. Thompson, 1876), and in the continuations of Higden. The controversial works of Wodeford and Walden are important, but must be used with caution.

Of modern biographies that by G. V. Lechler (*Johann von Wiclif und die Vorgeschichte der Reformation,* 2 vols., Leipzig, 1873; partial Eng. trans., by P. Lorimer, 1878, 1881 and 1884) is by far the most comprehensive. Shirley's introduction to the *Fasciculi Zizaniorum,* and F. D. Matthew's to his edition of *English Works of Wyclif hitherto unprinted* (1880), as well as Creighton's *History of the Papacy,* vol. i., 1882, and Sir H. C. Maxwell Lyte's account in his *History of the University of Oxford* (1886), contain valuable criticism. *See* also Mr. R. L. Poole, (*Illustrations of the History of Mediaeval Thought,* 1884); J. Loserth (*Hus und Wiclif,* Prague, 1884; also Eng. trans.). G. M. Trevelyan, *England in the Age of Wycliffe* (London, 1899); Oman, *History of England 1377–1485* (London, 1906); W. W. Capes, "History of the English Church in the 14th and 15th Centuries," in *Hist. of the Eng. Church,* ed. Stephen and Hunt (London, 1900); J. Loserth's article "Wiclif," in Herzog-Hauck, *Realencyklopädie* (3rd ed., 1908), xxi., pp. 225–227; H. B. Workman, *John Wyclif* (1926).

Wycliffe's works are enumerated in a *Catalogue* by Shirley (Oxford, 1865). Of his Latin works only two had been published previous to 1880, the *De officio pastorali,* ed. G. V. Lechler (Leipzig, 1863) and the *Trialogus,* ed. Lechler (Oxford, 1869). Under the auspices of the Wyclif Society the following have been published.—*Polemical Tracts,* ed. R. Buddensieg (2 vols., 1883); *De civili dominio,* vol. i. ed. R. L. Poole, vols. ii.–iv., ed. J. Loserth (1885–1905); *De composicione hominis,* ed. R. Beer (1884); *De Ecclesia,* ed. Loserth (1886); *Dialogus sive speculum ecclesiae militantis,* ed. A. W. Pollard (1886); *Sermones,* ed. Loserth, vols. i.–iv. (1887–90); *De officio regis,* ed. A. W. Pollard and C. Sayle (1887); *De apostasia,* ed. M. Dziewicki (1889); *De dominio divino,* ed R. L. Poole (1890); *Quaestiones. De ente praedicamentali,* ed. R. Beer (1891); *De eucharistia tractatus major,* ed. Loserth (1893); *De blasphemia,* ed. Dziewicki (1894); *Logica* (3 vols., ed. Dziewicki, 1895–99); *Opus evangelicum,* ed. Loserth (4 vols., 1898), parts iii. and iv. also bear the title *De Antichristo; De Simonia,* ed. Herzberg-Fränkel and Dziewicki (1898); *De veritatae sacrae scripturae,* ed. R. Buddensieg (3 vols., 1905); *Miscellanea philosophica,* ed. Dziewicki (2 vols., 1905) (vol. i. has an introduction on Wycliffe's philosophy); *De potestate papae,* ed. Loserth (1907).

For his works in English see *Select English Works,* ed. T. Arnold (3 vols., 1869–71), and *English Works hitherto unprinted,* ed. F. D. Matthew (1880). *The Wicket* (Nuremberg, 1546; reprinted at Oxford, 1828) is not included in either of these collections. (R. L. P.; X.)

WYCOMBE (commonly HIGH WYCOMBE, officially CHEPPING WYCOMBE), a municipal borough in Buckinghamshire, England, 26½ mi. N.W. of London by the G.W. railway, but also served by the L.N.E. railway. Pop. (1938) 33,940. Area 11 sq.mi. The town and district of High Wycombe is the centre of the cane- and rush-seated chair industry. Other furniture is also made, besides paper and postage stamps. Wycombe (Wicumbe, Chepyng) appears to have been settled from very early times. There is evidence of Bronze Age occupation, while in 1929 was unearthed a quantity of human bones and skulls thought to be analogous in type to that of the skull found at Engis, in the Meuse Valley, in 1833, suggesting that a similar race of long-headed men had existed in the Wycombe locality. There are various British remains, including an encampment, but the many traces of Roman settlement indicate that there was an important station here. In Domesday the manor only is mentioned, but the borough existed in the time of Henry II, though it was not chartered until 1558.

WYE, a river of England, famous for beautiful scenery. It rises on the eastern slope of Plynlimmon, close to the source of the Severn. Its length is 130 mi. Running at first S.E. it passes Rhayader and receives the Elan, in the basin of which are the Birmingham reservoirs. It then receives the Ithon (left) and after Hay reaches a level of 250 ft., 55 mi. from its source, 2,000 ft. high. As it enters Herefordshire it bends E. to reach Hereford. It soon receives the Lugg, which, augmented by the Arrow and the Frome, joins from the north. The course now becomes sinuous; and the valley narrows nearly to Chepstow. It passes Monmouth, where it receives the Monnow on the right, and finally Chepstow, 2 mi. above its junction with the Severn estuary. The river is navigable for small vessels for 15 mi. up from the mouth on high tides. The average spring tide is 38 ft. at Chepstow,

and the average neap tide is 28½ ft. The scenery is finest between Rhayader and Hay in the upper part, and from Goodrich, below Ross, to Chepstow in the lower, the second being the portion which gives the Wye its fame.

The name of Wye belongs also to two smaller English rivers—a tributary of the Derbyshire Derwent and a tributary of the Thames, watering a valley of the Chilterns.

WYMAN, JEFFRIES (1814–1874), American scientist, born in Chelmsford, Mass., Aug. 11, 1814. He graduated at Harvard in 1833, and in 1837 also received his medical degree there. He began medical practice in Boston and became a demonstrator of anatomy at Harvard, but in 1843 he went to Europe for a short period of study at London and Paris. Upon his return he was for four years professor of anatomy and physiology at Hampton-Sidney College, Richmond, Va., and was then recalled to Harvard as Hersey professor in anatomy. He began the task of building a museum of comparative anatomy at Harvard, one of the first in the United States, and travelled widely in search of specimens, his trips ranging along the Atlantic coast from Labrador to Florida, and including expeditions to Europe, to Guiana, and, notably, up the La Plata, Uruguay and Parana rivers and across the pampas and Andes to Santiago, Chile. In 1866 he was made a trustee of the museum of archaeology and professor of archaeology and ethnology on the George Peabody foundation. His scientific papers embrace a wide range of studies, including human, comparative and microscopic anatomy, physiology, paleontology and ethnology. Especially notable were his papers on "Observations on the Crania" (*Proc. of Boston Soc. of Nat. Hist.*, 1868), on the nervous system of the bullfrog and the changes undergone during metamorphosis (*Smithsonian Institution Contributions*, 1852), the first account of the osteology of the gorilla (*Memoirs, Boston Soc. of Nat. Hist.*, 1847), and "Unusual Methods of Gestation in Certain Fishes" (*Silliman's Journal*). He died at Cambridge, Mass., Sept. 4, 1874.

There is a memoir and complete bibliography of his writings in the *Biographical Memoirs, Nat. Acad. of Science*, vol. 2 (1886). His colleague, Oliver Wendell Holmes, wrote a biographical sketch in the *Atlantic Monthly* (Nov. 1874).

WYMONDHAM (pronounced *Windham*), urban district (1935) in Norfolk, England, 10 mi. S.W. of Norwich by L.N.E.R. Pop. (1938) 5,121. Area 17.1 sq.mi. The church of St. Mary the Virgin, on the outskirts, was attached to a Benedictine priory, founded in the 12th century as a cell of St. Albans abbey by William de Albini. In 1448 this foundation became an abbey. The nave is Norman with a massive triforium, surmounted by a Perpendicular clerestory and a beautiful wooden roof. The north aisle is Perpendicular, and has a fine rood screen. At the west end there is a Perpendicular tower. In the centre of the town is a half-timbered market cross (1616), with an octagonal upper chamber.

WYNAAD, highland tract, south India, forming part of Malabar district, Madras. It consists of a table-land amid the west Ghats, 60 m. long by 30 m. broad, with an average elevation of 3,000 feet. A large amount of British capital was sunk during the decade 1876–86 in gold mines in the district. It had still earlier been a coffee-planting district, but more tea is now grown. Cardamoms are also produced in large quantities.

WYNDHAM, SIR CHARLES (1837–1919), English actor, was born in Liverpool on March 23, 1837, the son of a doctor. He was educated abroad, at King's college, London, and at the College of Surgeons and the Peter street anatomical school, Dublin. Early in 1862 he made a first appearance in London as an actor. In that year he went to America, volunteered during the Civil War and became brigade surgeon in the Federal army, resigning in 1864 to appear on the stage in New York with John Wilkes Booth. Returning to England, he played at Manchester and Dublin in various pieces. He reappeared in London in 1866 as Sir Arthur Lascelles in Morton's *All that Glitters is not Gold*, but his great success at that time was in F. C. Burnand's burlesque of *Black-eyed Susan*, as Hatchett, "with dance." This brought him to the St. James's theatre, where he played with Henry Irving in *Idalia*; then with Ellen Terry in Charles Reade's *Double Marriage*, and Tom Taylor's *Still Waters Run Deep*. He had a great success as Charles Surface, his best part for many years. In 1876 he took control of the Criterion theatre. Here he produced a long succession of plays, notably a number of old English comedies, and among modern plays, *The Liars, The Case of Rebellious Susan* and others by Henry Arthur Jones; his most famous part was in *David Garrick*. In 1899 he opened his new theatre, called Wyndham's. In 1902 he was knighted. From 1885 onwards his leading actress was Miss Mary Moore (Mrs. Albery), who became his partner in the proprietorship of the Criterion and Wyndham's theatres, and of his New theatre, opened in 1903; and her delightful acting in comedy made their long association memorable on the London stage. Wyndham died in London on Jan. 12, 1919.

WYNDHAM, GEORGE (1863–1913), British politician and man of letters, was born Aug. 29, 1863, the eldest son of Percy Scawen Wyndham, and grandson of the first Lord Leconfield. His mother was Madeline Caroline Frances Eden, daughter of Sir Guy Campbell, bart., and through her he was great-grandson of Lord Edward Fitzgerald, the Irish rebel. He was educated at Eton and Sandhurst, obtained a commission in the Coldstream Guards in 1883, and served through the Suakin campaign of 1885. He left the army in 1887, married Sibell Mary, daughter of the 9th Earl of Scarborough, widow of Earl Grosvenor. He became private secretary to A. J. Balfour, at the time Irish Secretary, and in 1889 entered Parliament as Conservative member for Dover, a seat which he retained till his death.

After serving, from 1898–1900, as financial secretary to the war office, he was appointed in 1900 chief secretary for Ireland. His early work in Ireland met with general approval. He developed enormously the Conservative policy of land purchase; and the act which he carried in 1903 for that end was the most comprehensive measure of the kind ever submitted to Parliament. He hoped to arrange a form of local government which should sufficiently meet Nationalist demands, and with this in view appointed in 1902 an eminent Anglo-Indian, Sir Antony (afterwards Lord) MacDonnell to the under-secretaryship. The Unionist party, both in Ireland and in England, became suspicious of the tendencies of his administration, and he was driven in 1905 to resignation. He never held office again, but was active in support of tariff reform and woman suffrage; he was a keen critic of Haldane's army reforms, and threw himself vigorously into the "Diehard" campaign against the Parliament Bill in 1911.

He was also a man of letters. Here his genius was stimulated by his friendship for W. E. Henley, who dedicated a book to "George Wyndham, soldier, courtier, scholar." His principal published work was an edition of *Shakespeare's Poems* (1898); but he wrote also on North's *Plutarch* and *Ronsard*. The Admirable Crichton of his day, handsome and debonair, he was keen alike on field sports and the arts, a working railway director and an efficient colonel of yeomanry, the pet of society and the recipient of honorary distinctions from several universities. On June 8, 1913, at the comparatively early age of 50, he died in Paris.

See his *Life and Letters*, ed. J. W. Mackail and Guy Wyndham (2 vols., 1925).

WYNDHAM, SIR WILLIAM, BART. (1687–1740), English politician, was the only son of Sir Edward Wyndham, Bart., and a grandson of William Wyndham (d. 1683) of Orchard Wyndham, Somerset, who was created a baronet in 1661. Educated at Eton and at Christ Church, Oxford, he entered parliament in 1710 and became secretary-at-war in the Tory ministry in 1712 and chancellor of the exchequer in 1713. He was closely associated with Lord Bolingbroke, and he was privy to the attempts made to bring about a Jacobite restoration on the death of Queen Anne; when these failed he was dismissed from office. In 1715 the failure of a Jacobite movement led to his imprisonment, but he was soon set at liberty. Under George I. Wyndham was the leader of the opposition in the House of Commons, fighting for his High Church and Tory principles against Sir Robert Walpole. He was in constant communication with the exiled Bolingbroke, and after 1723 the two were actively associated in abortive plans for the overthrow of Walpole. He died at Wells on June 17, 1740. Wyndham's first wife was Catherine, daughter of Charles Seymour, 6th duke of Somerset. By her he had two sons, Charles,

who became 2nd earl of Egremont in 1750, and Percy, who took the name of O'Brien and was created earl of Thomond in 1756.

The Wyndham Family.—Sir John Wyndham, a Norfolk man, was knighted after the battle of Stoke in 1487 and beheaded for high treason on May 2, 1502. He married Margaret, daughter of John Howard, duke of Norfolk, and his son Sir Thomas Wyndham (d. 1521), of Felbrigg, Norfolk, was vice-admiral of England under Henry VIII. By his first wife Sir Thomas was the father of Sir John Wyndham, who married Elizabeth, daughter of John Sydenham of Orchard, Somerset, and founded the Somerset branch of the family, and also of Sir Edmund Wyndham of Felbrigg, who was sheriff of Norfolk at the time of Robert Ket's rebellion. By his second wife Sir Thomas was the father of the seaman Thomas Wyndham (*c.* 1510–53), an account of whose voyage to Morocco in 1552 is printed in Hakluyt's *Voyages*.

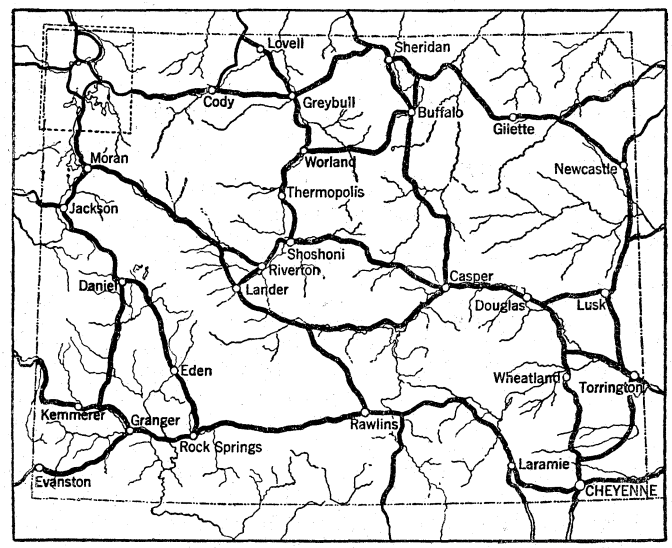
The Wyndhams are also connected through a female line with the family of Wyndham-Quin, which holds the earldom of Dunraven. Valentine Richard Quin (1752–1824), of Adare, county Limerick, was created Baron Adare on the union with England in 1800, and earl of Dunraven and Mount-Earl in 1822. His son, the 2nd earl (1782–1850), married Caroline (d. 1870), daughter and heiress of Thomas Wyndham of Dunraven castle, Glamorganshire, and took the name of Wyndham-Quin. Their son, the 3rd earl (1812–71), who was created a peer of the United Kingdom as Baron Kenry in 1866, was a well-known man of science, especially interested in archaeology and in Celtic antiquities. His son, Windham Thomas Wyndham-Quin (1841–1926), the 4th earl, served in the Abyssinian campaign and the South African War. He was under-secretary for the Colonies in 1885–87, and was a great figure in Irish politics, as chairman of the Irish Land Conference (1902) and president of the Irish Reform Association; he was also prominent as a yachtsman, competing for the America's cup (*see* YACHTING) in 1893 and 1895. He died on June 14, 1926.

WYNTOUN, ANDREW OF (?1350–?1420), author of a long metrical history of Scotland, called the *Orygynale Cronykil of Scotland,* was a canon regular of St. Andrews, and prior of St. Serf's in Lochleven. He wrote the *Chronicle* at the request of his patron, Sir John of Wemyss, whose representative, Mr. Erskine Wemyss of Wemyss Castle, Fifeshire, possesses the oldest extant ms. of the work. The subject is the history of Scotland from the mythical period (hence the epithet "original") down to the accession of James I. in 1406. The earlier books are of no historical value, but the later have in all outstanding matters stood the test of comparison with contemporary records. The philological interest is great, for few works of this date, and no other of like magnitude, are extant in the vernacular.

The text is preserved in eight mss., of which three are in the British Museum, the Royal (17 D. xx.), the Cottonian (Nero D. xi.) and the Lansdowne (197); two in the Advocates' library, Edinburgh (19, 2, 3 and 19, 2, 4), one at Wemyss castle (*u.s.*); one in the university library at St Andrews, and one, formerly in the possession of the Boswells of Auchinleck, now the property of John Ferguson, Duns, Berwickshire. The first edition of the *Chronicle* (based on the Royal ms.) was published by David Macpherson in 1795; the second by David Laing, in the series of "Scottish Historians" (Edin., 1872). Both are superseded by the elaborate edition by Amours for the Scottish Text Society (1906).

WYOMING, popularly known as the "Equality" state because it was the pioneer in woman suffrage, is one of the central-western states of the United States of America, and is situated between 104° 3′ and 111° 3′ long. W. and 41° and 45° N. lat. It is bounded north by Montana, east by South Dakota and Nebraska, south by Colorado and Utah, and west by Utah, Idaho and Montana. Including Yellowstone park (area 3,114 sq.mi.), Wyoming has an area of 97,914 sq.mi., of which 408 sq.mi. are water surface. Over Yellowstone park, however, the United States has exclusive jurisdiction and control. East and west the state has an extreme length of 367 mi., and north and south an extreme breadth of 277 miles. In shape it is an exact rectangle. Its mean elevation is 6,700 ft. above sea level and in this respect it is exceeded only by Colorado. The name "Wyoming," originally bestowed upon the Wyoming valley in Pennsylvania, is a corruption of a word of the Delaware Indians meaning "upon the great plain." It is not known who first applied it to the State.

Physical Features.—The great plains in Wyoming have an elevation of from 5,000 to 6,000 ft. over much of the State, and consist of flat or gently rolling country, barren of tree growth, but often covered with nutritious grasses, and possessing a soil rich in the mineral elements necessary for plant life which it produces abundantly when it receives sufficient moisture. Erosion buttes



MAP SHOWING THE MAIN ROADS IN WYOMING

and mesas occasionally rise as picturesque monuments above the general level of the plains, and in the vicinity of the mountains the plains strata, elsewhere nearly horizontal, are bent sharply upward and carved by erosion into "hogback" ridges. These features are well developed about the Big Horn mountains, an outlying range of the Rockies which boldly interrupts the continuity of the plains in north-central Wyoming.

Notwithstanding high elevations in both the northern and southern portions of the State, the low central portion makes a distinct break in the continuity of the northern and southern ranges of the Rockies, giving a broad relatively low pass through which went the Oregon and Overland trails in the early days and later the Union Pacific railway. In this central region the plains are interrupted by minor mountain groups, volcanic buttes and lava flows. In the north-east are outlying spurs of the Black hills, the Little Missouri buttes and the Devil's Tower, the latter a prominent erosion remnant of volcanic intrusion. The higher levels of the Big Horn range have been modified by local glaciation, giving glacial cirques, alpine peaks and many mountain lakes and waterfalls. Several small glaciers still remain about the shoulders of Cloud Peak (13,165 ft.), the highest summit in the range. The various ranges in the north-western part of the State form some of its most magnificent scenery. A vast portion of this has been set aside as Yellowstone National park, but areas in the Absarokas east of the park are also considered beautiful. Just south of the park, the Teton mountains rise abruptly from Jackson's Hole to elevations of 10,000 and 11,000 feet. They are an imposing landmark and were hailed by all emigrants of the Oregon Trail as a welcome sign that they were approaching Pacific waters. In the famous Wind River Range farther south-east are Gannett Peak (13,785 ft.), the highest point in the State, and Fremont Peak (13,720 ft.).

In addition to the hot springs of the Yellowstone region, mention should be made of large hot springs (about 135° F) at Thermopolis and Saratoga.

Drainage.—About two-thirds of the State is drained by branches of the Missouri river, the most important being the Yellowstone, Big Horn and Powder rivers flowing north and the Cheyenne and North Platte flowing east. The Green river, a branch of the Colorado drains the south-western part of the State. The Snake river, flowing into the Columbia, heads in the southern part of Yellowstone park and flows south-west through the beauti-

ful valley known as Jackson's Hole into Idaho. Along the western border the Bear river takes its course a short distance, draining ultimately into the Great basin. Southwest of the centre of the state is an area with no outward drainage, the streams emptying into desert lakes.

Wild Life.—Wyoming still abounds in wild life and game animals. The game population of the state in 1940 was officially estimated at 165,000 animals, including 35,000 elk, 60,000 mule deer, 35,000 antelope, 3,500 moose, 1,500 black bear, 450 grizzly bear and 2,400 bighorn sheep. The kill in 1940 according to the report of the state game and fish commission was: elk, 5,405; deer 5,564; antelope 3,267; mountain sheep 19; bear 51; and moose 44. About 27,583,000 fingerlings and fry were planted in 1939–40 in Wyoming waters.

Climate.—It is difficult to generalize about Wyoming's climate, since the varied and rugged topography makes corresponding local variations. Precipitation for the state averages 13·89 in. annually, but it varies from about 6 in. in the lower Big Horn basin, Sweetwater county and lower Wind river valley, the driest portions, to 35 in. in the mountains bordering on Yellowstone park. In the agricultural region of the southeastern counties the average annual rainfall is 15·20 in. East of the continental divide about 70% of the precipitation occurs between April and September. The cool summer months of the mountain regions lower the average temperature of the state materially. The annual mean for the valleys is 46° F. and for the mountains 36°. The average of 85 stations, well distributed over the state, gives a day average for July of 81° and a night average of 47°. Day temperature for January averages 32° and night 7°. The portion of the state west of the divide has a lower average and longer winters than that east of the divide. The cold spells are not severe for their chilling effect is modified by the normally low humidity.

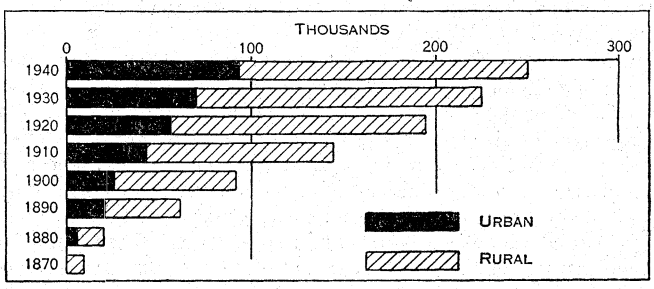
Government.—The legislature is composed of a senate and a house of representatives. Each county elects one senator for each 11,000 inhabitants or major portion thereof, and one representative for every 4,150 inhabitants or major portion thereof, though each county has a right to one senator and representative regardless of its population. New apportionments are made after each federal and state census, the state census occurring in every year that ends with a five. In 1941 there were 27 senators and 56 representatives. The regular sessions of the legislature meet in Cheyenne on the second Tuesday in January every odd-numbered year and may continue 40 days. The governor has the power to veto any bill, but if upon reconsideration it is repassed by a two-thirds majority in each house it becomes a law without the governor's signature. The governor may veto any item in the appropriations bill. Special laws are not to be passed where a general one may be made applicable.

The chief executive officer is the governor. There are only four other elective executive officers, the secretary of state, auditor, treasurer and superintendent of public instruction. These men not only direct their own departments but some, together with appointed officers, act on many executive boards, such as the state board of charities and reform, state land commission, state fiscal board, state board of pardons, state farm loan board, state board of supplies, state historical board, etc. An unusually large number of the executive officers are appointed by the governor and are responsible to him. Among them are a state examiner, a state engineer, two inspectors of coal mines, a state geologist, the attorney-general, four water superintendents for the four irrigation districts of the state, three live stock commissioners and three sheep commissioners, five members of the state highway commission, three members of the board of equalization, state land commissioner, five members of the state board of health, the members of the board of agriculture, the commissioner of law enforcement, and the commissioner of labour and statistics, etc.

The supreme court of Wyoming has three justices who are elected by the voters for a term of eight years. Two terms of supreme court are held annually, one in April and the other in October. A special term can be held when two justices so vote. There are seven district courts. A regular term is held yearly in each, and special terms may be called in any district by the presiding judge. Each of the seven district judges is elected by his district for a six-year term. The counties are also divided by the county commissioner into judicial districts for which the voters of the district elect a justice of the peace. Incorporated towns and cities have municipal courts and police justices.

Every citizen of the United States over 21 years of age who has lived in Wyoming one year and in the county where he is to vote 60 days and in the election district ten days, who can read the constitution of the state, and who is not insane, an idiot or a person convicted of infamous crimes (unless restored to his civil rights) has the right of suffrage.

Population.—The population of Wyoming in 1870 was 9,118; in 1890 it was 62,555; in 1910, 145,965; and in 1940, 250,742. This last figure represents an increase of 11·2% over the population in 1930. The population per square mile, which was only 0·9 in 1900, had risen to 2·6 in 1940, as compared with 44·2 for the United States as a whole. Of the 1940 population, 93,577, or 37·3%, lived in urban places, that is, in cities and towns of 2,500



BY COURTESY OF THE U.S. BUREAU OF THE CENSUS

URBAN AND RURAL POPULATION OF WYOMING: 1870–1940

or more. The rural population, occupying the remainder of the state, thus constituted 62·7% of the total. The number of occupied dwelling units returned in the housing census of 1940 was 69,357, which is approximately the same as the number of families. The average population per family (occupied dwelling unit) declined from 4·0 in 1930 to 3·6 in 1940. The white population of Wyoming formed 98·4% of the total in 1940, as compared with 98·1% in 1930. The number of males per 100 females in the entire population of the state was 117·4, the sex ratio being 105·6 for the urban population and 125·1 for the rural population. The population of the state and of its principal cities is summarized for recent censuses in the following table:

Area	Population			Percent of increase	
	1940	1930	1920	1930–40	1920–30
The State	250,742	225,565	194,402	11·2	16·0
Urban	93,577	70,097	57,095	33·5	22·8
Rural	157,165	155,468	137,307	1·1	13·2
Percent urban	37·3	31·1	29·5	..	..
Principal cities:					
Cheyenne	22,474	17,361	13,829	29·5	25·5
Casper	17,964	16,619	11,447	8·1	45·2
Laramie	10,627	8,609	6,301	23·4	36·6
Sheridan	10,529	8,536	9,175	23·3	−7·0

Finance.—The assessed valuation of taxable property in Wyoming in 1926 was $457,760,169, in 1935 $300,022,218, and in 1940 $330,022,618. The figure for 1935 was the lowest taxable valuation of the state since the year 1919. There are 478 units of government in Wyoming that levy general property taxes, the state, 23 counties, 79 cities and towns and 375 school districts. In addition, there are drainage and irrigation districts that levy special assessments. For state purposes, property taxes are limited to 4 mills on the dollar of assessed valuation (generally 60% of true valuation), except for support of state educational and charitable institutions and payment of state debt. In 1935 a 2% excise tax was initiated on retail sales of all tangible personal property including services by carriers, telephone and telegraph, public utilities, municipal and private, and places of amusement. This sales tax became a principal source of state revenue. Another important source of revenue has been the wholesaling of liquor. For the two years ending Sept. 30, 1940, sales and use taxes returned $3,464,306.96; the Wyoming liquor com-

mission (liquor wholesaling) revenues were $1,196,700.83; state property taxes returned $1,154,732.17; insurance taxes returned $360,557.41 (from a levy of 2½% on the premiums received by insurance companies); inheritance taxes returned $66,870.53 (basic 2% tax with exemption of $10,000); and automobile taxes returned $55,434.05. The property tax levy declined from $1,269,176 in 1934 to $617,000 in 1936, and to $495,852.75 in 1940 as the levy was changed from 4·13 mills to 2 mills to 1·5 mills.

Each person between the ages of 21–50 is subject to a $2 school poll tax. A state tax of 4 cents per gallon is levied on all gasoline used or sold for domestic consumption.

The report of the state treasurer for the biennium ending Sept. 30, 1940, showed total receipts of $29,342,596.89 and total disbursements of $27,560,756.39. This was a decline from the biennium ending Sept. 30, 1936, when the receipts totalled $36,861,241 and disbursements totalled $31,320,989.

The bonded debt of Wyoming Sept. 30, 1940 was $3,878,000. Of this total $2,800,000 represented state highway bonds, and $623,000 represented bonds issued for the construction of buildings at the University of Wyoming.

Education.—The department of education, which administers the public school system of Wyoming, is composed of the superintendent of public instruction and six members, appointed by him, who serve for six years and without salary. To carry into effect their plans and decisions the department appoints, with the governor's approval, a commission of education upon which the actual work of travelling, inspection and correspondence falls.

The total school attendance in 1939–40 was 56,199 out of a school census population of 72,283. Of the total number registered in 1940, 39,917 were enrolled in the elementary schools of the state, and 16,282 in the secondary schools. High school enrolment has increased steadily, from 11,164 in 1930. The average daily attendance in the public school system during 1939–40 was 47,234. The average number of days schools were in session, exclusive of holidays, in the school year 1939–40 was 172. An effort to improve the rural schools, begun in the 1920s, has borne fruit. Improved equipment and facilities have been introduced. Buses bring most of the rural enrolment to school. In 1939–40, 644 bus routes were maintained, and 13,650 pupils were carried daily.

Like many other western states, Wyoming received, upon its admission to the union, a grant from the federal government of one-sixteenth of the land within its borders for school purposes. Income from the sale of this land is to be held in a permanent school fund, only the interest of which may be used, with any proceeds which may come from leasing the land. Royalties from oil, coal and other minerals on these lands also go into this fund; and in addition 5% of all receipts for federal lands sold within Wyoming's borders. This permanent fund increased from $3,153,516 in 1920 to $18,872,125 in 1932 and to $20,830,897.35 in 1940; and its income available for use in the school year 1939–40 was $802,108.75. When oil and other minerals are obtained from federal lands within the state, the U.S. government pays to Wyoming certain royalties on such minerals, 50% of which is distributed to the school districts of the state, upon the basis of the number of teachers and drivers of school buses. The continuing royalty on oil is a welcome supplement to the amount secured by direct taxation. Government royalties distributed among the school districts in the school year 1939–40 amounted to $321,790.20.

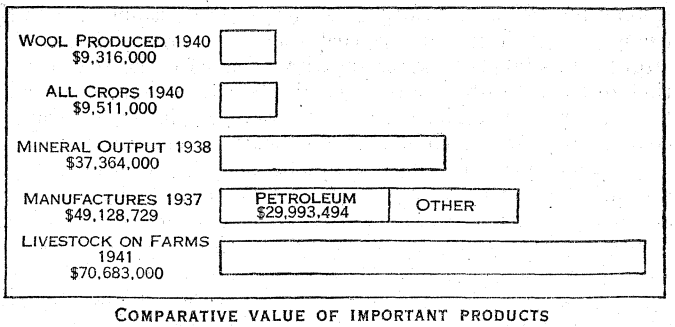
School expenditures in 1939–40 totalled $6,877,676.85. Of this amount, $197,262.77 was for the salaries and expenses of superintendents; $212,273.69 for the salaries of principals and supervisors; $496,851.08 for the salaries of high school men teachers; $527,173.33 for the salaries of high school women teachers; $1,198,511.20 for the salaries of grade and special teachers; and $654,586.42 for the salaries of rural teachers. In 1939–40 there were 2,805 teachers employed in the Wyoming schools: 652 men and 2,153 women.

An equalization fund was established in 1935 to equalize educational opportunity. The plan is to enable schools to maintain the minimum program established by law. Up to 1940 a total of $1,325,541.77 was received into the fund, of which $1,314,373.30 was distributed. The sections of the state which were most affected by drought and grasshoppers received the largest shares in the funds available.

The University of Wyoming, the only institution of higher learning in the state, is at Laramie. The university had a 1940 fall-quarter enrolment of 2,110, the highest in its history, and a faculty of 160. The legislature granted a sum of $1,055,500 for the biennium, 1941–42. This appropriation included as principal items $760,000 for the main university; $104,000 for agricultural extension; $90,000 for new equipment; $50,000 for the state experiment farms; $25,000 for athletic improvements. Although the university opened its doors in 1887, most of the buildings are comparatively new. A new liberal arts building was completed in 1936, a new student union building in 1939, and a new women's dormitory in 1941. The university was granted a charter of Phi Beta Kappa in 1940. The main library contains 104,397 volumes in addition to pamphlets. The Rocky Mountain Herbarium, largest and most representative collection of plants of the central Rocky mountain region, is also at the university.

Penal and Charitable Institutions.—The Wyoming state penitentiary is at Rawlins and in 1941 had 285 inmates. A dairy and poultry farm, an excellent garden, a shirt factory, and a rug and blanket-weaving plant furnish occupation for the prisoners and pay the major share of the expenses. The state hospital for the insane is at Evanston. In 1941 it had 675 patients, 410 men and 265 women. The hospital has grown rapidly since it was opened with 8 patients in 1889. The sailors' and soldiers' home, with 26 inmates in 1941, is at Buffalo. There is a state training school for feeble-minded children at Lander with an enrolment of 400 in 1941. The industrial institute for delinquent boys is at Worland (1941 enrolment, 74), and that for girls is at Sheridan (1941 enrolment, 65). At both these institutions there are extensive grounds where gardening and agriculture are practised. A children's home at Casper takes care of 105 children. At Rock Springs there is a general state hospital providing medical care and surgical attention for the public, and in connection with which a nurses' training school is maintained. Big Horn hot springs and Saratoga hot springs are owned by the state and are free for public use. Appropriations were made and the contract let in 1926 for a state tuberculosis sanitarium at Basin. The sanitarium in 1941 had a bed capacity of 33. All these institutions are under the supervision of the state board of charities and reform, composed of the governor, secretary of state, treasurer, auditor and state superintendent of public instruction. These officials also constitute the board of pardons. Besides the state institutions there is the Cathedral home for children at Laramie, a private institution which operates under an annual permit from the state board to which it is responsible. The deaf and blind are cared for at state expense in schools of the neighbouring states.

Agriculture.—Of the 62,460,160 ac. of land area of Wyoming almost half was privately owned in 1938. The 12 national forests in the state included a gross area of 9,116,786 ac. and a net area of federal ownership of 8,644,163 ac. Government withdrawals of oil, coal and phosphate lands included in 1940 3,158,296 ac. more. According to the state board of equalization, the following acreages and values were recognized for assessment purposes in



COMPARATIVE VALUE OF IMPORTANT PRODUCTS

1940: suburban lands, 14,555 ac. valued at $37.14 per ac.; irrigated first-class lands, 338,897 ac. valued at $31.65 per ac.;

irrigated second-class lands, 373,938 ac. valued at $20.74 per ac.; uncultivated lands with water rights, 262,680 ac. valued at $14.93 per ac.; irrigated pasture lands, 258,292 ac. valued at $8.18 per ac.; dry farm lands, 752,089 ac. valued at $4.31 per ac.; grazing lands, 23,346,848 ac. valued at $1.51 per ac.; coal lands, 81,232 ac. valued at $11.20 per ac.; timber lands, 41,442 ac. valued at $6.12 per ac.; mineral lands, 27,640 ac. valued at $8.34 per ac.; and waste and bog lands, 107,918 ac. valued at $1.03 per ac. (values almost the same as those used in 1936).

Livestock and land values reached their peak in 1929; then agriculture suffered severe depression from which it recovered slowly. In 1930 there were 824,000 head of cattle valued at $45,688,003. By 1935 there were 858,000 cattle valued at only $14,554,304. In 1940 there were 836,000 cattle valued at $19,000,000. Sheep in 1930 numbered 3,417,460 head. In 1940 there were 3,114,000 sheep.

The Federal Grazing administration, under the Taylor Grazing act as amended in 1936, organized five grazing districts within Wyoming to prevent soil deterioration and overgrazing.

The number of farms increased from 16,011 in 1930 to 17,487 in 1935; but according to the 1940 census of agriculture the figure was down to 15,018 farms, representing a 6·2% decrease since 1930. The 1940 census of agriculture gives 28,025,979 ac. for all land in farms and gives the value of farms (land and buildings) as $158,971,294.

Crop Production.—Hay is the leading crop both in acreage and in value, the principal types being alfalfa and wild hay. In 1940 the alfalfa crop totalled 598,000 tons and the wild hay crop amounted to 207,000 tons. Second crop in importance was wheat. In 1935 the wheat yield was 2,706,000 bu. By 1940 the yield had increased to 3,320,000 bu. with an average yield of 33 bu. per ac. The corn yield in 1940 was 1,930,000 bu. Goshen, Laramie, Campbell, Platte and Crook, in order, were the leading corn-growing counties. Sugar-beet production rose from 525,000 tons in 1935 to 634,000 tons in 1940. Bean production also increased, the total in 1940 being 605,000 cwt. as compared with only 460,000 cwt. in 1939. The largest increase in 1940 over 1939 was in the production of alfalfa seed, the total in 1940 being 104,000 bu. as compared with 68,000 bu. in 1939. The potato crop in 1940 was 2,400,000 bu., also a substantial increase in comparison with the figure of 1,620,000 bu. for 1939. The 1940 production of oats was 2,915,000 bu. Rye production in 1940 totalled 168,000 bu., and barley production amounted to 1,838,000 bu. in the same year. The figure for 1940 rye production represents an increase of 5% over the 1939 production; and the 1940 figure for barley represents an 18% increase over the 1939 figure.

Livestock.—The extensive grazing lands of Wyoming, with insufficient rainfall for profitable cultivation, have favoured livestock raising since territorial days. Stockmen have been leaders in territorial and state politics. In the 1870s and 1880s cattle were most important, and cattlemen were dominant. After the 1890s sheep were of great importance. In 1890 there were more cattle than sheep, somewhat more than 1,000,000 of each. In 1940 there were 3,114,000 sheep and only 836,000 cattle. The old antagonism between cattlemen and sheepmen has broken down, and many leading stockmen have both cattle and sheep.

Wyoming has long ranked among the leading states in wool production, her output reaching 38,400,000 lb. in 1910. In 1920 and 1921 she held first place among the states, third in 1922, 1923 and 1924, second in 1925. Later, she generally came after Texas and Montana. The yield in 1934 was 33,212,000 lb. and the yield in 1940 was estimated at 33,000,000 lb. Hogs have not been very numerous in Wyoming, there being 49,000 in 1939. In the same year there were 137,000 horses.

Dairying.—In 1939, 66,000 Wyoming cows valued at $3,828,000 produced $3,081,000 in cash farm milk income. The amount of milk produced was 32,000,000 gal., slightly less than the output of 32,879,000 gal. in 1929. Production of creamery butter totalled 2,709,000 lb. in 1939; cheddar cheese, 826,000 lb., and ice cream, 209,000 gal.

Chickens are raised on 85% of Wyoming farms. In 1940 farm income included $1,273,000 from eggs; $756,000 from sale of chickens; and $100,000 from the sale of baby chicks. In 1940, 312,000 turkeys valued at $583,000 were raised in Wyoming. In 1929 there were 233,016 turkeys, but they were valued at $672,636.

Mining.—Wyoming's most important mineral resources, coal, petroleum and phosphate, are of the bulky sort and their development was long retarded by inadequate transportation facilities. The value of all mineral products in 1909 was $10,572,188; in 1919, $41,928,788; in 1929, $51,237,000 and in 1934, $27,640,000. During these latter years mining fell from its place as the leading Wyoming industry.

Foremost in value is petroleum. Capt. Bonneville reported oil springs near Lander as early as 1832. Oil from such springs was used by the early trappers as liniment, and by the overland emigrants for wagon grease. In 1883 and 1884 the first three wells were drilled near Lander, but lack of transportation facilities made it impossible to market the product on a paying basis. Not until production leaped from 187,000 bbl. in 1911 to 1,572,000 bbl. in 1912 did Wyoming become an important oil-producing state. From 1912 to 1916 the rate of increase was about 1,000,000 bbl. annually. By 1920 production amounted to 16,831,000 bbl.; by 1921 to 19,333,000 barrels. After intensive developments in the Salt Creek district production leaped again from 26,715,000 bbl. in 1922 to 44,785,000 bbl. in 1923. Then the wells began to give out; in 1929 production fell to 19,314,000 bbl., and by 1935 to 13,650,000 bbl. The value of this output during the years 1923, 1924, 1931 and 1934 was respectively $48,900,000, $48,600,000, $11,120,000 and $10,550,000. Of the 1934 production 6,520,000 bbl. came from the Salt Creek district 40 mi. north of Casper. Oregon Basin, Big Muddy, Frannie and Lost Soldier, the next most important oil districts, were producing between 880,000 bbl. and 1,605,000 bbl. each. The construction of a pipe-line in 1924 from the Salt Creek and Teapot Dome fields across Nebraska and Kansas to Freeman, Mo., a distance of 700 mi., enabled the petroleum from Wyoming to enter into competition with oil from the mid-continent fields. The development of its petroleum resources kept Wyoming in a fairly prosperous condition during the years immediately after the war of 1914–18, when depression was general in other industries. Royalties contributed millions of dollars to the state treasury, thereby lessening the taxation burden throughout the state. Oil fields and oil towns furnished a good market for labour and for agricultural produce. In its petroleum output Wyoming in 1939 ranked ninth among the states with 21,417,000 bbl. The committee on petroleum reserves of the American Petroleum institute estimated the state's proved oil reserves at 306,000,000 bbl., thus placing Wyoming tenth among the states in reserves. Deeper drilling and extensions in the Lance Creek field made possible the increased output in the period after 1935. Lance Creek displaced Salt Creek as the leading producer in 1939. In 1940 Wyoming's production included 20,465,457 bbl. of oil and 29,828,909 cu.ft. of natural gas.

Next to petroleum, coal is the most important mineral in the state. Coal-bearing formations underlie about 60% of its area. The largest area known to contain workable coal lies east of the Big Horn mountains and extends from Douglas northward to the boundary, an area of 15,000 sq. miles. Coal mining, however, is carried on in every county of the state, the largest production at present being from the mines of the Union Pacific railway near Rock Springs. The coal is all of the bituminous or sub-bituminous variety. The U.S. geological survey estimates Wyoming to contain over 1,076,000,000,000 tons of coal.

This amounts to about one-seventh of the coal resources of the nation. The output of the coal mines rose from 5,971,000 short tons in 1922 to 6,705,000 short tons in 1929. Production in 1940 was 5,387,621 short tons with an assessed valuation of $10,516,068.

The copper output, valued at $642,213 in 1916 and $553,605 in 1917, mostly from the Encampment district, was worth no more than $280 in 1934 and by 1940 no copper was produced. Gold production rose temporarily after the raising of the purchase price by the United States treasury in 1933; in 1935 3,715 fine oz. were produced, valued at $130,025; but by 1939 production was down

to 583 fine oz. Other mineral production, 1939, included 1,893,612 short tons of sand and gravel valued at $781,283; 252,170 short tons of stone valued at $346,018; 58,911 short tons of raw clay valued at $246,562. Miscellaneous mineral production, 1939, including 275,995 long tons of iron ore, was valued at $1,605,743.

Forests and Lumber.—There are 12 national forests in Wyoming with a gross area of 9,116,786 ac. and a net area of federal ownership of 8,644,163 ac. These forests are all high up in the back country, rugged and remote. About 60% of the timber stand is lodge-pole pine, used mostly for railroad ties. The next most abundant varieties are the Englemann spruce and Alpine fir, which displace the lodge-pole pine at between 8,000 and 9,000 ft. above sea level. In addition to these main types, there are the Douglas fir and limber pine, both restricted in their distribution to favoured localities, the Douglas fir between the lodge-pole-spruce line, especially on moist north slopes, and the limber pine on exposed rocky sites rising toward the timber line, where it usually takes the frontier stand. The timber cut in 1919 was 25,876,000 board feet; in 1929, 26,000,000 board feet; in 1937, 58,000,000 board feet. There is very little cut except in the national forests where it is supervised by the forest rangers. The forests also pastured 125,000 head of cattle and horses, and 575,000 head of sheep for the farmers and ranchers living in the valleys below.

Manufactures.—Except for petroleum refining, manufactures are of little importance in Wyoming, most of them being local in character and dependent on local products for their raw material. In 1937 there were 235 establishments, employing 3,795 workers, paying $5,219,000 in wages, and manufacturing products valued at $40,129,000, of which $16,101,000 was added by manufacture. Of the total value of products $29,993,494 represented the output of 22 oil refineries employing 1,169 men and paying $2,117,522 in wages. Other important industries and the value of their products in 1937 were: bread and other bakery products, $1,419,501; printing and publishing of newspapers and periodicals, $1,013,946; lumber and timber products, $1,359,445; flour and grain-mill products, $841,887; butter, $1,076,855. There were three wholesale meat-packing establishments employing 35 men in 1937.

Transportation.—Wyoming was fortunate in being in the path of the Union Pacific, the first transcontinental railway, which crossed it in 1869. Branches, however, were slow in building, and they are still few, the aim of most railways being to reach Pacific coast connections rather than local development. This handicap has been offset somewhat by good roads and the use of motor vehicles. There were 1,993 mi. of railway in the state in 1940, the Chicago, Burlington and Quincy system leading with 683 mi., the Union Pacific following with 593 mi. The total valuation of the railroads for taxation purposes in 1940 was $76,873,101, of which $41,350,125 was the valuation of the Union Pacific.

Highways.—In 1940 there were 3,863 mi. of state highway in Wyoming. Wyoming had spent $86,620,151 since the creation of the state highway department in 1917 to create this road system. By 1934, 82.2% of the state highway mileage had been completed to a gravel-surface standard. The 1934 legislation made available sufficient revenue to complete the remaining 17.8% within the ensuing ten years. During the biennium 1938–40 the highway department disbursed $9,866,350.18. One-half of the highway fund comes from the federal government, which matches state appropriations. The state highway income consists of 37½% of the oil and mineral royalties, the fees for licences, and a tax of 4¢ a gal. on gasoline. There were 94,249 motor vehicle registrations in 1940.

HISTORY

Wyoming contains land from all four of the principal annexations which made up the territory of the United States west of the Mississippi river. Except for a small portion in Carbon and Albany counties, the land east of the continental divide was acquired from France by the Louisiana Purchase of 1803. The remaining portion formed the northern tip of the Texas annexation in 1854. The north-western corner of the State, drained by the Snake river into the Columbia, formed a part of the old "Oregon Country," held jointly by the United States and Great Britain until the British relinquished their claims in the treaty of 1846. The portion of the State drained south-west into the Colorado river or into the Great Basin was secured by the Mexican cession of 1848.

Exploration.—There are legends of Spanish exploration of Wyoming, but so far they are unconfirmed by documentary evidence. Verendrye, a French explorer, coming overland from the Saskatchewan river, may also have reached the State's borders in 1743, but the vagueness of his journals makes it impossible to determine the fact with certainty. John Colter, a member of the Lewis and Clark expedition who left that body on their homeward trip and plunged back into the wilderness as a free trapper, is the first white man known definitely to have entered the State. Doubtless there were similar wanderers before him whose tales are forever lost. Colter trapped to the east and south of Yellowstone park, and finally, in 1807, crossed that wonderland itself and brought to the world the first news of its strange phenomena. Four years later an expedition of more than 50 men, commanded by Wilson Price Hunt and bound overland to the mouth of the Columbia to begin the American fur trade in that region, entered north-eastern Wyoming, proceeded south and west around the Big Horn mountains, up the Big Horn and Wind rivers, across the divide by Sherman pass, and on by the Snake river valley into Idaho. In 1812 several of the same party, led by Robert Stuart, returned over a more southern route, discovering, it seems almost certain, the famous South pass, through which the Oregon and California trails were later to pass, and exploring for the first time the valleys of the Sweetwater and Platte rivers.

Period of Trappers and Traders.—In the following years a number of free trappers and employees of the various St. Louis fur companies trapped in eastern Wyoming but not until the spring of 1824 was the continental divide again crossed, this time by Thomas Fitzpatrick, leading a detachment of William Henry Ashley's fur traders across to new grounds. Fitzpatrick is usually given the credit for the discovery of South pass, and was the first to make it known. After 1824 several hundred traders crossed it each year, the annual rendezvous of the Americans being held on the other side of the divide, either in the valley of the Green river or in Jackson's Hole. The rendezvous was a colourful frontier gathering of Indians, fur traders and company employees for the purpose of meeting the pack trains of the company and exchanging the furs for next year's supplies. Hundreds of tents and tepees would dot the river bottoms during the frontier's one great social event. In 1834 Ft. Laramie was built by the traders at the confluence of the Laramie and North Platte rivers in eastern Wyoming, and it served as a centre for the fur trade until 1849 when the U.S. Government purchased it to use as a military post for the protection of emigrants.

Overland Emigration through Wyoming began in 1842 when Fitzpatrick piloted the first train over the Oregon trail. Movements increased steadily during the next few years, and in 1847 they were swelled by the Mormon emigration which followed the Oregon trail over the pass and then branched south-west past Ft. Bridger, built by James Bridger on Black's Fork.

The first rush to California came in 1849, the "Forty-niners" following the Oregon trail through Wyoming, and branching south-west after they entered Idaho. The first stage-coach line, over this route, a monthly service to Salt Lake City, started in 1851. In 1858 a daily line from Atchison to San Francisco was travelling the trail. In 1860 the famous Pony Express was established. In 1861 the first telegraph line to the Pacific was constructed across Wyoming along this route.

Indian Hostilities.—In 1862, however, Shoshone and Sioux depredations were so constant that it became necessary to move the stage line to a southern route nearly parallel with the present Union Pacific railway. Government troops were detailed to protect the stage stations, emigrant trains and freighting trains. Indian hostilities increased in 1863, 1864 and 1865 and came to a climax in 1866, known as "the bloody year on the plains." That year Government troops were constantly on the move, and there were numerous engagements in which many soldiers were lost. In attempting to keep open the Bozeman road, a cut-off from Ft. Laramie to the gold mines of Montana, Col. Fetterman and his entire company of 80 men were surprised and massacred. War with the Sioux continued until peace was made in 1868 with their chief, Red Cloud.

Permanent Settlement.—The Union Pacific railway commenced to build across the State in 1867 and pushed rapidly forward. Cheyenne and Laramie were founded at this time. In order to protect and govern new settlements along the railway the Territory of Wyoming was organized in 1868, though territorial officials were not appointed until 1869. At the first territorial legislature, held in Cheyenne in Dec., 1869, women of Wyoming were given the right to vote at all elections. This right

was confirmed by an equal suffrage clause in the State Constitution drawn up in 1889. Wyoming was the pioneer State of the United States, and perhaps of the world, to grant woman suffrage. Gold discoveries in the South pass region in 1867 and 1868 brought additional settlers to the new territory. The first land office was opened in Cheyenne in 1870 and the first homestead entry completed in 1871.

Rise of Cattle Industry.—But Wyoming did not at first prove attractive to homesteaders except in the best valleys along the Union Pacific. Instead it was discovered that the bunch and buffalo grass of the plains made excellent feed for cattle. Not only did they fatten on it in the summer, but the thick ripe bunches, retaining all their nutritious food elements, penetrated the thin snows of the wind-swept plains, enabling the herds to live and thrive all winter without extra food or care. Also cattle could be grazed at a distance from the railroad and when ready for market transported themselves. Soon great herds were on the way north from the overstocked ranges of Texas, cowboys driving them up the "long trail" to the tune of:

> Whoopee ti yi yo, git along little dogies,
> For you know Wyoming will be your new home,

and other trail songs. By the late '70s the ranges of Wyoming were well stocked. Herds increased rapidly and almost without expense. Only a "home ranch" for headquarters was necessary, and the herds ranged far and wide on the public domain. Once or twice a year they were rounded up, the calves branded, and the steers for market cut out from the herd and started on the "drive." The cattle industry sprang suddenly into full bloom in Wyoming and declined almost as suddenly because the cattlemen overreached themselves. The ranges were so overstocked that there was no longer grass left for winter feeding. Thousands upon thousands of cattle perished during severe and long-continued storms of the winters of 1886, 1887 and 1888 so that many "cattle barons" were financially ruined while others were left with only a shadow of their former herds. Disease also broke out among the herds and brought down the market price to less than one-half what it had been.

Cattle War of 1892.—Finally railroads, long blocked by Indian troubles, now pushed forward again, breaking up the ranges, and bringing in the settlers. Stockmen were long bitter against these "nesters." True, stockmen did not own the range, but they had been there first, and most of them would have purchased their lands had not the homestead law forbidden them to do so. Besides, the stockmen felt the land was fit in many districts only for grazing. They were not only inhospitable to the settlers but in many instances took active measures to drive them out of the country. A movement of this sort was the famous Johnson county cattle war of 1892 when more than 50 armed men entered Johnson county in a body against the settlers and small cattle owners, some of whom they branded as "rustlers," while the settlers organized to resist them. Only two lives were sacrificed, owing to the intervention of troops from Ft. McKinney at a decisive moment. It was one of the last struggles of the industry to keep its prestige. After that many big owners were forced out of business, and the country divided up among men with smaller outfits, who took no chances, but cut the hay in the bottom lands for winter feed. Thus began that combination of farming and stock-raising which still prevails and seems best fitted for the State.

Rise of Sheep Raising.—With decline of cattle-raising, sheep-raising began to increase. The first large herds reached the State in the latter '80s. A long feud was also waged between the cattlemen and the sheepmen, for the sheepmen tried to force their way into ranges already occupied. Cattlemen claimed that cattle would not go where sheep had grazed, and that the sheep destroyed the range and polluted the water-holes. An imaginary "deadline" was drawn by the cattlemen beyond which sheep must not go. Herders violated this arbitrary law at their own peril, for the annals of Wyoming record many cases where camps were burned and herds and herders both killed. As the sheepmen grew stronger these persecutions ceased, and when it was found that sheep were fully as profitable as cattle, public opinion sided with the sheepmen. In politics the Republicans more frequently dominated until the Democrats under Roosevelt won the State (1932, 1936, 1940).

BIBLIOGRAPHY.—The most important official State reports are the biennial ones of the treasurer, secretary of State, commissioner of public lands and farm loans, State geologist, board of equalization, department of education, board of charities and reform; the bulletins of the University of Wyoming and the Wyoming state historical department; the yearly bulletin of the state department of agriculture; bulletins of the state geologist, bulletin No. 17 being a *Bibliography and Index of Wyoming Geology 1823–1916*. Miscellaneous Circular No. 28 of the U.S. dept. of agriculture deals with the *National Forests of Wyoming* (1927). For history and government: H. H. Bancroft, *History of Nevada, Colorado and Wyoming* (1890); C. G. Coutant, *History of Wyoming;* G. R. Hebard, *History and Government of Wyoming* (1919); Charles Lindsay, *The Big Horn Basin* (1932). F. Beard (ed.), *Wyoming from Territorial Days to the Present* (1933); John Clay, *My Life on the Range* (1924); A. H. Dixon and C. O. Downing, *Civil Government of Wyoming* (1926); Noel J. Breed, *The Early Developments of the Wyoming Country, 1743–1853* (1928); *Wyoming* (American Guide Series, WPA, 1941); *Reports* of U.S. bureau of the census. (A. T. L.)

WYOMING VALLEY, a valley on the north branch of the Susquehanna river, in Luzerne county, Pennsylvania, U.S.A. The valley, properly speaking, is about 3½m. wide and about 25m. long, but the term is sometimes used historically to include all of the territory in the north-east of the State once in dispute between Pennsylvania and Connecticut. In Connecticut the Susquehanna Land Company was formed in 1753 to colonize the valley, and the Delaware Land Company was formed in 1754 for the region immediately west of the Delaware river. The rights of the Six Nations to all this territory were purchased at Albany (N. Y.), by the Susquehanna Company in 1754, but the work of colonization was delayed by the Seven Years' war. A few colonists settled at Mill Creek in 1763, but were attacked on Oct. 15 and driven away by the Indians. The five original towns of Wilkes-Barré (*q.v.*), Kingston, (*q.v.*), Pittston (*q.v.*), Hanover and Plymouth were founded by the company early in 1769.

In the meantime the Six Nations (in 1768) had repudiated their sale of the region to the Susquehanna Company and had sold it to the Penns. Settlers from Pennsylvania had arrived and taken possession of the block-house and huts at Mill Creek in Jan. 1768. The conflict which followed between the Pennsylvania and the Connecticut settlers is known as the first Pennamite-Yankee War. Although defeated in the early stages of the conflict, the Yankees finally gained the ascendancy and terminated the war in the battle of "Rampart Rocks" on Dec. 25, 1775. The General Assembly of Connecticut, in Oct. 1776, gave the valley the status of a county (Westmoreland county).

As the War of Independence came to a close the old trouble with Pennsylvania was revived. A court of arbitration appointed by the Continental Congress met in Trenton (N.J.), in 1782, and on Dec. 30 gave a unanimous decision in favour of Pennsylvania. The refusal of the Pennsylvania Government to confirm the private land titles of the settlers, and the arbitrary conduct of her agent, Alexander Patterson, resulted in 1784 in the outbreak of the second Pennamite-Yankee War. Treachery and harsh treatment by the Pennsylvania officers created a strong public opinion in favour of the Yankees, and the Government was compelled to adopt a milder policy. Patterson was withdrawn, the disputed territory was erected into the new county of Luzerne (1785), the land titles were confirmed (1787), and Col. Timothy Pickering (*q.v.*) was commissioned to organize the new county and to effect a reconciliation. The trouble was again revived by the repeal in 1790 of the confirming act of 1787 and by a subsequent decision of the U.S. circuit court, unfavourable to the Yankees, in the case of *Van Horn* v. *Dorrance.* All of the claims were finally confirmed by a series of statutes passed in 1790, 1802 and 1807. Since 1808, mainly through the development of its coal mines (*see* PITTSTON, PA.), the valley has made remarkable progress both in wealth and in population.

For a thorough study of the early history of Wyoming Valley, *see* O. J. Harvey, *A History of Wilkes-Barré.*

WYON, THOMAS (1792–1817), English medallist, was born at Birmingham. He was apprenticed to his father, the chief engraver of the king's seals, and studied at the Royal Academy, London. He became probationary engraver to the Mint in 1811,

and engraved his medal commemorative of the peace, and his Manchester Pitt medal. In 1815 he was appointed chief engraver to the Mint. His younger brother, Benjamin Wyon (1802–1858), his nephews, Joseph Shepherd Wyon (1836–1873) and Alfred Benjamin Wyon (1837–1884), and his cousin, William Wyon (1795–1851), were also distinguished medallists.

WYRE FOREST, the remains of an ancient forest in south-eastern Shropshire and northwestern Worcestershire. It lies on high ground southwest of the Severn river and contains some fine scenery. It forms the southern portion of the Severn valley coal-fields. Wyre Forest station is on the G.W.R. three miles north-west of Bewdley.

WYSPIAŃSKI, STANISLAW (1869–1907), Polish painter and dramatist, was born in Cracow in 1869. His paintings reveal a genius for dramatic construction, but the loss of the use of his hand forced him to turn to writing. *Wesele* (The Wedding) is usually regarded as his greatest work and has a high place in Polish literature. The three tragedies *A Warsaw Song, Lelewel* and *November Night* constitute a vivid and powerful portrayal of the November revolution of 1830. In these plays and in *The Legion, Deliverance* and *The Acropolis* he gives voice to the national aspirations of his countrymen and concentrates on the causes of weakness in his nation which put off the hour of its delivery. *The Curse* and *The Judges* are concerned with the lot of the peasants, their ignorance and passions and the pathos of their lives. They adapt the form of the Greek tragedies, the people of the village forming the chorus which comments on the actions of the principal characters. *Boleslas the Bold, The Church on the Rock, King Casimir* are historical dramas. Wyspiański seems to have felt prophetically the approach of a stormy era of war and sacrifice which his people must prepare to meet. The World War greatly increased his influence and Polish drama of recent times has remained under his spell.

WYSS, JOHANN (1781–1830), Swiss author, was born on Mar. 13, 1781, at Bern, where in 1806 he became professor of philosophy and later chief librarian of the University. He was a collector of Swiss tales and folklore, writing *Idyllen und Erzählungen aus der Schweiz* (1815–22), and editing the 15 volume collection *Alpenrose* (1811–30). He is better remembered, however, as the author of *Der Schweizerische Robinson* (1812–13), first translated into English in 1820 as *The Swiss Family Robinson* and appearing in many editions since. He is also the author of the Swiss National hymn, "Rufst du, mein Vaterland?" He died at Bern on Mar. 31, 1830.

WYTHE, GEORGE (1726–1806), American jurist, was born in the county of Elizabeth City, Va., in 1726. He had little formal schooling but was well taught by his mother and was admitted to the Virginia bar in 1757. He was elected to the house of burgesses in 1758 and as such in 1764 was placed on a committee to prepare petitions to the King and both houses of Parliament against the threatened Stamp Act. Wythe drew up the petition to the House of Commons in such strong language that it required considerable modification before it could be sent. In 1775 he was sent to the Continental Congress where he remained to sign the Declaration of Independence. In 1776 he was appointed with Jefferson and Pendleton to make the laws of Virginia more appropriate for an independent State, an important work which required three years to complete. In the meantime he was an important member of the constitutional convention in Virginia. He was a member of the Federal constitutional convention in 1787, and, in the following year, of the Virginia convention which ratified it.

In 1777 Wythe was appointed a judge of the court of chancery, and in 1786 when the court was reorganized he was made sole chancellor of the State, which position he held until his death. He was one of the first judges to lay down the principle (*Comth.* v. *Catron,* 1782) that a court can annul a law deemed to conflict with the constitution, a doctrine which became of tremendous importance as applied by his pupil, John Marshall (*q.v.*). From 1779 to 1789 he also held a professorship of law at William and Mary College, one of the first such chairs in the United States, but his increasing duties as chancellor forced him to relinquish it. He continued a private school at Richmond afterward. Wythe's influence as a teacher probably constituted his most lasting service to the nation. Besides the great chief justice, Marshall, two presidents, Thomas Jefferson and James Monroe, were numbered among his pupils, and Henry Clay was for four years clerk of his court. Wythe died at Richmond, Va., on June 8, 1806. His *Decisions* were published in 1795 (2nd. ed. with memoir, 1852).

Thomas Jefferson prepared a sketch found in his *Writings* (Monticello ed., vol. i., 1904). *See* also L. S. Herrink, "George Wythe," in *John P. Branch Historical Papers,* vol. iii. (1912).

WYTTENBACH, DANIEL ALBERT (1746–1820), German-Swiss classical scholar, was born at Bern on Aug. 7, 1746. He studied Greek under Heyne at Göttingen, and dedicated his first work to Ruhnken, who wrote that he had not expected to find in Germany such knowledge of Greek and such critical powers. Heyne recommended him to Ruhnken and Valckenaer, and in 1770 he went to Leyden. He obtained a professorship in 1771, and began his *Bibliotheca Critica,* which continued to appear for about 30 years. He became professor of Greek at the Athenaeum at Amsterdam in 1785. He edited the *Moralia* of Plutarch for the Clarendon Press, the second portion of which underwent strange adventures during the war between Holland and Great Britain, and was eventually found at Hamburg. The book was finished in 1805. He went to Amsterdam in 1799 on Burmann's death and published his charming *Vita Ruhnkenii* (Leyden, 1799). During his last years he became nearly blind. His only important work was his edition of the *Phaedo,* and he died of apoplexy on Jan. 17, 1820.

Hemsterhuis, Valckenaer, Ruhnken and Wyttenbach, more than any others after Bentley, laid the foundations of modern Greek scholarship. The precise study of grammar, syntax and style, and the careful criticism of texts by the light of the best manuscript evidence, were upheld by these scholars in the Netherlands when they were almost entirely neglected elsewhere on the Continent, and were only pursued with partial success in England.

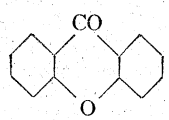
WYVERN, WIVERN or **WYVER,** the name of an heraldic monster, with the forepart of a winged dragon and the hind part of a serpent or lizard (*see* HERALDRY). The earlier spelling of the word was *wiver* or *wivere*; O.E. *wyvre;* O.Fr. *wivre,* mod. *givré.* It is a doublet of "viper," with an excrescent *n,* as in "bittern," M.E. *bitore.*

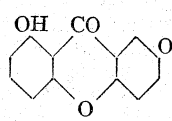
X IN both the eastern and western Greek alphabets a form Χ or + occurred, but it had a different value in each. In the western it was used to represent the double sound *ks*, with which value it passed into Latin and came down to modern times. In the eastern or Ionic alphabet it had the value of the unvoiced velar aspirate (*kh*). We have insufficient evidence to determine the exact nature of the connection between the forms in both alphabets or the origin of either. It is possible that the western Χ with the value of modern X was descended from the same stem as Semitic ⌶ (*samech*), which is otherwise represented in the Greek alphabet only by its name transferred to another letter. It is, however, far from certain that this is so, and were it the case the value of the letter in the east would not be accounted for. Certain facts tend to show that the forms were regarded as one letter in spite of its difference in value in the two alphabets. In the Lydian alphabet a form ⊹ occurs, whose value cannot always be determined, though it appears in some cases to be that of *p*. The letter was probably in use in the Asianic alphabet from which the Greeks derived their own representing a sound that did not occur in Greek. (B. F. C. A.)

XANTHIC ACID (xanthogenic acid), the name applied to any one of a group of organic acids, which are the mono-esters of dithiocarbonic acid. Their alkali-metal salts are obtained by the action of an alcoholic solution of the metallic alkoxide or hydroxide upon carbon disulphide, thus: $RONa+CS_2 \rightarrow ROCS.SNa$. The name is derived from the Greek ξανθός, yellow, in allusion to the bright yellow colour of the copper salts. Ethyl xanthic acid, $C_2H_5O.CS.SH$ (also known more simply as xanthic acid) is obtained by the action of dilute sulphuric acid on the potassium salt at 0° C. It is a colourless oil which is very unstable, decomposing at 25° C. into carbon disulphide and alcohol. The potassium salt crystallizes in colourless or pale yellow needles and is formed by shaking carbon disulphide with a solution of potassium hydroxide in absolute alcohol. On the addition of cupric sulphate to its aqueous solution it yields a yellow precipitate of cuprous xanthate. Potassium xanthate is used in the flotation of ores (*see* METALLURGY) and in the control of insect pests. Salts of the xanthic acid derived from cellulose are used in the production of viscose silk (*see* SYNTHETIC FIBRES). (G. W. WD.)

XANTHIPPE, the wife of Socrates (*q.v.*). Her name has become proverbial in the sense of a nagging, quarrelsome woman. Attempts have been made to show that she has been maligned, notably by E. Zeller ("Zur Ehrenrettung der Xanthippe," in his *Vorträge und Abhandlungen*, i, 1875).

XANTHONE, in organic chemistry, a compound containing a ring system (formula I) similar to that present in many of the natural colouring matters. (*See* ANTHOCYANINS AND ANTHOXANTHINS; CHEMISTRY: *Organic: Heterocyclic Division.*)

(I) 



(II)

It is dibenzo-γ-pyrone, $C_{13}H_8O_2$, and crystallizes in needles which melt at 173–174° C.; it boils at 350° C. and is volatile in steam. Its yellow solution in concentrated sulphuric acid has a blue fluorescence. Xanthone is prepared by the thermal decomposition of phenyl salicylate (salol). Euxanthone (1:7-dihydroxyxanthone, formula II) is the colour principle in Indian yellow obtained from the urine of cows fed on mango. In this dye the euxanthone is partly free and partly present as the calcium or magnesium salt of euxanthic acid (a combination of euxanthone and glucuronic acid) crystallizing in yellow needles (m.p. 237° C.). Euxanthone is prepared synthetically by condensing resorcinol with hydroquinonecarboxylic acid.

Gentisein, a trihydroxyxanthone, of which the methyl ether (gentisin) is contained in the gentian root, dyes mordanted cotton in bright yellow shades and has been synthesized from phloroglucinol and hydroquinonecarboxylic acid.

XANTHUS (mod. Günük), an ancient city of Lycia, on the river Xanthus (Eshen Chai) about 8 mi. above its mouth. It was besieged by the Persian general Harpagus (546 B.C.), when the acropolis was burned and all the inhabitants perished (Herod. i, 176). The city was afterwards rebuilt; and in 42 B.C. it was besieged by the Romans under M. Junius Brutus. It was taken by storm and set on fire, and the inhabitants perished in the flames. The ruins lie on a plateau, high above the left bank of the river. The nearest port is Kalamaki, whence a tedious ride of three to four hours round the edge of the great marsh of the Eshen Chai brings the traveller to Xanthus. The whole plan of the city with its walls and gates can be discerned. The well-preserved theatre is remarkable for a break in the curve of its auditorium, which has been constructed so as not to interfere with a sarcophagus on a pedestal and with the "Harpy monument" which still stands to its full height, robbed of the reliefs of its parapet (now in the British museum). In front of the theatre stands the famous stele of Xanthus inscribed on all four sides in Lycian and Greek. Behind the theatre is a terrace on which probably the temple of either the Xanthian Apollo or Sarpedon stood. The best of the tombs—the "Payava tomb," the "Nereid monument," the "Ionic monument" and the "Lion tomb"—are in the British museum, as the result of Sir Charles Fellows' expedition; only their bases can be seen on the site. A fine triple gateway, much polygonal masonry, and the walls of the acropolis are the other objects of most interest.

See O. Benndorf and G. Niemann, *Reisen in Lykien und Karien* (1884). (D. G. H.)

XAVIER, FRANCIS (Francisco de Yasu y Xavier, 1506–1552) Jesuit missionary and saint, styled the "Apostle of the Indies," was the youngest son of Juan de Yasu, a high official of the kingdom of Navarre and of his wife, Maria Aznarez de Sada, Xavier y Azpilcueta. Francis was born on April 7, 1506, at the castle of Xavier in Navarre and received his early education from the castle's chaplain. Meanwhile, in the struggle between France and Spain for the mastery of Navarre, the Xaviers, who had espoused the cause of the French, came upon evil days. In 1515 Francis' father died of sorrow over the destruction of the kingdom and his elder brothers Juan and Miguel were branded as traitors. The prudent mother was able to save but little from the wreck of the family fortunes.

Francis, cadet (younger son) of a noble family, was destined for the church and early received the tonsure. He was naturally inclined to study, and learning was a way to honours and wealth. His father had received the doctor's degree at Bologna while his uncle Martin de Azpilcueta (1493–1586) was already making a name for himself in canon law and moral theology. Francis determined to follow this example and in 1525 he matriculated at the University of Paris, taking quarters at the Collège de Ste. Barbe, then under the protection of the King of Portugal and frequented especially by Spanish and Portuguese students. Soon after his arrival Xavier made a friend of Peter Favre, a Savoyard, and they became roommates. In 1530 the friends finished their philosophical course and received the title of *magister*, roughly the equivalent of the 20th century Ph. D. In October of that year Xavier began his theological studies, at the same time lecturing on Aristotle to the students of the Collège de Dormans-Beauvais.

In 1528 there had arrived at Paris a man who was destined to change the whole outlook of Xavier and his friend Favre. This was the ex-soldier Ignatius Loyola (*see* LOYOLA, IGNATIUS OF). Xavier and Favre were among his first permanent disciples. Ignatius did not win Xavier without a struggle and he afterward stated that Xavier was the stiffest clay he had ever moulded.

But by 1533 Ignatius had won Xavier completely to the service of Christ. He was among the six first companions of Ignatius who on Aug. 15, 1534, pronounced vows and formed a union which was to result in the foundation of the Society of Jesus six years later. Xavier remained in Paris until the end of 1536 and during this period he made the "Spiritual Exercises" under the guidance of Loyola. In Jan. 1537 the companions met in Venice, hoping to be able to make a pilgrimage to the Holy Land. During the following spring they went to Rome where Paul III received them with kindness, blessed their plan of pilgrimage, and authorized the ordination of those who were not already priests. Xavier was ordained at Venice on June 24, 1537. While waiting for an opportunity to sail to Palestine, Ignatius and his companions led a life of poverty, self-denial and zealous apostolic endeavour in the cities of Italy. Xavier laboured in Venice, Monselice near Padua, Vicenza and Bologna. At the close of 1538 Ignatius concluded that it was vain to wait any longer for an opportunity to make the pilgrimage which they had vowed. He accordingly summoned the companions to Rome to deliberate about their future. Xavier took an active part in the conferences which led to the foundation of the Society of Jesus, of which he was the first secretary. At the same time he showed himself active in works of zeal among the Romans. When, however, Paul III formally approved the Society of Jesus in Sept. 1540, Xavier was no longer at Rome.

John III of Portugal on the advice of the rector of the Collège de Ste. Barbe had asked the pope for six companions of Ignatius for work in the immense Portuguese colonial empire in the East. Paul III granted the request but reduced the number to two. Ignatius assigned Rodrigues and Bobadilla to the mission. When Bobadilla fell sick, Xavier was named to replace him. Two days later on March 16, 1540, Xavier took leave of Ignatius and set out for Portugal. While waiting at Lisbon for transportation to the east, Xavier and Rodrigues laboured with so much spiritual success that John III wished to retain both in Portugal and actually succeeded in retaining Rodrigues.

Mission in the Portuguese East Indies:—On his 35th birthday, April 7, 1541, Francis Xavier set sail from Lisbon and, after wintering in Mozambique where he was seriously ill of fever, arrived at Goa, capital of the Portuguese Indian Empire on May 6, 1542. His first act was to present himself to the bishop, the Franciscan Juan de Albuquerque, and show his credentials, among which was a papal brief, obtained by John III, and appointing Xavier papal legate for the Indies. Xavier promised to make use of these powers according to the directions of the bishop. Dominicans and Augustinians, as well as Franciscans, were already at work in the vast mission field and Xavier looked upon himself as their collaborator. Goa was to be his headquarters and was the scene of his first labours in the east. For five months he devoted himself exclusively to the welfare of the Portuguese and their servants in the capital. He went into the streets and gathered a crowd about him by ringing a small bell. Children, workingmen and slaves would gather sometimes to the number of 300. Xavier would lead them to the principal church and give them instruction in Christian doctrine. By this and other means he sought to rouse the consciences of the Christians of Goa.

In Oct. 1542, Xavier went to the southern tip of the peninsula to work among the Paravas of the Fishery coast. These pearl fishers had accepted Portuguese protection against the Moslem and with it baptism. Much remained to be done, however, to make them a truly Christian people. For two years, 1542–44, Xavier was principally occupied, assisted by some priests, catechists and interpreters, in completing the instruction of the baptised, building churches and chapels, settling disputes among the villages, organizing the defense against, and making peace with, external enemies. At the same time he preached to crowds and baptised thousands. In the last month of 1544 he baptised ten thousand fisher folk of Macua in the neighbouring kingdom of Travancore, writing that his arm had grown lame from pouring the baptismal waters. Schurhammer estimates that in all he baptised about 30,000 in southern India.

In 1545 after visiting Cochin, San Thomé near Madras (with its shrine of St. Thomas the Apostle) and Ceylon, Xavier set out for the east, arriving in September at Malacca. Here he worked to revive the faith of the Portuguese while he planned a voyage to the Spice Islands. On Jan. 1, 1546 Xavier sailed for Amboina where he passed the spring. The summer was spent at Ternate. Later Halmahera and Morotai were visited. In May 1547 Xavier left the Moluccas and returned to Malacca.

Mission to Japan.—In Malacca Xavier was presented to Hachiro (Yajiro, Anjiro), a native of newly discovered Japan. What he learned from this Japanese and from the Portuguese who had visited the island empire filled the heart of Xavier with joy. The simple fisher folk of southern India and the barbarous natives of the Moluccas seemed incapable of being the foundation stones of the church in the far east. But Japan was a populous country with an ancient culture and its inhabitants, could they be won for Christianity, would probably afford ideal material for the development of Christianity. Xavier felt that he was called by God to evangelize Japan and accordingly began his preparations. Hachiro and two other Japanese were despatched to Goa for instruction and baptism. Xavier himself also returned to India, visiting Ceylon, Cochin and the Fishery coast as well as Goa, and all the time preparing for the Japanese expedition.

In 1549, accompanied by three Japanese and two other Jesuits, Xavier set out on the long hazardous voyage to Japan. On Aug. 15, 1549 the little expedition landed at Kagoshima, the country of Hachiro. Xavier was the first Christian missionary to Japan of whom there is any record. The *daimyo* of Kagoshima received the party in a friendly manner and converts were made. Until Nov. 20, 1551, Xavier remained in the country preaching at Hirado, Kyoto, the capital, Yamaguchi and Bungo, as well as at Kagoshima. During this time he baptised about two thousand; most of them were members of the lower classes but some, particularly in Yamaguchi, belonged to the military caste. Actual converts were the least part of Xavier's work in Japan. He explored and organized a new field of missionary labour, which was destined to show tremendous results. The spiritual quality of the Japanese promised a brilliant future for Christianity in Japan, a promise which was, however, obliterated in blood at the turn of the century.

Voyage to China.—On his way to Japan Xavier had touched at Canton. In Japan he had met Chinese and had formed a high opinion of their capabilities. He knew that no pagan land could be compared to China in population and wealth. He saw that the Japanese esteemed Chinese culture. It was inevitable then that Xavier should make an attempt to penetrate into the Chinese empire, then closed to foreigners.

But other business had to be despatched first. Xavier learned at Malacca that Ignatius Loyola, as general of the Society of Jesus, had separated India and the east from the jurisdiction of the Provincial of Portugal and formed it into a new "province" of the society. The first provincial was to be Xavier himself. It is probable that Loyola had taken this step to free the great missionary from fetters imposed by nationalistic feeling among the Portuguese. Studying the reports from the missions he had inaugurated, Xavier learned that his companions and successors on the Fishery coast, in Thana near Bassein, in Quilon, at San Thomé, in Ternate and the Moluccas (except Amboina) and finally in Ormuz were struggling heroically to advance the work against great difficulties. Almost everywhere progress was reported. Xavier was finally able to make satisfactory arrangements in the College at Goa, which was destined to furnish native priests for the missions. This task occupied Xavier until April 1552.

When his duties as provincial had been attended to, Xavier turned toward China. In India he elaborated a plan for an embassy to the Emperor of China by which he hoped to negotiate an alliance between Portugal and China and so be enabled to begin a Christian mission among the Chinese. At Malacca the Commandant Alvaro de Ataide firmly refused to allow the embassy, which he considered an infringement of his rights, to depart. Xavier then decided to go alone. He sailed to Sancian (Shang Ch'uan) an island off the south coast of China not far from Canton. Here he arrived during the last days of Aug. 1552 and for more than three months tried in vain to obtain passage to the mainland. Toward the end of November, Xavier, who was practically abandoned, fell seriously ill. On Dec. 3, 1552 (not Nov. 27) he died before the closed doors of the great empire he

longed to convert.

Achievement.—Xavier deserves to be ranked as one of the greatest Christian missionaries with Patrick, Boniface, Columba and Anskar. Charges of superficiality and instability have been made, but these rest on a misunderstanding of the circumstances and of the position of Xavier, who was mission superior as well as missionary. An organizer of great gifts and a saint whose very appearance gave him a spiritual ascendancy, Xavier united the fiery but cheerful temper of the Navarrese, the tact of the nobleman, and the learning of the graduate of Paris to the stubborn persistence and dauntless daring of the Basque. The first Jesuit missionary and founder of the Christian mission to the Japanese, he was a pioneer of modern missionary method by his careful examination and occupation of the mission field. He favoured the study of the languages, religions and customs of the natives, made use of native collaborators, endeavoured to create a mission literature in the vernacular and strove to organize his missions thoroughly. Xavier was canonized in 1622.

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XENIA, a city of south-western Ohio, U.S.A., the county seat of Greene county; 16 m. S.E. of Dayton, near the Little Miami river, at an altitude of 910 feet. It is served by the Baltimore and Ohio and the Pennsylvania railways, and buses. Pop. (1930) 10,507; (1940) 10,633. It is the trade centre of a rich farming and stock-raising district; the seat of the Ohio Soldiers' and Sailors' Orphans' home; and an important manufacturing city, making rope, twine and cordage, monuments, furniture and various other commodities. About 3m. N.E. is Wilberforce University for Negroes (1856). Xenia was laid out in 1803, incorporated as a town in 1808 and as a city in 1870. It has a city-manager form of government.

XENOCRATES, OF CHALCEDON (396–314 B.C.), Greek philosopher and rector of the Academy from 339 to 314 B.C., removed to Athens in early youth. He became the pupil of the Socratic Aeschines, but presently joined himself to Plato, whom he attended to Sicily in 361. Upon his master's death (347 B.C.), in company with Aristotle he paid a visit to Hermias at Atarneus. In 339, Aristotle being then in Macedonia, Xenocrates succeeded Speusippus in the presidency of the school. On three occasions he was member of an Athenian legation, once to Philip, twice to Antipater. Soon after the death of Demosthenes in 322, resenting the Macedonian influence then dominant at Athens, Xenocrates declined the citizenship offered to him at the instance of Phocion, and, being unable to pay the tax levied upon resident aliens, was sold, or on the point of being sold, into slavery. He died in 314, and was succeeded by Polemon, whom he had reclaimed from a life of profligacy. Besides Polemon, the statesman Phocion, Chaeron, tyrant of Pellene, the Academic Crantor, the Stoic Zeno and Epicurus are alleged to have frequented his lectures.

Xenocrates's earnestness and strength of character won for him universal respect. Wanting in quickness of apprehension and in native grace, he made up for these deficiencies by a conscientious love of truth and an untiring industry. Less original than Speusippus, he adhered more closely to the letter of Platonic doctrine, and is accounted the typical representative of the Old Academy. With Plato Xenocrates postulated ideas or numbers to be the causes of nature's organic products, and derived these ideas or numbers from unity (which is active) and plurality (which is passive); but unlike Plato, he took for his principles arithmetical unity and plurality, and accordingly identified ideal numbers with arithmetical numbers. In thus reverting to the crudities of certain Pythagoreans, he laid himself open to the criticisms of Aristotle, who, in his *Metaphysics,* recognizing amongst contemporary Platonists three principal groups—(1) those who, like Plato, distinguished mathematical and ideal numbers; (2) those who, like Xenocrates, identified them; and (3) those who, like Speusippus, postulated mathematical numbers only—has much to say against the Xenocratean interpretation of the theory, and in particular points out that, if the ideas are numbers made up of arithmetical units, they not only cease to be principles, but also become subject to arithmetical operations. Xenocrates's theory of inorganic nature was substantially identical with the theory of the elements propounded in the *Timaeus,* 53 C *seq.* Nevertheless, holding that every dimension has a principle of its own, he rejected the derivation of the elemental solids—pyramid, octahedron, icosahedron and cube—from triangular surfaces, and in so far approximated to atomism. Moreover, to the tetrad of simple elements—viz., fire, air, water, earth—he added ether. His cosmology was also drawn almost entirely from the *Timaeus.*

Soul is a self-moving number, derived from the two fundamental principles, unity and plurality whence it obtains its powers of rest and motion. It is incorporeal, and may exist apart from body. The irrational soul, as well as the rational soul, is immortal. The universe, the heavenly bodies, man, animals, and presumably plants, are each of them endowed with a soul. Xenocrates identifies the universe and the heavenly bodies with the greater gods, and reserves a place between them and mortals for the lesser divinities. Xenocrates appears to have recognized three grades of cognition, each appropriated to a region of its own—viz., knowledge, opinion and sensation, having for their respective objects supra-celestials or ideas, celestials or stars, and infra-celestials or things. Of his logic we know only that with Plato he distinguished τὸ καθ' αὑτό and τὸ πρός τι, rejecting the Aristotelian list of ten categories as a superfluity.

Valuing philosophy chiefly for its influence upon conduct, Xenocrates bestowed especial attention upon ethics. He wrote much upon this subject; but the indications of doctrine which have survived are scanty. Things are goods, ills or neutrals. Goods are of three sorts—mental, bodily, external; but of all goods virtue is incomparably the greatest. Happiness consists in the possession of virtue, and consequently is independent of personal and extraneous advantages. The virtuous man is pure, not in act only, but also in heart. To the attainment of virtue the best help is philosophy; for the philosopher does of his own accord what others do under the compulsion of law. Speculative wisdom and practical wisdom are to be distinguished.

Xenocrates was not in any sense a great thinker. His metaphysic was a travesty rather than a reproduction of that of his master. His ethic had little which was distinctive. But his austere life and commanding personality made him an effective teacher, and his influence, kept alive by his pupils Polemon and Crates, ceased only when Arcesilaus, the founder of the so-called Second Academy, gave a new direction to the studies of the school.

See D. Van der Wynpersse, *De Xenocrate Chalcedonio* (Leiden, 1822); C. A. Brandis, *Gesch. d. griechisch-römischen Philosophie* (Berlin, 1853), ii. 2, 1; E. Zeller, *Philosophie d. Griechen* (Leipzig, 1875), ii. 1; F. W. A. Mullach, *Frag. Philo. Graecorum* (Paris, 1881), iii., and Überweg, *Grundriss der Gesch. der Philosophie,* Bd. I. (1926).
(H. JN.; X.)

XENON, a very rare gas occurring to the extent of one part in about 20 million parts of the atmosphere (*q.v.*). Xenon (symbol Xe, atomic number 54, atomic weight 130·2), was isolated in 1898 by Sir W. Ramsay and M. W. Travers who liquefied it at −109° C and solidified it at −140° C.

XENOPHANES of Colophon, the reputed founder of the Eleatic school of philosophy, is supposed to have been born in the third or fourth decade of the 6th century B.C. An exile from his Ionian home, he resided for a time in Sicily, at Zancle and at Catana, and afterwards established himself in southern Italy, at

Elea, a Phocaean colony founded in the 61st Olympiad (536–533). In one of the extant fragments he speaks of himself as having begun his wanderings 67 years before, when he was 25 years of age, so that he was not less than 92 when he died. His teaching found expression in poems, which he recited rhapsodically in the course of his travels. In the more considerable of the elegiac fragments which have survived, he ridicules the doctrine of the migration of souls (xviii.), asserts the claims of wisdom against the prevalent athleticism, which seemed to him to conduce neither to the good government of states nor to their material prosperity (xix.), reprobates the introduction of Lydian luxury into Colophon (xx.), and recommends the reasonable enjoyment of social pleasures (xxi.). Of the epic fragments, the more important are those in which he attacks the "anthropomorphic and anthropopathic polytheism" of his contemporaries. According to Aristotle, "the first of Eleatic unitarians was not careful to say whether the unity which he postulated was finite or infinite, but, contemplating the whole firmament, declared that the One is God." Whether Xenophanes was a monotheist, whose assertion of the unity of God *suggested* to Parmenides the doctrine of the unity of Being, or a pantheist, whose assertion of the unity of God was also a declaration of the unity of Being, so that he *anticipated* Parmenides is a question about which authorities differ.

Of Xenophanes's utterances about (1) God, (2) the world, (3) knowledge, the following survive: (1) "There is one God, greatest among gods and men, neither in shape nor in thought like unto mortals. . . . He is all sight, all mind, all ear (*i.e.,* not a composite organism). . . . Without an effort ruleth he all things by thought. . . . He abideth ever in the same place motionless, and it befitteth him not to wander hither and thither. . . . Yet men imagine gods to be born, and to have raiment and voice and body, like themselves. . . . Even so the gods of the Ethiopians are swarthy and flat-nosed, the gods of the Thracians are fair-haired and blue-eyed. . . . Even so Homer and Hesiod attributed to the gods all that is a shame and a reproach among men—theft, adultery, deceit and other lawless acts. . . . Even so oxen, lions and horses, if they had hands wherewith to grave images, would fashion gods after their own shapes and make them bodies like to their own. (2) From earth all things are and to earth all things return. . . . From earth and water come all of us. . . . The sea is the well whence water springeth. . . . Here at our feet is the end of the earth where it reacheth unto air, but, below, its foundations are without end. . . . The rainbow, which men call Iris, is a cloud that is purple and red and yellow. (3) No man hath certainly known, nor shall certainly know, that which he saith about the gods and about all things; for, be that which he saith ever so perfect, yet doth he not know it; all things are matters of opinion. . . . That which I say is opinion like unto truth. . . . The gods did not reveal all things to mortals in the beginning; long is the search ere man findeth that which is better."

There is very little secondary evidence to record. "The Eleatic school," says the Stranger in Plato's *Sophist,* 242 D, "beginning with Xenophanes, and even earlier, starts from the principle of the unity of all things." Aristotle, in a passage already cited, *Metaphysics,* A5, speaks of Xenophanes as the first of the Eleatic unitarians, adding that his monotheism was reached through the contemplation of the *οὐρανός*. Theophrastus (in Simplicius's *Ad Physica,* 5) sums up Xenophanes's teaching in the propositions, "The All is One and the One is God." Timon (in Sext. Empir. *Pyrrh.* i. 224), ignoring Xenophanes's theology, makes him resolve all things into one and the same unity. The demonstrations of the unity and the attributes of God, with which the treatise *De Melisso, Xenophane et Gorgia* (now no longer ascribed to Aristotle or Theophrastus) accredits Xenophanes, are plainly framed on the model of Eleatic proofs of the unity and the attributes of the Ent, and must therefore be set aside.

The wisdom of Xenophanes, like the wisdom of the Hebrew Preacher, showed itself, not in a theory of the universe, but in a sorrowful recognition of the nothingness of things and the futility of endeavour. His theism was a declaration not so much of the greatness of God as rather of the littleness of man. His cosmology was an assertion not so much of the immutability of the One as rather of the mutability of the Many. Like Socrates, he was not a philosopher, and did not pretend to be one; but, as the reasoned scepticism of Socrates cleared the way for the philosophy of Plato, so did Xenophanes's "abnormis sapientia" for the philosophy of Parmenides.

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XENOPHON, Greek historian and philosophical essayist, the son of Gryllus, was born in Athens about 430 B.C. As the description of the Ionian campaign of Thrasyllus in 410 (*Hellenica,* i. 2) is clearly derived from Xenophon's own reminiscences, he must have taken part in this campaign, and cannot therefore have been less than 20 years of age at the time. He belonged to an equestrian family of the deme of Erchia. It may be inferred from passages in the *Hellenica* that he fought at Arginusae (406 B.C.), and that he was present at the return of Alcibiades (408 B.C.), the trial of the Generals and the overthrow of the Thirty. Early in life he came under the influence of Socrates, but an active career had more attraction for him. In 401 B.C., being invited by his friend Proxenus to join the expedition of the younger Cyrus against his brother, Artaxerxes II. of Persia, he at once accepted the offer. It held out the prospect of riches and honour, while he was little likely to find favour in democratic Athens, where the knights were regarded with suspicion as having supported the Thirty. At the suggestion of Socrates, Xenophon went to Delphi to consult the oracle; but his mind was already made up, and he at once proceeded to Sardis, the place of rendezvous. Of the expedition itself he has given a full and detailed account in his *Anabasis,* or the "Up-Country March." After the battle of Cunaxa (401 B.C.), in which Cyrus lost his life, the officers in command of the Greeks were treacherously murdered by the Persian satrap Tissaphernes, with whom they were negotiating an armistice with a view to a safe return. The army was now in the heart of an unknown country, more than a thousand miles from home and in the presence of a troublesome enemy. It was decided to march northwards up the Tigris valley and make for the shores of the Euxine, on which there were several Greek colonies. Xenophon became the leading spirit of the army; he was elected an officer, and he it was who mainly directed the retreat. Part of the way lay through the wilds of Kurdistan, where they had to encounter the harassing guerrilla attacks of savage mountain tribes, and part through the highlands of Armenia and Georgia. After a five months' march they reached Trapezus (Trebizond) on the Euxine (Feb. 400 B.C.). At Cotyora he aspired to found a new colony; but the idea, not being unanimously accepted, was abandoned, and ultimately Xenophon with his Greeks arrived at Chrysopolis (Scutari) on the Bosporus, opposite Byzantium. After a brief period of service under a Thracian chief, Seuthes, they were finally incorporated in a Lacedaemonian army which had crossed over into Asia to wage war against the Persian satraps Tissaphernes and Pharnabazus. Xenophon, who accompanied them, captured a wealthy Persian nobleman, with his family, near Pergamum, and the ransom paid for his recovery secured Xenophon a competency for life.

On his return to Greece Xenophon served under Agesilaus, king of Sparta, at that time the chief power in the Greek world. With his native Athens and its general policy and institutions he was not in sympathy. At Coroneia (394 B.C.) he fought with the Spartans against the Athenians and Thebans, for which his fellow-citizens decreed his banishment. The Spartans provided a home for him at Scillus in Elis, about two miles from Olympia; there he settled down to indulge his tastes for sport and literature. After Sparta's crushing defeat at Leuctra (371 B.C.), Xenophon was

driven from his home by the people of Elis. Meantime Sparta and Athens had become allies, and the Athenians repealed the decree which had condemned him to exile. There is, however, no evidence that he ever returned to his native city. According to Diogenes Laërtius, he made his home at Corinth. The year of his death is not known; all that can be said is that it was later than 355 B.C., the date of his work on the *Revenues of Athens*.

The *Anabasis* (composed at Scillus between 379 and 371 B.C.) is a work of singular interest, and is brightly and pleasantly written. Xenophon, like Caesar, tells the story in the third person. His description of places and of relative distances is very minute and painstaking. The researches of modern travellers attest his general accuracy. It is expressly stated by Plutarch and Diogenes Laërtius that the *Anabasis* was the work of Xenophon, and the evidence from style is conclusive. The allusion (*Hellenica*, iii. 1, 2) to Themistogenes of Syracuse as the author shows that Xenophon published it under an assumed name.

The *Cyropaedia*, a political and philosophical romance, which describes the boyhood and training of Cyrus, hardly answers to its name, being for the most part an account of the beginnings of the Persian empire and of the victorious career of Cyrus, its founder. The *Cyropaedia* contains, in fact, the author's own ideas of training and education, as derived conjointly from the teachings of Socrates and his favourite Spartan institutions. It was said to have been written in opposition to the *Republic* of Plato. A distinct moral purpose, to which literal truth is sacrificed, runs through the work. For instance, Cyrus is represented as dying peacefully in his bed, whereas, according to Herodotus, he fell in a campaign against the Massagetae.

The *Hellenica* written at Corinth, after 362 B.C., is the only contemporary account of the period covered by it (411–362 B.C.) that has come down to us. It consists of two distinct parts; books i. and ii., which are intended to form a continuation of the work of Thucydides, and bring the history down to the fall of the Thirty, and books iii.–vii., the *Hellenica* proper, which deal with the period from 401 to 362 B.C., and give the history of the Spartan and Theban hegemonies, down to the death of Epaminondas. There is, however, no ground for the view that these two parts were written and published as separate works. There is probably no justification for the charge of deliberate falsification. It must be admitted, however, that he had strong political prejudices, and that these prejudices have influenced his narrative. He was a partisan of the reactionary movement which triumphed after the fall of Athens; Sparta is his ideal, and Agesilaus his hero. Hardly less serious defects than his political bias are his omissions, his want of the sense of proportion and his failure to grasp the meaning of historical criticism. The most that can be said in his favour is that as a witness he is at once honest and well-informed. For this period of Greek history he is, at any rate, an indispensable witness.

The *Memorabilia*, or "Recollections of Socrates," in four books, was written to defend Socrates against the charges of impiety and corrupting the youth, repeated after his death by the sophist Polycrates. The work is not a literary masterpiece; it lacks coherence and unity, and the picture it gives of Socrates fails to do him justice. Still, as far as it goes, it no doubt faithfully describes the philosopher's manner of life and style of conversation. It was the moral and practical side of Socrates's teaching which most interested Xenophon; into his metaphysical speculations he seems to have made no attempt to enter: for these, indeed, he had neither taste nor genius. Moving within a limited range of ideas, he doubtless gives us "considerably less than the real Socrates, while Plato gives us something more." It is probable that the work in its present form is an abridgement.

Xenophon has left several minor works, some of which are very interesting and give an insight into the home life of the Greeks.

The *Oeconomics* (to some extent a continuation of the *Memorabilia*, and sometimes regarded as the fifth book of the same) deals with the management of the house and of the farm, and presents a pleasant and amusing picture of the Greek wife and of her home duties. There are some good practical remarks on matrimony and on the respective duties of husband and wife.

In the essays on horsemanship (*Hippikē*) and hunting (*Cynegeticus*), Xenophon deals with matters of which he had a thorough knowledge. In the first he gives rules how to choose a horse, and then tells how it is to be groomed and ridden and generally managed. The *Cynegeticus* deals chiefly with the hare, though the author speaks also of boar-hunting and describes the hounds, tells how they are to be bred and trained, and gives specimens of suitable names for them.

The *Hipparchicus* explains the duties of a cavalry officer. He dwells at some length on the moral qualities which go to the making of a good officer, and hints very plainly that there must be strict attention to religious duties.

The *Agesilaus* is a eulogy of the Spartan king, who had two special merits in Xenophon's eyes: he was a rigid disciplinarian, and he was particularly attentive to all religious observances. We have a summary of his virtues rather than a picture of the man himself.

The *Hiero* works out the line of thought indicated in the story of the Sword of Damocles. It is a protest against the notion that the "tyrant" is a man to be envied, as having more abundant means of happiness than a private person.

The *Symposium*, or "Banquet," to some extent the complement of the *Memorabilia*, is a brilliant little dialogue in which Socrates is the prominent figure. He is represented as "improving the occasion," which is that of a lively Athenian supper-party, at which there is much drinking, with flute-playing, and a dancing-girl from Syracuse, who amuses the guests with the feats of a professional conjurer. Socrates's table-talk runs through a variety of topics, and winds up with a philosophical disquisition on the superiority of true heavenly love to its earthly or sensual counterfeit.

There are also two short essays, attributed to him, on the political constitution of Sparta and Athens, written with a decided bias in favour of the former, which he praises without attempting to criticize. Sparta seems to have presented to Xenophon the best conceivable mixture of monarchy and aristocracy. The second is certainly not by Xenophon, but was probably written by a member of the oligarchical party at Athens shortly after the beginning of the Peloponnesian War.

In the essay on the *Revenues of Athens* (written in 355 B.C.) he offers suggestions for making Athens less dependent on tribute received from its allies. Above all, he would have Athens use its influence for the maintenance of peace in the Greek world and for the settlement of questions by diplomacy, the temple at Delphi being for this purpose an independent centre and supplying a divine sanction.

The *Apology*, Socrates's defence before his judges, in the general opinion of modern critics is not a genuine work of Xenophon, but belongs to a much later period.

The editions of Xenophon's works, both complete and of separate portions, are very numerous, especially of the *Anabasis;* only a selection can be given here. Editio princeps (1516, incomplete); E. C. Marchant (1900–1912, in the Clarendon Press *Scriptorum Classicorum Bibliotheca*). *Anabasis:* J. F. Macmichael (1883); C. W. Krüger and W. Pökel (1888); W. Gemoll (1899). *Cyropaedia:* G. M. Gorham (1870); L. Breitenbach (1875); A. Hug (1883); F. Hertlein and W. Nitsche (1886); H. A. Holden (1887–90). *Hellenica:* L. Breitenbach (1874–84); R. Büchsenschütz (1880–91); O. Keller (1890); G. E. Underhill, *Commentary on the Hellenica* (i.-vii., 1900). *Memorabilia:* A. R. Cluer (1880); R. Kühner (1882); L. Breitenbach (1889); J. Marshall (1890). *Oeconomicus:* H. A. Holden (1895); C. Graux and A. Jacob (1886). *Hiero:* H. A. Holden (1888). *Agesilaus:* R. W. Taylor (1880); O. Güthling (1888). *Resp. Lacedaem.:* G. Pierleoni (1905). *Resp. Atheniensium:* A. Kirchhoff (1874); E. Belot (1880); H. Müller and Strübing (1880); E. Kalinka (1913). *Cynegeticus:* G. Pierleoni (1902). *Hippikē:* Tommasini (1902). *Reditus Athen.:* A. Zurborg (1876). *Scripta Minora:* L. Dindorf (1888). There is a good English translation of the complete works by H. G. Dakyns (1890–94), and of the *Art of Horsemanship* by M. H. Morgan (U.S.A., 1890). Of general works bearing on the subject may be mentioned: G. Sauppe, *Lexilogus Xenophonteus* (1869); A. Croiset, *X., son caractère et son talent* (1873); I. Hartmann, *Analecta Xenophontea* (1887) and *Analecta Xenophontea Nova* (1889); C. Joël, *Der echte und der Xenophonteische Socrates* (1892); Lange, *X., sein Leben, seine Geistesart und seine Werke* (1900). *See* also GREECE: *History: Ancient Authorities*, and works quoted; J. B. Bury, *Ancient Greek Historians* (1909). Bibliographies in Engelmann-Preuss, *Bibliotheca Scriptorum Classicorum* (i., 1880) and in

C. Bursian's *Jahresbericht* (*c.*, 1900) by E. Richter. (E. M. Wa.)

XERXES (the Greek form of the Pers. *Khshayārshā;* Old Testament *Ahasverus, Akhashverosh—i.e.,* Ahasuerus [*q.v.*]—with wrong vocalization and substitution of *y* for *v,* instead of *Akhshavarsh;* in Aramaic inscriptions and papyri from Egypt the name is written *Khshai'arsh*), the name of two Persian kings of the Achaemenid dynasty.

1. Xerxes I., son of Darius I. and Atossa, the daughter of Cyrus the Great, and therefore appointed successor to his father in preference to his eldest half-brothers, who were born before Darius had become king (Herod. vii. 2 f.). After his accession in October 485 B.C. he suppressed the revolt in Egypt which had broken out in 486, appointed his brother Achaemenes as satrap and "brought Egypt under a much heavier yoke than it had been before" (Herod. vii. 7). His predecessors, especially Darius, had not been successful in their attempts to conciliate the ancient civilizations. This probably was the reason why Xerxes in 484 abolished the "kingdom of Babel" and took away the golden statue of Bel (Marduk, Merodach), the hands of which the legitimate king of Babel had to seize on the first day of each year, and killed the priest who tried to hinder him[1]. Therefore Xerxes does not bear the title of "King of Babel" in the Babylonian documents dated from his reign, but "King of Persia and Media," or simply "King of countries" (*i.e.,* of the world). This proceeding led to two rebellions, probably in 484 and 479; in the Babylonian documents occur the names of two ephemeral kings, Shamash-irbā and Tarziya, who belong to this time. One of these rebellions was suppressed by Megabyzus, son of Zopyrus, the satrap whom the Babylonians had slain[2].

Darius had left to his son the task of punishing the Greeks for their interference in the Ionian rebellion and the victory of Marathon. From 483 Xerxes prepared his expedition with great care: a channel was dug through the isthmus of the peninsula of Mount Athos; provisions were stored in the stations on the road through Thrace; two bridges were thrown across the Hellespont. Xerxes concluded an alliance with Carthage, and thus deprived Greece of the support of the powerful monarchs of Syracuse and Agrigentum. Many smaller Greek states, moreover, took the side of the Persians ("Medized"), especially Thessaly, Thebes and Argos. A large fleet and a numerous army were gathered. In the spring of 480 Xerxes set out from Sardis. At first Xerxes was victorious everywhere. The Greek fleet was beaten at Artemisium, Thermopylae stormed, Athens conquered, the Greeks driven back to their last line of defence at the Isthmus of Corinth and in the Bay of Salamis. But Xerxes was induced by the astute message of Themistocles (against the advice of Artemisia of Halicarnassus) to attack the Greek fleet under unfavourable conditions, instead of sending a part of his ships to the Peloponnesus and awaiting the dissolution of the Greek armament[3]. The battle of Salamis (Sept. 28, 480) decided the war. (*See* Salamis.) Having lost his communication by sea with Asia, Xerxes was forced to retire to Sardis; the army which he left in Greece under Mardonius was in 479 beaten at Plataea (*q.v.*). The defeat of the Persians at Mycale roused the Greek cities of Asia.

Of the later years of Xerxes little is known. He sent out Sataspes to attempt the circumnavigation of Africa (Herod. iv. 143), but the victory of the Greeks threw the empire into a state of languid torpor, from which it could not rise again. The king himself became involved in intrigues of the harem (*cf.* Herod. ix. 108 ff.—compare the late Jewish novel of *Esther,* in which a remembrance of the true character of the king is retained) and was much dependent upon courtiers and eunuchs. He left inscriptions at Persepolis, where he added a new palace to that of Darius, at Van in Armenia, and on Mount Elvend near Ecbatana; in these texts he merely copies the words of his father. In 465 he was murdered by his vizier Artabanus (*q.v.*) who raised Artaxerxes I. to the throne.

2. Xerxes II., son and successor of Artaxerxes I., was assassinated in 424 after a reign of forty-five days by his brother Secydianus or Sogdianus, who in his turn was murdered by Darius II. (*q.v.*).

See Ctesias, *Pers.* 44; Diod. xii., 64, 71, and the chronographers; neither of the two ephemeral kings is mentioned in the canon of Ptolemy nor in the dates of Babylonian contracts of this time.

The name Xerxes was also borne by a king of Armenia, killed about 212 B.C. by Antiochus the Great (Polyb. viii. 25; Johannes Antiochenus, p. 53; his name occurs on copper coins); and by a son of Mithradates the Great of Pontus (Appian, *Mithr.* 108, 117). (Ed. M.)

XINCA, a group of about 10,000 Indians living in southern Guatemala along the Rio de los Esclavos, including most of the departments of Santa Rosa and Jutiapa. They were first encountered by the Spaniards under Pedro de Alvarado in 1524 and were finally subdued two years later by Pedro Portocarrero. On account of their stubborn resistance many of them were branded and sold as slaves, whence the name of the river that cuts their territory. The Xinca may be the remnants of an ancient population which preceded the Maya and Nahua. The Maya regarded the Xinca as barbarians, a feeling very generally entertained in Guatemala to-day.

See D. G. Brinton, *On the Xinca Indians of Guatemala* (American Philosophical Society, *Proceedings,* Philadelphia, 1884); Walther Lehmann, *Zentral-Amerika,* 1 Teil, ii. Band (1920).

XIPHILINUS, JOANNES, epitomator of Dio Cassius, lived at Constantinople during the latter half of the 11th century A.D. He was a monk and the nephew of the patriarch of Constantinople of the same name. (Migne, *Patrologia Graeca,* cxx.) The epitome (ἐκλογαί) of Dio which was prepared by order of Michael Parapinaces (1071–78), comprises books 36–80, the period included being from the times of Pompey and Caesar down to Alexander Severus. Book 70 appears to have been missing in his copy, while in books 78 and 79 a mutilated original must have been used. Xiphilinus divided the work into sections, each containing the life of an emperor. He omitted the name of the consuls and hence sometimes falls into chronological errors. The epitome is valuable as preserving the chief incidents of the period for which the authority of Dio is wanting.

See J. Melber's Dio in Teubner series; C. Wachsmuth, *Einleitung in das Studium der alten Geschichte* (1895); W. Christ, *Geschichte der griechischen Literatur* (1898).

XIPHOSURA, marine arthropods commonly known as king crabs or horseshoe crabs. Originally classified as crustacea, later placed as an order in the class Arachnida, the Xiphosura are now generally recognized as an independent class. Geologically an old group, already in existence in the Devonian, the Xiphosura are represented by only five species forming a single family Xiphosuridae. Formerly these five species were all referred to a single genus *Limulus.* They are now divided among three genera and the old genus *Limulus* has been completely abolished. *Xiphosura polyphemus* is found along the Atlantic coast from Maine to Yucatan; *Carcinoscorpius rotundicauda,* in southern Japan; *Tachypleus gigas,* in Malaysia; *Tachypleus hoeveni,* in the Moluccas; and *Tachypleus tridentatus,* from north Borneo to China and southern Japan. King crabs live in shallow water, feed on worms and molluscs, reach the maximum size of about 60 cm. and are supposed to have a life span of eight years. The females lay from 200 to 300 eggs which they bury deep in the sand. After three weeks of development little "trilobite"-larvae emerge from the eggs. They have a relatively large abdomen and their tail or telson is quite small, so small that it does not project beyond the edge of the abdomen. The larva does not ingest any food, but lives at the expense of the embryonic yolk which fills its mid-gut. In a month the yolk is completely digested, the larva moults and assumes the appearance of a small, young "limulus." From now on the creatures are able to eat. They moult at more or less regular intervals, increasing in size with every moult.

[1] Herod. i. 183, by Ctesias changed into a plundering of the tomb of Belitanas or Belus: *cf.* Aelian, *Var. Hist.* 13, 3; Aristobulus *ap.* Arrian vii. 17, 2, and Strabo xvi., p. 738.

[2] Ctesias, *Pers.* 22; his legendary history is transferred by Herodotus, iii. 150 ff., to the former rebellion against Darius.

[3] *See* G. B. Grundy, *Great Persian War* (1901), and in criticism W. W. Tarn, "The Fleet of Xerxes," in *Journal of Hellenic Studies* (1908), 202–234; also Macan's notes on Herod. iv.-vi. (1895), and authorities for Plataea, Salamis.

External Anatomy.—The body of a king crab is clearly divided into a cephalothorax and an abdomen, the latter broadly and movably joined to the former and bearing a long, hard and pointed tail or telson. The dorsal surface of the cephalothorax is covered by a hard, convex, almost horseshoe shaped chitinous shield, the carapace, on which a pair of small, closely approximated simple eyes or ocelli and a pair of large, widely separated compound eyes are situated.. The shield extends to the ventral surface where it becomes concave and protects the appendages, hiding them from view when the animal is moving in its normal position on the ground. The abdomen is also covered with a single, chitinous shield extending to its ventral surface. It has on each side a row of six movable spines representing the remnants of its original segmentation. The tail or telson is considerably longer than the abdomen to which it is movably joined. If the animal is turned on its back, it rights itself by stemming the end of the tail in the ground and lifting the end of the abdomen thus forming an appreciable angle between the body and the tail, trying at the same time to get hold of some object with the legs and swinging sideways until the edge of the carapace reaches the bottom.

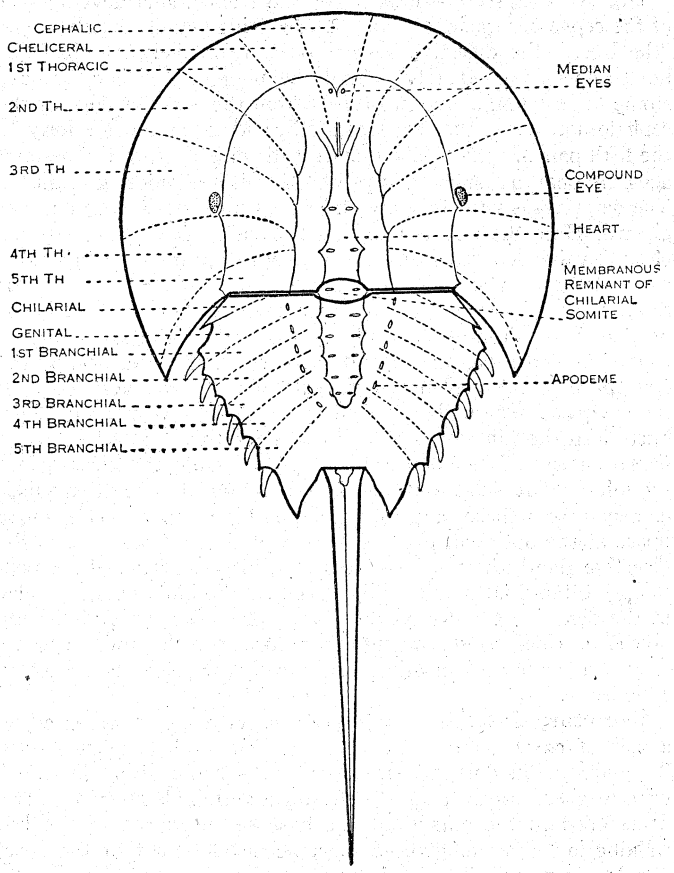

FIG. 1.—SEGMENTATION IN XIPHOSURA. DORSAL ASPECT

The dotted lines represent the limits between the somites. The heart is shown in the position in which it lies under the carapace

The middle portion of the ventral surface is occupied by the appendages. The first pair of these are the three-jointed, chelate chelicerae. The following five pairs of appendages are walking legs. They are six-jointed and except for minor differences are all built on the same plan. Their coxae (first segment of the leg nearest the body) have gnathobases and are used as mouth-parts. The legs of the first pair are undoubtedly homologous with the pedipalpi of Arachnida and are still often called that way, although they are in no way different from the following pair and like the latter end in a chela. The fifth legs alone are appreciably different from the other four pairs. Their basitarsus has four flat, spatulate, movable spines and their tarsus is considerably more slender and ends in a pair of pointed, movable spines. Moreover, the gnathobase is almost rudimentary and the coxa has a flat, movable flabellum interpreted as an exopodite. Furthermore, unlike the preceding appendages this pair has no chela and therefore cannot be used for grasping. Instead, they are used for removing sand from the underside of the carapace by spreading the four basitarsal spatulae and closing them over the grains of sand.

The knee in all five pairs of walking-legs is formed by the articulation between the femur and the tibia, but the latter is the result of a complete fusion of the patella with the tibia, as still evidenced by the articulation line which remains visible in all but the first pair.

The last pair of cephalothoracic appendages are single-jointed and are called the chilaria. Embryologically representing the first pair of abdominal appendages, the chilaria become later incorporated in the cephalothorax and are situated in the adult between the coxae of the fifth pair of legs. Their function is not clear.

The ventral depression of the abdomen is occupied by six flat plates representing as many pairs of appendages grown together in the middle line. The first pair form the genital operculum, the following five are gill-books. Each anterior gill-book overlaps the following one almost completely while the operculum covers the whole lot of them and protects them from injury.

There are six openings on the ventral side of the animal, but only two of these can be easily seen: the mouth, situated between the coxae of the second and third pairs of legs and the anus opening to the outside at the end of the abdomen, immediately in front of the telson. A pair of excretory openings of the so-called coxal glands are near the base of the fifth pair of coxae, and a pair of genital openings are on the posterior surface of the operculum, facing the body.

Segmentation.—The segmentation of the adult king crab does not correspond exactly with the original segmentation of the developing embryo, even if one disregards the later fusion of the body into an undivided cephalothorax and an equally undivided abdomen and considers only the appendages. Nor does our present knowledge, especially our knowledge of the nervous system and embryology of the king crab as well as of other arthropods, support the interpretation still found in the majority of textbooks. It is now definitely known that the portion of the brain called the deutocerebrum is wanting in Xiphosura as in Arachnida and must have been lost at an early period of their evolutionary history. It is also known that the nerves supplying the upper lip or rostrum (camerostome), and formerly interpreted as belonging to a neuromere of their own and representing a lost segment, do not have that significance. On the other hand the absence of the deutocerebrum clearly indicates the disappearance of the corresponding segment because the deutocerebrum persists in other arthropods and the tritocerebrum of the king crab is identical with the tritocerebrum of those arthropods. The cephalic portion of the cephalothorax is therefore composed of at least three somites, possibly even four, if the median ocelli and the compound eyes represent separate somites and if the deutocerebrum is included in the count. Moreover, this count includes also the somite represented by the tritocerebrum the nerves of which supply the chelicerae. These appendages are clearly preoral in adult arachnids and king crabs, the mouth in all cases moving backward during embryological development, in Xiphosura even farther backward than in Arachnida. Yet the tritocerebrum of Arachnida forms a part of the brain proper, while in Xiphosura it still belongs to the ventral portion of the nerve ring and forms the first neuromere of the suboesophageal ganglionic mass.

There has already been mentioned the incorporation of the chilarial segment in the cephalothorax although the chilaria represent embryologically the first abdominal somite. On the dorsal surface of the embryo this somite is restricted to a small, lens-shaped area retained in the adult as a soft membrane between the cephalothoracic and the abdominal shields. The second abdominal somite of the embryo becomes the anterior portion of the adult abdomen and is represented by the genital operculum on the ventral side, by the first pair of movable spines on the sides of the abdomen and by a narrow strip across the abdominal

dorsal surface, including the first pair of apodemes. Next follow five branchial somites represented by the gill-books on the ventral side, by five pairs of movable spines and dorsal apodemes. The rest of the abdomen shows no traces of segmentation even in the embryo. Whether it represents five somites, bringing the total number of abdominal somites up to 12 as in Arachnida, must be left unanswered at the present state of our knowledge.

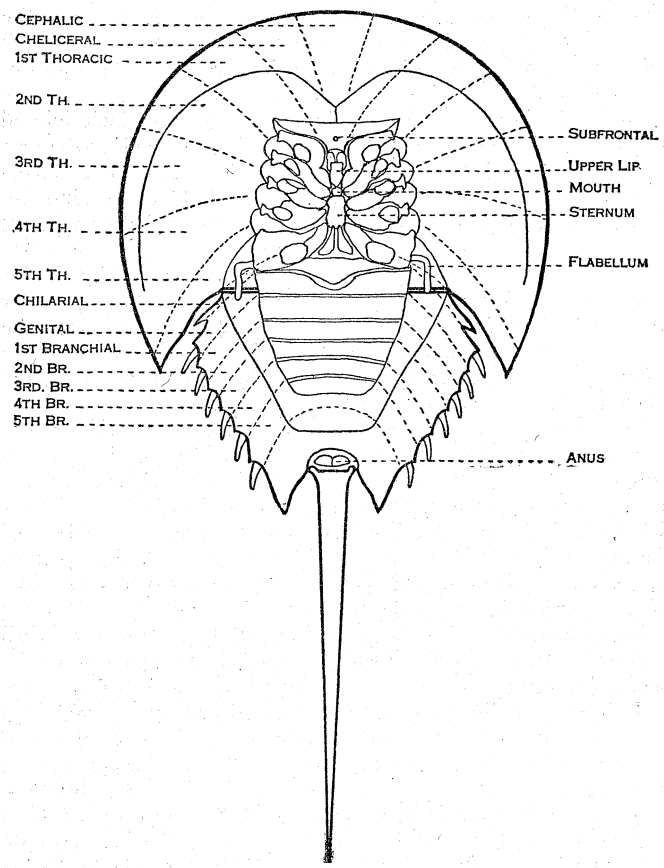

FIG. 2.—SEGMENTATION IN XIPHOSURA. VENTRAL ASPECT

The appendages are omitted so as not to obscure the rest of the body. Only their coxae are shown. The gills are also omitted, only their attachment to the ventral abdominal wall represented. The dotted lines represent the limits between the somites

It is clear that segmentation in Xiphosura has many features in common with Arachnida, yet presents unmistakable and important differences. The original number of cephalothoracic appendages is the same, and both the Arachnida and the Xiphosura exhibit a tendency of the first abdominal somite to considerable reduction in size. In spiders it forms the slender petiolus by which the abdomen is attached to the cephalothorax. In scorpions it disappears completely during development, so that the broad juncture of the abdomen to the cephalothorax is accomplished by the second abdominal somite which now appears as the first abdominal segment. In Xiphosura the first abdominal somite fuses with the cephalothorax and is represented by the chilaria, *i.e.*, by a pair of appendages which have no homologous counterpart in Arachnida. The shape of the cephalothorax is also very different from that of any known arachnid, recent or fossil, and has a counterpart only among Trilobita and some lower crustacea, such as *Apus*. It cannot possibly be regarded either as homologous with or ancestral to the arachnid cephalothorax.

Endoskeleton.—The endoskeleton consists of a complex mesodermal connective tissue plate suspended in the cephalothorax between the oesophagus and the mid-gut and known as the endosternite; six endochondrites in a median row on the floor of the abdomen, and seven pairs of ectodermal apodemes or endapophyses, formed as invaginations and serving for the attachment of muscles. The first pair of the apodemes arises from the posterior edge of the carapace, and the muscles attached to these apodemes help to keep the endosternite in suspension. These apodemes are, therefore, not homologous with the mid-dorsal apodeme of the Arachnida to which the dorsal dilators of the gizzard are attached. They belong to the chilarial somite, that is, are not really cephalothoracic, but primarily abdominal and only secundarily incorporated in the cephalothorax. The following six pairs are abdominal and are invaginations of the dorsal wall of the abdomen. Several muscles are attached to each of these apodemes.

Muscular System.—This system is very complicated in Xiphosura, differing in many respects from the corresponding system of Arachnida. It consists of many dozens of paired and single muscles. The muscles holding the endosternite in suspension were already mentioned. There are several pairs of them. The muscles moving the cephalothoracic appendages arise some from processes of the endosternite, others from the carapace. Six pairs of branchiothoracic muscles also arise from the carapace, run downward and backward and are attached to the abdominal ventral apodemes. Other branchial muscles situated in the abdomen, help to move the gill-books. Several powerful muscles situated in the posterior portion of the abdomen move the telson up and down and to a lesser degree laterally.

Digestive System.—Except for the tremendous development of the cephalothoracic, endodermal digestive glands usually called "the liver," the digestive system is comparatively simple. The mouth opens immediately behind the upper lip, called camerostome or rostrum, about two-thirds from the anterior edge of the cephalothorax, has the shape of a slit, and extends posteriorly to the fifth pair of coxae. The mouth leads directly into the oesophagus. A pharynx, such as is present in all arachnids, is wanting. The oesophagus runs forward and opens into the large, muscular gizzard. Here the ingested food is broken up into smaller particles. A valve separates the gizzard from the mid-gut which runs as a straight tube backward above the endosternite until it reaches almost the end of the abdomen. A short rectum opens with an anus situated ventrally at the end of the abdomen. A pair of immense digestive glands, already mentioned, occupy the free space in the cephalothorax, extending to the very edge of the carapace. These glands open by means of two pairs of short ducts into the mid-gut behind its anterior third and close to its dorsal surface. Fine food particles passed from the gizzard into the mid-gut are subjected here to the action of several enzymes, namely a proteinase, a carboxypolypeptidase, an amylase and a lipase at the optimum pH 8.0. The chyle is now passed into the digestive gland where it is subjected to further action of a dipeptidase. Interstitial tissue holding together the individual ampullae of the digestive gland serve as storage place for fat, protein and glycogen. Undigested remnants are returned to the mid-gut where they are enveloped in slime and finally emptied as excretory cylinders.

Excretory System.—The excretory system is represented by a pair of coxal glands which are situated in the cephalothorax. They are modified nephridia, consist of a sacculus into which four urinary glands open, a labyrinth and a terminal duct. The two ducts open to the outside at the base of the coxae of the last walking leg. Preceding the embryonic development of the coxal glands, six pairs of coelomic sacs are formed, corresponding to the original six cephalothoracic somites. The first and sixth pair disappear, the fifth pair forms the two sacculi, while the second, third and fourth pair give rise to the urinary glands and the labyrinths. In life the coxal glands are brick-red.

Circulatory System.—This system in Xiphosura is distinguished by many peculiarities not found in any other arthropods. As in higher crustacea it consists of both arteries and veins, but the similarity is upset by the many peculiarities. The arterial system reminds more that of Arachnida, but here, too, the similarity is upset by features lacking in Arachnida. Moreover, Arachnida have no veinous system.

The heart is a muscular tube situated partly in the abdomen, partly in the cephalothorax. Its posterior end is blind. Laterally it is perforated by eight pairs of dorsoventral slits, called ostia and serving as valves. The first and second pair of ostia are in that portion of the heart which extends into the cephalothorax

and which has rather thin walls. The abdominal portion of the heart with its five pairs of ostia has much thicker muscular walls. The entire heart is surrounded by a pericardium into which six pairs of veins open. Anteriorly the heart forms an aorta which splits almost immediately into three vessels, a median anterior artery and a pair of aortic arches. The median artery runs to the edge of the carapace, divides here into a right and left branch which fuse with corresponding branches of the second lateral arteries, thus forming the so-called marginal arteries. The two aortic arches turn ventrally at the sides of the gut and open into the sinus-ring of the ventral arterial sinus inside which the entire nervous system lies enclosed. The arteries leading into all cephalothoracic appendages arise from the ring-sinus. That portion of the sinus which extends into the abdomen in the shape of a vessel is known as the ventral artery and gives off five pairs of branchial arteries supplying the gills. One of the most characteristic features of the arterial system in Xiphosura is the presence of a pair of longitudinal collateral arteries connected with the heart by short, transverse vessels and united behind the heart into a single, median dorsal abdominal artery which runs to the very end of the telson. The lateral arteries which supply with blood the organs situated in the cephalothorax and in the abdomen arise from the collateral arteries. We have already mentioned the branch of the second artery, which forms with the branch of the median dorsal artery the marginal artery. An inner branch of the same second artery runs forward on the corresponding side of the heart to the digestive gland, which it supplies with blood, and is known as the hepatic artery.

The veinous system consists of a pair of anterior and a pair of posterior hepatic veins opening into a pair of large, longitudinal ventral veins which give off branchial veins carrying the blood to the gills. Five pairs of branchio-cardiac veins carry the blood from the gills to the pericardium, from which it enters the heart through the ostia. The blood is propelled by the heart forward and a counterflow is prevented by a cardio-aortic valve.

Although the veinous system is highly developed, the circulatory system of Xiphosura is an open one as in all arthropods, both the arterioles and the venules opening directly into the body cavity.

The blood is a slightly bluish, milky fluid containing a considerable quantity of haemocyanin in solution and blood-corpuscles of the leucocyte type in suspension.

Body Cavity.—The body cavity of Xiphosura, in which the various organs are situated and which extends into all appendages, is a haemocoele. It is at least in part derived from the confluent cavities of several coelomic pouches, is bounded on the outside by the basal membrane of the hypodermis—except where muscles are attached to the body wall—and seems, therefore, to be what is now appropriately called a "myxocoele." The cavity is fully occupied by the organs. A diaphragm, such as found in scorpions, does not exist in king crabs.

Respiratory System.—Respiration in Xiphosura is strictly of the aquatic type. The appendages of the third to seventh abdominal somites of the embryo become modified and function as gills from the earliest larval stage and throughout the life of the animal. The appendicular nature of the gills is clearly visible even in the adult. Each pair of appendages grown together in the median line, forms a plate on the posterior surface of which the right and left gill-books are situated. Each gill-book is composed of up to one hundred and fifty lamellae. The gill-books are regarded as being homologous to the lung-books of Arachnida, but the attempt of Verluys and Demoll to derive the gill-books from the lung-books, instead of vice-versa, has nothing to recommend it and remains only as an example of futile speculation.

Nervous System.—This system in Xiphosura is characterized by two peculiarities. The first of these, namely the absence of a deutocerebrum in the adult, it shares with other Chelicerata. The second peculiarity, that the entire nervous system is enclosed in the ventral sinus, is restricted to the Xiphosura. Owing to the shape of the body the brain lies not above, but on the same level with the suboesophageal ganglionic mass with which it forms a compact ring perforated by the oesophagus and surrounded by the ring-sinus. The brain is formed only by the protocerebrum. It gives rise to the following nerves: a median optic nerve leading to the ocelli and originating by a pair of roots; a pair of ventral nerves supplying the ventral body wall; a pair of originally ventral eye nerves which later serve as olfactory nerves and finally a pair of optic nerves leading to the compound

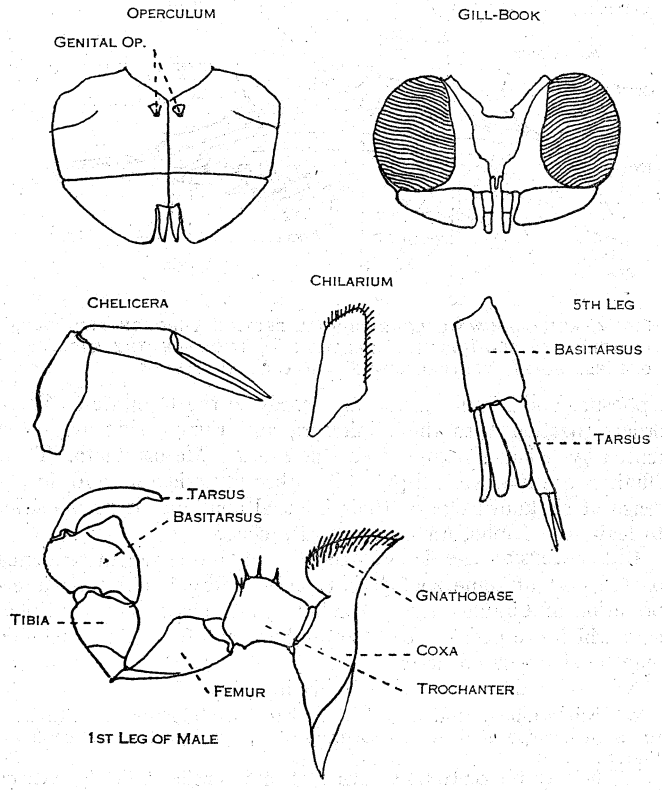

FIG. 3.—APPENDAGES OF XIPHOSURA POLYPHEMUS

The genital operculum and the gill-book are drawn in their posterior aspect

eyes. The postoral portion of the nerve ring, *i.e.*, the suboesophageal ganglionic mass is composed of eight neuromeres. The first of these corresponds to the tritocerebrum of other arthropods and gives off the cheliceral nerves, the following five pairs supply with nerves the thoracic appendages, the seventh neuromere gives off the chilarial nerves and the eighth the opercular (genital) nerves. Posteriorly, the nerve ring forms the ventral nerve cord enclosed in the longitudinal sinus (ventral artery). The cord presents four pairs of ganglia followed by a ganglionic mass composed of three pairs of fused ganglia. Each ganglion gives off two nerves, an anterior motor and a posterior sensory nerve.

Sense Organs.—King crabs possess a pair of median ocelli, a rudimentary ocellus, a pair of compound eyes, a rudimentary compound eye and a ventral rudimentary eye which is later replaced by the olfactory lobe. Supposed organs of taste have been described on the gnathobases of the appendages.

Reproductive System.—The sexes are separate, and the plan of structure of the reproductive organs is the same in both. The originally paired reproductive glands form a network between the lobes of the digestive gland. A pair of ducts—vasa deferentia in the male, oviducts in the female—open to the outside on the posterior surface of the genital operculum. The males are easily distinguished by the swollen appearance of the basitarsus of their first pair of legs, but copulatory organs of any kind are wanting. The spermatozoa have a tail. The eggs are globular, rich in yolk, from 2 to 3 millimetres in diameter. They are inseminated by the male sitting on the back of the female while she lays them in a batch of 200 or 300 in a hole in the ground.

Paleontology.—Fossil remains of Xiphosura occur already in

the Devonian, where they are represented by the family Belinuridae. Representatives of this same family are known also from the Carboniferous of Europe and Pennsylvanian of North America. An aberrant family Cyclidae is found in the Carboniferous. Representatives of the family Xiphosuridae (formerly called Limulidae) first appear in the lower strata of the Triassic. Supposed relatives of the Xiphosura belonging to the orders Synxiphosura and Limulava appear already in the Cambrian. These orders together with the Xiphosura and Eurypterida are often united by palaeontologists in a single Class Merostomata. Their affinities are however, disputed by other investigators and, in absence of all knowledge of their internal anatomy, it seems safer to leave the Xiphosura in a separate class.

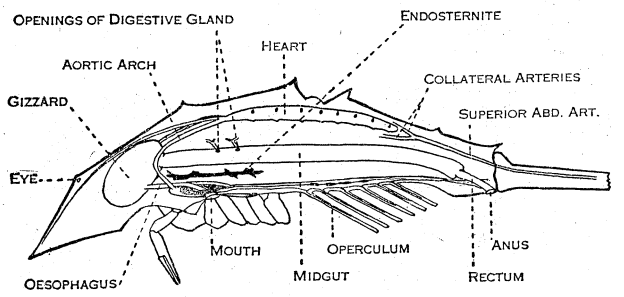

FIG. 4.—DIAGRAMMATIC LONGITUDINAL SECTION THROUGH XIPHOSURA POLYPHEMUS, SHOWING THE RELATIVE POSITION OF THE DIGESTIVE ORGANS, HEART, VENTRAL SINUS AND NERVOUS SYSTEM

Characters of the Class.—In view of the persistent tendency on the part of some zoologists to follow Ray Lankester's interpretation of Limulus as an Arachnid those characters of Xiphosura which are peculiar to them and are not found in Arachnida may be summarized here.

Xiphosura differ from Arachnida in that:

1. Their segmentation is different, the first abdominal somite having been incorporated in and forming an integral part of the cephalothorax.
2. Their entire central nervous system is enclosed in the ventral blood-sinus.
3. Their brain is formed only by the protocerebrum, the tritocerebrum forming the first neuromere of the suboesophageal ganglionic mass.
4. They possess a veinous system.
5. Their heart ends blindly behind.
6. They possess a pair of longitudinal collateral arteries from which lateral arteries arise and which unite posteriorly to form the posterior median artery.
7. Their organs of respiration are aquatic gill-books.
8. Their genital openings are paired.
9. They have a "trilobite" larval stage.
10. They have a pair of compound eyes.

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XOSA, a group of Bantu-speaking peoples occupying the eastern half of the Cape Colony. They comprise a large number of independent tribes, each governed by a chief assisted by councillors. Their subsistence is derived from a combination of cattle-keeping with agriculture. Socially they are organized into patrilineal exogamous clans. Marriage is polygamous and involves the payment of a bride-price; and both the sororate and the levirate are practised. Ancestor-worship is the main form of religious cult, and both magic and witchcraft play a strong part in the lives of the people.

See A. Kropf, *Das Volk der Xosa-Kaffern,* 1889.

X-RAYS, NATURE OF. X-rays or Röntgen rays form an important subgroup of the general class of phenomena known in the language of physics as electromagnetic radiation.

Introduction.—For convenience, the gamut or spectrum of electromagnetic radiation is usually subdivided into about seven regions which, named in the order of decreasing wave length (or increasing frequency) are: radio waves; radiant heat; infra-red radiation; visible light; ultra-violet light; the far ultra-violet or Millikan region; X-rays (both the "soft" and "hard" or penetrating varieties); and gamma rays. These subgroups merge indistinguishably into one another without sharp boundaries for they are all manifestations of radiant energy of identical basic nature, the difference being only one of wave length λ, or frequency $\nu = c/\lambda$. Here, c is a universal constant "the velocity of light in vacuo," very nearly equal to 2.998×10^{10} cm. per second. If this number is divided by either one of the two quantities, the frequency in cycles per second or the wave length in centimetres, the other one is obtained. The subdivisions are named from the technical means of generating and detecting the radiant energy. They are somewhat arbitrary in extent and overlap considerably upon each other. The wave lengths of the electromagnetic spectrum extend continuously over the huge range from radio waves, which are thousands of metres in length, down to gamma rays with wave lengths much less than 10^{-9} cm. (one billionth of a centimetre). (The reader should familiarize himself with the exponential method of abbreviating very large and very small numbers which will here be constantly used. Thus $10^2 = 100$, $10^4 = 10{,}000$, $10^{-6} = 0.000{,}001$). An octave, in analogy to the musical term, is that range of the spectrum which separates two wave lengths (or frequencies) which stand in the ratio 2 : 1, and measured on such a scale the complete electromagnetic spectrum just alluded to contains well over 50 octaves.[1] The relatively minute portion of this gamut which is visible to the human eye is a little less than one octave in extent ranging through wave lengths which give the subjective effects of the colours, red, orange, yellow, green, blue and violet, or from $\lambda = 7{,}000 \times 10^{-8}$ cm. to $\lambda = 4{,}000 \times 10^{-8}$ cm. The X-ray region may perhaps be said to start at wave lengths of about $\lambda = 1{,}000$ Ångstrom units ($\lambda = 1{,}000 \times 10^{-8}$ cm.) and to extend down to wave lengths of about $\lambda = 0.1$ Ångstrom ($\lambda = 0.1 \times 10^{-8}$ cm.), a stretch, therefore, of about 14 octaves, commencing about two octaves shorter in wave length than the visible region. The X-ray wave lengths in common use for the diagnostic examination of the human body are of the order of $\lambda = 0.2 \times 10^{-8}$ cm. to $\lambda = 0.1 \times 10^{-8}$ cm. (The frequently used unit of length, 10^{-8} cm. or 0.000,000,01 cm., is called an Ångstrom, while the one-thousandth part of this or 10^{-11} cm. is called an x-unit.)

If a source of high-voltage direct current is connected to the terminals provided in a glass bulb such as the one shown in fig. 1, known as a Crookes tube (the cathode being made negative), and the tube is then connected to a vacuum pump and evacuated to progressively lower and lower air pressures, one observes the following effects: At pressures in the neighbourhood of 1 mm. of mercury or 0.0013 atmospheres the tube is filled with an almost uniform pink glow. With further reduction of pressure a dark space appears in the neighbourhood of the cathode. At pressures between 0.1 mm. and 0.001 mm. of mercury or 0.00013 and 0.000,001,3 atmospheres a bluish beam is seen extending from the cathode. This is the beam of "cathode rays," a stream of electrons, the ultimate indivisible negative charges of electricity

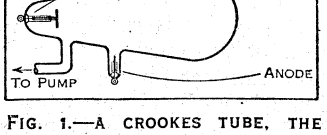

FIG. 1.—A CROOKES TUBE, THE TYPE OF VACUUM TUBE WITH WHICH RÖNTGEN DISCOVERED X-RAYS

[1] The choice of gamma ray wave lengths as the upper limit of the electromagnetic spectrum is completely arbitrary. If we wish to include electromagnetic radiations associated with cosmic rays, there is no known upper limit.

whose paths through the rarefied air of the tube are made visible by the excitation of the air molecules with which they collide. As the air pressure in the tube falls still lower the cathode rays, though still present, fade from view, save where they strike the walls of the tube, because their collisions with air molecules become infrequent. The glass wall at the end of the tube opposite the cathode now becomes luminescent with a brilliant apple-green light. If the tube is provided with means for introducing a metal obstacle at some distance in front of the cathode, its shadow formed by obstruction of the invisible cathode rays can be clearly seen in the midst of the apple-green luminescence proving the origin of the latter and showing that the cathode rays move away from the cathode. The fact that they are repelled from the negative terminal proves them to be negatively charged particles and this can be shown also by the bending of the cathode rays in the magnetic field of a permanent magnet held appropriately close to the tube. By a refinement of this experiment to measure quantitatively the degree of bending by a magnetic field of known strength the ratio of the charge to the mass of the electrons can be measured.

If a fluorescent screen consisting of a piece of paper or cardboard on which has been spread finely granulated crystals of barium platinocyanide is held near the Crookes tube, operating at the stage we have just described, X-rays will be found to be coming from the glass walls wherever they are bombarded with the cathode rays. These X-rays will pass through the cardboard of the fluorescent screen and produce luminescence in the barium platinocyanide crystals. As the air pressure in the Crookes tube becomes more and more reduced by the vacuum pump it will be found necessary to increase the voltage applied to the terminals of the tube in order to maintain the discharge. In the earlier stages of this process the X-rays will not have great penetrating power as shown by introduction of absorbing screens. The X-rays are said to be "soft." With improving vacuum and increasing voltage applied to the tube the X-rays become more and more penetrating until with a potential of 100,000 volts even the bones in the hand cast only a faint shadow on the fluorescent screen. The rays are now described as "hard." Heavy materials such as barium, lead, gold or platinum when used as screens are found to absorb the X-rays much more than light materials such as carbon or aluminum. The glass wall of the Crookes tube where the electrons strike and from which the X-rays come will be found to be hot and may in this way easily be melted. The impact of the electrons heats the glass just as heat is generated by the blows of a hammer upon an anvil. For this reason a metal "target" was soon introduced in X-ray tubes to replace the glass wall as the point of electron impact. Such targets can readily be brought to incandescence by the bombardment unless they are provided with ducts through which cooling water or other fluids can circulate.

When, through continued pumping, the pressure in the tube has reached a value of 0.0003 millimetres of mercury it is no longer possible with voltages usually available to pass a discharge through the tube and the X-rays cease. However, if the cold metal cathode is replaced by an incandescent filament, electrons will be emitted from this and we have the pure electron discharge tube of Coolidge which with appropriate design can be operated at 1,000,000 volts and higher. The current is readily controlled by varying the temperature of the incandescent cathode.

It is the very abrupt stoppage of a certain small fraction of the bombarding electrons when they hit the atoms of the material target which produces the bulk of the X-radiation. It is a fundamental law of the electromagnetic field, well-known to radio engineers, that when an electrical charge experiences an acceleration, or its opposite a deceleration, it radiates energy in the form of electromagnetic waves. The wave lengths of the X-rays emitted by ordinary X-ray tubes are various, forming, as we shall see, a continuous and also a line spectrum. Targets of heavy materials are more efficient in producing them.

The "quality" of the X-rays, that is to say their varying degrees of penetrating power for material screens starting with soft X-rays emitted at operating voltages from 1,000 to 20,000 volts and passing on to medium hard X-rays from tubes operating at 20,000 to 50,000 volts and hard X-rays for voltages in the hundreds of thousands or even up to one million volts have been shown to be associated on the one hand with the wave lengths (or frequencies) of the X-radiation and on the other hand with the quantum energy of the photons associated with these wave lengths about which we are to be here much concerned. The penetrating power of soft X-rays is so low that X-ray tubes must be provided with special windows of very thin glass or of very light materials such as beryllium in order to let them out. Table I gives the shortest wave length (hardest radiation) emitted from an X-ray tube for different operating voltages, the penetrating power of that wave length and the application usually made of such radiation in technology and medicine. The penetrating power is expressed by giving the thicknesses in lead, copper, aluminium, water and air required to absorb half the intensity of the incident beam.

Danger From Exposure to X-Rays.—Mention should be

TABLE I.—*X-Ray Characteristics*

Giving X-ray tube operating voltages and penetrating powers of the shortest wave lengths emitted, thickness of screens required to absorb half the radiation of that wave length, and applications to technology and medicine. (The most copiously emitted wave length from an X-ray tube is about three halves the shortest wave length).

Operating Kilovolts	Shortest Wave Length in cm.	Thickness in cm. of screen to reduce X-rays to half intensity*					Technical and Medical Applications
		Air at 0°C., 760 mm.	Water	Aluminum	Copper	Lead	
1,000	0.0124×10^{-8}		10.0	4.15	1.35	0.865	Deep cancer therapy. Radiography of steel castings and welding.
124	0.1 "		4.3	1.6	0.21	0.016	
62	0.2 "		3.9	0.92	0.051	0.013	Radiography of the human body.
41.2	0.3 "		2.4	0.55	0.018	0.0044	
31	0.4 "		1.6	0.23	0.0078	0.0020	Studies of crystal structure. Radiography of light materials. Therapeutic treatment of the skin.
24.8	0.5 "	1120	1.1	0.13	0.0040	0.0011	
20.6	0.6 "	720	0.69	0.076	0.0024	0.00068	
17.7	0.7 "	410	0.46	0.050	0.0016	0.00044	
15.5	0.8 "	340	0.33	0.035	0.0011		
13.7	0.9 "	260	0.25	0.023	0.00078		
12.4	1.0 "	210	0.18	0.017	0.00059		NOTE: At certain X-ray wave lengths characteristic of each absorber there is an abrupt reduction in absorption as we pass toward longer wave lengths. The intervals where these occur are marked in this table with horizontal lines.
6.2	2.0 "	26	0.025	0.0025	0.00071		
4.1	3.0 "	8.5	0.0082	0.00082	0.00025		
3.1	4.0 "	3.8	0.0036	0.00034	0.00013		
2.5	5.0 "	2.0	0.0020	0.00020	0.000069		
1.24	10.0 "	0.31	0.0003	0.00048			

*The law of X-ray absorption is such that if the thicknesses given above are doubled the intensity will be halved a second time; *i.e.*, reduced to one-quarter of its original value, if n thicknesses are used the reduction factor is $(\frac{1}{2})^n$.

made here of the great danger to life from overexposure of living tissues to X-rays. The photoelectrons (*see* below) ejected (from atoms of the tissue) with energies of thousands of volts destroy the structure of tissue cells in flesh, bone and blood, producing a general effect on the organism and a local effect of at first erythema, then severe lesion very difficult to heal, like a burn. *No X-ray equipment should ever be operated by uninstructed or unskilled persons.* Deplorable examples of ignorant neglect of such facts on a large scale resulting in widespread permanent and frequently fatal injuries are of record as late as 1941. Fortunately, the rather complex problems of, (1) the measurement of quality and intensity of X-rays used upon patients and (2) techniques of their safe dosage, are both thoroughly understood by competent medical X-ray authorities all over the world, though this field is one of the most difficult, requiring a thorough knowledge of both the biological and physical sciences. It is safe to say that even in 1945 not more than a handful of experts in each country of the world, had a complete grasp of such problems. Workers with X-rays, who may receive continual even though weak exposure, should have periodic examination of their blood to reveal cumulative effects which might otherwise be very harmful. These warnings cannot be overemphasized.

Particle-Wave Duality.—Chiefly because of its rectilinear propagation, Isaac Newton in a famous communication to the Royal society in 1675, proposed very tentatively the hypothesis that visible light consisted of tiny particles projected from the luminous source into the eye of the observer. His contemporaries, Christiaan Huygens and Robert Hooke, on the contrary, believed light to be undulatory in nature, a wave motion in three dimensions analogous to the two dimensional ripples spreading outward upon the surface of water from a point where a pebble has been dropped. The wave theory of light through the work of Thomas Young, Augustin Jean Fresnel and many others held undisputed sway throughout the 19th century. One of the most astonishing results of 20th century scientific research is that both points of view, contradictory as they may at first seem, turn out to be complementary aspects of the same phenomenon. Not only do light and all electromagnetic radiations exhibit this duality (of particles and waves)—it has been found to be also a general property of all the elementary particles of nature, a universal duality applicable to all forms of energy matter. We are here in the presence of a great fundamental fact of nature whose physical and philosophic consequences probably reach far beyond our present ken. It is not for us to rebel against this weirdness merely because the gross behaviour of familiar objects furnishes nothing analogous to help our understanding. Rather we must remember that the behaviour of familiar things is only to be understood in terms of this duality which we must accept as fundamental, a stubborn fact of observation.

So skilfully has nature erected barriers to man's experimental questioning that it appears impossible ever to arrange an experiment which will simultaneously reveal both the particle nature and the wave nature of radiation (or matter), though endless experiments can be devised to study either of the two aspects singly. It was the unique distinction of X-rays to be the tool which (1) first unlocked the secrets of atomic theory, (2) revealed the family relationship between the chemical elements and the quantized nature of their atomic dynamics and (3) brought into accented relief (through the Compton effect) the mysterious particle-wave duality principle. The story of this unfolding from 1895 over a half century is one of the most exciting chapters in the whole of human intellectual progress. The by-products of this "pure" research in the form of techniques useful in our every-day lives already innumerable as they are, are as nothing compared with the implications for the future.

The nature of X-rays is so closely associated with the nature of the atoms which emit and absorb them that it is impossible to explain one without the other. We can never examine radiation in transit. Assumptions regarding that something which is propagated through empty space from the atoms which emit light (or radiation in general) to those in the photographic plate, the retina of our eyes, or the X-ray ionization chamber where the light is detected by being absorbed, such assumptions are merely convenient models which help us to understand radiant phenomena by analogy with grosser and more familiar phenomena (such as bullets and water waves).

For the present, perhaps the most satisfactory model to help our thinking will be to picture radiation, including X-rays, in terms of both particles and waves, the waves guiding the particles to their appropriate destinations. Light, the quantum theory has taught us, always acts as though its energy were in bundles (quanta) whose sizes are proportional to the frequency ν of the light. The constant of proportionality $h = 6.62 \times 10^{-27}$ erg sec. was first measured by Max Planck at the opening of the 20th century, who, from the laws of "black body" radiation, inferred and proposed the famous law of light quanta which bears his name

$$W = h\nu \qquad (1)$$

wherein W is the energy of a light quantum (or "photon") in ergs for the case of light of frequency ν cycles per second (or $\lambda = c/\nu$ cm. wave length in vacuo). (*See* QUANTUM MECHANICS.) At that time, however, it was not yet known that the energy of each quantum frequently appears to be extremely localized in space. Instead of spreading out in all directions from the source, as the energy associated with water ripples would do, each photon of light frequently makes all of its energy manifest in its action on a single atom, be that atom one centimetre or a million light years distant from the source. To use an analogy suggested by Arthur Compton, it is as though a man had jumped off a springboard into a pool and the water-wave energy created by his fall had somehow succeeded in concentrating itself to perform the feat of lifting another man of equal weight floating elsewhere in the pool back onto another springboard practically as high as that from which the first man jumped; and all this even if the pool be limitless and the men separated by astronomical distances! For radiation this is no wild stretch of the imagination; it is an event which the physicist or the astronomer can reproduce at will whenever they wish. Nevertheless, it is incorrect to reject the spreading wave picture of radiation merely because of this phenomenon. The observed phenomena of "interference" of light waves forbid such a simplification. It is a well-known fact (diffraction) that light from the same atomic source can reach the same point (the same absorbing atom) by two or more different paths. The simplest case occurs when monochromatic light from a source passes through two very closely adjacent very fine slits and then farther on, falls upon a screen. At certain points on the screen where the light waves which have traversed the two paths differ in phase (upon arrival at the screen) by exactly one half cycle, the superposition of the two lights produces darkness. (*See* LIGHT; INTERFEROMETER.) At intermediate points between these dark fringes there is brilliant reinforcement of the light ascribed to the arrival of light by the two paths in "phase coincidence." Such regions of "destructive" and "constructive" interference can readily be observed by anyone if water ripples are made to pass through small uniformly spaced adjacent openings in a barrier dividing the surface of a quiet pool. What happens in the case of electromagnetic radiation? The photons manifest their energy $h\nu$ upon an absorbing atom of the screen, only at the bright fringes of constructive interference, and this, whether they have come from the star Sirius or a candle one foot distant! Thus the wave aspect of light forces itself upon our acceptance. The waves guide the particles to their correct destinations but when the energy is made manifest by absorption in an atom and transformation into tangible phenomena it appears localized at one point, not spread out over the entire wave front. These are stubborn facts of observation which we must accept.

With this brief foretaste of the conditions we are to study and before passing to a detailed survey of our knowledge of the nature of X-rays in its interaction with matter, the reader is entitled to a brief historical review of the outstanding discoveries beginning with the original one of Röntgen's in 1895. To the initiate who may have had the breathless privilege of living it from day-to-day as it unfolded, the story is more fascinating and full of excitement than any novel.

HISTORICAL

Discovery.—X-rays were discovered near the end of the year 1895 by Wilhelm Konrad Röntgen, professor of physics in the University of Wurzburg, Bavaria.[1] Röntgen was experimenting with a highly evacuated glass bulb, called a Crookes tube, of the type shown in fig. 1, through which an electric discharge was made to pass by connecting the terminals, cathode and anode, to a source of high voltage, an induction coil. He happened to notice that some crystals of barium platinocyanide spread upon a paper screen and placed in the vicinity became brilliantly fluorescent while the discharge was passing in the tube, even though the visible light from the tube was completely screened by "a somewhat closely fitting mantle of thin black cardboard." He found that various metallic and other objects cast shadows of various densities on the fluorescent barium-platinocyanide screen and he inferred that these absorbed in different degrees the unknown and invisible radiation which from the geometry of shadow formation evidently came from that portion of the glass walls of the Crookes tube which were being bombarded with the electrical discharge from the cathode. Röntgen displayed the masterly thoroughness of genius. His first paper described correctly most of the basic qualitative properties of X-rays, to wit:

(1) All substances were more or less transparent to X-rays. Named in order of decreasing transparency were, for example, wood, aluminum, lead glass.

(2) Many substances beside barium platinocyanide, such as calcium compounds, uranium glass, rock salt, emitted light (fluoresced) when exposed to X-rays.

(3) Photographic emulsions were found susceptible to X-rays.

(4) Reflection and refraction of X-rays were investigated with negative result (these effects are slight and difficult to reveal) and Röntgen concluded X-rays could, therefore, not be concentrated with lenses.

(5) By means of pinhole photographs X-rays were shown to travel in straight lines and to be undeflected by magnetic fields.

(6) X-rays were shown to discharge electrified bodies independent of the sign of the charge (through ionization of the surrounding air which thereby becomes an electrical conductor). (This effect was independently discovered and explained by Sir J. J. Thomson in 1896, who pointed out its importance as a quantitative measure of X-ray intensity. Time has not diminished this importance.)

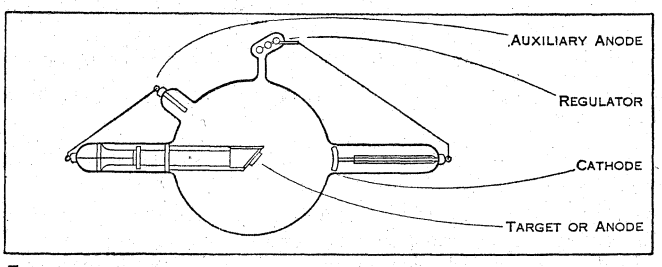

FIG. 2.—ORDINARY "GAS" X-RAY TUBE WITH CONCAVE FOCUSING CATHODE, METAL TARGET AND REGULATOR FOR LIBERATING GAS BY ELECTRICAL DISCHARGE WHEN, AFTER PROLONGED USE, THE TUBE BECOMES TOO "HARD" THROUGH GRADUAL ABSORPTION OF RESIDUAL GAS

(7) X-rays, Röntgen showed, were generated wherever and whenever the cathode rays of the discharge tube struck any solid body as a target. A heavy element, such as platinum, when so used as a target, was found to yield X-rays more efficiently than a light element such as aluminum. The Crookes tube was soon replaced by one in which the cathode rays were focused to bombard a metallic anti-cathode or target (invented by Sir Herbert Jackson and shown in fig. 2.).

Scattering.—Although X-rays are not reflected by ordinary mirrors, they are scattered diffusely, when they encounter a material scattering body, to different degrees depending on the angle of scattering, measured between the forward directions of incident and scattered rays.

In 1906, Charles Barkla and C. A. Sadler, by measuring the scattered coefficient of carbon for X-rays, correctly determined the number of electrons in the carbon atom as six. The determination was based on a theory of J. J. Thomson which yields a quantitative value of the X-ray scattering coefficient for a single free electron under certain assumptions which happened fortuitously to be approximately fulfilled in the Barkla-Sadler experiment (*see* below).

In the decade following Röntgen's discovery, speculation was rampant as to the nature of the new radiation and literally thousands of papers were written, some of which contained the most fantastic suggestions, such, for example, as that X-rays might be a longitudinal component (*sic*) of electromagnetic radiation or that they might be a form of "elastic" waves. Barkla's work formed a strong support for the supposition that X-rays were of the same nature as other known electromagnetic radiations especially as J. J. Thomson had found the same number of electrons (in the carbon atom) by a quite independent method using β-rays (fast bombarding electrons from naturally radioactive substances).

Polarization.—At about the same time, Barkla showed by scattering a beam of X-rays twice in succession, each time through 90° scattering angle, that this radiation, like light, could be polarized,[1] at least partially, and that it was therefore, in all probability, a transverse wave propagation similar to other electromagnetic radiations.

Fluorescence.—Barkla and his co-workers over a period (1908–12) observed in their scattering experiments that certain X-radiations characteristic of the scatterer and of less penetrating quality than the primary X-radiation were emitted from the scattering body, more especially when heavier elements, such as silver, were used as scatterers. The scattering body thus becomes a secondary emitter of X-rays. By ingenious experiments in which the penetrating power of these characteristic X-rays was studied for different secondary emitting substances and with absorbing screens of different materials it became clear, (1) that such fluorescent X-rays from secondary emitters can differ very greatly as to penetrating power so that they can be arranged in a scale of harder and softer radiations; (2) that the absorbing screens exhibit abrupt changes in opacity as one passes continuously through a scale of these fluorescent radiations, say from the softer to the harder varieties. Thus the existence of a spectrum of X-rays and of their undulatory properties was distinctly foreshadowed.

Undulatory Nature of X-Rays[1]—Numerous attempts were made to reveal an undulatory nature in X-rays and to estimate the wave length by searching for diffraction fringes (similar to those observed with visible light) when a beam of X-rays passed through a narrow slit. All were unsuccessful until 1902 when H. Haga and C. H. Wind showed a slight broadening of the image formed by the narrow end of a tapering slit. A careful repetition of this experiment in 1908 by B. Walter and R. W. Pohl led these investigators at first to conclude no such effect existed, but careful photometric measurements about four years later by P. P. Koch on Walter and Pohl's plates showed that with softer X-rays the blackening of the photographic slit image fell off more gradually than for hard X-rays. A. Sommerfeld at Munich in 1912 estimated from these results an average wave length (from a medical X-ray tube) of the order of 0.4×10^{-8} cm.

At this time Max von Laue, then in Munich, was profoundly interested in these results and searched in his mind for a method of revealing and measuring with greater certainty the wave lengths of X-rays. Something like the diffraction gratings used for visible light but on a much finer scale was needed. Coming one day for a talk with A. Sommerfeld he found him discussing with P. P. Ewald the theoretical work the latter was doing on the transmission of light waves through a "molecular lattice" (a term we

[1] More than a decade earlier E. Goldstein had observed that from the places where the cathode rays in a vacuum tube strike the wall or another obstacle a radiation was emitted which in its turn was capable of producing secondary radiation by fluorescence. He did not, however, investigate its further properties. (For this and numerous other interesting historical details which follow, the author is indebted to Prof. P. S. Epstein.)

[1] The advanced nature of the subject material of this article unfortunately necessitates the occasional use of technical terms of the more elementary sort without preparatory explanation because of space limitations. Definitions and elucidation of such terms can be found in other *Encyclopædia Britannica* articles or in elementary texts on physics.

shall explain more fully below). Von Laue here heard for the first time the hypothesis that crystals were regular latticework atomic structures with a spacing between atoms of the order of 10^{-8} cm. Here were the gratings needed for X-ray diffraction ready-made by nature herself, and Von Laue realizing this in great excitement lost no time in suggesting to his associates, W. Friedrich and P. Knipping, what proved to be an epoch-making experiment, for it (1)

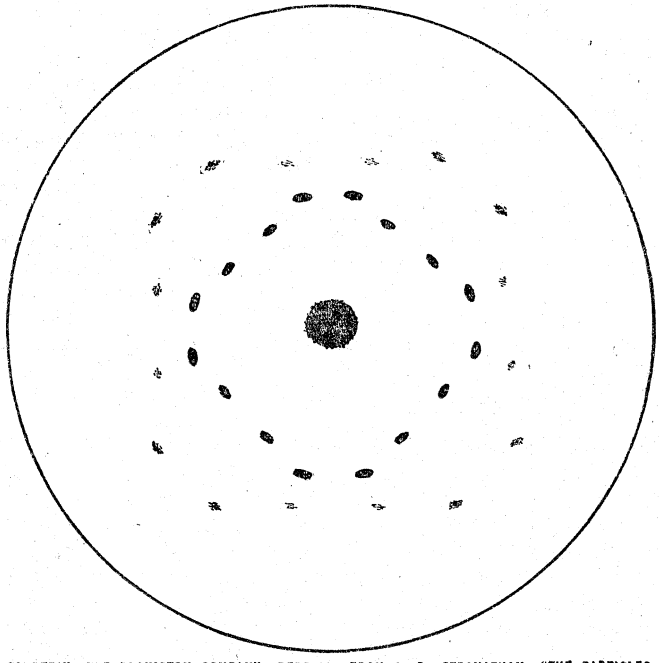

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FIG. 3.—DIAGRAM OF VON LAUE, FRIEDRICH AND KNIPPING'S PHOTOGRAPH SHOWING THE "LAUE SPOTS" REFLECTED FROM VARIOUSLY ORIENTED ATOMIC LATTICE PLANES IN A ZINC SULPHIDE CRYSTAL

The large central spot shows where the primary beam of X-rays passing through the crystal fell on the photographic plate. The surrounding reflected spots are not quite symmetrically disposed because the primary beam was imperfectly aligned with one of the axes of symmetry of the crystal

revealed the nature and structure of crystals as three-dimensional latticework patterns of atoms, (2) led to the study of X-ray spectra which unlocked the secrets of atomic structure. Von Laue suggested that a fine pencil of X-rays collimated by passage through pinholes in two lead screens be allowed to fall on a crystal of zinc sulphide. A photographic plate, placed a short distance behind the crystal, received the original X-ray beam which had passed directly through the crystal and in addition after a long exposure, there was found on the plate a regular pattern of spots coming from subsidiary X-ray beams reflected to the plate by the structure of the crystal at considerable angles to the primary beam.

The analytical explanation of these spots by Von Laue became much easier to understand intuitively after the work of William Bragg in England in the next year and for brevity and simplicity we shall, therefore, present it in this light, though it was not at first so understood by Von Laue.[1] Bragg's work (to be further explained below) suggested to him that the atomic lattice planes in the crystal were the agents which reflected the X-rays. Departing momentarily, therefore, from the historic sequence, it can easily be shown by experiment that the positions of the Laue spots vary with (1) direction of the incident beam (crystal and plate fixed), and (2) orientation of the crystal, (incident beam and plate fixed), just as though each secondary beam were formed from a part reflected out of the primary beam according to the well-known mirror law (equal angles of incidence and reflection) from a multitude of partially reflecting, partially transmitting, surfaces inside the crystal, oriented in a great variety of symmetrically arranged directions. Fig. 3 shows how these spots appeared on the Von Laue photograph. It becomes clear that the reflecting planes are so related to the structure and symmetry of the developed faces and other properties of the crystal (optical, mechanical, dielectric, etc.) as to permit of interpreting them as atomic lattice planes. This calls for a little explanation. Those who have observed an orderly, two-dimensional latticework of regularly spaced objects such as trees in an orchard, say from a moving railway train, will recall how the trees align themselves in straight parallel rows in many directions beside the principal rows and columns, e.g. at 45° thereto and at many other angles. In each oblique direction the trees will appear more or less densely studded along oblique parallel rows, each of which will be characterized by an angle to the principal rows whose tangent is the ratio of two integers, different for each oblique direction. In a three-dimensional latticework of atoms which constitutes a crystal, we must think of many such groves of trees piled in regular layers one above another in a perfectly ordered way in all three directions. It then becomes clear that we should observe not only principal and oblique rows of trees but analogously principal and oblique planes of them in a great variety of orientations in space, each plane being studded with a regular orderly pattern of trees. Moreover, in a crystal, each such plane, be it horizontal, vertical, oblique or whatnot as to orientation, will be a member of a large family of such planes, all of the same orientation, all equidistant and rigorously parallel to each other like a geological stratification, and each studded with atoms in the same pattern and density. These in a crystal are the atomic lattice planes. Fig. 4 should help the reader to imagine them.

X-rays are not reflected from ordinary mirrors. On the minute scale of X-ray wave lengths, ordinary polished surfaces are insufficiently flat, smooth and uniform in properties. In the case of a single atomic crystal plane the fraction of an incident beam of X-rays specularly reflected therefrom is very minute indeed, and were it not for the fact that in a crystal such planes, whatever their direction, occur in myriads of parallel uniformly spaced duplicates, the reflections would probably be too weak to be observed. The atomic lattice planes approach perfect flatness much closer than any polished mirror but it is the uniformity of plane spacing which is the especially favourable factor. Actually, out of a heterogeneous primary X-ray beam, containing a continuous spectral distribution of wave lengths, only one extremely small spectral region of these wave lengths is selectively reflected by a given family of planes of specified common interplanar spacing, d, but this reflection is extremely efficient because of constructive interference between the reflections from the different planes when the wave length and the angle of reflection are properly related, as Sir William Bragg showed immediately after the experiment of Von Laue, Friedrich and Knipping.

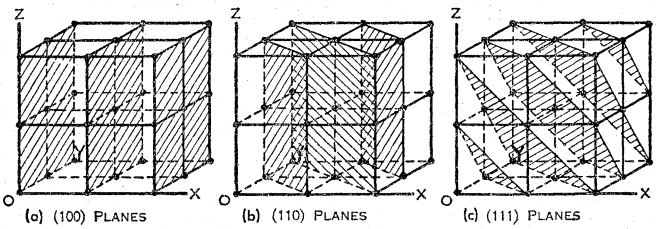

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FIG. 4.—SHOWING THE (100) THE (110) AND THE (111) PLANES OF A CUBIC CRYSTAL.

The three parenthetical digits are called Miller indices. They are proportional to the reciprocals of the intercepts of the plane on the three principal axes of the crystal

Selective Reflection, the X-ray Spectrometer.—There is an analogy between the selective reflection of X-rays by the periodicity of interplanar spacing of the superposed layers of atomic lattice planes and the selective reflection (or "diffraction") of visible light by the periodicity of spacing of the rulings on an optical diffraction grating. Sir William Bragg showed, in 1912, that if the wave length λ of the X-radiation, the interplanar

[1] Von Laue showed in a later paper the identity of the two modes of description, Bragg's being the common-sense intuitive one but Von Laue's being the more rigorous and general method of treatment. Still more elaborate treatments have been made of the physical optics of X-rays in crystal lattices by C. G. Darwin, by P. P. Ewald and by Von Laue himself.

spacing d, and the angle θ of reflection (or its equal the angle of incidence) measured between the beam and the crystal plane satisfied the relationship

$$n\lambda = 2d\sin\theta \qquad (2)$$

wherein n is a small integer known as the order number, a very strong reinforcement of reflection through constructive interference was to be expected. This is known as the Bragg law and it forms the foundation upon which all x-ray crystal spectrometers are dependent. (For further details, *see* SPECTROSCOPY, X-RAYS). A beam of heterogeneous X-rays incident upon the atomic planes of a crystal was analyzed into its component wave lengths in Bragg's original spectrometer by slowly rotating the crystal so as to change the angle of reflection θ and therefore the selected wave length λ according to the above Bragg law. The intensity of the reflected beam was then measured (and plotted as a function of θ) using an "ionization chamber" in which the rate of formation of ions in a gas, chosen and disposed so as completely to absorb a beam of X-rays, is taken as a measure of the X-ray intensity. The selectively reflected beam could also be studied photographically. By slow rotation of the crystal on which was incident a suitably collimated X-ray beam, there could be spread out upon a photographic plate a spectrum of the selectively reflected radiation, and it soon became evident that the radiation from ordinary X-ray tubes was of two types, a "continuous spectrum" and a "line spectrum," the latter characteristic of the target material in the tube.

From measurements of the diffraction angles θ Bragg was able to compute with moderate quantitative accuracy the wave lengths in centimetres of the X-ray lines in the spectra he formed by crystal diffraction. The key to this was the value of, d, the interplanar atomic spacing in the crystal used for forming the spectra according to equation 2. This spacing he was able to compute from (1) the newly obtained knowledge of the geometry of the crystal lattice, (2) the measured density of the crystal, and (3) the absolute weight[1] (in grams) of a single atom. The last quantity was, even at that time, known with moderate accuracy from (1) studies of the Brownian motion (Perrin), and (2) the famous oil-drop measurement of the elementary unit of electricity, the electron, by Robert Millikan (1909). Either of these experiments yields the "Avogadro number" ($N = 6.023 \times 10^{23}$), the absolute number of atoms in one gram-atomic-weight of any element, a universal constant. The absolute weight of any atom is merely the quotient of its chemical "atomic weight" divided by N.

From such considerations as these, Bragg was able to assign absolute as well as relative values to the wave lengths of all of his X-ray spectral lines. Thus, for example, to the shortest wave length line in the L group from a platinum target (now known in Siegbahn's notation as $L\gamma_1$) Bragg assigned the wave length 0.97 Ångstroms (0.97×10^{-8} cm.) correct within 2%. The absolute scale of X-ray wave lengths was later established with very much higher precision by diffraction of X-rays from artificial ruled gratings used in grazing incidence (J. A. Bearden, E. Bäcklin, A. H. Compton, J. Thibaud) so that by a reversal of the process the most precisely reliable values of the electronic charge and of Avogadro's number have been calculated. This use of ruled gratings is difficult, however, and natural crystals still remain the best agents for general X-ray spectroscopy.

Moseley's Law.—In 1914, H. G. J. Moseley, in two classic papers, presented a systematic study of the characteristic line spectra emitted by targets of various metals when "excited" by cathode ray bombardment in an X-ray tube of special construction which permitted rapid substitution of several different target materials. Unlike optical spectra the X-ray characteristic spectra are relatively simple, consisting, for a given element, of widely spaced groups, of but a few lines. Following the original nomenclature of Barkla, the groups of spectral lines for each element are designated in order of their increasing wave length location in the spectrum as K, L, M, etc. The pattern of lines in each group is very similar for a wide range of elements save for the actual wave-length position in the spectrum and it is of extreme significance that as we pass from element to element in the so-called "periodic table" of the elements (arranged in increasing order of atomic weight) the wave length of a given homologous spectrum line (such as $K\alpha_1$), observed successively in the spectrum of each element, varies in a regular and perfectly uniform way, if it is plotted not as a function of the atomic weight of the atom which characteristically emits it, but as a function of an ordinal number Z (the atomic number, as Moseley called it) of the atom in the periodic or Mendeleeff table. Moseley showed that if the square root of the frequency ν of a given identifiable X-ray line, as we examine it from element to element, is plotted against the atomic number Z of that element, a beautifully linear relationship is obtained over a wide range of frequencies and atomic numbers ($Z = 13$ to $Z = 30$) whereas no such linearity exists when the atomic weight is used as the parameter for plotting (*see* fig. 5). The importance of the atomic number, which actually turns out to be nothing more nor less than the number of fundamental units of positive electricity possessed by the nucleus of the atom, was thus for the first time brought to light. Moseley assigned atomic numbers in the order of increasing atomic weights as follows: *H*-1, *He*-2, *Li*-3, *Be*-4, *B*-5, *C*-6, *N*-7, *O*-8, *F*-9, *Ne*-10, *Na*-11, *Mg*-12, *Al*-13, *Si*-14, *P*-15, *S*-16, *Cl*-17, *A*-18, *K*-19, *Ca*-20, etc., to *Zn*-30. This assignment actually requires in some cases a reversal of the general order of increasing atomic weights.

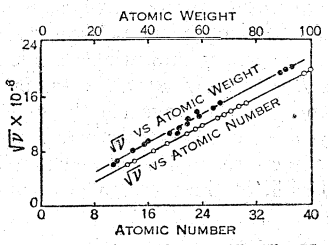

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FIG. 5.—MOSELEY'S CURVE ILLUSTRATING THE MORE REGULAR DEPENDENCE OF $\sqrt{\nu}$ ON ATOMIC NUMBER AS CONTRASTED TO ATOMIC WEIGHT, FOR ELEMENTS Z=13 TO Z=30

The Rutherford-Bohr Atom.—Sir Ernest Rutherford had shown from his beautiful experiments on the scattering of alpha particles passing through thin foils (*see* article ATOM) that the atom must consist of an extremely tiny heavy positively charged nucleus, about 10^{-12} cm. in diameter (in which the great bulk of the weight of the atom resided), surrounded by a swarm of relatively light negatively charged electrons presumably executing orbits in the central field of attraction of the nucleus somewhat like the planets about the sun. In the normal electrically neutral atom from which none of the electrons have been lost the number of attendant negative electrons is just equal to the number of elementary positive charges on the nucleus, in short the atomic number, Z. (The positive and negative elementary units of which electricity consists are exactly equal, but opposite in sign, though they are, in the electron and the proton, associated with very different masses. The numerical value of this elementary charge is about 4.803×10^{-10} electrostatic units. The mass of the electron is about 0.91×10^{-27} grams while the mass of the proton is 1,836 times larger. *See* article ELECTRON for the methods whereby its charge and mass were determined.) Rutherford's experiments had further shown that the nuclear charge for a given atom is very approximately half its atomic weight and Barkla had shown from experiments on the scattering of X-rays, mentioned earlier, that the number of electrons surrounding the nucleus is also approximately half the atomic weight. It was these considerations which guided Moseley. In 1913, Niels Bohr had proposed a quantitative model of the hydrogen atom based on Rutherford's general model with certain very shrewd additional hypotheses drawn from the existing rudimentary quantum theory and from an effort to explain the regularities in the characteristic spectral lines emitted by the simplest of all atoms, hydrogen (atomic number $Z = 1$). Bohr's theory predicted that the frequency ν of a spectral line should obey the formula

$$\nu = Z^2 \frac{2\pi^2 me^4}{h^3}\left\{\frac{1}{n_2^2} - \frac{1}{n_1^2}\right\} \qquad (3)$$

[1] The word "weight" is strictly incorrect since "mass" is really meant. Chemical usage, however, has followed this error when "atomic weights," really the relative scale of masses of atoms, are spoken of.

In this formula Z is the atomic number, m, the mass of the electron, e, the elementary electrical charge unit, and h, Planck's constant, all of which quantities were known with reasonable accuracy at the time (1913). The numbers n_1 and n_2 are simply small integers which Bohr called quantum numbers, whose significance will soon become clear. The number $2\pi^2me^4/h^3$ is known as Rydberg's fundamental frequency and when divided by the velocity of light this gives $R=2\pi^2me^4/(h^3c)$, the famous Rydberg wave number, the reciprocal of the wave length corresponding to the Rydberg frequency. $R=1.0973742\times10^5$ waves per cm., is one of the most accurately measured universal constants. Bohr's theory gives the permitted radii of the electron orbits as

$$a_{nz}=\frac{h^2}{4\pi^2me^2}\,\frac{n^2}{Z}. \qquad (3.1)$$

The radius a_o of the smallest permitted Bohr orbit in hydrogen ($Z=1$, $n=1$) is

$$a_0=\frac{h^2}{4\pi^2me^2}=5.27\times10^{-9}\text{ cm.} \qquad (3.2)$$

Now the really astonishing success of Moseley's investigation (and of Bohr's theory) was that whereas Moseley's plot of the square roots of the frequencies, $\sqrt{\nu}$, of spectral lines (the "Kα line") against the atomic numbers of the elements emitting them, gave the numerical relation for elements from $Z=13$ to $Z=30$

$$\nu_{K\alpha}=0.248\times10^{16}\,(Z-1)^2. \qquad (4)$$

The entirely theoretical formula of Bohr, yielded upon substitution of the known values of m, e, h, *and* the integers $n_2=1$, $n_1=2$

$$\nu=0.246\times10^{16}Z^2 \qquad (5)$$

Even the discrepancy between Z in one expression and $Z-1$ in the other had a perfectly logical explanation, as we shall see.

Bohr's picture of the atom contained a new and revolutionary idea. It seemed a safe guess at the time that the swarm of electrons about the nucleus must be in rapid motion, for a mathematical theorem developed much earlier by S. Earnshaw gave convincing proof that no system of point charges could ever be in static equilibrium under the action of their own fields. On the other hand, according to the electromagnetic theory of radiation propounded by C. Maxwell and extended by H. A. Lorentz, any such system of moving charged electrons must, according to the then known macroscopic laws of electricity and magnetism, radiate electromagnetic waves with attendant loss of energy at the expense of their motion until the electrons would eventually fall into the nucleus just as planets would fall into the sun if their total orbital energies could be sufficiently reduced. After such a catastrophe, were it possible, very little of the atom that could be detected would remain. That this does not happen is obvious since the "sizes" of atoms, the space they occupy in crystals, for example, never change, and there is every evidence that it is the size or extent of the electron swarm about the nucleus that defines the space an atom must occupy among its neighbours. The forces between atoms which hold them together, which give steel and diamond their strength and rigidity, which keep the oxygen and the two hydrogen atoms together in water vapour, are forces in part created by the interaction of the electron swarms surrounding the nuclei in these various aggregates. All the solidity we know of, and upon which our intuitive notion of rigid frames of reference is based is due to nothing more substantial, on the atomic scale, than the ceaseless interplay of swarms of electrons. Now, according to the then known "classical" laws of mechanics, electricity, and magnetism, up to the time of Bohr's theory (1913), a negatively charged electron rotating in an orbit about a positively charged, relatively heavy, nucleus might be expected to have any energy whatever so long as the well-known mechanical laws of orbital motion (illustrated by the planets) were obeyed. (If a little energy were somehow stolen from a planet it would merely fall somewhat closer inward to the sun with a consequent increase in its average orbital kinetic energy but a decrease twice as great in its average potential energy, thus accounting for a net decrease in its total energy corresponding to that stolen.) Bohr's revolutionary new concept asserted that for the orbital electrons this infinite choice of possible energies and orbits did not hold. There were certain orbits, and total electron energies associated therewith, which he called permitted or stationary states. He laid down a precisely definite mathematical condition defining such states or orbits. In any one of these, for some then mysterious reason, the electron might play forever without radiating its energy. For such orbits or states the classical laws of electromagnetism were somehow abrogated. Only when the electron passed from one such stationary state to another of lesser total energy did it emit electromagnetic radiation and the quantum of energy thus emitted was just the difference in energy between the two stationary states. The integers, n_1 and n_2 in Bohr's formula referred to the two states, "initial" and "final" from which and to which the atom passed in the transition.

For the simple mathematical reasoning leading to Bohr's derivation of formula (3) above, *see* the article ATOM. At the time, the justification for his entirely mysterious postulate was the dazzling success with which it explained (1) the exact frequencies of lines in the spectrum of hydrogen and (2) the frequencies of the lines in X-ray spectra of higher atomic number elements. The latter success was of the unforeseen variety, hence doubly convincing. After 1913, the meaning of Bohr's nonradiating orbits or stationary states became much clearer. To satisfy the reader's curiosity some of that meaning should perhaps be anticipated at this point by a temporary forward jump of ten years.

X-RAYS AND WAVE MECHANICS

De Broglie's Wave Electrons.—In 1923 Louis de Broglie made a very bold suggestion regarding electrons, namely, that they might also possess undulatory properties, exhibiting thus the same duality as the photons of radiation. Many years earlier the great Irish mathematician, Sir William R. Hamilton, emphasized a subtle mathematical analogy between Pierre de Maupertuis'[1] principle of "least action" which controls the mechanics of mass particles (their trajectories in passing through fields of force) and Pierre Fermat's principle of "least time" which controls the paths of rays of light in geometrical optics (their paths in traversing media of differing refractive index). It is to De Broglie's great credit that he sensed that this analogy went deeper than anticipated by Hamilton and followed this tenuous, unpromising lead to its stirring conclusion.

It has turned out that a particle moving from free space down a potential gradient into a field of (attractive) force and a wave propagating from empty space into a region of greater refractive index are two complementary aspects (in the sense explained near the end of the introduction above) of the same phenomenon; there is a quantitative equivalence principle between "field of force" and "change of refractive index." De Broglie arrived at a quantitative formulation of his ideas by applying a famous principle from the theory of relativity.

Albert Einstein had asserted, as a consequence of his relativity theory (*q.v.*), that mass and energy are equivalents according to the law

$$W=mc^2 \qquad (6)$$

in which W is the energy in ergs, m the mass equivalent to that energy in grams, and c the velocity of light in vacuo. According to this law a small amount of mass, m, could be conceivably annihilated, as such, and converted (for example) into radiation[2] of energy $W=mc^2$ (one gram thus yielding 25,000,000 kilowatt hours). Fantastic as this sounded when first proposed, both this process and its reverse have been observed with quantitative accuracy on a minute scale in the laboratory.

[1] The principle of least action as we know it and as Hamilton knew it, before he set up his own, was due to Joseph Louis Lagrange. The formal identity of the principles of least action and of least time was common knowledge in the 18th century when Sir Isaac Newton's corpuscular theory of light was dominant and it was thought that the identity was not only one of form but of substance.

[2] The conversion of mass into energy need not necessarily take the form of radiation. The law of equivalence of mass and energy is a very general one and the conversion may be to energy in any of its forms or manifestations.

On a huge scale in the form of the atomic bomb first used in 1945 the partial control of this conversion of mass into energy now yields a stupendous source of energy which also promises possibilities of great practical utility. De Broglie made the daring assumption for that time that the total energy equivalent (mc^2) of the electronic mass m was associated with a frequency of vibration ν according to the quantum law $h\nu = mc^2$. The word "vibration" here is not intended to imply a rapid to-and-fro motion of the electron corpuscle. The vibration (of *what*, he left undefined) was supposed, for a stationary electron, to occur in the same phase throughout all space or at least in an undefined region in the vicinity of the electron. Applying the laws of the Lorentz-Einstein relativity transformation to such a state of affairs to see how it would appear when in motion, he arrived very simply at the result that the electron vibration would appear as a set of plane waves[1] normal to the direction of motion of the electron corpuscle and of wave length λ given by the formula

$$\lambda = h/(mv) \qquad (7)$$

in which mv is simply the momentum of the moving electron. These waves would travel with a "phase velocity," u, greater than light velocity while their "group velocity," less than light velocity, was to be identified with v the particle velocity of the electron: v and u were related by the equation

$$uv = c^2 \qquad (8)$$

De Broglie's superlative insight (like Einstein's) was regarded as idle fantasy—but not for long. Four years later, at the American Bell Telephone laboratories, C. J. Davisson and L. H. Germer, while searching for a slightly different supposed phenomenon, discovered that electrons, when reflected from the clean surface of a crystal (nickel), exhibit selective reflection from the atomic planes of the crystal lattice in complete analogy to the behaviour of the waves of X-rays observed earlier by Von Laue and Bragg. The wave lengths of electrons thus determined, with an appropriate small correction for the "index of refraction" of the electrons inside the force field of the crystal, were found to depend on the velocity of the electrons in complete quantitative confirmation of the De Broglie law, $\lambda = h/(mv)$! Moreover, it was later shown that the principle is a perfectly general one including all the fundamental particles of nature, such as protons or neutrons, and O. Stern and his collaborators demonstrated (1930) that such a complex particle as a helium atom is undulatory and obeys the De Broglie law completely. Others (A. Ellett and R. M. Zabel, 1931) even revealed the undulatory property for neon and argon atoms. But no "particle" ever exhibits both the particle and the wave characteristics in the same experiment; we cannot see both sides of the coin at once.

It was Louis de Broglie's original suggestion that the stationary or nonradiating orbits of Bohr's atom model were those around which the electron waves according to the above formula could just fit with an exactly integral number of them in one circumference, in analogy to the "standing waves" set up on a violin string, or in still closer analogy to a ring of some sonorous metal excited by a blow to vibrate in its characteristic modes. These analogies fail only to the extent that they exhibit some dissipation of the wave energy whereas the electron in its nonradiating orbit loses no energy whatever. The quantum numbers of Bohr (n_1 and n_2 in formula 3) were supposed to correspond to the number of these complete waves in one circumference for the electron in the initial and final states of a radiative transition. The idea was almost right but it needed a little refinement which was supplied by Erwin Schrödinger who laid down the general wave equation for an electron in a potential field and gave the highly successful wave mechanical solution of the hydrogen atom.

The successes of this solution in predicting with high quantitative accuracy the properties of the hydrogen spectra, far surpass even the successes of the original Bohr theory. In the Schrödinger wave mechanical atom it is the electron wave functions, whose interplay about the space surrounding the nucleus (previously supposed to be occupied by the electron swarm) according to the wave mechanical Schrödinger equation, controls and defines the entire electronic structure. These are three-dimensional waves present in greater or less degree at all points of the space in question and indeed, with sufficiently attenuated amplitude, extending to the farthest confines of the universe. They are, as it were, trapped and held in place by the refracting effect of the field of the nucleus and under these restrictions there are set up certain permanent modes of vibration of the structure as a whole. Thus the particle mechanics of the older Bohr atom is replaced by a physical optics of the electron waves, elastically retained by the nuclear field so as to pulsate in various possible permanent modes of vibration, though not boxed in any sharply bounded enclosure.

An unavoidable result of the Schrödinger theory is that the amplitude of the waves at every point in the space must be described by the complex numbers of algebra (of form, $a+ib$, where $i=\sqrt{-1}$ and a and b are ordinary numbers). It is these complex amplitudes which must be added, according to those algebraic laws, when two or more of the waves are superposed. It also turns out that a very definite interpretation can be given to the square of the "modulus" of this complex-number-amplitude at every point. If the amplitude $a+ib$ is denoted as ψ and its conjugate $a-ib$ as $\bar{\psi}$ then the square of the modulus ($a^2+b^2=\psi\bar{\psi}$), which is an ordinary "real" number, is also a wavelike pulsating distribution about the nucleus and turns out to be nothing more or less than the probability that an electron shall be observed at the point in space where $\psi = a+ib$. These waves of probability are very physical, nay even tangible[1] things. Their average distributions can be studied for example by X-ray diffraction experiments. The phase waves or ψ-waves of which they are the moduli on the other hand are strangely elusive and beyond our experimental ken. The ψ waves are our inferred "causes" of electronic behaviour.

Electrons not only occupy positions in space—they also move and hence have momentum; literally they can deliver blows so as to set other bodies in motion. (The "free" electrons emitted by the cathode in an X-ray tube are doing just this to the atoms of the target on which they impinge; the resultant agitation of these atoms we call heat and, in X-ray targets, melting of the most refractory metals can thus readily occur.) Not only do free electrons have momentum; as we shall see, the attendant "bound" electrons pulsating around the nuclei of atoms and the electrons undulating in the internuclear spaces of the atomic lattices of crystalline solids (the same which conduct electricity through wires) have momentum and can deliver very real blows to prove it; when questioned, by throwing suitable projectiles at them they can "hit back" at the particles and modify their motion very observably.

The complex algebraic number, ψ, describing the amplitude of the Schrödinger electron waves varies from point to point in the space surrounding the nucleus. Briefly we say that "ψ is a function of the space co-ordinates, x, y, z"; or we write briefly in mathematical symbols $\psi(x,y,z)$. Then $\psi\bar{\psi}$ gives the chance of observing the electron at the point x, y, z.

The momentum of an electron (or any mass particle) can be described by an arrow directed in the forward direction of motion and having a length (to some convenient scale) proportional to the momentum mv. If, preserving the various space directions in which they point, a multitude of such momentum arrows are plotted outward from a common origin we have what has been called a momentum "hedgehog" plotted in "momentum space." Each of these momentum vectors may be described completely as to magnitude and direction by giving its components p_x, p_y, p_z, that is to say its projections (positive or negative) on the three cartesian axes of co-ordinates x, y, z.

It is a curious result (derived from the transformation theory of P. A. M. Dirac) of the DeBroglie-Schrödinger wave me-

[1] De Broglie waves should not be confused with their offspring, electromagnetic radiation.

[1] Our sense of touch must be ascribed to the interactions of electron wave functions since these are responsible for the forces exerted when bodies make contact.

chanics that the probability of encountering electron momenta p_x, p_y, p_z, (associated with the electrons surrounding the nucleus of an atom, for example) can be described in momentum space by an analogous undulatory distribution very similar to ψ whose value at each momentum vicinity p_x, p_y, p_z, is again a complex quantity φ (p_x, p_y, p_z) and most curious of all, the momentum distribution φ (p_x, p_y, p_z) can be obtained from the space distribution $\psi(x,y,z)$ by means of a definite integral to be extended over the entire region where these quantities have amplitudes sufficient to be of interest. This integral is

$$\varphi\,(p_x, p_y, p_z) = \int \psi\,(x,y,z)\, e^{-\frac{h}{2\pi i}(p_x x + p_y y + p_z z)}\, dx\, dy\, dz \qquad (9)$$

that is to say, the chance $\phi\,\tilde{\phi}$ of encountering a definite electron momentum, (p_x, p_y, p_z) in an experiment in which the location of the encounter is undefined is definitely related to a weighted average taken over the entire electron position-wave-function. Where the electrons are (in the sense of their wave amplitudes ψ) is thus by no means immaterial to the statistics of how fast and in what direction they move (in a way that is not to be confused with the action of the mutual repulsive forces between them). This is very closely related to W. Pauli's famous "principle of exclusion in phase space," which will soon arise when we consider the construction of atoms with more than one electron retained by multiply charged positive nuclei.

There has been a tendency, created by the substitution of wave functions for the earlier planetary electrons, to think of the atomic structure as something static. This error tends to be encouraged by many publications of remarkably beautiful electron probability density space distributions $\psi\,\tilde{\psi}$ represented by ingenious artificial photographic techniques in which the degree of blackening (or the contrary) at each point represents the probability (that an electron will manifest its presence there by interaction with some external investigating particle such as a photon). The immediately preceding discussion of atomic electron momenta and momentum wave functions has been deliberately introduced here to dispel any such erroneous impression of a static structure. True, the principle of uncertainty, soon to be explained, asserts that no experiment can be devised which permits simultaneous observation (with more than specified accuracy) of the position and momentum of an electron. But there is no limitation whatever upon observing, without regard to their positions in space, the momenta of the atomic electrons or of those in a crystal lattice. The momenta referred to are very real things for which there is clear-cut direct experimental evidence and the momentum wave functions φ have an equal claim to validity with the position functions ψ.

Before the advent of wave mechanics the original orbital electron theory of Bohr was refined and made more elaborate by him and by many others notably A. Sommerfeld, P. S. Epstein, and G. E. Uhlenbeck and S. Goudsmit so that: (1) quantized elliptical as well as circular orbits with relativistic precession in variously tilted space-quantized planes were included, modifications in atomic spectra under the influence of magnetic and electric fields were treated, and the instability of the not-infinitely-heavy nucleus under the drag of the rotating electron was taken into account; and (2), electrons each having definitely directed spin angular momentum, also quantized, were brought into the picture with considerable added success in the explanation of complicated line spectra, but also with considerable additional mystery. All this required the addition of many more quantum numbers than the original single one, n, of Bohr (formula 3) in order to describe completely the quantum state, but the reader must refer to other articles for the details. (*See* SPECTROSCOPY; SPECTROSCOPY, X-RAY.) Suffice it to say here that most of these *ad hoc* assumptions (save for electron spin[1]) were completely harmonized and explained in one stroke by the magic of electron waves in Schrödinger's first paper giving the solution of the hydrogen atom. They fell out of the mathematics as a natural consequence of the solutions of his single wave equation. Only those solutions are regarded as valid for which $\int \psi\tilde{\psi}\,d\tau$ (the probability of encountering an electron ascertained by exploring over the whole of space without limit to infinity) is finite. This condition alone suffices to define the needed multitude of discrete quantized stationary states.

A certain correspondence between the Bohr orbits and the wave functions of Schrödinger is discernible with interesting differences. The orbit has one more unit $(h/2\pi)$ of angular momentum than has the Schrödinger wave function and in the "ground state" (algebraically lowest energy level) the latter has no angular momentum at all (as against one unit thereof in the Bohr theory) as though oscillation rather than revolution in an orbit were taking place. Another striking correspondence is that the maximum radial probability density of certain of the Schrödinger wave functions occurs at the same radius from the nucleus as did the circular orbits which were the analogues of those states in the Bohr theory.

Atomic Structure.—As the result of extensive investigations in nuclear physics (*see* ATOM; NUCLEUS) there is strong evidence that the nuclei of atoms consist of only two kinds of heavy particles, protons and neutrons, sticking tightly together in a tiny droplet not more than 10^{-12} cm. in diameter. Protons and neutrons have almost exactly the same mass, about 1.66×10^{-24} grams, but the neutron as its name implies exhibits no electrical charge, while the proton has one fundamental unit[1] of positive charge (4.802×10^{-10} esu. in magnitude). Hydrogen, the lightest atom of all, then has a nucleus consisting of just one proton with one attendant outer negative electron (if the atom is neutral or unionized as are by far the great majority under ordinary terrestrial conditions). Helium has two protons and two neutrons in its nucleus, hence a positive nuclear charge of two units but a mass equal to about four protons. Neutral helium atoms then have two attendant outer electrons. Lithium nuclei consist of three protons and four neutrons, hence have a charge of three units and a mass equal to about seven protons. Three electrons, therefore, form the outer structure of neutral lithium. In this way we can proceed up the atomic table to the heaviest natural atom, uranium, with 92 protons and 146 neutrons tightly packed in its nucleus and hence with a nuclear charge of 92 units and with 92 negative electrons undulating in its outer structure when neutral. We must here omit many interesting details such as isotopes and changes in the total mass of a nucleus ascribable to its energy of formation from its constituent particles. The important thing for us is the regular progression in steps of one unit of the nuclear charge (atomic number Z) as we pass from element to element, attended with the addition of one more outer electron at each step. The characteristic X-rays emitted by these elements come from changes in this outer electronic structure. How do these electrons arrange themselves as we pile more and more of them around the nucleus in going to higher and higher atomic numbers?

The interesting answer is that they arrange themselves in "shells," that is to say groups of electrons such that the members of a group are all at about the same radial distance from the nucleus, differing rather widely from the radial distances of other groups. (The radial distance has, of course, the indefiniteness of a wave function but we refer to the radial distance of greatest density $\psi\,\tilde{\psi}$.) More important still, the "energy of extraction" of the electrons in the different groups or shells is about (but not absolutely) the same for all electrons in a shell but differs widely for the different shells. By the energy of extraction we mean the energy which must be supplied from outside sources to remove one of the electrons completely from the atomic structure so that it is just free but possessed of no kinetic energy in that free state. Unlike the radial distances, very sharply determinate, experimentally measured values can be assigned to the energies of extraction. They can be plotted as a diagram of different energy levels. Following the original terminology of Barkla, the shells,

[1] Later shown to be a consequence of a more inclusive relativistic version of the wave mechanics by Dirac in 1928.

[1] It was the very logical intention of R. A. Millikan, to use the term "electron" to designate the fundamental unit of electricity, positive or negative, but customary usage has linked this word so firmly to the negative particle that any other use may be misunderstood.

named in order of increasing radial distance from the nucleus and decreasing energy of extraction of their electrons, are called *K, L, M, N, O, P* and *Q*. As we pass from element to element toward increasing atomic numbers *Z*, each new electron is (usually) added in the outermost shell (though quite frequently the addition may be to the penultimate shell) until a limiting number, the capacity as it were of that shell, is reached and then a new shell is started.[1] The number of electrons needed to complete a shell, named in shell order, *K, L, M, N*, etc., are 2, 8, 18, 32. In the elements above $Z=36$ there are also *O* and *P* shells and in *Ra, Ac, Th, Pa* and *U* ($Z=88$ *to* 92) there is even a *Q* shell. The highest number of electrons observed in these shells occurs for uranium, namely 18, 12, and 2 in *O, P* and *Q* respectively but it cannot be said with certainty that some of these might not be increased if the table went higher. It does not do so in the natural elements because of some sort of nuclear instability when *Z* exceeds 92. Artificial transuranic elements ($Z=93$, 94) however have been produced by transmutation.

An atomic structure from which an electron in some specified shell has been extracted, has had work done on it (the work of extraction) and is, by just that amount, at a higher total energy level than before. It is now momentarily an ionized atom, not neutral because of the absence of one electron. There is in this condition a very strong tendency for an electron from some shell of larger radius than the ionized one to "fall down" and occupy the vacancy. In doing so the atom as a whole passes to a lower energy level and the difference in energy is radiated in the form of a photon of frequency ν according to the equation

$$W_1-W_2=h\nu \qquad (10)$$

wherein W_1-W_2 is the difference between the initial and final energy levels of the atom and h is Planck's constant. It is worthy of note here that P. Auger has shown by experiments with the C. T. R. Wilson cloud chamber that this is not the only mechanism whereby the downward atomic energy transitions (of an atom ionized in an inner shell) can expend their energy. The atom may choose to emit not a photon but another one of its electrons, in which case the available energy is expended on this electron in part to do its work of extraction W_e and the remainder to give it kinetic energy W_{kin} in the free state. The equation of energy balance is

$$W_1-W_2=W_{kin}+W_e. \qquad (11)$$

This is called the Auger effect, first revealed in 1925 by P. Auger.

The Exclusion Principle.—All we have said implies that save for its outermost shell there is a close-packed quality about the structure of a neutral many-electron atom in its lowest energy state. In spite of the grouping of electrons in rather widely separated shells the entire structure is as dense as its wave-mechanical quantum laws permit. These laws require the formation of the wide intershell spacings (in both radius and energy) and their essence is summed up in what is known as Pauli's principle of exclusion, which in one of its forms asserts that for no two electrons in an atomic structure can all of the quantum numbers required to describe their states be identical. Since space does not here permit a discussion of the detailed significance of the different quantum numbers, this form of Pauli's principle will be less significant to the reader than another one which has been used with great success by Fermi, Thomas and others when the electron swarm has to be treated statistically without detailed knowledge of the complicated force fields in which the electrons find themselves (their own fields and those of the nuclei). This statistical form of the statement must be made in terms of a phase space (a concept due to that great U.S. physicist, Josiah Willard Gibbs) of six dimensions: three, the position co-ordinates x, y, z of an electron; the other three, its momentum co-ordinates, p_x, p_y, p_z. Pauli's principle asserts that in such a space a small cell of volume $\Delta x\Delta y\Delta z\Delta p_x\Delta p_y\Delta p_z=h^3$ at the point x, y, z, p_x, p_y, p_z cannot contain more than two electrons (and this only if their spins are in opposite directions). The exclusion principle lays no restriction on the shape of the exclusion cell, only on its volume. The shapes are determined by the detailed mechanics of each particular case. The cell of volume h^3 is made up of the product of two factors, an ordinary and familiar spatial volume $\Delta x\Delta y\Delta z$, inside which the pair of electrons is supposed to be situated, and a momentum volume $\Delta p_x\Delta p_y\Delta p_z$ within which they also lie; meaning that in the momentum "hedgehog" (*see* above) the momentum arrow for that electron pair has its point inside the momentum cell in question so that its three momentum co-ordinates lie between p_x and $p_x+\Delta p_x$, p_y and $p_y+\Delta p_y$, p_z and $p_z+\Delta p_z$ respectively.[1] The presence of the position vector of the electron pair inside the first cell and the momentum vector inside the second cell excludes all other electrons from having their positions and momenta so located. Since the product of the volumes of the two cells is a universal constant, h^3, this means, in rough language, that if electrons are very densely packed in space they must be spread wider apart in momentum and vice versa, since their number density in the phase space is a constant. Consider the two electrons (with opposite spins) which have been packed into the *K* shell of helium where the classical dynamics plus the quantum laws require them to have high momenta (group velocities of the order of 1/68 that of light). When we increase the nuclear charge by one unit to form a lithium atom, not only does the *K* shell shrink, with increased orbital speed, but the additional electron must be placed in an *L* shell at considerably greater radial distance than the first two and at considerably lower momentum and kinetic energy than they, under the requirements of the phase exclusion principle.

Origin of Optical and X-ray Spectra Contrasted.—All the characteristic spectral lines emitted when atoms give off electromagnetic radiation are due to transitions of atomic electrons between the different initial and final stable electronic states.[2] In the case of optical lines, an outer electron (one in the outermost shell) has been, by additional energy supplied from some external source, raised to a quantum-mechanically-permitted (but not ordinarily occupied) energy level of value sharply defined by the wave-mechanical requirements. (The atom is said to be "excited".) Its "fall" from this energy level W_1 to the normal one W_2 is then accompanied by emission of a photon of radiation whose energy $h\nu$ just accounts for the difference W_1-W_2

$$W_1-W_2=h\nu \qquad (12)$$

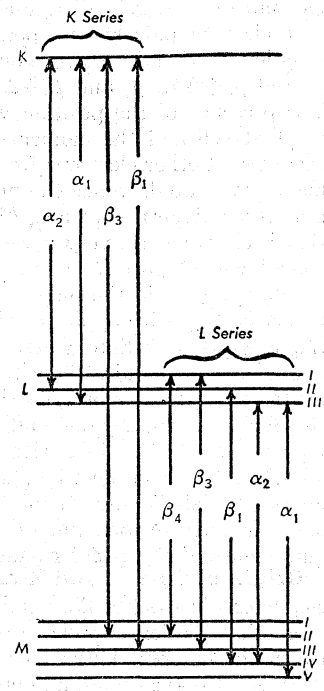
In the case of X-ray lines the atom is said to be "excited" when an electron in some inner shell is ejected completely from the atomic structure (by a supply from some external source of energy in amount equal to or greater than the energy of extraction). The atom is now left with a hole in its previously dense inner structure. The characteristic X-ray spectral line is then emitted when an electron from some shell outside the excited one "falls" into the hole or vacancy. Since it is the change in the total energy state of the entire atom which must be held accountable for the emission of the photon it turns out to be distinctly preferable to say that the hole in the structure has travelled upward to a new shell rather than to say that an electron from the new shell has fallen into the hole. (For clarity and brevity we shall use both descriptions in what follows as convenience dictates.) This process may occur in several steps before the hole reaches the outer surface. Eventually an electron from some external source will be picked up in the final vacancy and the atom will have returned to normal. In the process, characteristic spectral lines will have been emitted with definite frequencies determined by equations of the type of (12) for each of the discrete steps of readjustment. Note that in the X-ray case the

[1] This statement is only roughly true. A new shell is quite frequently started at somewhat earlier *Z* than the completion of its predecessor. The entire "rare earth" series is formed by the successive addition of electrons in an $N_{vi\ vii}$ shell, which process starts 21 atomic numbers later than the *O* shell outside it. Also with increasing *Z*, electrons are sometimes removed from outer shells and added to inner ones.

[1] This somewhat over-simplified language of cartesian co-ordinates implies that the cells are rectangular boxes, but no such restriction exists—their shapes are here undefined. In reality x, y, z, p_x, p_y and p_z should be regarded as generalized co-ordinates appropriate to the mechanics of the case.

[2] Certain very faint lines known as satellites are an exception to this statement. These however are accounted for by a similar but more complicated mechanism in atoms which have lost two or more electrons.

initial state of the atom, required for emission of a line, is one of ionization, creation of a hole. Now associated with this initial state there is a whole series of possible lines corresponding to electrons falling from different outer shells into that one vacancy. The most energetic of these lines (those of highest frequency) will be those that come from the remotest outer shells, those nearest the periphery of the atom. Such lines will approach in energy, $h\nu$, the energy of extraction of the electron removed when the hole was formed. The aggregate of all lines formed by such electron transitions from say the L, M, N, etc. shells into one ionized shell, say the K shell, is called a series, the K-series. The initial state of the atom characterizes the X-ray series. In optical spectra on the contrary it is the final state of the atom which characterizes a series of lines. Note, however, that in both cases if we think in terms of the "jump" the electron executes when the line is emitted, then it is the final level on which the electron lands which characterizes the series designation.



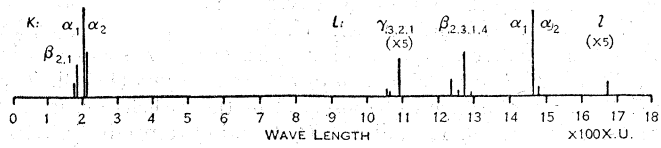
COURTESY, JESSE W. M. DUMOND

FIG. 6.—TYPICAL ARRANGEMENT OF THE HIGHER X-RAY ENERGY LEVELS OF AN ATOM

The vertical lines indicate the transitions or jumps between pairs of these levels which account for some of the stronger X-ray spectral lines as designated. Only K and L series lines are shown and by no means all of these. The magnitudes of the transitions are not shown to scale

X-Ray Energy Level Diagrams and X-Ray Spectra.—As we have already indicated, the extraction energy is not quite identical for all electrons in the same shell, the energy levels of the shells being said to have "a fine structure." For the detailed explanation of this the reader must consult more extended works. The accompanying small diagram, fig. 6, shows three principal atomic energy levels corresponding to an atom which has lost one electron from its K, L, or M shell. Since more energy is required to ionize a K-electron than an L or M-electron the K-level is plotted at the top. In such a diagram an electron falling from the L-shell into the K-shell appears to move upward but this is merely due to the convention used in plotting. It will be noted on this diagram that there is but one K-level while the L-levels are split into a triple fine structure and the M-shell has five distinct sublevels. It is the transitions of electrons as indicated by the lengths of the vertical lines which account for all of the frequencies of the characteristic spectral X-ray lines. (Except for certain very weak lines called "satellites" which are the result of multiply-ionized atoms, about which space does not permit us to elaborate.) Not all possible transitions occur with equal probability and some are so improbable as to have earned the name "forbidden." These transition probabilities control the relative intensities with which the various X-ray spectral lines are observed, for spectra must always come from a great multitude of excited atoms so that the probability of a radiative transition is statistically translated into the intensity of a line.

As a result of the spacing of the energy levels, large from K to L, relatively much less from L to M, relatively much less than the latter from M to N, etc.[1], the spectral lines of a given X-ray series form a rather compact group quite isolated from those of neighbouring series in the spectrum. As an example, we show in fig. 7 the K series and the L series lines of the spectrum of a tungsten target plotted against wave length, with the heights of the lines drawn to indicate roughly the relative intensities. If the value of $h\nu$ for the shortest wave length or highest frequency line in each group is computed, it is found to correspond almost



REDRAWN FROM RICHTMYER AND KENNARD, "INTRODUCTION TO MODERN PHYSICS," (MCGRAW-HILL BOOK CO.)

FIG. 7.—PLOT OF THE PRINCIPAL K AND L SERIES LINES OF TUNGSTEN AGAINST WAVE LENGTH

The relative intensities of the lines are indicated roughly by their heights save that the L γ and l lines are so weak that they are here magnified fivefold. The same line designations have been used as in fig. 6. Note the compactness of the pattern of lines of a given group (K or L) and the wide separation of groups

exactly (but not quite) to the extraction energy of the electron whose expulsion created the hole characterizing that series of lines. (Such extraction energies can be readily measured directly in a number of different ways as we shall see.)

We owe our first insight into atomic structure and the complexity of spectra in general to the simplicity of X-ray spectra, paucity and compactness of lines in a series, absence of overlapping of series, etc., as well as to the fact that the frequencies of the K series, the one first studied by Moseley, are chiefly determined by the energy levels of the K shells, those nearest the nucleus, as we pass from atom to atom. The K electrons are in the full attractive field of the nucleus itself with minimum screening by negatively charged electrons of the full nuclear positive charge Ze. It is this screening effect which accounts for the factor $(Z-1)^2$ instead of Z^2 in Moseley's equation (4) above. After excitation by removal of one K electron, the electrons of the outer structure (L, M, etc., shells) find themselves in the field of a nuclear charge Ze screened by one K electron, hence effectively $(Z-1)e$.

EXCITATION OF X-RAYS

Atoms can be excited to emit their characteristic X-rays (by expulsion of deep-lying electrons) in a number of ways as follows:

Electron Bombardment.—In this case the atom is ionized by collisions of fast electrons. (Of far greater total energy than the line spectrum from an X-ray tube, however, is the continuous spectrum generated directly by the impacts of the cathode electrons on the target, as explained below.) This is the method used in all X-ray tubes. As shown by experiments of W. Duane and F. L. Hunt and also of D. L. Webster, it is necessary that the colliding fast electrons have energy greater than the electron extraction energy W_e, the energy level of the series of X-ray lines to be excited. If V is the steady (D.C.) voltage applied in the tube to accelerate the electrons and e the electronic charge, then eV must equal or exceed W_e. The K series lines of silver, for example, just begin to make their appearance in the X-rays coming from the electronically bombarded silver target when, as we increase the voltage, we reach a value of 25,600 volts although the L series lines of silver are already strongly in evidence. At the critical voltage, all the K series lines appear at once. It is such behaviour that so strongly confirms the picture we have given of the atomic X-ray emission process. This critical value, 25,600 volts, is the extraction or ionization energy of silver K electrons expressed in "electron volts." The electron volt is a convenient unit of energy much used by physicists. It is equal to the energy possessed by one electron which has fallen through a difference of potential of one volt and is equal to about 1.601×10^{-12} ergs. A quantum $h\nu$ of radiation having this energy has a frequency of 242 million million cycles per second and a wave length $\lambda = 1.24\times10^{-4}$ cm. Energy, in quantum physics, can thus be expressed in ergs, volts, cycles per second, or wave length units. Convenient conversion relations from electron volts, V, to wave length λ in

[1] The reason for this rapidly decreasing energy level spacing is implicit in Bohr's original formula for the individual permitted energy levels of his orbits (*c.f.* Eq. 3). His permitted energy levels were given by

$$W_{nz}=\frac{2\pi^2me^4}{h^2}\frac{Z^2}{n^2}.$$

In an atom such as silver (Z=47), for example, the two K electrons are in a nuclear field of about 47 units; while the shielding of these places, the eight L electrons (also somewhat shielded by each other), in a field of somewhat less than 45 units. Also and more important, the quantum number. n=1, applies to the K while n=2 applies to the L electrons. Similar reasoning applied to the M, N, etc., shells will convince the reader of the rapid decrease in energy-level spacing.

centimetres and frequency ν in cycles per second are

$$\lambda=\frac{1.2378\times10^{-4}}{V};\quad \nu=2.4218\times10^{14}V \qquad (13, 14)$$

The original Crookes tube of fig. 1 used by Röntgen and the gas discharge tube of Sir Herbert Jackson, fig. 2, have been replaced by various forms of the "pure electron discharge" tube or "hard vacuum" tube invented by W. D. Coolidge of the Ameri-

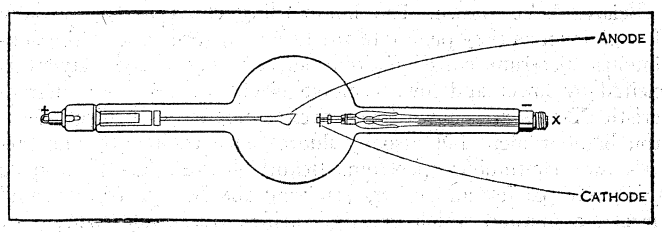


FIG. 8.—DIAGRAM OF THE STANDARD COOLIDGE X-RAY TUBE

Earlier tubes needed residual gas to sustain the electrical discharge but in the Coolidge tube the electrons forming the cathode rays are supplied by thermionic emission from an incandescent cathode

can General Electric company in 1913, of which an example is pictured in fig. 8. The electrically heated incandescent cathode emits electrons by a process analogous to the boiling of vapour from a liquid, first discovered by Thomas Edison but only well understood after much work on thermionics by many investigators, notably, Sir John Fleming and Owen Richardson. The target or anode may also be permitted to become incandescent, through the bombardment (this is not permissible however unless the tube is operated on a "rectified" supply so that the cathode is always negative); or if its substance is too easily melted, it may be kept cool by a supply of running fluid circulating in its interior. Such a tube must be evacuated of gas in the space surrounding cathode and anode to such an attenuation that the chance of an electron in the bombarding stream colliding with and ionizing an atom of the gas in its path from cathode to anode is very low indeed. We say the "mean-free-path" for electron collisions must be much longer than the cathode-anode separation. Pressures as low as of the order of 10^{-6} (one millionth) millimetre of mercury (or about one-billionth of an atmosphere) are required. The attainment of such vacuua was made possible by the invention of the diffusion pump by Irving Langmuir of the General Electric Co. and by the general development and improvement, in many laboratories, of high vacuum technique.

In another tube known as "Metalix," developed at the Philips laboratories, Eindhoven, Holland, and pictured in fig. 9, the disposition of the metal anode and cathode together with a cylindrical metallic section in the envelope of the tube is such that X-rays can only emerge through a small window thus obviating the necessity for large complicated and expensive external protective shielding.

Fluorescent Excitation of Characteristic X-Rays.—The second method whereby atoms can be excited to emit their characteristic X-rays consists in using radiation to supply the energy needed to extract one of the deeper electrons. In order for this to take place the photons of the exciting radiation (like the electrons in the previous method) must have energies, $h\nu$, equal to or greater than the work of extraction of the atomic electron whose removal accounts for the series of X-ray lines to be excited. Thus, in order to excite by fluorescence a sheet of silver to emit its K-series lines when exposed to a beam of monochromatic X-rays, it is necessary that the frequency of the X-ray beam exceed 6.2×10^{18} cycles per second (or, what is equivalent, that its wave length be less than 0.48×10^{-8} cm.). Both these figures are simply the quantum equivalents (computed from the formulae 13, 14) of the extraction energy, 25,600 electron volts, for the K electrons of silver. This is a striking example of the quantum or particlelike behaviour of X-radiation. Consider in detail how the event must take place:

A beam of X-rays from which has been selected a small bundle of monochromatic radiation of the required critical wave length either by reflection at a definite angle from a crystal surface or by diffraction from an artificial ruled grating or in any other way, falls on a sheet of silver. No matter how much the intensity of this beam is attenuated, either by distance of transmission, or by absorption in matter before reaching the silver, its photons will always possess the property of being able to eject K electrons from the silver (the ejected K electrons can be observed by appropriate means) and of exciting the silver sheet to emit the silver K spectrum of lines (easily observable by means of an X-ray crystal spectrometer). Weakening the intensity of the beam does not reduce the energy of the photons, it merely diminishes their number. Even the elementary process has been frequently observed, taking place in single isolated events. One photoelectron of the proper energy and one photon of the characteristic fluorescent X-rays were frequently observed simultaneously ejected from a copper plate when a beam of primary X-rays of sufficiently high $h\nu$ fell upon it by C. T. R. Wilson and others in cloud chamber experiments. The fluorescent photon gave evidence of itself by ejecting another photoelectron from a gas atom at some distance from the fluorescent copper and doing this with the proper energy.

Fluorescent excitation is rarely used for the production of characteristic X-rays. It does, however, furnish one method of chemical analysis applied with great success by G. Hevesy who, with D. Coster, in 1923 discovered the new element ($Z=72$), hafnium, by means of its characteristic X-rays.

Maurice de Broglie was the first to show that there is a class of photoelectrons ejected by X-rays of frequency ν whose kinetic energy, W_{kin}, accurately satisfies the equation

$$W_{kin}=h\nu-h\nu_q \qquad (15)$$

wherein $h\nu_q$ is the characteristic energy of extraction of some level of the irradiated matter.

The Continuous X-Ray Spectrum.—The characteristic line spectra we have described are not the only nor the most important X-radiation given off by X-ray tube targets when bombarded with electrons. There is also a smoothly spread, continuous spectrum of X-rays upon which the lines are superposed. The lines are very narrow, though they do have a finite measured width in wave length or frequency units and a very definite structure or profile which has been carefully studied. The X-ray energy in a section of continuous spectrum the same width as a line is much smaller, even in the most intense regions, than that in the stronger spectral lines. Nevertheless the lines are so narrow and the gaps between them so large that the total energy in the continuous spectrum far outweighs that in the lines. The bulk of the X-ray

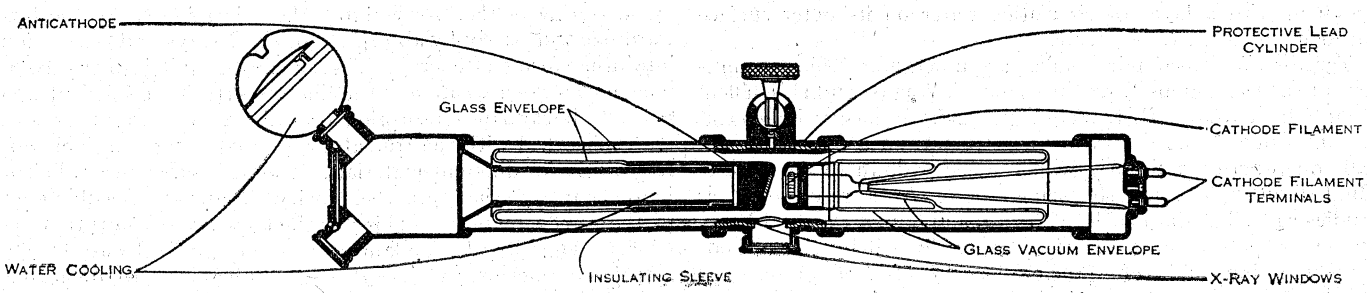


FIG. 9.—DIAGRAM OF THE "METALIX" X-RAY TUBE OF PHILIPS, SHOWING THE WATER-COOLED ANTICATHODE, THE TUBULAR METAL WAISTLINE WITH A THIN GLASS WINDOW AND THE OUTER PROTECTIVE LEAD JACKET

output of the tube is therefore in its continuous spectrum. Because of this it is chiefly the continuous spectrum which does the work in medical diagnosis and therapy.

The continuous spectrum has a sharp upper frequency limit beyond which it is absent altogether and which constitutes its most striking feature. If the X-ray tube is excited with a steady (D.C.) voltage V so that all electrons (of charge, e) impinging on the target have the same energy eV at all times then this highest frequency emitted ν_{max} satisfies the equation

$$h\nu_{max}=eV \qquad (16)$$

wherein h is Planck's constant. This important law, first observed about 1915 by D. L. Webster working in Duane's laboratory is usually called the Duane-Hunt law. It furnishes one of the important methods of measuring the ratio h/e from which, knowing e from other sources, Planck's constant h can be computed. The law asserts that no X-ray photon can be emitted from the X-ray tube with energy $h\nu$ greater than that of the impinging electrons which excite the X-rays. But it is the fact that some photons (even though relatively rarely) can be emitted with energies of this magnitude, which is the astonishing thing. This mechanism, especially in the case of complete conversion of electron energy into photon energy, is a difficult problem in quantum or wave mechanics (treated by A. Sommerfeld and others). It is closely related in classical analogy to sudden stoppages of the cathode ray electrons striking nearly "head-on" blows at the nuclei of the atoms of the target, accompanied with complete radiative loss of their energy. In this curious type of electron quantum transition the electron "falls" from the energy level of the free electrons emitted by the cathode to a final state as one of the conduction electrons of the target. In the wave-mechanical theory of Sommerfeld the free electron is envisaged as a positive energy state of a wave-mechanical atom, the positive energy states differing from the stable negative (total) energy states by forming a continuous rather than a discrete set of possible energies. In the mechanics of the solar system the analogue of an electron in a positive total energy state is a comet (possessing sufficient energy so that its return to the sun is not guaranteed) whereas the planets are analogous to electrons in negative energy states or bound electrons, save for the fact, of course, that the planetary negative energies do not have similar quantum restrictions on their permitted values.

The continuous spectrum from an X-ray tube is found to be partially polarized with its electric vector parallel to the direction of motion of the electrons impinging upon the target. The effect is more pronounced in thin targets and as one approaches the short wave-length limit of the spectrum.

At moderate electron voltages the direction of strongest emission is nearly at right angles to the direction of the impinging electrons but as we pass to higher voltages the maximum inclines toward the forward direction of the impinging electrons. At 24,000 volts the maximum emission is at about 70° to the forward direction of the cathode rays, at 38,000 volts it is at 64° while at 1,000,000 volts it is at about 25° only. The effect is best studied with a "thin" target consisting of a foil in which the X-ray absorption and cathode ray straggling are minimized. Because of this effect some very high voltage X-ray tubes have been constructed so as to utilize the X-rays transmitted directly through the target which is made appropriately thin for the purpose and provided with a layer of circulating water on its outer surface through which the rays emerge.

Targets of high atomic number are much more efficient emitters of the continuous X-ray spectrum, E. Wagner and H. Kuhlenkampff have shown that, plotted per unit frequency increment, the intensity in the continuous spectrum from a massive target falls off practically linearly with frequency down to the Duane-Hunt limit with some steepening there. As a result of their studies as well as those of R. T. Beatty and others, the total X-ray energy output of an X-ray tube target divided by the cathode ray energy input (therefore the efficiency ϵ of X-ray production) has been shown to be given by the approximate formula: $\epsilon=kZV$, wherein Z is the atomic number of the target material, V the voltage and k a constant probably about 1.1×10^{-9} according to S. K. Allison. (More recent elaborate theoretical calculations in 1945 by P. Kirkpatrick and L. Wiedmann indicate $K=1.4\times10^{-9}$. The formula obviously must fail long before $\epsilon=100\%$.) Thus a tungsten target ($Z=74$) bombarded at 100,000 volts would emit in all X-ray wave lengths about 0.8% of the electrical energy input. The other 99.2% of the input energy is converted into heat. The emission from massive X-ray targets is a very complex process as D. L. Webster, W. Hansen, P. Kirkpatrick and their associates have shown. The bombarding electrons are rapidly slowed down as they penetrate the target surface so that the continuous spectrum emission from successively deeper layers is excited by lower and lower voltage electrons. Also the characteristic X-rays are shown to be excited not only by direct electron bombardment but also by fluorescence excited by the target's own continuous spectrum. Beautiful work has been done by P. Kirkpatrick and others studying the X-rays from "thin" targets, a method which greatly clarifies the whole process of X-ray generation.

The emission from X-ray targets of radiation at the short wavelength limit of the continuous X-ray spectrum is an even more striking example of the particlelike behaviour of X-rays. Here we have almost literally the case (see *Particle-Wave Duality* above) of Compton's swimmer lifted up to the springboard by waves from a diver at a great distance. An electron in an X-ray tube strikes a target after having fallen a potential difference of 25,700 volts (the critical K extraction energy of silver plus 100 volts for good measure). The resulting X-rays falling on a silver surface will occasionally eject K electrons therefrom and the silver will (albeit weakly) emit its characteristic K spectrum, just as it would if it had been bombarded directly with 25,700 volt electrons in an X-ray tube. And this will happen no matter how far the X-rays have travelled to do it! Also the ejected photoelectrons will in some cases possess kinetic energies ranging all the way up to the extra 100 volts provided. Here on an atomic scale is radiant energy transmitted over great distances without any loss or diffusion at all! Yet there is not the slightest doubt that the same radiation has wavelike properties for it is by diffraction from crystal lattices and ruled gratings that we know the wave length of the short-wave limit of the very continuous X-ray spectrum of which we speak.

INTERACTIONS OF X-RAYS WITH MATTER

Photoelectric Absorption; The Effects upon the Radiation.—When a pencil of X-rays passes through a material-absorbing screen its intensity is reduced as an exponential function of the path length in the screen according to the law

$$I_x=I_0e^{-\tau x} \qquad (17)$$

Here I_x is the intensity after passage through x centimetres of screen, I_0 the initial intensity and τ is called the total linear absorption coefficient per cm. (An unfortunate lack of standardization exists in the use of the symbols τ and μ. Many physicists use μ to represent the total absorption and τ to represent the true absorption exclusive of scattering. It is experimentally difficult to separate true absorption from scattering in many cases.) It is clear that this law implies that each additional increment Δx of screen thickness removes the same fraction of intensity from the beam. This removal occurs partly by scattering of the X-rays into other directions than the forward one and partly by absorption of the X-rays and conversion into other forms of energy. Thus τ can be split into two components $\tau=\sigma+\mu$ where σ is the linear scattering coefficient and μ is the linear true absorption coefficient. We are at present only concerned with the true absorption coefficient μ. This differs widely for different materials. A more significant coefficient however is μ/ρ where ρ is the density (in grams per cubic cm.) of the screen material. This is called its mass absorption coefficient. Of still more fundamental significance is the atomic absorption coefficient, $\mu_{At}=(\mu/\rho)\,(A/N)$ wherein A is the atomic weight of the absorbing material and N is Avogadro's number. μ_{At} is the fraction of X-rays removed from an X-ray beam one

sq.cm. in cross section by each atom placed therein. It may be regarded as a cross section, the equivalent stopping area of the atom for the X-rays in question.

When μ/ρ or μ_{At} for a given absorbing screen is plotted as a function of λ, the wave length of a monochromatic beam of X-rays whose absorption coefficient is under investigation, certain very abrupt discontinuities are observed at well-defined values of λ which depend on the material of the screen. Such a curve is shown in fig. 10 as an example for the mass absorption coefficient of a lead-absorbing screen. The first, or K, discontinuity occurs at a wave length λ_K or frequency ν_K, for which the quantum energy (photon energy) of the radiation is just sufficient to eject K electrons from lead. There are three L discontinuities at wave lengths λ_L (or frequencies ν_L) such that the radiation just has the quantum energy to eject L electrons from the three different L levels of the lead atom. The sudden increase in absorption as the wave length is shortened in crossing one of these critical values, say the K, is caused by the fact that a new group of electrons in the lead atom (the K electrons), previously inactive, are now taking some extra energy from the beam (by being ejected from their atoms). Let us call the critical wave length values, λ_K, λ_L, etc.

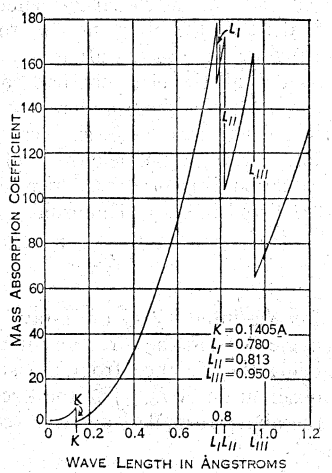


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FIG. 10.—MASS ABSORPTION COEFFICIENT CURVE OF LEAD IN THE WAVE LENGTH REGION OF THE K AND ALSO OF THE THREE L ABSORPTION DISCONTINUITIES

The sudden increase in absorption at each discontinuity as one passes toward shorter wave lengths λ or higher frequenole $\nu(=c/\lambda)$ is due to the fact that the quantum energy of the radiation has become sufficient to eject a new class of electrons, previously taking no part in the absorption process

In 1914 W. H. Bragg and S. E. Pierce showed that apart from the discontinuities, the coefficient μ/ρ approximately followed a law of the form

$$\frac{\mu}{\rho}=C\lambda^3Z^3 \qquad (18)$$

Z being the atomic number of the absorber. The coefficient C assumes a new value at each discontinuity. If we consider the absorption per atom, C is replaced by a constant, A' and the exponent of Z becomes 4 (since A is approximately proportional to Z).

$$\mu_{At}=A'\lambda^3Z^4 \qquad (19)$$

F. K. Richtmyer finds for the region $\lambda<\lambda_K$ that $A'=2.25\times10^{-2}$ and for the region $\lambda_K<\lambda<\lambda_L$, $A'=0.33\times10^{-2}$ when in both cases λ is in cm.[1]

The absorption discontinuities taken together with the characteristic X-rays emitted by the absorber give a complete verification of the picture we have formed of the absorption process and of the structure of atoms. As we diminish the wave length incident on the absorber, for example, in the range $\lambda_K<\lambda<\lambda_L$, the L series of lines is strongly emitted by the absorber but the K series is absent. But as soon as the wave length of the incident beam becomes shorter than λ_K, the entire K-series makes its appearance. All the K series lines are on the long wave-length side of the K edge, etc., because, to use rough figurative language, no energy of transition of an electron from a higher to a lower atomic level can exceed the work required to raise an electron from the lower of the two levels completely out of the atomic structure in the act of ionization, the essential preparation for the former transition. All this furnishes highly satisfactory confirmation of the picture we have formed of the atomic processes of absorption of radiation quanta when these have sufficient energy to eject a given class of electrons, and the concomitant process of emission of characteristic lines from the absorbing atom after the hole has been created by ejecting one of these electrons. The absorption edges furnish one of the best ways of determining the atomic extraction energies or energy levels. All the prominent X-ray spectral lines can be accounted for, as to their frequencies (photon energies $h\nu$) as the difference between two of these levels. Thus for example the $K\alpha_1$ line satisfies the equation

$$h\nu_{K\alpha_1}=h\nu_K-h\nu_{L_{III}} \qquad (20)$$

wherein ν_K and $\nu_{L_{III}}$ are the frequencies of the K and the third L absorption discontinuities. Moseley diagrams for the critical absorption frequencies (plotted between $\sqrt{\nu_A}$ and Z) are even more convincing than for the emission lines.

Although in the preceding discussion we have phrased our description of the process of ionization of an atom with subsequent emission of an X-ray line in the rough and forceful language of electrons jumping about, as it were, on the rungs of an energy ladder it is more accurate to regard such transitions as changes in the state of the total, densely-packed, atomic structure regarded as a unit. This calls for a rephrasing in terms of the motion not of an electron but of the hole in the atomic structure which the electron leaves as it were in its wake.

The Bragg-Pierce law of absorption is not rigorously accurate but is merely a good approximation. L. de Broglie and A. H. Kramers have constructed only partially successful theories to explain it.

It is important to note what an enormous range of atomic absorption the Z^4 law affords for a given X-ray wave length, in virtue of the 92 different atomic numbers. Thus if the law were rigorously true[1] an atom of uranium would absorb $92^4=71{,}639{,}296$ times as much radiation as an atom of hydrogen ($Z=1$). The process accounting for this true fluorescent absorption is not the only one whereby radiation acts on atoms. We still have the scattering coefficient σ to account for and still another process, the creation of electron pairs out of radiant energy, enters when the quantum energy of the incident radiation exceeds twice the rest-mass energy of the electron $2mc^2$ (about a million electron-volts). (*See* RADIATION, RAYS.)

Photoelectric Absorption, Effects Upon the Absorbing Atoms.—If we wish a rough classical analogue to the true fluorescent absorption process we must think of the electric vector of the incident electromagnetic waves as acting simultaneously on two members of an electric dipole, the positive consisting of the heavy nucleus and all but one of its attendant electrons, the negative consisting of one electron only of the outer structure, setting the latter (the lighter member of this dipole) into forced vibrations of increasing amplitude until practically the entire quantum energy of the incident photon has been transferred to the electron and the latter is ejected from the atom moving away as a "free" photoelectron with kinetic energy equal to the photon energy less the "work of ejection" just necessary to free it. The momentum given the photoelectron is balanced by an equal and opposite momentum given the heavy nucleus (and also the rest

[1] B. Walter (1927) gives the following results which may be slightly more reliable than Richtmyer's:

$\lambda<\lambda_K$; $\mu_{At}=2.64\times10^{-2}Z^{3.94}\lambda^3$, λ in cm.
$\lambda_K<\lambda<\lambda_L$; $\mu_{At}=8.52\times10^{-4}Z^{4.30}\lambda^3$, λ in cm.

[1] The figures we give here, while only approximate, do convey a correct idea of the orders of magnitude through which absorption coefficients can range.
E. Jönsson at Uppsala, Sweden, in 1928 in his thesis succeeded in formulating a universal law of absorption, designed to express the true atomic absorption coefficient for any element and any wave length. Jönsson bridges each of the absorption discontinuities by introducing, as one crosses each in the direction of decreasing wave length, a new multiplying coefficient equal to the ratio of the extraction energies for (1) the level just being excited and (2) its next lowest predecessor. By dividing the true atomic absorption coefficients by the atomic number Z he defines a new true absorption coefficient which might be called the electronic absorption coefficient and which in our notation would be

$$\mu_e=\mu_{At}/Z.$$

Jönsson's approximate universal rule may then be stated by saying that μ_e is a function of the product $(Z\lambda)$ only. This function is nearly but not exactly linear when $\log(\mu_e)$ is plotted against $\log(Z\lambda)$ and has been given as a curve in Compton and Allison's text, *X-Rays in Theory and Experiment*. Jönsson's rule is a better approximation at the higher atomic numbers and shorter wave lengths.

of its attendant electronic structure) which experiences a recoil like that of a gun when a bullet is fired. As might be expected from this picture, cloud chamber experiments with polarized radiation show that the ejected photoelectrons are most numerous in the direction of the electric vector of the radiation. There is also a slight statistical inclination of the ejected photoelectrons to move in the forward direction of the incident radiation which is a result of the fact that momentum, $h\nu/c$, is associated with the radiation itself—the photons. (The most probable forward momentum thus given to the photoelectron turns out however to be twice the momentum of the incident radiation. It is this momentum $h\nu/c$ which is associated with the pressure of light.) F. W. Bubb and also P. Auger and F. Perrin and A. Sommerfeld have discussed the process theoretically.

The velocities of the photoelectrons ejected by X-rays have been studied by H. Robinson, E. C. Watson, G. G. Kretschmar and many others in great detail by bending those coming from absorbing foils with known magnetic fields and also by observing their tracks in a Wilson cloud chamber (Auger and others) in which case the individual ejected electron tracks can be seen. It turns out that besides the primary photoelectrons already described, others appear which were ejected by the characteristic fluorescent X-ray lines emitted in the absorber. If these lines have characteristic frequencies ν_p and the work of extraction of a given electron is W_q then the energies of these electrons conform with the formula

$$\text{secondary photoelectron energy} = h\nu_p - W_q \qquad (21)$$

yielding another rich source of information as to energy levels and characteristic emission frequencies of the absorber in complete accord with the more directly observed values.

The X-ray ionization of gases and the effects of X-rays on living tissues have been shown to be due not to the direct action of the X-rays but to the photoelectrons which the X-rays eject from atoms of the gas or the tissue. These photoelectrons may, as we have explained, have energies (in volts) ranging practically all the way up to the energies of the electrons in the cathode ray stream of the X-ray tube where the radiation was generated. As the photoelectrons plough through a gas (or living tissue) they ionize many thousands of atoms in their paths, the average energy expended in ionizing an atom of air for example being only about 30 to 35 volts. The process is made indubitably clear in the Wilson cloud chamber. Of profound biological significance is the action of the photoelectrons in inducing mutations of the genes in living cells. It has been shown by M. Delbrück in such X-ray studies that the size of the molecular structure of a gene, the carrier throughout the ages of hereditary traits of amazing permanence, is of the order of that of a cube (or sphere) having only ten atoms in its linear dimensions! A book by the great physicist Erwin Schrödinger, *What Is Life,* reviews this evidence and suggests the most profound consequences to an understanding of biology and even perhaps of consciousness itself.

The Scattering of X-Rays.—The tremendously significant work of Arthur Compton dating from his discovery in 1923 of modified scattering, followed by the work of a long list of other investigators, has established that there are two important ways in which X-rays are "scattered" (deflected from their original paths) by atoms, called respectively modified and unmodified scattering. It was in this field that the particlelike behaviour of the photons of radiation was first driven home with telling force. As in the photoelectric process, here again there are two experimental aspects—the effect on the radiation and the effect on the atoms which scatter it.

It is the electrons in the atomic structure which are responsible for scattering X-rays. In unmodified scattering, which occurs the more frequently (for radiation of specified quantum energy) the higher the binding energy of the scattering electrons, the radiation is not changed in wave length at all by the scattering process—it is merely deflected into a new direction. Such unmodified scattering accounts for all of the selective diffraction phenomena in crystals and on ruled gratings which result in the formation of spectral lines. Each atom of the periodic structure reradiates the incident radiation without change of wave length in definite phase relationship to the primary exciting radiation. Since the photons lose none of their quantum energy $h\nu$ in the process, no net work is done on the atom, no electrons are removed or disturbed, and the final state of the atom is exactly like the initial state. It is as though all the electrons had co-operated in the reradiating process, each absorbing and re-emitting its share of the total $h\nu$, an insufficient amount in each case to equal the work of extraction.[1] For certain wave lengths and atomic numbers the amount of radiation thus scattered per electron approximates the amount predicted by J. J. Thomson's classical formula

$$I'_\phi = \frac{I}{r^2}\ \frac{e^4}{m^2c^4}\ \frac{1+\cos^2\phi}{2} \qquad (22)$$

for the intensity I'_ϕ of X-rays scattered per free electron at an angle ϕ from the direction of the incident beam of intensity I, r being the distance from the scattering electron to the point of observation of I'_ϕ. The total scattering in all directions given by the above formula leads to a scattering coefficient per electron

$$\sigma_e = \frac{8\pi}{3}\ \frac{e^4}{m^2c^4} = 6.66\times 10^{-25}\ \text{cm}^2. \qquad (23)$$

corresponding to a circle of radius 4.6×10^{-13} cm. When however the wave length of the radiation is long compared with the size of the atomic electron swarm there is a constructive interference of the radiation scattered by the individual electrons so that N of them instead of scattering N times the amount σ_e behave (in the limiting case of very long wave lengths) as though the charge e (raised to the fourth power in the formula) were first multiplied by N so that ten electrons become equivalent to $10^4 = 10{,}000$ independently scattering electrons. The presence of m^2 in the denominator, however, reduces the ratio by the divisor $10^2 = 100$ so that the net effect of ten electrons is one hundredfold that of one. All this is fairly reasonable according to classical concepts.

It has been possible, by study of the intensity of unmodified X-ray scattering as a function of scattering angle for gaseous atoms and also for atoms in crystal lattices, to learn a very great amount about the statistics of the spatial distribution of electrons around the atomic nuclei both in single atoms and in solid crystals, to reveal the sizes of the cloudlike electron shells and to map the regions of periodically varying electron density in crystals.

It is as the wave length becomes short, however, that our classical ideas of scattering break down completely and the scattering becomes very much lower than Thomson's formula predicts. The Compton effect here becomes pronounced.

The Compton Effect.—It had been observed by J. A. Gray (1920) that short wave-length radiation, after scattering from carbon and other low atomic number atoms, was somewhat more absorbable than the primary radiation. It is a simply demonstrable consequence of Maxwell's electromagnetic theory of radiation that when any quantity of radiant energy W is absorbed by a charged particle there will be exerted upon the latter an impulse (or quantity of momentum) in the direction of propagation, of magnitude W/c where c is the "velocity of light in vacuo." Thus a photon of energy $h\nu$ should carry with it the ability, if completely absorbed, to exert a momentum $h\nu/c$ on an electron (or any other charged particle). In 1923 Arthur Compton and simultaneously P. P. Debye proposed the daring hypothesis that a photon of X-rays might be regarded as a small projectile able to hit one and only one electron in the scattering atom (actually their initial theory envisaged as a first approximation only a free electron). The idea was that the photon bouncing off the electron (in the direction of scattering that was being studied) would deliver a blow giving, at the expense of some of its energy, a recoil velocity and a recoil energy to the electron in accord with the familiar laws of conservation of energy and

[1] The electrons must not be extracted by the radiation, their final energy states must be the same as their initial energy states before scattering the radiation in order that the latter shall not be modified in frequency. There is a finite chance according to ideas first enunciated by A. Smekal that this can occur even if the quantum energy $h\nu$ *exceeds* the energy of extraction. One may perhaps think of the electron as momentarily ejected and then immediately falling back to its original state.

momentum applicable to larger colliding masses. The energy so lost by the photon, initially of energy $h\nu_0$, would result in a new lowered frequency ν_θ corresponding to a lesser quantum energy, $h\nu_\theta$. Clearly the loss of energy should increase with increasing angle of scattering θ. The accompanying fig. 11 shows the simple vector momentum diagram with the help of which, together with the conservation of energy, it was possible for Compton and Debye to compute that the modified photon should exhibit a

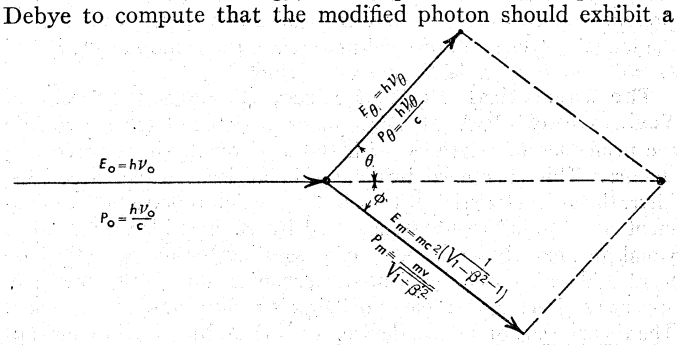

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FIG. 11.—VECTOR DIAGRAM SHOWING THE CONSERVATION OF MOMENTUM IN ITS TRANSFER FROM PHOTON TO ELECTRON IN THE COMPTON EFFECT

P_m is the momentum received by the recoiling electron. P_0 and P_θ are the momenta of incident and scattered photons. θ is the "scattering angle" through which the photon is deviated. Formulae for the energies E_0, E_θ and E_m are also given. The fundamental law of conservation of momentum requires that the vector sum of P_θ and P_m after the collision, that is to say the dotted diagonal of the parallelogram, shall be equal in magnitude and direction to the initial momentum of the radiation P_0 before the collision

shift toward longer wave lengths relative to the primary wave length and independent of the value of the latter given by

$$\lambda_\theta - \lambda_0 = (h/mc)(1-\cos\theta) = 0.0242\times 10^{-8}(1-\cos\theta) \text{ cm.} \quad (24)$$

Compton outdid Debye in that he immediately and quantitatively demonstrated this shift in wave length in the laboratory together with its dependence on the scattering angle θ. The effect on the entire world of physicists was electrifying. Confirmations followed almost immediately from many other laboratories, notably by P. A. Ross, J. A. Becker, S. K. Allison and W. Duane. The theory shows that the recoiling electron must have a forward velocity in an obvious well-specified direction and an energy E_r given by

$$E_r = h\nu_0 \frac{\xi(1-\cos\theta)}{1+\xi(1-\cos\theta)} \text{ wherein } \xi = \frac{h\nu_0}{mc^2} \quad (25)$$

Immediately following Compton's prediction of their existence, these "recoil" electrons were discovered in the laboratory by C. Wilson and by W. Bothe. Compton and Alfred W. Simon (1925) showed with fair quantitative accuracy in the Wilson cloud chamber that both the scattered photon and the recoil electron obey the required laws in individual scattering processes and A. A. Bless has checked their energy accurately by the method of the magnetic spectrograph.

E. Schrödinger (1927) proposed an alternate theory of the Compton effect based entirely on a wave picture in which the initially free recoiling electron must be replaced by its train of De Broglie waves, completely unlocalized in space, which act to reflect the X-radiation like the atomic layers in a crystal. The change in wave length, in this picture of the process, is to be ascribed to a Doppler effect caused by the velocity of recoil of the reflector. No basis for preference can be shown for either viewpoint, and we have here a striking example of the dual aspect of all nature. N. Bohr after very painstaking study of the entire duality principle resumed his work in what he calls the two principles of "complementarity" and "renunciation," *i.e.* the wave and the particle concepts are complementary aspects of the same phenomena (like the two sides of a coin which cannot both be seen at once) and we must renounce further efforts to reject either one or to harmonize them.

Evidence for Motion of Atomic Electrons.—The scattering electron in the original Compton-Debye theory was assumed free and initially at rest. P. A. Ross proposed and G. E. M. Jauncey, J. W. M. DuMond and H. Kirkpatrick have each analyzed the case where the electron possesses an initial velocity before the scattering process takes place. Thus not only does the photon deliver a blow upon the electron but the electron (like a baseball bat) may (1) either happen to hit back, thus decreasing somewhat the loss of photon energy, or (2) may recede as it receives the blow (as in "bunting") so as to increase the loss of photon energy. Now there is no such thing as a supply of free stationary electrons in nature to use as a scattering agent. All the electrons in sufficient numbers for this purpose are in the atoms of solids, liquids or gases. In monatomic gases the electrons may be expected to be in motion (to have momenta) quite rigorously as the wave mechanics predicts for single atoms. In solids or liquids, on the other hand, the electronic momenta will not be quite the same as for free atoms because of the perturbing effect of neighbouring atoms. In the case of metallic solids, conductors of electricity, a theory of A. Sommerfeld proposes as a first approximation that about one electron per atom in the metal crystal lattice is substantially unattached to any particular atom and wanders about freely so that the totality of all such electrons forms a "free electron gas" in the interspaces of the lattice. The quantum theory (principle of exclusion in phase explained above) requires the electrons of this "degenerate gas" to be in a state of extremely rapid motion at velocities on the average substantially higher than they would have as outer electrons in a free atom. (They are crowded into less volume in the crystal lattice than in the free atom and hence their "momentum hedgehog" must occupy more momentum space.) These electron velocities required by Sommerfeld's theory and the corresponding electronic energies are enormously greater at terrestrial temperatures than an equipartition of the ordinary thermal energy between the atoms and the electrons can alone account for.

These ideas would lead us to expect a considerable broadening of the Compton modified line as a statistical result of the individual shifted scattering processes from electrons rapidly moving in every conceivable direction, and exactly this was observed by DuMond and Kirkpatrick both with solid and with gaseous scatterers.[1] The structure and width of the broadened modified line is in complete accord with the magnitude and distribution of electron velocities predicted not only for single atoms and molecules (helium and hydrogen gases as scatterers) but also for the free electron gas in a solid electrically conducting crystal. We thus have quantitative experimental verification of the high velocity free electron degenerate gas in a conductor predicted by Sommerfeld, at least as concerns the velocities and the approximate number of electrons which belong to the class, and a refutation of the older statistical idea that such free electrons should on the average possess only the same energy as that associated with the thermal vibration of the atoms of the crystal lattice. The breadth of the modified line in wave-length units should diminish with decreasing scattering angle and also with decreasing primary wave length in a definite way and DuMond and Kirkpatrick have shown experimentally that it does, thus confirming the validity of the entire picture. The dynamic character of the electronic structure of the atom and of the electrons in solids is thus rather directly confirmed. Two figures, 1 and 2 on Plate III, are shown giving the spectra of (1) the K lines of molybdenum after scattering at three different angles from a block of graphite and (2) the K lines of molybdenum, silver and tungsten respectively each after scattering from graphite at about the same angle. In these spectra the modified α line is very clear but the modified β line can also be seen with less intensity. The sharp unmodified α and β lines formed by the unmodified scattering process are also clearly

[1] The first indubitable evidence of the broadening was in 1928 (*Proc.*, Natl. Acad. Sci., vol. 14, p. 875). It was not observed with certainty in the earlier work of Compton and many others because of the very low intensity of scattered X-rays which led earlier investigators to sacrifice spectral resolving power and accurate definition of the scattering angle in exchange for increased intensity. Compton, Ross and others had cautiously stated that their results led them to suspect such an effect but it was not proved and an index of this early uncertainty is the fact that even as late as 1930 N. Gingrich in Compton's laboratory reported the observation of very narrow modified lines in which he thought the $K\alpha$ doublet was clearly resolved, an observation which no one up to 1945 had been able to repeat. It was only after the development of an especial spectrometer permitting greatly increased intensity coupled with great homogeneity of the scattering angle that DuMond and Kirkpatrick were enabled to study the broadening with quantitative certainty.

visible. (The modified lines in the picture are designated α_c and β_c while the c is omitted in the subscript for the unmodified lines.) Figs. 1 and 2 obviously not only illustrate the effect of the broadening of the Compton line by the electronic motions and the variations of the breadth with scattering angle and primary wave length; they also clearly illustrate the Compton shift itself, its variation with scattering angle and its independence of primary wave length, all in perfect accord with the theoretical picture of the process.

In modified scattering the light pressure may be thought of as the agent which ejects the electron from the atom with the energy of recoil. The fact that the electron is initially bound to the atomic nucleus, which therefore shares slightly in the momentum transfer, introduces a slight correction to the Compton shift (in wave length). This correction, computed by F. Bloch, was verified in very careful and ingenious work by Ross and Kirkpatrick. In cloud chamber experiments with polarized X-radiation F. Kirchner has shown that the most probable direction of ejection of Compton recoil electrons is perpendicular to the electric vector as one would expect on the light-pressure ejection hypothesis. It is very clear that Compton modified scattering is an almost-private transaction between photons and single electrons in the scatterer.

If photons can be used as projectiles or probes to study the velocities of the electrons in matter, why not electrons? A. L. Hughes at St. Louis, Mo., has done exactly this. Certain classes of electrons after scattering from gas atoms exhibit modifications of their energies and momenta (or De Broglie wave lengths if we prefer) which yield information as to the atomic electron velocity or momentum distributions in completely satisfactory accord with the X-ray results of DuMond and Kirkpatrick. The method had not, in 1945, been extended to electrons in solids.

The Bohr-Heisenberg Uncertainty Principle (1930).—From this evidence that both radiation and matter act like particles, combined with the equally good proof that they have the characteristics of waves, there flows a consequence of the deepest philosophical and physical significance. This consequence is that there is a definite and fundamental limit placed upon the precision of prediction of the future actions of any object or system as based upon observations made with any form of radiation or matter. Space is not available to give here the interesting chain of reasoning leading to this conclusion. (*See* UNCERTAINTY PRINCIPLE.) This principle asserts that no physical experiment of any present known type can be devised which will simultaneously measure the momentum p_x and the position q_x of a system to precisions of order p_x and q_x respectively greater than the limits prescribed by the inequality

$$\Delta p_x \Delta q_x > h. \qquad (26)$$

A sufficient relaxation of precision in either factor, momentum or position, will permit any desired degree of precision in the other but the product of their uncertainties cannot be less than the constant, h. To predict the course of future events with certainty from present observations (the postulated ideal possibility of the determinists) we must have information other than the partially statistical data contained in the De Broglie-Schrödinger ψ-waves (not just their moduli $\psi\ \bar{\psi}$). Such information is physically inaccessible. To give an example of the far-reaching philosophical conclusions of a rigorous nature flowing from the uncertainty principle, a partial quotation from P. S. Epstein in *The Scientific Monthly* (1937) is given as follows:

"The views of modern physical science are incompatible with the doctrines of predestination and determinism which are no longer tenable. This statement should not be construed as an attack on religion and metaphysics; in fact it should be a boon to them. The metaphysicians were those who invaded the field of science by postulating as truth the religious equivalent of the law of causality, [thus creating] for themselves difficulties which they could not resolve. Science is now showing them the way out of the dilemma. . . ." [From the old point of view, determinism and free will were supposed tightly linked as mutually exclusive alternatives but this traditional linkage] "is converted into its opposite on the newly shifted ground of science. . . ." "The discoveries of physics [ringing the death-knell of mechanistic determinism] do not change in any way the status of the problem of free will. . . ." "The existence of free will is just as incompatible with the new non-deterministic physics as with the old deterministic. However, living organisms may be possessed of free will, if they are not completely controlled by the laws of physics. . . ." "Although, at present science cannot answer the question whether the laws of the human psyche and of dead matter are the same or not, *it will be able to answer it in the course of time.*"

The Theoretical Work of Dirac, Its Consequences and Verifications.—P. A. M. Dirac made an attempt (1928) to fuse the principles of relativity with those of quantum or wave mechanics. This succeeded brilliantly in at least three directions. First, the characteristics of the electron which required the assignment of a "spin" to it as suggested by G. E. Uhlenbeck and S. Goudsmit, namely its property of possessing both a magnetic moment and a definitely associated mechanical angular momentum, appear as direct consequences of Dirac's rather simple ingredients. The theory was, of course, devised with this objective in view, but its other successes are the more brilliant because they were unforeseen. Second, the theory predicts the existence of a positive counterpart of the negative electron (indicating that the two should have comparable[1] masses), and just such a particle was discovered four years later by C. Anderson in 1932 (verified by similar observations six months later by P. M. S. Blackett and G. P. S. Occhialini) in his studies of cosmic rays with the Wilson cloud chamber. *See* fig. 3 on Plate III. Third, Dirac's theory envisages the possibility of the "creation" and also "annihilation" of matter, in the form of pairs of positive and negative electrons, by the process of its conversion from or into radiant energy, and these processes have also both been firmly established as experimental facts. Colliding positive and negative electrons, say of equal velocities, can neutralize each other's charge and the total kinetic mass, $2m$, of the two particles, whose relativistic energy equivalent in ergs is $2mc^2$, can reappear as the mass of two photons of quantum energy $h\nu$ which, if no third body intervenes appreciably in the reaction, will satisfy the equation

$$2mc^2 = 2h\nu \text{ (equivalent to 1,022,000 electron volts).} \qquad (27)$$

Radiation of this type was first observed by C. Y. Chao (1930) and its explanation as "annihilation radiation" was established on a firm experimental basis by F. Joliot in 1933 and by J. Thibaud in 1934. Almost but not quite conversely a photon of energy $h\nu$ in the presence of a strong nuclear field can be converted into a positive and a negative electron, previously nonexistent, according to the equation

$$h\nu = m_1c^2 + m_2c^2 \qquad (28)$$

where m_1 and m_2 are the kinetic masses of the two electrons (m_1 and m_2 may differ slightly if the two oppositely charged electrons have somewhat different kinetic energies, a possibility which enters through the possible sharing of momentum with the nucleus). This creation of electron pairs was first observed by C. D. Anderson and S. H. Neddermeyer in 1933 (*see* fig. 4 on Plate III). These reactions are features quite appropriately to be classified under the nature of X-rays. The energy equivalent of the "rest mass" of the electron is about a half million volts, so that even before the advent of D. W. Kerst's "Betatron,"[2] it was not theoretically impossible to produce artificially X-radiation capable of materializing itself into electron "pairs."

Dirac's theory requires the conclusion that such a weird state of affairs as a particle with negative kinetic energy (and therefore imaginary[3] velocity) can be a physical reality. Indeed he formulates the supposition that what we call empty space is everywhere filled densely with negative electrons in negative kinetic energy states as closely packed as Pauli's principle of exclusion in phase

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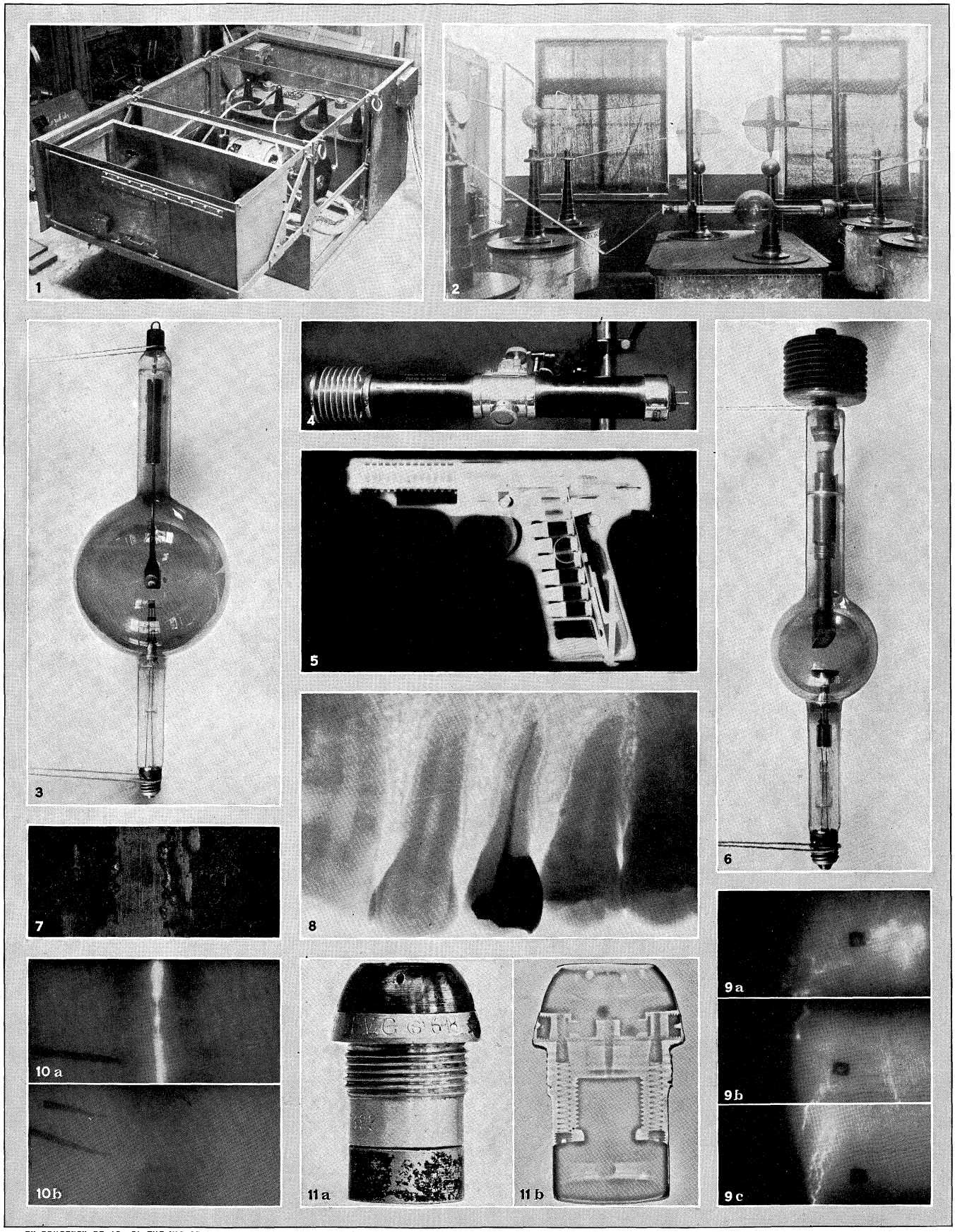
[1] At the time, Dirac was much troubled by the fact that the only elementary positively charged particle then known, the proton, was so much heavier than the negative electron.

[2] The Betatron, in 1945 a commercially available instrument, can give electrons a kinetic energy equivalent to 20,000,000 volts or more. Equipment capable of twenty- or thirtyfold this voltage by other methods is not beyond the realm of expectation.

[3] We mean here imaginary in the sense of the algebraic symbol $\pm\sqrt{-1}$.

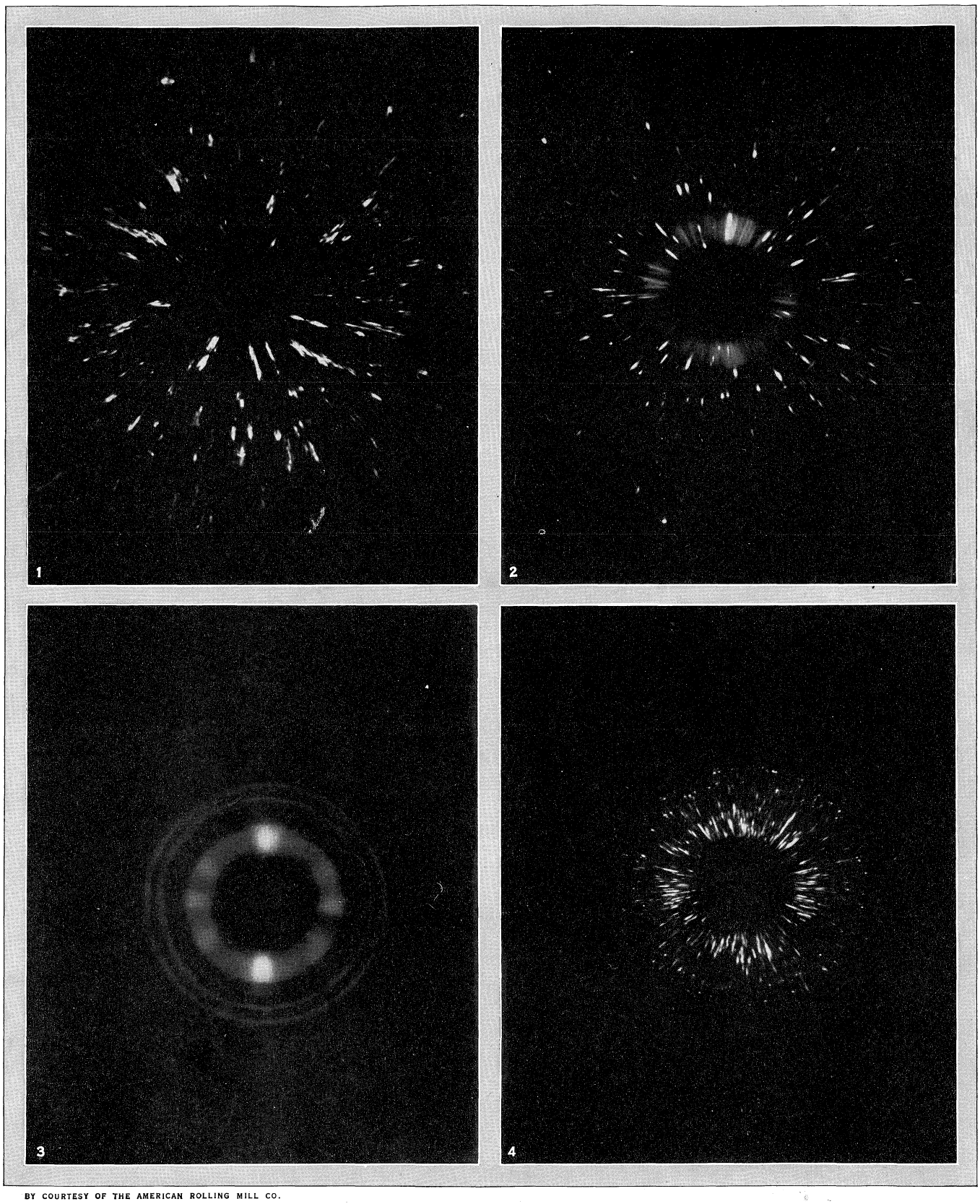


BY COURTESY OF (3, 6) THE VICTOR X-RAY CORPORATION, LTD., (4) THE PHILIPS LAMP COMPANY, (5) THE GENERAL ELECTRIC COMPANY (U.S.A.)

X-RAY APPARATUS, AND SPECIMENS OF RESULTS OBTAINED

1. Self-contained and self-protecting 200,000 volt X-ray installation, as used for the routine examination of castings. 2. A 400,000 volt X-ray installation, showing transformer, in centre four valve rectifiers, and high power Coolidge tube. 3. Coolidge tube. 4. "Metalix" hot-cathode X-ray tube. 5. X-ray photograph of an automatic pistol. 6. Coolidge tube radiator, with heat-radiating fins at top. 7. Common photograph of butt weld, apparently sound. 8. Radiograph of the human teeth, revealing a metallic filling. 9. Radiograph illustrating hidden cracks in casting. 10. (Upper) Radiograph of poor butt weld. (Lower) Radiograph of good weld. 11. Ordinary and X-ray photographs of a fuse

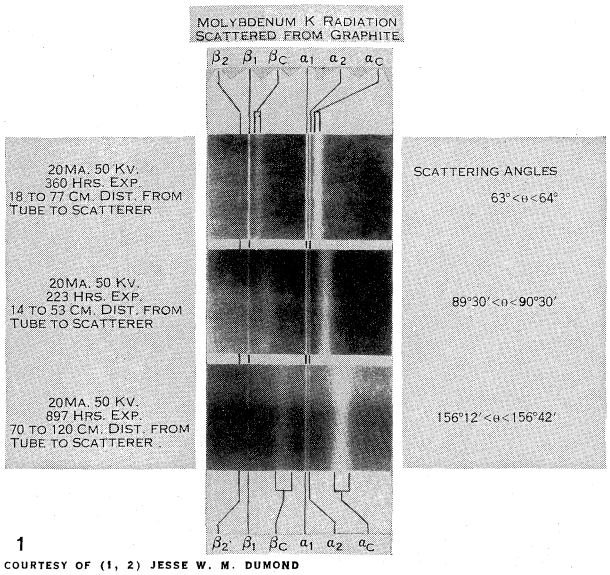
X-RAYS, NATURE OF



BY COURTESY OF THE AMERICAN ROLLING MILL CO.

X-RAY DIFFRACTION OF IRON AS IT PROGRESSES FROM THE INGOT TO ONE OF THE FINAL PROCESSES IN MANUFACTURE

1. Piece of ingot of typical cast structure photographed by the usual Laue procedure. The grains are quite large and have been very much strained in cooling
2. Thin bar from the continuous mill showing a considerable reduction in grain size, and amount of strain, as evidenced by the smaller and more uniform spots. The fine radial streaks near the center show the presence of some fragmentation of grains. The slight tendency towards the appearance of groups of spots on the central band indicates the beginnings of a preferred orientation of grains
3. Very fine grained structure of nicely oriented crystals in highly cold rolled iron. The absence of individual spots proves the smallness of the crystals, while the large spots on the various rings show the cubic iron crystals to be, to a very considerable extent, arranged in the sheet with a cube face parallel to the surface of the sheet and a face diagonal parallel to the rolling direction
4. The thoroughly annealed sheet, heat treated after the severe cold roll, is shown completely re-crystallized into slightly strained grains of quite uniform size. No crystal fragments are present and the preferred crystal orientation caused by the cold rolling has completely disappeared, leaving a structure with practically no directional properties



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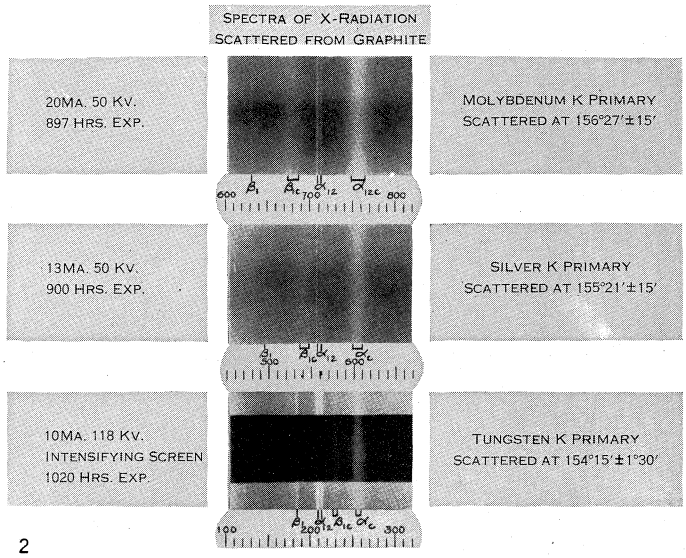
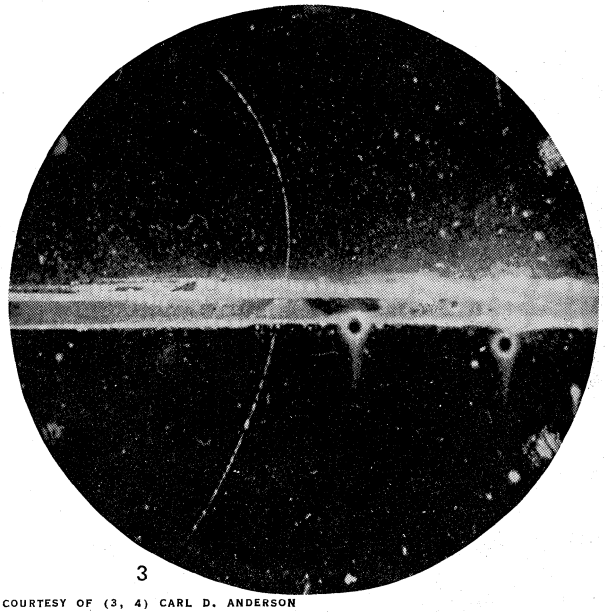


2

COURTESY OF (1, 2) JESSE W. M. DUMOND

1. Spectra of molybdenum K-lines scattered by carbon at three different scattering angles θ illustrating both the Compton shift and the DuMond-Kirkpatrick broadening in their dependence on θ. The unmodified α_1, α_2 and β_1 lines of the molybdenum K spectrum are clearly visible and testify by their sharpness to the high resolving power. The broad shifted β_c and shifted α_c lines show increasing shift and increasing breadth as the scattering angle increases in complete quantitative accord with the theory as photometric measurements show. The broadening is evidence of the motion in the atom of the electrons which are the scattering agents. The shifted α_c line is a superposition of the shifted α_1 and shifted α_2 lines and is therefore a little broader than the shifted β_1 line

2. Spectra of scattered X-rays of three different wave-lengths λ scattered by carbon at about 155 degrees scattering angle θ, illustrating both the Compton shift and the DuMond-Kirkpatrick broadening in their dependence on λ. The wave-lengths in x-units are shown on the scales. The unmodified β and α lines can be clearly seen in the first (molybdenum) spectrum but with diminishing primary wave-length the unmodified scattering becomes too faint to be seen so that reference lines have been made on the edge of the tungsten spectrum by means of an auxiliary exposure with direct radiation to establish their positions. The broadened and shifted β and α lines of the scattered spectrum can be seen in all three cases. The constant shift and the diminishing broadening (in wave-length units) can be clearly seen and photometric measurements show both effects to be in good accord with the theory of the scattering process and of the motion of the scattering electrons in the atoms of the scattering substance



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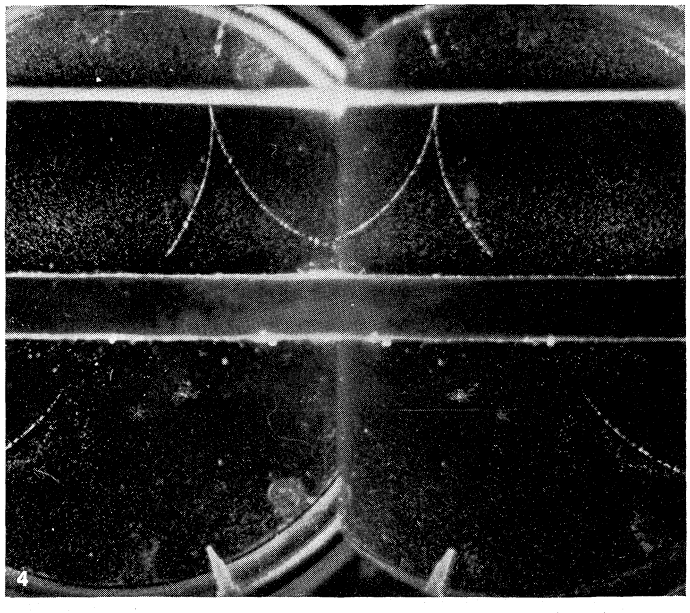


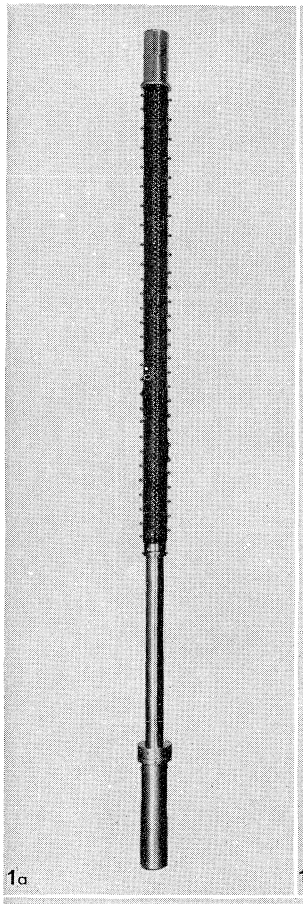
4

COURTESY OF (3, 4) CARL D. ANDERSON

3. A photograph of great historical interest made by C. D. Anderson in 1933 with the Wilson cloud chamber provided with a strong magnetic field capable of deflecting fast electrons. He inserted a 6-mm. thick lead septum horizontally across the chamber. In this picture the track is one left by a positron. This positron possessed an energy of 63,000,000 electron volts before entering the lead plate *from below* as shown by its curvature in the known magnetic field. After penetrating the plate its curvature shows that it proceeded with an energy of 23,000,000 electron volts. The change of energy, in good accord with the loss to be expected for such an electron in 6 mm. of lead, proves definitely the direction of motion of the particle and, therefore, with the known direction of the magnetic field enforces the conclusion that it is positively charged. The low specific ionization as attested by the density of the track and also the low energy loss in the lead exclude the possibility that the particle could be a proton. This was one of the first clinching evidences for the positron. This photograph is reproduced from Anderson's Nobel Prize lecture

4. The creation of an electron-positron pair in a lead plate by hard gamma rays from Th C'' shown in a Wilson cloud chamber photograph by C. D. Anderson. This photograph is reproduced from Anderson's Nobel Prize lecture. The two particles responsible for these tracks produce equal specific ionizations as judged by the track density and hence have the same mass. From the known direction and intensity of the magnetic field in which the chamber was operated (800 gauss) one concludes that the track of greater curvature was made by a negative electron of about 0.7 million electron volts energy while the track of lesser curvature was made by a positron of 0.8 million electron volts energy. Anderson and Neddermeyer have photographed thousands of similar examples of the same process wherein the hard gamma rays from Th C'' (of known quantum energy, $h\nu$=2.62 M.E.V.) falling on lead, aluminum or carbon produced the same result. In no case did the aggregate kinetic energies of pairs so produced exceed 1.6 M.E.V. thus leaving just the required margin of energy (1.02 M.E.V.) for the creation of the two masses. In this photograph the direct image is at the left; the right hand reversed image, taken with a mirror, is for stereoscopic observation. Stereoscopic viewing shows that the third track near the bottom of the picture is of entirely independent origin

X-RAYS, NATURE OF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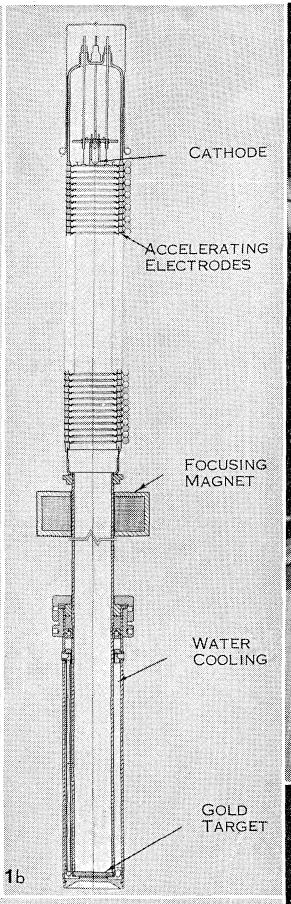

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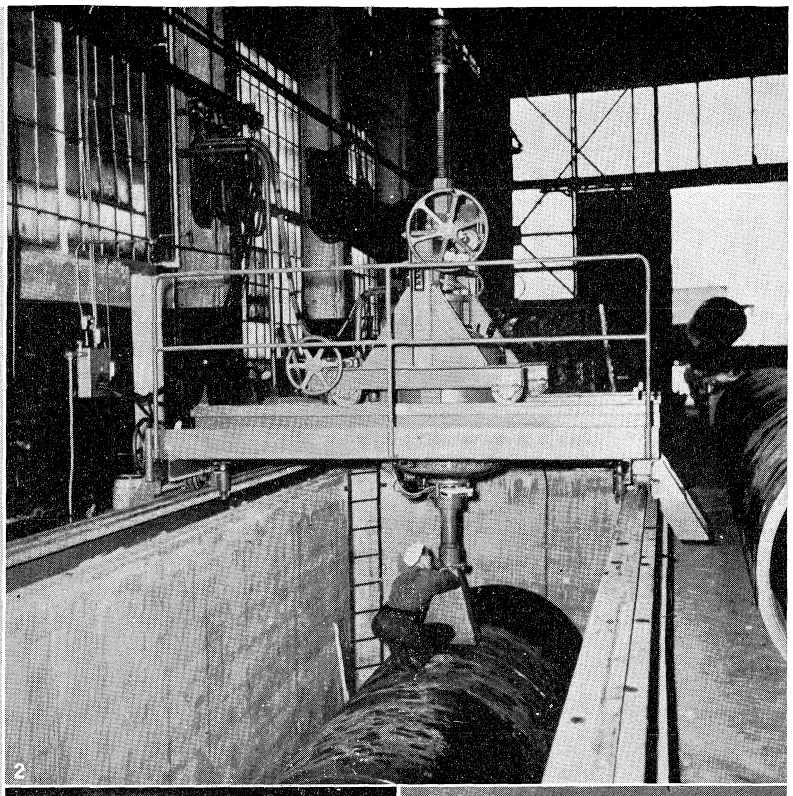
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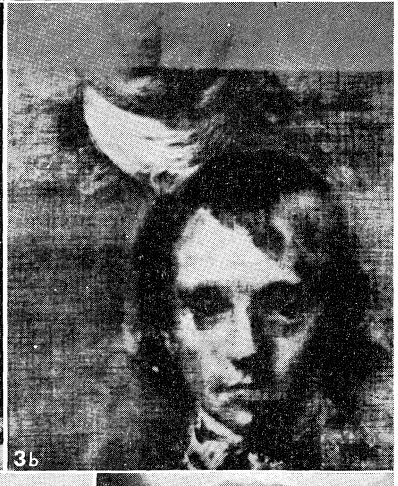
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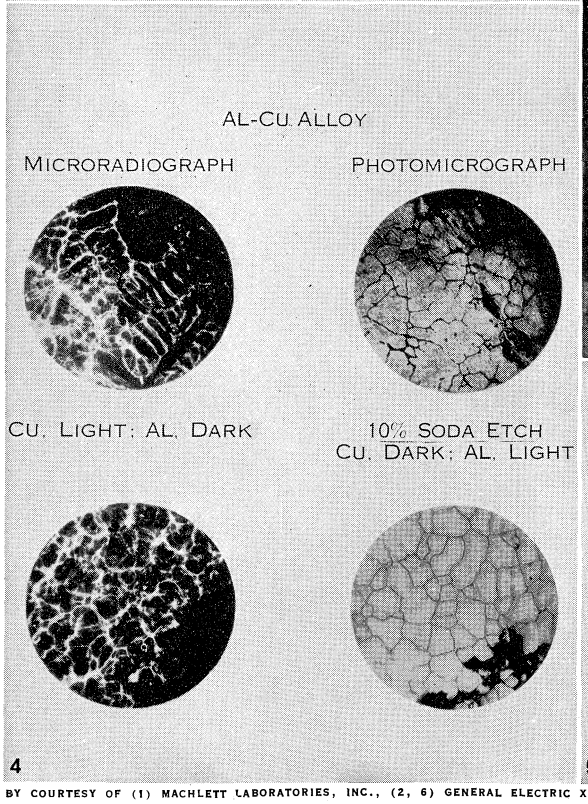

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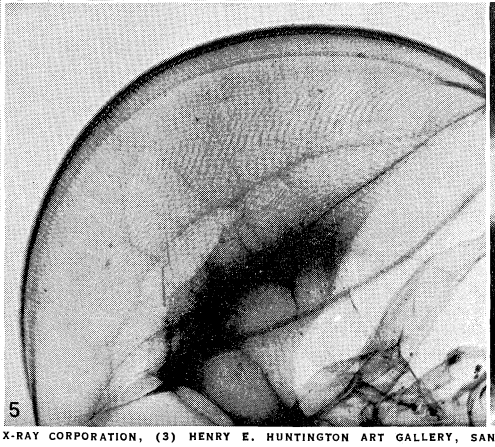
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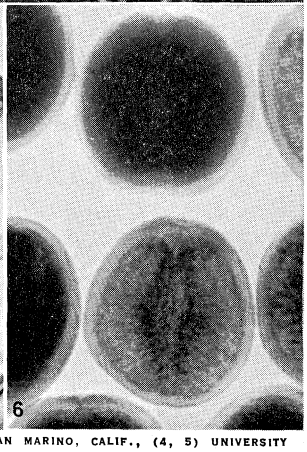
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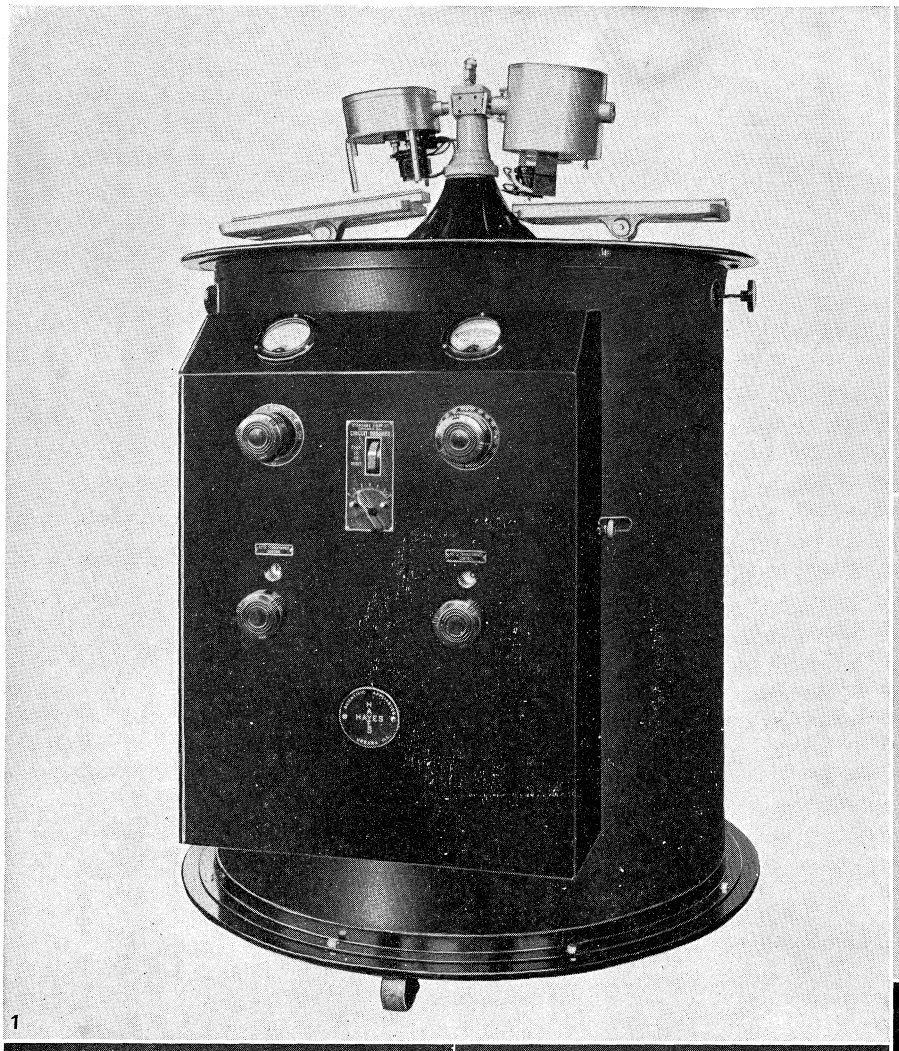
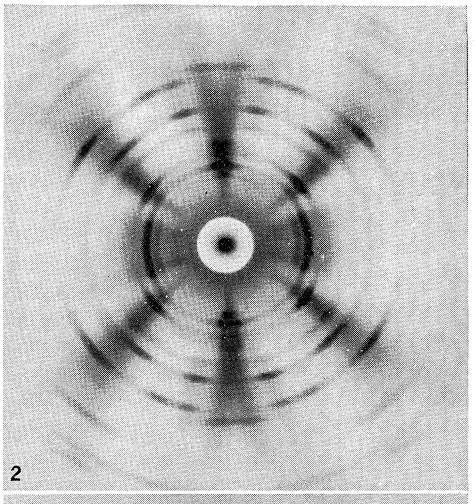
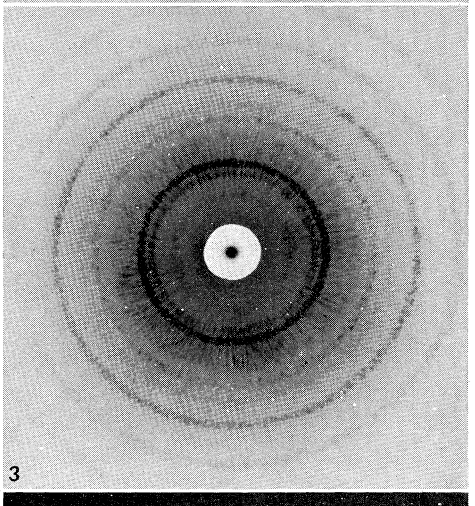
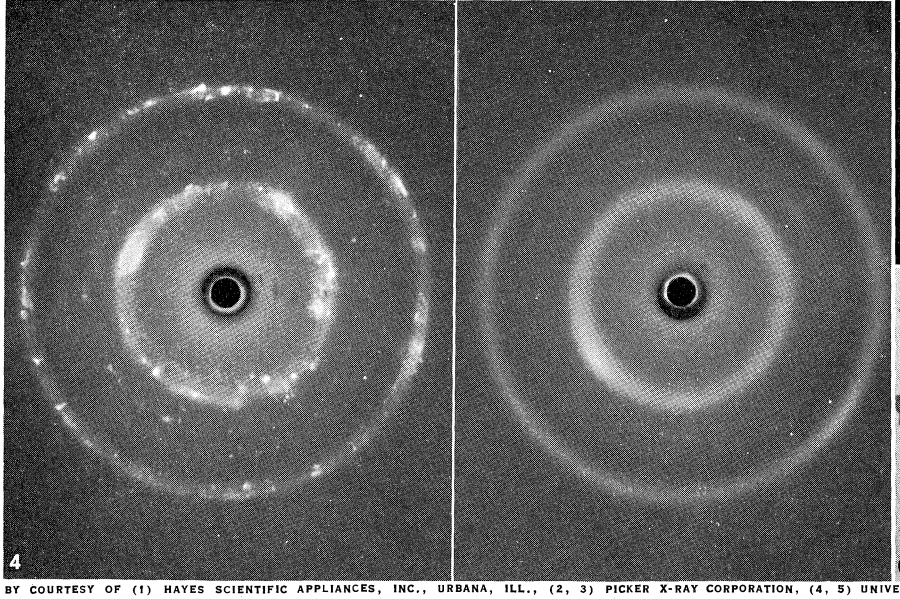
BY COURTESY OF (1) MACHLETT LABORATORIES, INC., (2, 6) GENERAL ELECTRIC X-RAY CORPORATION, (3) HENRY E. HUNTINGTON ART GALLERY, SAN MARINO, CALIF., (4, 5) UNIVERSITY OF ILLINOIS X-RAY LABORATORY

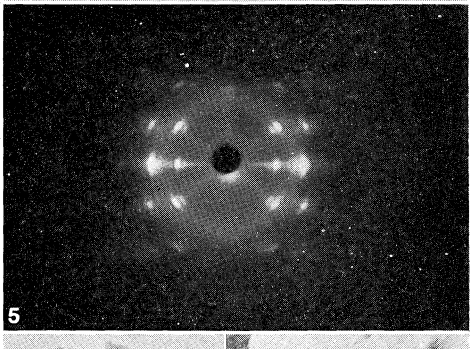
1. X-ray tube for operation at 2,000,000 volts producing beam capable of penetrating 12 inches of steel; and diagram of construction
2. Million-volt radiographic unit in use in plant of Babcock & Wilcox, Barberton, Ohio
3. X-ray examination of Gainsborough's "Blue Boy," showing (right) hidden painting of man with white stock above head in visible painting, which accounts for light shadow (pentimento)
4. Microradiographs of aluminum-copper alloy used in aircraft construction, compared with corresponding photomicrographs. Magnification, 100 diameters
5. Microradiograph of eye of common housefly. Magnification, 150 diameters
6. Radiographic classification and sorting of oranges; upper, juicy, high quality; lower, pithy, low quality

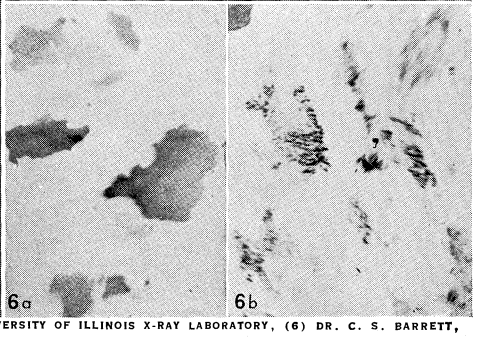












BY COURTESY OF (1) HAYES SCIENTIFIC APPLIANCES, INC., URBANA, ILL., (2, 3) PICKER X-RAY CORPORATION, (4, 5) UNIVERSITY OF ILLINOIS X-RAY LABORATORY, (6) DR. C. S. BARRETT, CARNEGIE INSTITUTE OF TECHNOLOGY

1. Multiple X-ray diffraction apparatus, showing two types of cameras supported from head of diffraction tube
2. Diffraction pattern of rolled aluminum sheet showing high degree of preferred orientation of crystal grains in sheet
3. Diffraction pattern of well annealed sheet steel with complete absence of preferred orientation introduced in rolling, and grain growth from spotted rings
4. Back reflection patterns from two sections of same aluminum alloy aeroplane motor castings, showing great difference in texture. With this method as a guide, casting techniques were improved until all sections, thin and thick, gave the same patterns and thus differential strains and failures were eliminated
5. Diffraction pattern of stretched rubber, showing crystallization and parallel arrangement of giant molecules; this behaviour has served as a guide in production of satisfactory synthetic rubber
6. Diffraction micrographs by new Barrett technique; A. individual grains in strain-free sheet of pure aluminum; B. effect of strain in grains introduced by 20% elongation of specimen

will permit (with no defined lower limit to this sea of negative energies). A few rare exceptions or holes in this close-packed array, created by photons after the general manner of the photo-electric effect are what appear to us, according to Dirac's picture, as positive electrons or "positrons."

The existence of negative kinetic energy states is not as fantastically "out of this world" as one might think. There seems to be experimental evidence that charged particles have a finite chance of penetrating potential barriers, if these latter are not too thick relative to the De Broglie wave length of the particle, even if the initial kinetic energy of the particle is inadequate to scale the barrier. The Ramsauer effect, in which atoms become surprisingly transparent to electrons of appropriate De Broglie wave length is of this nature, and E. U. Condon, R. W. Gurney and also G. Gamow explain the occasional escape of the constituent particles from radioactive nuclei also in this way. From the wave point of view this traversing of such otherwise insurmountable potential barriers is analogous to the fact that in physical optics the wave disturbance is to be found, albeit weakly and with penetration of the order of fractional wave lengths, in regions forbidden by geometrical optics. Now from the particle point of view, whose equal validity it seems unwise to contest, the corpuscle in its classically forbidden transit through the region of such potential barriers must have either (1) negative kinetic energy, or (2) energy borrowed temporarily from some unknown source, or (3) we must abandon the principle of conservation of energy. In 1945 these three possibilities seemed almost indistinguishable.

Inadequacies of Physical Theories.—We have tended in this review to stress the successes of the various theories which have been advanced to explain observed phenomena and which have frequently successfully predicted new phenomena later verified by experiment. The reader must not conclude however from this that any of these theories are in a satisfactory state. All are fragmentary, suffering from the fact that they have limited fields of applicability whose boundaries are ill defined. For example, J. C. Maxwell's theory of the electromagnetic field is very satisfactory indeed for the explanation of all the phenomena of radio waves. It starts to exhibit its weakness the moment the frequency reaches such values that the photon energy, $h\nu$, becomes comparable with characteristic energies in molecules or atoms. This is however not a well-defined boundary and there is no reason whatever to suppose that the nature of electromagnetic radiation has changed abruptly at some definite frequency or wave length. Even radio waves are undoubtedly quantized. There simply was no inclusive and satisfactory theory in 1945 for the electromagnetic field and its radiant energy. This state of affairs exists in every domain of physics. No satisfactory theory links gravitational and electrical phenomena. There is no satisfactory amalgamation of the theories of matter and of radiation. The mysterious ratios between the masses of the various fundamental particles and indeed nearly all the seemingly arbitrary relationships between the universal constants of nature are hardly understood at all. All physical theories are of the nature of half truths; they must have something right about them to claim our attention but improve them as we doubtless shall, it hardly seems likely they can ever escape from some incompleteness simply because nature proves to be so richly diverse and the number of new things to be explained seems always to keep pace with solutions. This is not in the least discouraging; quite the contrary, for it promises unlimited vistas of fascinatingly interesting human activity and we must never forget that the half truths we capture and incorporate into the scientific edifice are permanent gains. Relativity has not destroyed Newtonian mechanics; it has only refined and extended its predecessor without which as a starting point it would not have been possible. "The finest fate to which any theory can aspire is to become a special case of a better and more inclusive theory."

Conclusion.—Space limitations prevent inclusion in this article of a host of interesting subsidiary topics. Little or nothing has been said of the physical optics of X-rays such as: (1) M. Siegbahn's correction to the Bragg law necessitated by X-ray refraction; (2) total reflection of X-rays and the technique brought to astonishing accuracy by J. A. Bearden and others of their diffraction on artificial ruled gratings; (3) refraction of X-rays by prisms and prism spectra; (4) proof of their wave nature even down to $\lambda=8.3\times10^{-8}$ cm. by slit diffraction; (5) dispersion curves of X-rays near absorption edges; (6) polarization of X-rays by crystal reflection. The entire fascinating field of X-ray satellites explained by D. Coster and R. de L. Kronig and verified by F. Hirsh and by L. G. Parratt has been omitted as has also the evidence from the structure of absorption edges as to the less tightly bound or free electrons in solids. The enormous field of crystal structure study by a great number of methods has barely been mentioned. Nothing has been said of the technical means for supplying energy to X-ray tubes including the new Betatron of D. W. Kerst with electron energies of many millions of volts nor of the huge field of chemical, mineralogic and crystallographic applications. Many of these subjects are treated in other *Encyclopædia Britannica* articles and in the original research articles. The effort here has been: (1) to paint a thumbnail sketch of the unfolding of a complete branch of science from its inception, conveying if possible a little of the dramatic excitement it held for the participants, and the object lesson of their world-wide, free, spontaneous working co-operation as a result of the freedom of exchange of their information; (2) to thread the story on the most important news item it contains, namely the new concepts of radiation and matter and their fundamental duality, with their enormous implications; (3) to illustrate the primary importance of the search for truth and understanding, which at first always appear as "useless" knowledge, but inevitably open the door to all useful applications.

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USE IN MEDICINE

The extraordinary value of Röntgen's discovery has been nowhere more in evidence than in medicine, and for a full discussion of the use of X-ray in medicine, *see* RADIOLOGY; RADIO-THERAPY; X-RAY TREATMENT.

MODERN INDUSTRIAL APPLICATIONS

The industrial applications of X-rays fall mainly into two divisions, the first being radiography, including the newly developed special technique of microradiography. Under this heading will also be considered visual examination by means of a fluorescent screen, which has obvious advantages over the photographic method in many instances. The second main division is concerned with the more difficult technique known as X-ray crystal analysis.

Radiography—The Examination of Gross Internal Structure.—In the science of engineering X-rays have been shown to have a most important place. Engineering materials must be constantly studied for weaknesses. Castings are always subject to flaws and cracks which very often are discovered only after expensive machining has been completed; they may then have to be scrapped and the work is wasted. If X-rays could be used to examine all castings, they might be universally employed, but unfortunately there is a limiting thickness of metal beyond which X-rays cannot penetrate. However, in the year 1945 this limiting thickness was nearly 12 in. of steel as a result of the development and commercial use of 1,000,000 and 2,000,000 volt X-ray tubes. (*See* figs. 1 and 2, plate IV.) Even greater thicknesses are penetrated by X-rays generated at 20,000,000 volts in the new commercial model of the electron accelerator or Kerst betatron. Metal ingots and castings below this thickness are all capable of X-ray inspection, although owing to the complicated shape of many castings, their examination by X-rays is not always practical. The plates give illustrations of radiographs of castings. The white lines and patches indicate flaws—places where the metal departs from its normal homogeneity. They represent either blowholes, inclusions or cracks.

It is well to remember that radiography is the production of a shadow picture. The shadows exist in the picture because X-rays are absorbed to different degrees by different media. If we were to radiograph a perfectly homogeneous piece of muscle or steel we should obtain a photographic plate quite uniformly blackened because the X-ray absorption would be uniform. The absorption of X-rays by any material depends, first, upon the material itself—in general, the higher its atomic weight the more absorbent it is—and second, upon the penetrating power or wave length of the X-rays. The latter condition depends, generally speaking, on the voltage which is applied to the terminals of the X-ray tube. Thus, remembering the first condition, lead is more absorbent than iron, iron more than aluminium, and aluminium more than organic substances such as flesh. At the same time, if we use an X-ray tube having a tungsten target, the X-rays will be more penetrating when generated by 200,000 volts than at

100,000 volts, and so on. If a beam of X-rays of suitable penetrating power is passed through an object of varying thickness or varying composition, the emerging rays (which affect the photographic plate) will have different intensities corresponding to the variations in the object, and the result will be a mixture of shadows of varying degrees of intensity. For example, a hidden cavity in a piece of metal means that the total thickness of the material is less at that particular place, and the X-ray absorption will also be less; therefore, we shall obtain more intense X-rays in that area, resulting in a darker patch on the negative. If, instead of a photographic plate, we are using a fluorescent screen, we shall see a brighter patch on the screen corresponding to the more intense radiation.

Unfortunately, of the energy represented by the X-rays that fall on the photographic film only a very small fraction (less than 1%) has any photographic effect; the remainder simply passes through the emulsion without affecting it. The photographic effect, however, may be increased by the use of suitable intensifying screens that absorb more of the rays and in consequence emit actinic rays which reinforce the photographic image. There are many details of correct technique for obtaining sharp radiographs revealing smallest defects, which must be learned from theory and experience. For example, specifications are rigidly set up by the U.S. army air forces and other agencies. These involve distance and size of focal spot of the X-ray tube, protection of the film from scattered and secondary radiation in the specimen, correct exposure charts, and stereoscopic exposures for locating the depth of a defect. When the object has very irregular edges it may be convenient to use a wax impregnated with lead or other heavy element. Another method is to immerse the specimen in a liquid having about the same coefficient of absorption as the specimen.

A certain number of patches or cracks may occur in a casting and still not be serious enough to entail its rejection. The actual significance of the X-ray picture in terms of mechanical strength is a matter for experience in interpretation. The positions and dimensions of metallic flaws may be calculated with great accuracy by stereoscopic methods, and the radiograph becomes an infallible guide as to the soundness of material.

The faults to which castings are subject demand continuous research in the actual process of casting various metals, and here again X-rays have become a most valuable adjunct to the conventional methods. The castings produced by a certain method are radiographed and weak places noted, the technique is then suitably modified, the resulting castings again radiographed, and so on. Among the castings and forgings being radiographed by 1945 on a routine service scale, were those for gun carriages, turbine shells and parts, oil stills, aeroplane parts, locomotive parts, high pressure steam installations, and expensive steel cylinders. The method is in general use in the U.S. and installations are in use for the same purpose in the factories and dockyards of the British government. The greatly expanded use during World War II of light aluminium and magnesium alloy castings was made possible to a large extent by radiographic control of soundness, both as a routine procedure and as a means of developing correct foundry practice.

Metallic welding affords another wide field of X-ray usefulness. All welding is subject to faults and even the best methods depend largely upon the skill and care of the individual workman. X-rays are the only method of testing a weld without destroying it. After extensive experience it is customary to estimate the mechanical strength of a weld by a mere examination of the radiograph. Inspection of the soundness of welds now ranges from spot welds of thin aluminium foil on aeroplane wings to welded Liberty ships and the giant penstocks of Boulder dam and similar structures.

Another X-ray application has its main expression in the inspection of assembled articles such as aircraft instruments, electronic tubes, electric relays and resistances, artillery shells, bombs and rockets (including the proper filling with explosive and incendiary materials and safe inspection of ammunition captured from the enemy) and fuses, where the finished product depends for its proper functioning on the completeness and correct assembly of its internal components. In such cases elaborate and expensive systems of inspection are often necessary. In many instances X-rays afford an accurate method of making such a check.

Wooden structures, such as aeroplane and glider parts, railway ties, telephone poles and lead storage battery separators also offer a suitable field for X-ray application. Worm holes, resin pockets, and graining may be determined with great exactness. X-ray inspection of the roof beams of the ancient Cathedral of St. Peter in York, England, disclosed in 1938 such a dangerous internal honeycombing from boring of death-watch beetles that immediate replacement was necessary.

In the course of a research of glued joints it was necessary to determine the disposition of the glue. By adding a small percentage of a heavy salt to the glue, thereby rendering it opaque to X-rays, the dispersion of the glue in the joint was shown with clearness in a radiograph. Much of the success of modern laminated wood as a light and strong structural material is the result of this technique. Motor tires may be examined by X-rays to determine the position of the cords and the bonding of rubber. Electric insulating materials, such as ebonite and built-up paper materials, may be examined for the presence of impurities and electrically conducting particles. Abrasive wheels have been examined for cracks, and fireclay pots used in the manufacture of glass have been inspected for the presence of harmful metallic impurities. X-rays have also been used by customs authorities to investigate the contents of sealed packages. Real pearls may be distinguished nondestructively from imitations by X-rays because the real pearl emits a visible fluorescence under the action of the rays. The real pearl also discloses a series of layers or growth rings from the centre outward, to distinguish it from the cultivated or Japanese pearl which has an artificial centre upon which is deposited a thin nacreous layer. Diamonds, which are very transparent to X-rays, may be distinguished from imitations, which as a rule are much more opaque. The use of X-rays to demonstrate the fit of shoes and boots is now a familiar sight in a shoe store. The exact measurement of the fit of screw threads is a matter that has given rise to a good deal of difficulty; X-rays are now being used for this purpose.

Entirely new is the "instantaneous" radiography developed by Westinghouse Electric corporation. A condenser discharge through a special tube provides an X-ray beam of such great intensity that an exposure of the order of a millionth of a second is possible. Thus objects in rapid motion may be radiographed. The most important application has been to the science of ballistics, since the course of bullets through various materials is easily followed.

Prior to 1928, Dr. J. Heilbron, of Amsterdam, conducted some very remarkable and beautiful experiments with X-rays on pictures painted by old masters. The pigments of modern painters are in general much less opaque to X-rays than those used many years ago. Dr. Heilbron was able to produce X-ray evidence of extraordinary alterations having been made to some pictures. One picture examined by Dr. Heilbron was by Cornelis Engelbrechtsen, where the X-ray picture showed the figure of a vested priest which had been covered at a later date by the painted portrait of a woman. This hidden feature of the original painting had been undiscovered for 400 years. Another picture, a representation of the Madonna by Geertgen van St. Jans, was shown by the X-ray picture to have originally included an infant in the arms of the figure, which had subsequently been painted out. This method was greatly extended by Alan Burroughs of the Fogg Art museum of Harvard university, F. I. G. Rawlins of the National Art gallery, London, and others with the result that an X-ray laboratory is an essential part of museum equipment. Even one of the most famous paintings in America. Thomas Gainsborough's "Blue Boy," in the Henry E. Huntington Art gallery, San Marino, Calif. has not escaped. Recently an area above the head appeared to have a peculiar light reflection (pentimento). Radiographic examination showed the figure of a man over which the "Blue Boy" had been painted. The light spot corresponded with the white stock around the neck of this underlying figure on a canvas which had been cut down for the "Blue Boy" (fig. 3, plate IV).

The development of X-ray apparatus has resulted in the production of small and portable equipment for various purposes, among which may be mentioned a set for the use of plumbers and builders to enable them to locate the position of wires and pipes in the walls and floors of buildings. Automatic equipment with moving belts permits quality classification of many products, usually by visual fluoroscopy, such as elimination of candy containing foreign bodies, separation of juicy from pithy citrus fruits, and detection of damaged or contaminated food products of many kinds (fig. 6, plate IV).

A logical extension of radiography is to the examination of very small objects, the image of which must be enlarged. Since there are no magnifying lenses for X-rays, it follows that recourse must be taken to enlargement of radiographs registered on very fine-grained photographic emulsion, such as the Lippmann. After 1938 this technique of microradiography was developed as the result of work of G. L. Clark and associates at the University of Illinois, Urbana, Ill., into a successful and important practical method, especially in the field of metallurgy. Each separate phase in a complex alloy having a different absorbing power for X-rays can be delineated; by a simple calculation from absorption coefficients the proper wave length may be selected for maximum differentiation between two or more phases in the most complex bronzes and other important commercial alloys. Biological materials of very small size can be similarly photographed depending simply on differences in density within the structure or following differential "staining" with absorbing materials. Figures 5 and 6 in plate I are microradiographs of a commonly used aluminium-copper alloy in which the copper appears as white streaks; and the eye of a common housefly. A recent accomplishment involved specification of steel for vitreous enamelling, since steels of the same composition and structure acted very differently, in some cases causing enamel to shatter. Microradiographs proved that microporous channels could cause diffusion of gases through the metal with disruption of the bond between steel and enamel.

X-Ray Diffraction.—The Analysis of Fine Structures of Materials.—The second great branch of X-ray science applied to industrial problems depends upon the fact that solid crystalline materials serve as diffraction gratings for X-rays by virtue of the regular arrangement in space of the ultimate atoms, ions or molecules, just as closely ruled lines on glass or metal serve as a diffraction grating and produce a spectrum of ordinary light. This interaction between X-rays and crystals was predicted and experimentally proved by Von Laue in 1912, and given its simplest expression in the familiar Bragg law: $n\lambda = 2d \sin\theta$, where n is an integer (the order of the spectrum),

λ is the X-ray wave length, d is the interplanar spacing or distance between two identical planes of atoms or molecules in the crystal, and θ is the angle of incidence of the X-ray beam on this set of planes. Thus every crystalline chemical element or compound produces a diffraction pattern which is uniquely characteristic of the particular kinds and arrangement of atoms or molecules which are the ultimate building blocks of the crystalline architecture.

The pattern may be used to identify the solid exactly as it is without solution in a liquid or other change. It is a comparatively simple matter to identify an unknown material if a library of standard patterns of known pure materials is available for matching. To this end the American Society for Testing Materials, in conjunction with the Physical Society of London, has issued a card index of X-ray patterns for about 10,000 compounds, based on the original Dow-Hanawalt tables. For this identification, the material is finely powdered and a so-called powder pattern or spectrogram of sharp lines is photographed. By rapid methods of comparing the three most intense lines with recorded values, the unknown may be readily discovered if there is a standard pattern for it in the index.

The practical industrial use is self-evident of identification without proceeding to the more difficult techniques of determining the actual crystalline architecture, or precise scheme of arrangement in space of atoms or molecules, or even of atoms within molecules, particularly for organic compounds.

There are a number of diffraction techniques and types of cameras. A carefully collimated train of parallel X-rays, usually with one wave length, is directed through, or reflected from, the surface of the specimen which may be a powder, aggregate, fibre or single crystal, which may be stationary, rotated or oscillated. The diffraction pattern is registered on a photographic film, stationary or moving, flat or curved, at a fixed distance from the specimen. In the U.S. four manufacturers produce largely for industrial use complete multiple diffraction units on which two or four patterns may be photographed simultaneously. (Fig. 1, plate V.)

Until recently, complete structure analyses were largely confined to academic laboratories from which came a growing new crystal chemistry. Suddenly the problems of identity and synthesis of quinine, penicillin, synthetic rubber, alloys, and a long list of essential materials have required the practical use of the ultimate analyses, culminating in an electron density contour map of a single molecule. Many of the newest industrial materials have been the direct result of the guidance of X-ray diffraction research and testing. Natural materials such as minerals, clays and soils, cellulose, proteins and other textile materials are frequently studied.

In addition to analysis of crystalline architecture, X-ray patterns have the important function of indicating texture—the actual condition of a specimen in terms of grain size, orientation, effects of rolling, drawing, fatigue, strain, annealing, aging and other processes. (Figs. 2 and 3, plate V.) During World War II hundreds of thousands of quartz plates for control of radio frequencies were properly cut and ground for the signal corps of the U.S. army by X-ray diffraction control in nearly automatic apparatus. Aeroplane motor castings were so improved by means of X-ray back reflection control (fig. 4, plate V) that strain was eliminated and horsepower safely doubled for the same weight of light alloys (*see* 1944 Mehl Award lecture, before Congress of Metals). Carbon blacks for rubber reinforcing, charcoal for gas masks, storage batteries (grids and active materials), explosives, chemicals, antiseptics and medicinals, waxes and coatings, welded Liberty ships, fluorescent materials, surgical sutures and membranes, rayons and synthetic textiles, elastic polymers and plastics, pigments, electroplatings, lubricants, instrument pivots, abrasives, adhesives, wood and lignin, boiler scale, glass, soaps, parts of V-1 and V-2 German bombs—these are but a short list of materials of industrial and wartime importance to which X-ray diffraction methods contributed fundamental research information and routine production control (Fig. 5, plate V.) These examples illustrate the fact that practical behaviour in use so frequently depends on the ultimate structure and texture.

In 1945, Dr. C. S. Barrett of the Carnegie Institute of Technology announced a new microscopy of potential value in physical metallurgy and in other fields, which depends on Röntgen ray diffraction. This new adaptation supplements optical and electron microscopy and microradiography. It differs from usual technique in employing a fine-grained photographic plate in contact with or very close to the specimen upon which a beam of characteristic X-rays strikes. The diffraction image is enlarged just as in the case of microradiography. These diffraction micrographs show the places where inhomogeneous strain is concentrated. Along planes where slip has occurred throughout the interior of crystals and polycrystalline grains there is a local bending or rotation of the crystal lattice. At such points the efficiency of Röntgen ray reflection is increased and a dark line is produced on the photographic plate. Measurement can be made of the amount of rotation (usually less than 0.1°) and the thickness of the distorted layer. (Fig. 6, plate V.) Thus strain, plastic deformation, twinning, distortion from scratches and cutting tools, annealing, recrystallization, coring, clustering of similarly oriented grains, age-hardening and super lattices are all subjects for investigation by the technique. Sizes and shapes of polycrystalline grains are shown in truly amazing photographs. Since these diffraction micrographs register the effects in individual grains (while ordinary diffraction patterns are the summation of effects from large numbers of grains) it is possible to identify microconstituents from the directions of diffracted rays measured with two films at different distances, and application of the Bragg law. Thus nondestructive microanalysis on individual particles is one of the useful applications. (*See* also SPECTROSCOPY, X-RAY; QUANTUM MECHANICS.) (G. L. CK.)

X-RAYS AND CRYSTAL STRUCTURE. The idea of a regular, underlying structure has always been at the back of scientific studies of crystals. It is suggested by their very appearance, and it becomes almost a necessity to explain the regularities of the laws of the arrangements of the external faces, and the physical properties of the crystals. Christiaan Huygens, in the 17th century, first put forward the idea that a crystal was essentially a regular piling of atoms or molecules similar on a minute scale to a pile of shot or to the blocks of the Great Pyramid. It was not until the beginning of the 19th century, however, that the Abbé Haüy gave it a firm mathematical footing. (*See* CRYSTALLOGRAPHY.)

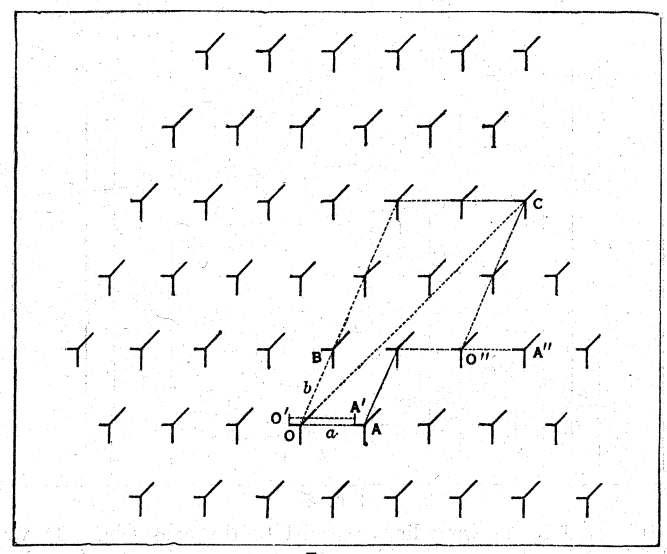


FIG. 1A

PART I. THE ANALYSIS OF STRUCTURE

The idea implicit in Haüy's work was that crystals consist of a regular ordering of exactly similar molecules in three dimensions.

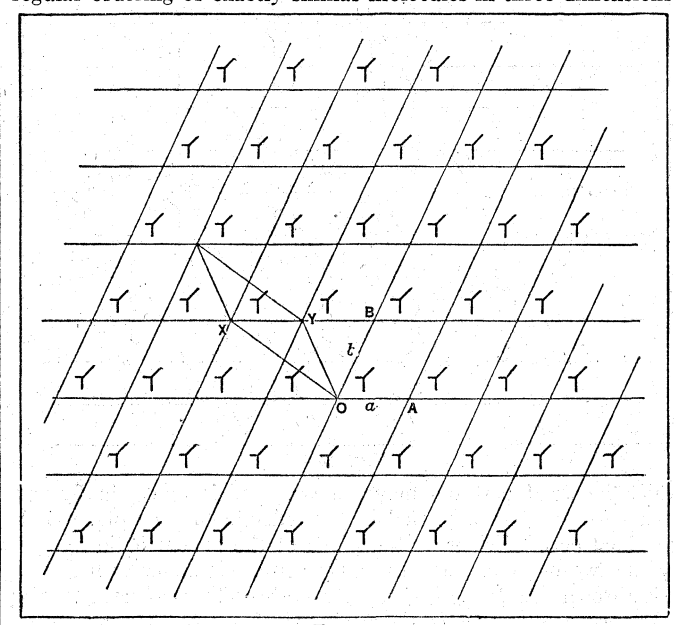


FIG. 1B

This is easiest to understand from its two dimensional analogue. In fig. 1A a set of similarly oriented identical patterns is shown, repeated, supposedly indefinitely. A certain movement O–A takes me from a point O of one pattern to a corresponding point A in

another. Now an exactly similar movement O′A′ would take me from any point of the pattern to the corresponding point, or from any point in any pattern O″ to a corresponding point on another A″. Similarly, the different movement O–B may be seen to have the same property. They are the so-called translations of the crystal. Now we can easily see that any translation O–C can be made up of a succession of translations O–A and O–B, so that O–A and O–B may be taken as the primitive translations or the axes *a, b* of the crystal. All the points derived in this way make up the

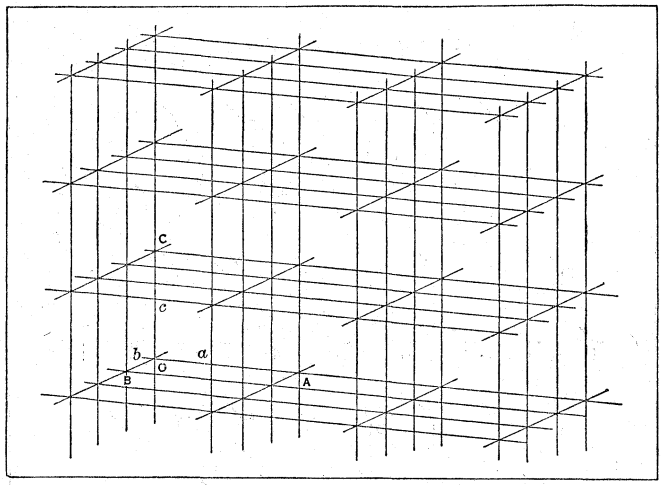


FIG. 2

lattice and by drawing lines parallel to the axes (fig. 1B) we define the cell of the crystal, the contents of all cells being identical. Of course, we might have chosen another set of axes, OX, OY instead, but the lattice is completely determined in either case by the lengths of the axes and the angle between them, and the whole crystal by the lattice and by the co-ordinates of each point in a single cell, referred to its axes as units. To extend this to three dimensions, we simply have to take another axis *c*, not in the plane of *a*–*b*, and the cells become parallelopipeds, extending in space in all directions. (*See* fig. 2.)

Symmetry.—Now there are other ways than translations in

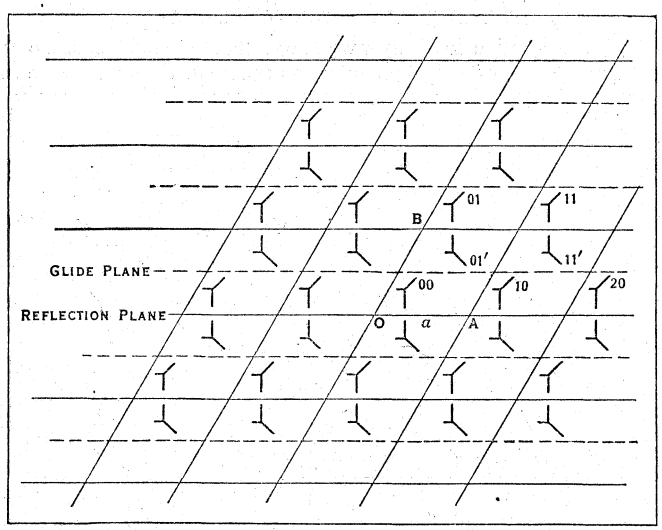


FIG. 3A

which identical patterns may appear. For instance, in fig. 3A each pattern is accompanied by its reflection in the plane O–A, imagined perpendicular to the plane of the paper; or in fig. 3B, by the two other patterns made by turning it about a three-fold axis through O. In fig. 3C we see both of these together. It is only necessary to specify the positions of one of the asymmetric patterns in the cell, and the nature of the symmetry, to define the crystal as completely as before. The elements of symmetry permitted in space lattices are essentially those of crystallography, that is, two, three, four and six-fold axes, centres of symmetry, reflection planes and axes of the second sort. (*See* CRYSTALLOGRAPHY.) But there is the important condition that all axes must be translations and all planes lattice planes, and in addition, there are glide planes and screw axes. In fig. 3A we have the two rows of patterns (marked $\begin{smallmatrix}01' & 11'\\ 00 & 10 & 20\end{smallmatrix}$), each of which can be seen to be a reflection of the other in a plane, but which has also been moved on a half translation of the cell. This is called a glide plane re-

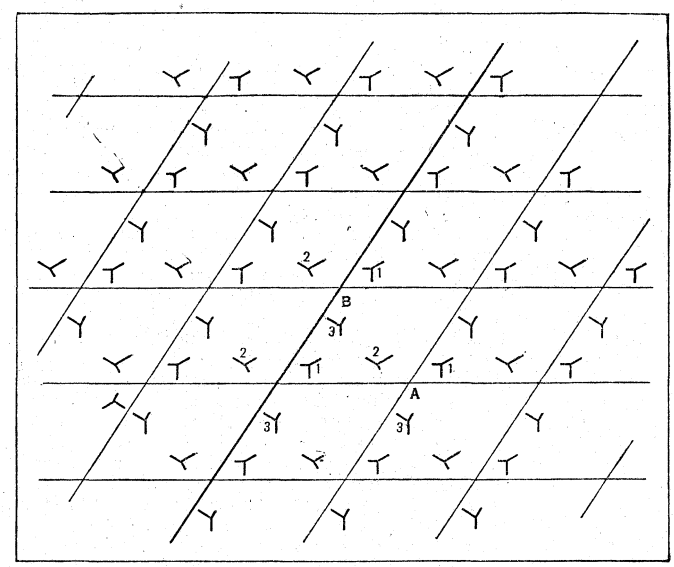


FIG. 3B

flection. An ordinary axis of symmetry is a pure rotation, but screw axes move the pattern a fraction ($\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{3}$ or $\frac{1}{6}$) of the lattice translation, parallel to the axis in each operation, so that at the end of a complete turn the pattern has moved through one translation, *e.g.*, three-fold screw axes perpendicular to the paper are shown in fig. 19. Screw axes may be right or left handed. In nature they are familiar as phyllotaxy, the arrangement of leaves on a stem.

The considerations of symmetry give us an ultimate method of classifying any regular arrangement of patterns in space. First we can divide the lattices into the fourteen types of Bravais

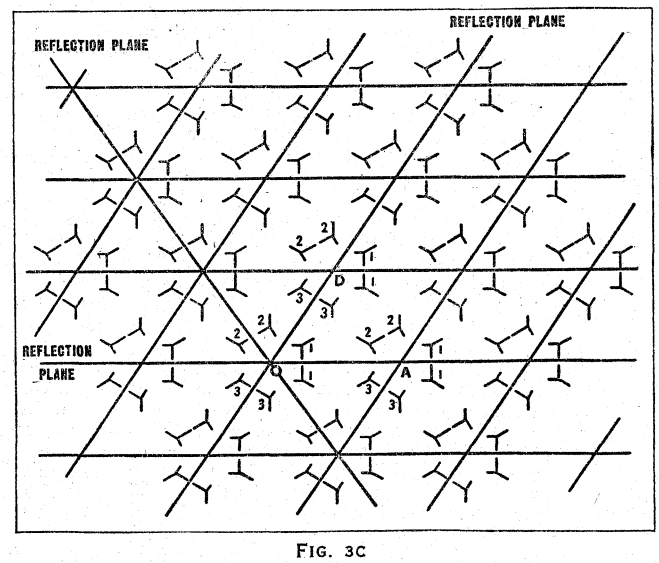


FIG. 3C

(1811–1863). (*See* fig. 4.) The seven systems of symmetry, cubic, tetragonal, hexagonal, rhombohedral, orthorhombic, monoclinic and triclinic, give rise to the simple lattices (i.) Γ_r, (iv.) Γ_t, (vi.) Γ_h, (vii.) Γ_{rh}, (viii.) Γ_o, (xii.) Γ_m, (xiv.) Γ_{tr}. But besides these there exist a number of face centred lattices [where the primitive translation is not from corner to corner of a rectangular face but to its midpoint]; one face centred (ix.) Γ_o', (xiii.) Γ_m', or all face centred (iii.) Γ_r'', (xi.) Γ_o'''. Lastly, there are the three

body centred lattices [where the primitive translation is to the centre of a rectangular parallelopiped rather than to its opposite corner]; (ii.) Γ_r', (v.) Γ_t', (x.) Γ_o''.

Next, we can divide the symmetry further, according to the nature of the axes and planes and the presence or absence of centres of symmetry into the thirty-two crystal classes. (*See* CRYSTALLOGRAPHY.) But the existence of glide planes and screw

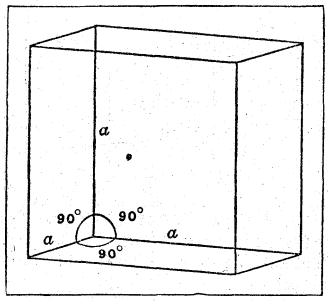


FIG. 4.—(I.) SIMPLE CUBIC LATTICE Γ_r equal axes of length ("a" at right angles)

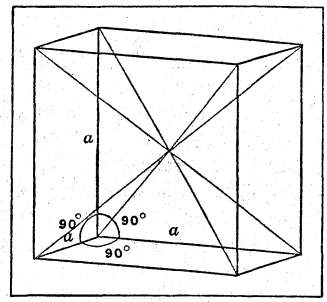


FIG. 4.—(II.) BODY CENTRED CUBIC LATTICE Γ_r' (equivalent point in centre of cube)

axes permits of still further divisions inside each class, and for each variety of lattice possible in that class. If these two are specified, the complete inner symmetry or space group of the crystal is given. The determination of the two hundred and thirty possible space groups was begun by Sonchke (1842–1897) and finished by Schoenflies, Fedorow and Barlow at the beginning of the present century.

Laue's Discovery.—But though the geometrical frame-work for the complete description of crystal structure had thus been worked out, there remained no way of applying it, for it was impossible to determine either the nature of the lattice, the existence of screw axes and glide planes or even the size of the cell, much less the positions of the atoms in it. Yet the labour of the mathematicians was not wasted. Soon after they were concluded, there was a controversy as to the nature of X-rays. Some maintained they were corpuscular and others that they were waves analogous to light. However, no one had then succeeded in diffracting them with a grating. (*See* LIGHT.) This seemed to show that if they were waves, their wave lengths must be much less than that of visible light, 10^{-5} cm. Now early in 1912 it occurred to von Laue, then a young physicist at Munich, who was in touch with the Crystallographic School of Groth, that the lattices of crystals, of which the little that was known indicated a periodicity of 10^{-8} cm., were of the right order to act as a grating for X-rays, and, if they were waves, to diffract them in definite directions. Friedrich and Knipping carried out the experiment of passing a narrow beam of X-rays through a crystal with a photographic plate behind it.

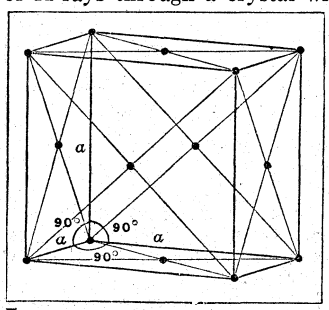


FIG. 4.—(III.) FACE CENTRED CUBIC LATTICE Γ_r'' (equivalent point at centres of cube faces)

The experiment was strikingly successful. The plate was covered with a regular pattern of spots, which was what von Laue had predicted. This experiment gave the key both to the nature of X-rays and the structure of crystals.

The Braggs' First Crystal Analyses.—The new discovery aroused immediate interest. In England it was taken up by Sir William Bragg and his son, W. L. Bragg, who in the same year determined the first crystal structures, those of rock salt and zinc-blende; and at the same time developed a method of analysis which was to be the basis of all further work. The way in which they accomplished the double task of determining the wave lengths of X-rays and the structure of crystals is told in their classic book, "X-rays and Crystal Structure." Here we will simplify it by assuming from the start that we can produce X-rays of single wave length λ (most easily from the fluorescent radiation of metals such as iron, copper and rhodium. *See* X-RAYS, NATURE OF).

Bragg's Law.—The action of X-rays on crystals is best dealt with as selective reflection from crystal planes. If a set of planes be drawn through corresponding points in a crystal (*see* fig. 5A), not necessarily in any relation to the superficial faces, these will be a constant interval apart. This is the spacing of the plane d_{hkl}; ([hkl] are the Millerian indices, that is, the reciprocals of the fractional intercepts on the axes. *See* CRYSTALLOGRAPHY). If a train of waves falls on such a set of planes p (*see* fig. 6) at a glancing angle θ, each plane will reflect a small part of the wave

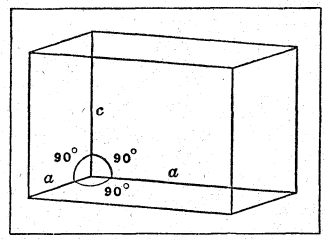


FIG. 4.—(IV.) SIMPLE TETRAGONAL LATTICE Γ_t (two equal axes "a" and "c" all at right angles)

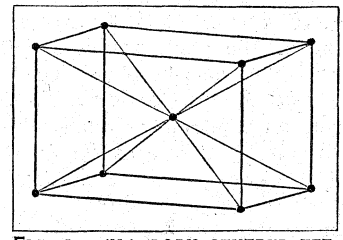


FIG. 4.—(V.) BODY CENTRED TETRAGONAL LATTICE Γ_t' (equivalent point in the centre of cell)

train regularly and let the rest through to the next plane. Now, in general, the reflected wave trains from successive planes will be out of phase with each other, will interfere and no reflection will result. (*See* LIGHT: *Interference.*) But if the path distance of the wave passing from plane to plane is a multiple of the wave length λ, all the reflected waves will be in phase and the train as a whole will be reflected by the crystal. This occurs when and only when

$$\sin\theta = n\lambda/2d.$$

This is the fundamental relation of crystal analysis known as "Bragg's Law." The integer n is the so-called order of the reflection. Thus the same plane will reflect at angles $\theta_1, \theta_2 \ldots \theta_n$, where $\sin\theta_1 = \frac{\lambda}{2d}$ $\sin\theta_2 = \frac{2\lambda}{2d}$ $\ldots$ $\sin\theta_n = \frac{n\lambda}{2d}$ for the same wave length. The higher the order or the smaller the spacing, the larger the angle of reflection. No plane whose spacing is less than half the wave length reflects at all. It is only necessary to measure θ, the angle at which X-rays of known wave lengths are reflected by a crystal, to know the spacing of its lattice planes.

But X-rays are able to give much more information than this. Consider a crystal with two scattering points in the cell of scattering powers A and B. (*See* fig. 5B.) Wave trains scattered from the A and B plane are now out of phase and necessarily interfere. If the B planes are xd from the A's, the resulting intensity of the nth order of reflection will be proportional to $(A+B\cos 2\pi nx)^2+B^2\sin^2 2\pi nx$. If, for instance, B was half way between two A's, $x=\frac{1}{2}$, this would become $(A+B)^2$ for the even orders and $(A-B)^2$ for the odd. The even orders would be strong and the odd weak, and these would vanish if A and B were equal, and the plane in this case is said to be halved. A crystal with more scattering points gives rise to a more complicated expression but it should be clear that the intensity of reflection is both an indication and a check on the positions of the scattering centres inside the cell.

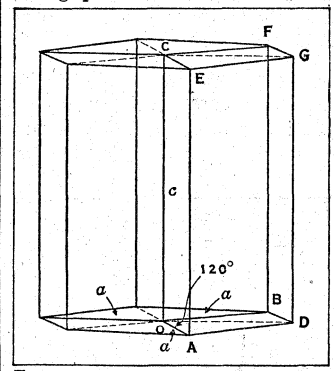


FIG. 4.—(VI.) HEXAGONAL LATTICE Γ_h (Three equal axes "a" at 120° and another "c" at right angles to them)

The chief experimental methods are therefore devised for a double purpose. Firstly, to find the glancing angles for the X-rays reflected by the different planes of the crystal, and secondly, to measure the intensity of the X-rays reflected. There are four chief experimental methods.

In the Bragg ionisation spectrometer (*see* fig. 7) the X-rays from the tube inside the lead box pass through the two slits

which limit them to a narrow beam, and meet the crystal mounted to rotate about a vertical axis. The reflection beam is received in an ionisation chamber, in which there is an absorbing gas such as methylene iodide, producing ions which charge the electroscope. The crystal and chamber are moved to record each reflection. Their angular position gives the glancing angle, while the ionisation current is a measure of the intensity. The Bragg spectrometer undoubtedly provides the most thorough method, but it is slow in action and suitable only for large crystals, so that methods depending on the photographic action of X-rays have also been developed.

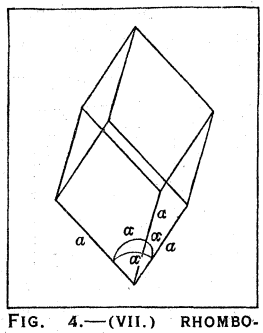


FIG. 4.—(VII.) RHOMBOHEDRAL LATTICE Γ_{rh}
Three equal axes (a) marking an angle (α) with each other

The Rotation Method.—For the rotation method originally due to de Broglie, an apparatus like fig. 8 is used. The X-rays from a tube (not shown) pass through the fine barrel aperture and fall on the crystal, which is rotated uniformly on the spindle, driven by the motor. As each crystal plane comes into a reflecting position, the reflected ray registers on the photographic plate, producing a pattern such as shown in fig. 9. Each plane reflects four times per revolution, giving the photograph a symmetrical appearance. From the position of the spot on the plate, the spacings or the indices of the planes can be calculated. An important property of the rotation method is that if the crystal is rotated about a translation a of the lattice, all the reflected rays lie on a set of cones ot angles ϕ_n where $\sin\phi = \frac{n\lambda}{\alpha}$ these cones intersect the plate in hyperbolae called layer lines (*see* fig. 9) and their distance apart is the best measure of the true axes of the crystal. It can be seen from the photograph that the spots are of very different intensities. These are usually estimated by eye, as strong, medium, weak, etc., so that the method is definitely inferior in this respect to the ionisation spectrometer.

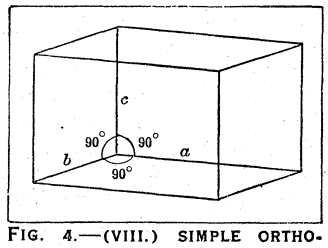


FIG. 4.—(VIII.) SIMPLE ORTHORHOMBIC LATTICE Γ_o
Three unequal axes a, b, c, at right angles

The Powder Method.—In the powder method, due to Debye and to Hull and Scherrer, a crystalline powder is used instead of a single crystal, depending on the fact that among so many grains some will be in the exact position to reflect. Consequently from the central beam diverge a set of cones each corresponding to the reflection from a single plane and forming circular rings on a plate (*see* fig. 10A) or so-called Debye curves on a film bent round a cylinder (*see* fig. 10B). Unfortunately, many planes often have the same or nearly the same spacings, which causes them to be confused and limits the method to simple crystals. However, as it is the only method for substances which cannot be obtained as single crystals, it is very useful, particularly for metals.

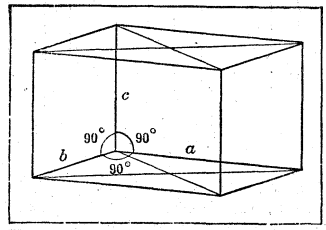


FIG. 4.—(IX.) ONE FACE CENTRED ORTHORHOMBIC LATTICE Γ_o' as (viii.) but with an equivalent point at the centre of one pair of faces

The Laue Method.—This depends on a different principle from the first three. Here the crystal is kept fixed, and a beam of white X-rays, that is with wave lengths ranging from between ·25 to ·5 A. (Ångström units $=10^{-8}$ cm.), is passed through it, usually parallel to a crystallographic axis. The apparatus used is the same as before (*see* fig. 8). For a great number of planes there will always be some wave length which is right for reflection and a spot is formed, the position of which depends only on the angular position of the reflecting plane. Thus the Laue method gives no information as to spacing. But, as can be seen from the photographs (*see* figs. 11a and 11b) it gives an excellent picture of the symmetry of the crystal and also of the relative intensities of a great number of reflecting planes.

Plainly, though any one of these methods but the last could be and has been used alone for crystal analysis, it is much better to use all to amplify and check each other's results. In this way we arrive at the experimental data for crystal analysis; *the spacings and intensities of the X-ray reflections of a number of planes of known indices.*

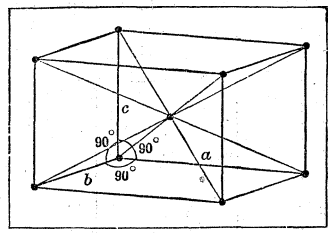


FIG. 4.—(X.) BODY CENTRED ORTHORHOMBIC LATTICE Γ_o'' as viii. but with an equivalent point in centre of cell

Stages in Structure Analysis.—With these data the actual analysis divides into two parts. It is carried out schematically as follows:

1. *Determination of Cell Size.* The lengths of the three axes, *a, b, c,* are found from rotation photographs or from the spacing of planes given by the formula

$$d_{hkl} = \frac{1}{\sqrt{\left(\frac{h^2}{a^2}+\frac{k^2}{b^2}+\frac{l^2}{c^2}\right)}}$$

for orthogonal crystals. For monoclinic and triclinic crystals it is more complicated and here the angles between the axes are usually obtained from the external crystal form. It is easiest to use the pinacoid spacings (100) (010) (001), which give the axes directly, but these may be halved, so for the true cell, one general plane (hkl) at least must be taken.

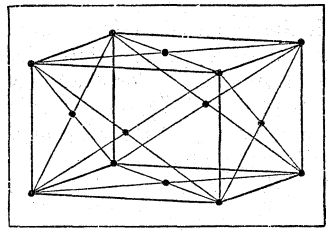


FIG. 4.—(XI.) FACE CENTRED ORTHORHOMBIC LATTICE Γ_o''' as (viii.) but with equivalent points in centres of all six faces

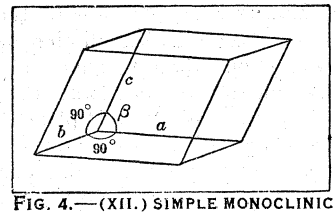


FIG. 4.—(XII.) SIMPLE MONOCLINIC LATTICE Γ_m
Two axes a and c making an angle β with each other and one axis b perpendicular to both of them

2. *Determination of the number of molecules per cell.* If D is the density of the crystal, and V its volume in cu.A. ($V=abc$ for an orthogonal cell), then the cell will contain Z molecules of molecular weight M, where $Z \times M \times 1{\cdot}66 = D \times V$. ($1{\cdot}66 \times 10^{-24}$ gm. being the weight of an atom of hydrogen.)

3. *Determination of the Lattice Type.* This is done by means of the halvings of planes of the type (hkl). In simple lattices there are no inner regularities and all kinds of planes appear, whereas in centred lattices, certain planes are inter-spaced identically so that they do not reflect in odd orders and are said to be halved. A halving when h+k is odd will, for instance, indicate an a c face-centred lattice Γ_m' (*see* fig. 4 [xiii.]).

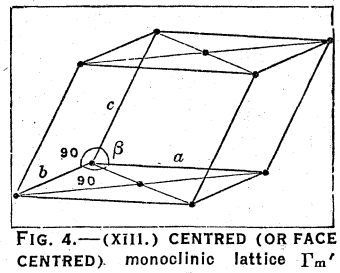


FIG. 4.—(XIII.) CENTRED (OR FACE CENTRED) monoclinic lattice Γ_m' (equivalent points in the centres of [a. b] faces)

4. *Determination of Space Group.* It is first necessary to know the crystal class. This must be done by the methods of ordinary crystallography. Laue photographs are useful in detecting axes, but unfortunately, X-ray methods cannot distinguish directly between crystals with or without a centre of symmetry. Next, screw axes and glide planes can be detected, for the former cause all orders of the plane normal to it to disappear except that corresponding to a multiple of the screw translation—*e.g.,* in quartz, owing to the trigonal screw axis, perpendicular to the c plane, only

the third, sixth, ninth, etc., orders of this plane reflect. Glide planes, on the other hand, halve whole sets of planes of the type (*hko*), where $h+k$ is odd. Space groups are usually found by the use of tables, of which those of Astbury and Yardley and Wyckoff are most used. They are denoted by a complex symbol, such as D^4_{6h}, where D_{6h} stands for the symmetry class and ^{4} is the ordinal number in a space group table, usually that of Schoenflies.

Once the space group is known and the number of molecules per cell, the symmetry of the individual molecule follows, which is in general lower than that of the crystal. Further, the conditions of symmetry fix the positions of the atoms within certain limits. If we designate the co-ordinates of the atom, referred to the axes *a b c* as *u v w*, the so-called parameters of the atom, then the symmetry conditions may fix the values of *u v w* within certain limits. If there are very few atoms of a particular kind in the cell, *u v w* may become o o o or 1/2 1/2 1/2, that is, the atom must be at a corner or in the centre of a cell. Or two parameters may be fixed, o o *v*, fixing the atom anywhere on the *c* axis; or o *v w*, fixing it anywhere in the *a* plane. However, it is only in the simplest cases that the symmetry positions fix all the atomic positions. Usually, a set of independent parameters are left undetermined, which may be only one, as in graphite, or twenty or more as in a silicate. The difficulty of fixing parameters leads to many crystals being left at this stage, but though it is indirect, the fixing of parameters by means of intensity considerations is far the most interesting part of crystal analysis.

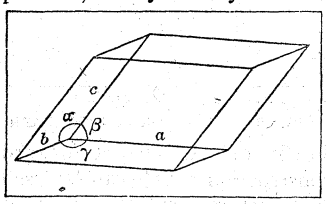


FIG. 4.—(XIV.) TRICLINIC LATTICE Γ_{tr}
Three unequal axes a, b, c, inclined at angles α, β, γ, to each other

The method consists in assuming certain values for the parameters and calculating from these the theoretical intensity of reflections from a set of planes. These are compared with the observed intensities, and the process repeated by trial and error, until the theoretical and observed intensities agree within the errors of the experiment. In many ways this method resembles the solution of a cross-word puzzle. The cell and space group provide the square and the pattern, the atoms the letters and the intensities the clues.

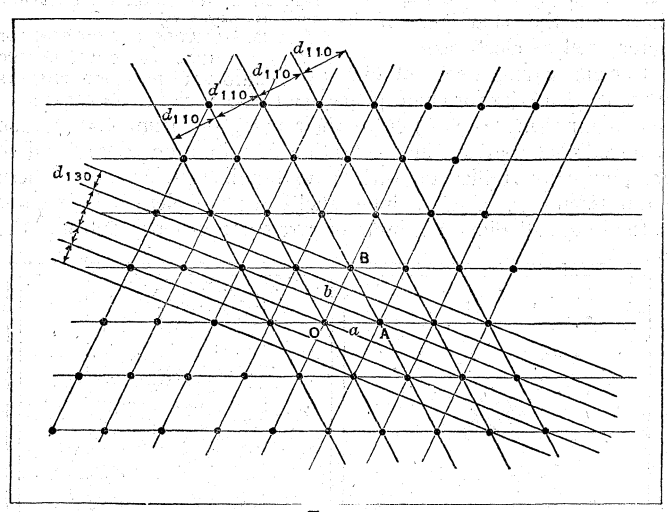


FIG. 5A

Atomic Structure Factors.—The amplitude of the reflection from the plane (*hkl*) of a crystal which has *n* atoms per cell with the parameters $u_1\ v_1\ w_1,\ u_2\ v_2\ w_2,\ \ldots\ldots\ u_n\ v_n\ w_n$ is given by

$$C_{(\theta)} \sum_{1\ldots n} F_{(r\theta)}\, e^{2\pi i(hu_r+kv_r+lw_r)}.$$

C_θ is the J. J. Thomson formula for the scattering from a single electron, which depends only on the angle of scattering θ. $F_1, F_2, \ldots\ldots F_n$ are the so-called structure factors of the different atoms. If the atoms scattered as points, $F_r = Z_r$ the total number of electrons in the atom. Actually, the electrons are diffused in space, so that their scattered radiations interfere, making *F* fall off very rapidly with the angle θ, particularly for light atoms. Structure factor curves giving F_θ can be found experimentally for each kind of atom or calculated from the wave mechanics distribution of electricity in the atom, as has been done by Pauling and Hartree. The exponential terms simply allow for the phase difference of the different atomic centres for the reflection of the plane (*hkl*). The observed intensity, before comparison with the calculated, must itself be corrected for absorption of the X-rays in the crystal, which is complicated by the fact that the very reflections of the X-rays increase the absorption differently for each plane. Corrections must also be made for temperature effects, as the atoms in a crystal vibrate more at higher temperatures, which reduces the reflection intensity.

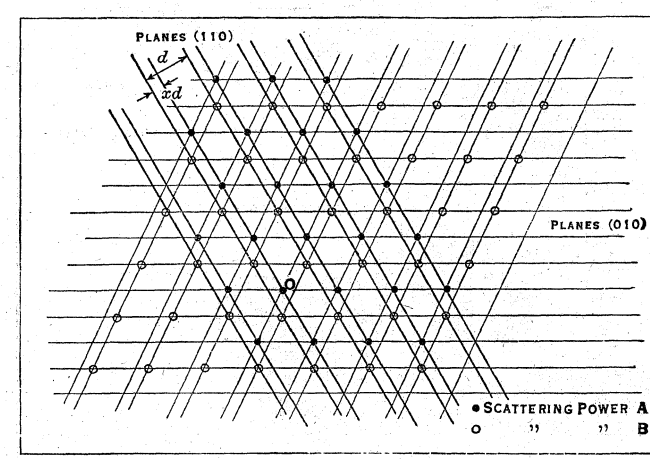
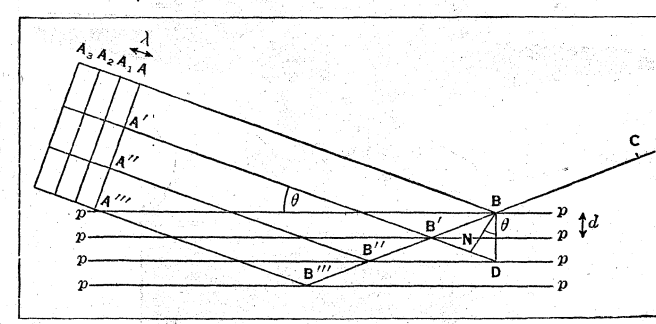


FIG. 5B

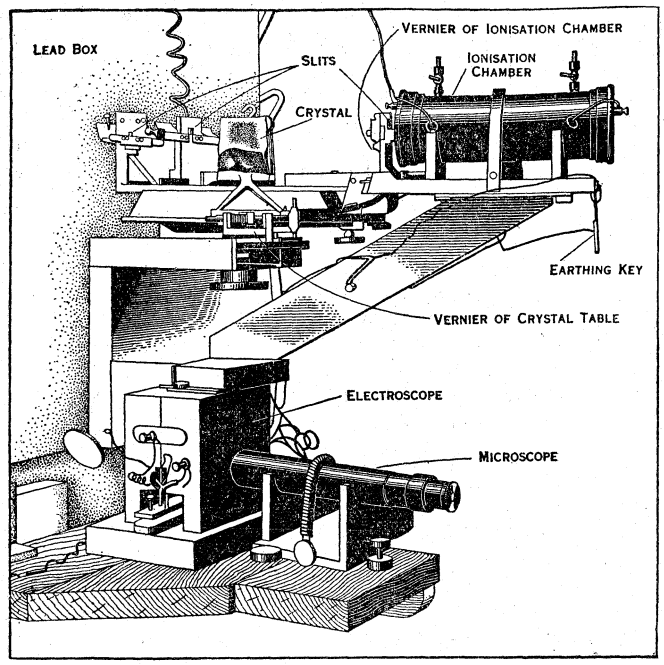
The calculation and comparison of intensities is a lengthy but straight-forward process, but the assigning of parameters is like solving a geometrical problem and always depends, in part, on intuition. Gradually, however, as more and more structures are being worked out, probable arrangements of atoms can be seen more easily, particularly by the use of the ideas of atomic diameters and co-ordination numbers (*see* Part II.). It was by the use of these that Pauling and West successfully and independently predicted the structure of topaz $Al_2SiO_4F_2$. But however the parameters are obtained, good intensity agreement absolutely confirms the structure as correct because the slightest change of atomic position causes such changes in intensity distribution between the different reflections as to wholly upset the agreement.



FROM BRAGG, "X-RAYS AND CRYSTAL STRUCTURE" (G. BELL & SONS)

FIG. 6

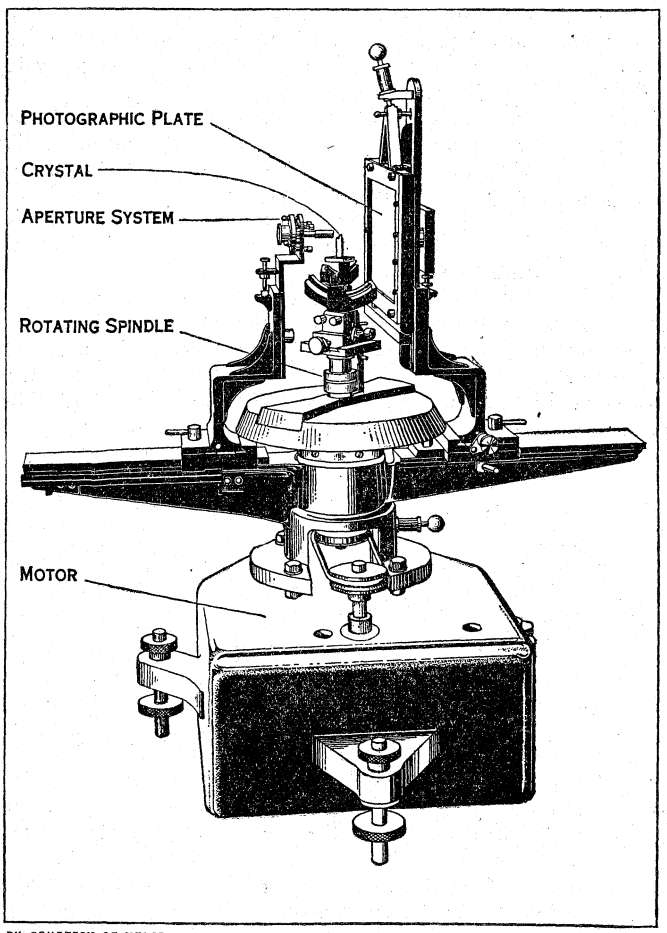
This completes our account of the methods of crystal analysis as far as the positions of the atoms are concerned. Unfortunately, to illustrate it with even a single example, would exceed the length of this article, and the reader must be content with the results of the analysis given in Part II. Strictly, however, merely to know the position of the centres of the atoms in a crystal, is only the beginning of a real knowledge of their structure. A complete knowledge must also include a quantitative account of the forces by which the crystal is held in equilibrium and of the dynamics of the crystal when it is acted on by mechanical or electrical



FROM BRAGG, "X-RAYS AND CRYSTAL STRUCTURE" (G. BELL & SONS)

FIG. 7.—BRAGG IONISATION SPECTROMETER

fields. Such an account should give all the mechanical and physical properties of the crystal in terms of its structure. This part of



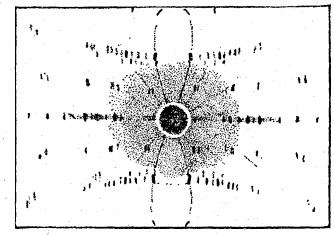
BY COURTESY OF MESSRS. W. G. PYE & CO.

FIG. 8.—APPARATUS FOR ROTATION AND LAUE PHOTOGRAPHS ETC.

crystal analysis is only beginning, but already the work of Born, Landé, Leonard Jones, Joffé and several others has accounted quantitatively for the mechanical properties of simple ionic crystals, particularly of the rock salt type.

PART II. THE STRUCTURES OF CRYSTALS

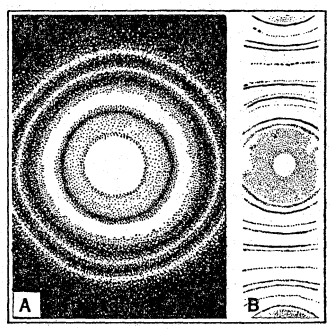
Crystal Chemistry.—By the methods outlined above, the structures of an ever increasing number of crystals have been worked out every year (1926 for instance, produced over three hundred papers on the subject) yet the field is so immense and the difficulties of analysis so considerable, that we can still only deal satisfactorily with the simpler types of crystal structure. Already, however, owing to the work of Sir William and W. L. Bragg, of Fajans, Wasatsjerna, Pauling and above all, V. M. Goldschmidt, we can put forward a theory of the mode of crystal construction which can be used to predict unknown structures, and structures and properties of new substances.



BY COURTESY OF J. M. ROBERTSON

FIG. 9.—ROTATION PHOTOGRAPH

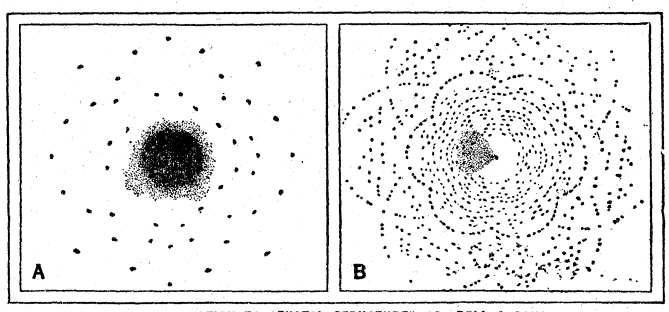
To understand the essence of this theory of crystal chemistry, we must start not from the crystal but from the atom. The most convenient form in which to represent the atom for this purpose is by Schrodinger's wave mechanics. Here each atom is pictured as a nucleus of positive electricity, surrounded by shells of diffuse negative electricity, growing denser towards the centre. Each shell corresponds to a set of Bohr orbits with the same chief quantum number in the classical quantum mechanics. These electron shells serve in the first place to give the atom a finite size (*see* fig. 12). This does not mean that the atom is a rigid sphere of definite radius. The wave mechanics atom must be considered as having a definite degree of compressibility and deformability. The chemical and crystallographic properties of an atom depend partly on the size but more on the character of its outer shell of electrons.



FROM BRAGG, "X-RAYS AND CRYSTAL STRUCTURE" (G. BELL & SONS)

FIG. 10.—POWDER PHOTOGRAPH OF (A) ALUMINIUM, (B) GOLD. (AFTER THE ORIGINAL PHOTOGRAPHS OF HALL AND DEBYE & SCHERRER)

Certain arrangements of electrons (2, 8, 18, 32 for chief quantum numbers 1, 2, 3, 4) have their inner quantum numbers so balanced that they are in a condition of minimum energy and so are physically stable and without external electric fields. These arrangements occur in the inner shells of most elements (but not in the iron, palladium, platinum or rare earth groups) but only the



FROM BRAGG, "AN INTRODUCTION TO CRYSTAL STRUCTURE" (G. BELL & SONS)

FIG. 11.—LAUE PHOTOGRAPH OF: (A) ROCK SALT, (B) BERYL

elements of the inert gas group have stable outer shells with 8 electrons. The other elements tend to fall into two groups. Those with one, two, or rarely up to four or five electrons more than the next lower stable grouping are the metals. They all tend to ionize, that is, to lose these spare electrons and assume a more stable configuration, acquiring a positive charge as a result; thus a sodium atom with eleven electrons loses one readily to become a singly charged sodium ion Na^+, with ten electrons in the configuration of the rare gas neon. The non-metallic type of atom is, on the other hand, one, two or three electrons short of the number required to

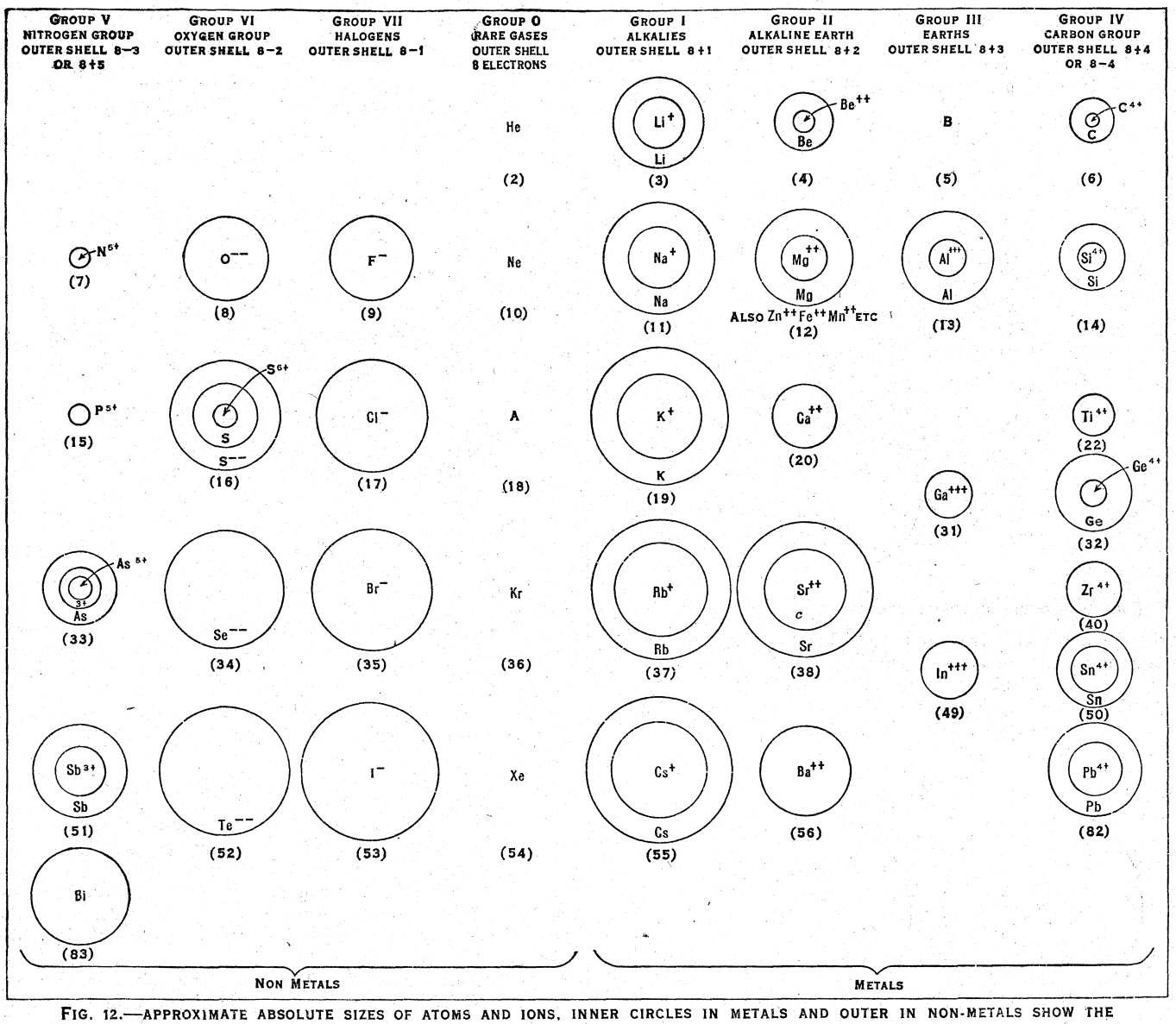


FIG. 12.—APPROXIMATE ABSOLUTE SIZES OF ATOMS AND IONS. INNER CIRCLES IN METALS AND OUTER IN NON-METALS SHOW THE IONIC STATE; NUMBERS IN () ARE ATOMIC NUMBERS (SCALE 50,000,000:1)

form the next stable configuration and tends to take up extra electrons to complete the shell, acquiring a negative charge in the process.

Isolated atoms and ions only exist at temperatures and pressures such as we find in stars and vacuum tubes. Under normal conditions they are always found combined. We know four such types of combination. These are called the heteropolar or ionic, the homopolar, the molecular and the metallic.

Ionic Combination.—Two ions such as Na^+ and Cl^- will attract each other with a force $\frac{e^2}{r^2}$ where r is the distance between them, and there will be an equilibrium when this force balances the repulsive force existing between their outer shells at close quarters. It is this repulsive force that gives the atoms their finite size. It is also electrical in origin but much more complex and expressible in such terms as $-\frac{c}{r^9}$. In the presence, however, of more Na^+ and Cl^- ions, it is easy to see that $\overset{+}{Na}\overset{-}{Cl}$ will become

$$\overset{+}{Na}\overset{-}{Cl} \quad \overset{-}{Cl}\overset{+}{Na} \qquad \text{and then} \qquad \overset{+}{Na}\overset{-}{Cl}\overset{+}{Na} \quad \overset{-}{Cl}\overset{+}{Na}\overset{-}{Cl} \quad \overset{+}{Na}\overset{-}{Cl}\overset{+}{Na}$$

and so on in three dimensions, each positive ion being surrounded by as many negative ions as possible and building up a crystal of rock salt (*see* fig. 13). Ions are of very different sizes (*see* fig. 12) and when a small, highly charged positive ion such as Be^{++} is close to a large, diffuse ion S^{--}, it not only attracts it but distorts its structure, attracting the electron shell and repelling the nucleus. This is called polarisation. Polarisation is particularly effective when the negative ion is unsymmetrically surrounded by positives, as in layer lattices (*see* fig. 29). A polarised heteropolar attraction can in this way build up a complex ion, such as $(Mg^{++}O_4^{--})^{6-}$.

Homopolar Combination.—In homopolar combination, two or more atoms with incomplete electron shells make up for their lack of stability by sharing electrons, thus achieving a completeness of outer shell for the combination which cannot exist for the individual. The simplest case is hydrogen. Individual hydrogen atoms, each with its one electron, are highly reactive because a one quantum shell is complete with two electrons, as in helium. Consequently two hydrogen atoms H combine to form the stable hydrogen molecule H_2, which spectrally and in many other ways resembles helium. In a similar way, by the sharing of a balanced pair of electrons, are formed the diatomic molecules F_2, O_2, N_2 of the non-metallic elements. An atom can share electrons with more than one other atom. Oxygen sharing electrons with two hydrogens forms the unsymmetrical water molecule $H\diagup O \diagdown H$, or carbon and two oxygens to form the symmetrical carbon diox-

ide O-C-O. The process, which can be extended indefinitely to form more and more complicated molecules, particularly those of organic chemistry (where the carbon atom possessing four two-electron bonds [co-valencies in modern chemical terms] which

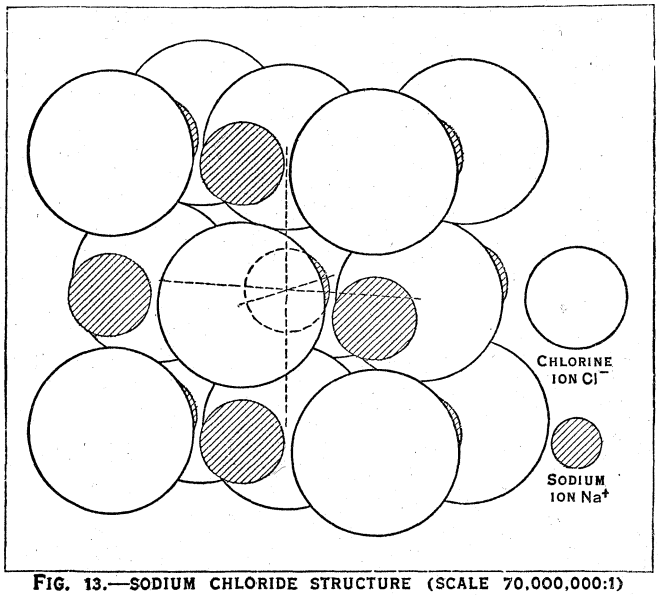


FIG. 13.—SODIUM CHLORIDE STRUCTURE (SCALE 70,000,000:1)

bring its outer shell from four to eight electrons) enables long chains of atoms to be formed as in the paraffins, or rings as in benzene derivatives. This reaches its ultimate limit when the linking is extended indefinitely in all directions and results, not in forming a molecule, but a crystal such as diamond (*see* fig. 23), which may

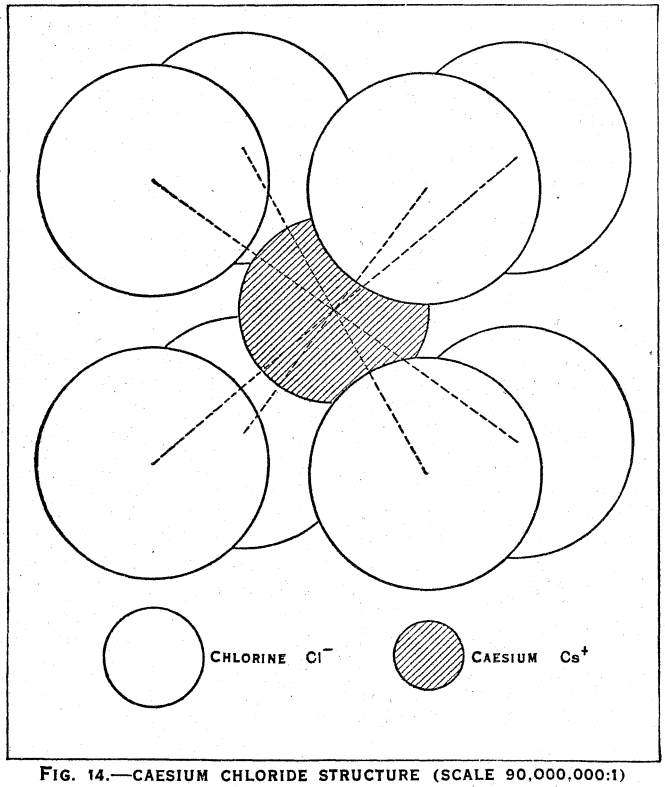


FIG. 14.—CAESIUM CHLORIDE STRUCTURE (SCALE 90,000,000:1)

be considered as one solid molecule. But homopolar bonds can also build up complex ions, such as the ammonium ion NH_4^+ with its ten electrons, which has the same relation to the neutral molecule CH_4 as the sodium ion Na^+ has to neon; or the series of negative ions ClO_4, SO_4, PO_4 and SiO_4.

Molecular Combination.—Between electrically neutral atoms and molecules which also have completed outer shells, there still exists a type of residual attraction which may be called molecular. In the simplest case of an inert gas atom, this residual attraction is only effective at very close distances and consequently, except at the lowest temperatures, the substance remains a gas. But at such temperatures it solidifies in a state of equilibrium between the attractive and repulsive forces, both probably due to distortions in the electronic structure. Very similar is the attraction

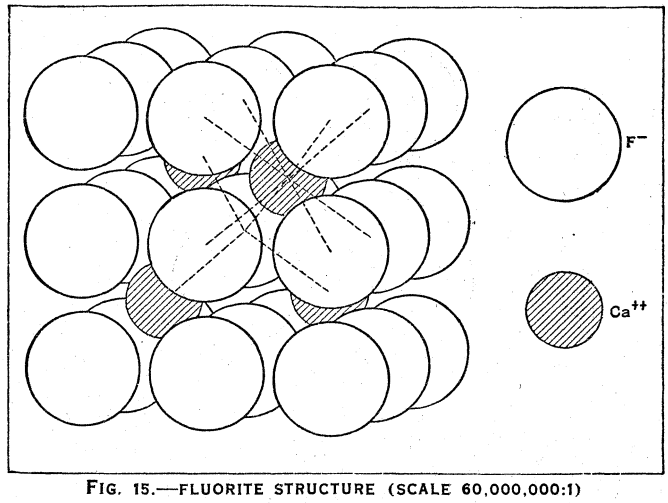


FIG. 15.—FLUORITE STRUCTURE (SCALE 60,000,000:1)

between non-polar molecules such as O_2 which also tend to have low melting points, but when a molecule is polar, that is, acts as an electric dipole or multipole, these poles attract others of opposite sign, with forces approaching those of ionic crystals.

Metallic Combination.—Metallic combination occurs when all the atoms tend easily to lose electrons. The positive ions thus formed cohere together, held by the electron gas, produced from the discarded electrons now no longer bound to particular atoms.

It is from such knowledge of the units of crystal structure, that is, atoms, simple and complex ions and molecules, and of the kind of forces holding them together, that we can see the physico-chemical meanings of the crystal structures which are found by the quite independent means of X-rays. But the process is two-sided. At the same time we learn from the structure much of the chemical and physical properties of atoms inaccessible by other methods.

Crystallised substances, that is to say, all solids with the exception of the glasses, may be divided into four main classes: the

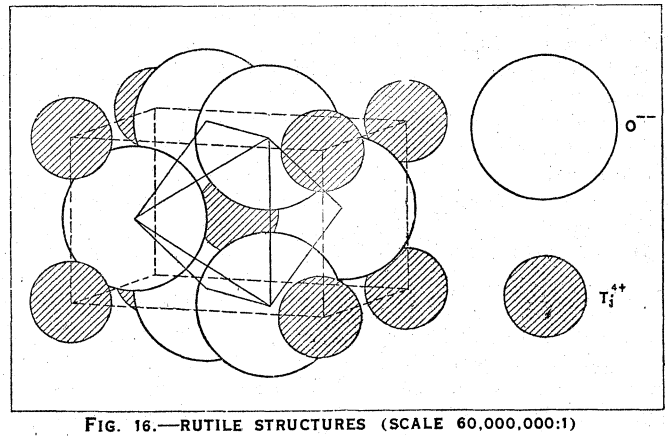


FIG. 16.—RUTILE STRUCTURES (SCALE 60,000,000:1)

ionic, the adamantine, the molecular and the metallic; and three prominent intermediate classes: the silicates, the layer lattices and the metalloids. The leading properties of these classes are shown in Table I.

Ionic Crystals.—These have been more studied than any of the other classes because the simple Coulomb electrical forces holding them together lead to simpler structures, of which it is sometimes possible to give a quantitative explanation. The first law of formation for ionic crystals was stated by Goldschmidt as follows:

Crystal type	Crystal units	Type of binding	Characteristic properties				Typical Crystals
			Optical	Electrical	Thermal	Mechanical	
Ionic	Simple and complex ions	Electrical attraction between ions of opposite signs, weak to moderate polarisation	Transparent, absorption: in visible (colour) if present is due to atoms; in short infra red is due to complexions; in long infra red is due to crystal lattice. Refractivity due to negative ions	Moderate insulators, in high fields conduct by transfer of ions. When polarisation is slight they dissolve with ionisation in ionising solvents (water); when stronger they are insoluble	Fairly high melting point, ionisation occurs in liquid and vapour	Hardness increasing with higher ionisation Tendency to fracture by cleavage	NaCl fig. (13) CaF_2 (15) $CaCO_3$ (21) K_2SO_4 $(NH_4)_2PtCl_6$ (20)
Silicate	O^{--} or F^- ions Si^{4+} or Be^{2+} or Al^{3+} and other positive ions				Very high melting points, glasses formed on cooling of melt	Very hard with tendency to cleave or fracture conchoidally	Olivine Mg_2SiO_4 (22) Cyanite Al_2SiO_5 Garnet $R''_3\,R'''_2Si_3O_{12}$ Spinel Al_2MgO_4 Corundum Al_2O_3
Adamantine	Atoms of the fourth group and groups on either side of it	Homopolar bonds throughout or strongly polarized ionic binding	Transparent with high refractivity or opaque metalloidal	Diamond is a perfect insulator. The others conduct metalloidally Very insoluble	Very high melting points with tendency to vapourise except in more metalloidal	Very hard Hardness less for metalloidal types	Diamond C (23) Zinc Blende ZnS Wurtzite ZnS (24) Carborundum CSi
Molecular	Inert gas atoms Non polar and polar molecules	Van der Waal's forces or residual electric fields between molecular poles	Transparent optical properties due to molecules and similar to gas and liquid phases	Insulators except when very polar; soluble in non-ionising (molecular) solvents except when polar	Melting point very low with neutral atoms, rises with heavier molecules and polar molecules	Very soft, hardness increasing with polarity of molecules. Deformation plastic	Argon A (31) CO_2 (25) Ice H_2O (18) Paraffins C_nH_{2n+2} (26) Calomel Hg_2Cl_2 (27)
Layer	Strongly polarising and easily polarised ions	In layers. Homopolar or polarised ionic Between layers Molecular	As Adamantine	Various. Similar both to molecular and adamantine	Various. Similar both to molecular and adamantine	Cleaving readily in layers which are soft and flexible	Graphite C (28) CdI_2 (29)
Metallic	Positive ions and electron gas	Electrical attraction between positive ions and electron gas?	Opaque (due to free electrons) with selective reflection in infra red	Conductors conductivity inversely proportional to number of free electrons Soluble in acids where H^+ ions absorb free electrons	Moderate to very high melting points. Long liquid interval	Moderate hardness increased by alloying. Elastic but yield by glide plane slipping when overstressed	Copper, Iron (30) Iron, Sodium (31) Zinc (32)
Metalloidal	Metal atoms and atoms of the sulphur and arsenic type	Mixture of homopolar ionic and metallic binding	Opaque metallic or transparent with high refractivity and colour	Medium to bad conductors Soluble only with decomposition	Tendency to vapourise or decompose at high temperatures	Moderately hard to soft. Properties a mixture of those of other types	Nickel Arsenide NiAs Fahlerz R''_2SbS_3 Pyrites FeS_2 (33)

"The crystal structure of a substance is determined by the size and polarisation properties of its components, which may be atoms, ions or atomic groups."

The size of an ion is, after its charge, its most important property. It varies very greatly for different ions. In fig. 12 is shown the size of a number of ions and atoms which illustrates their dependence on atomic number and charge. It can be seen that the size of a positive ion in the same group increases with the atomic number, while in the same series for positive ions, it decreases markedly with increasing charge, which acts by tightening the whole structure. But in negative ions, the increased size due to the repulsion of the extra electrons is counteracted by the greater fields they find themselves in, and consequently doubly charged negative ions are never greater than and sometimes smaller than singly charged. The way in which the increased charge tightens the structure is shown by the fact that in KCl, where both ions have eighteen electrons, the interatomic distance is 3·14 A; whereas in CaS, also with eighteen electrons each, but with quadruple electrostatic force, the corresponding distance has shrunk to 2·84 A.

The way in which atomic diameter influences structure can be seen from the simplest ionic structure of the type AX, with equal numbers of ions of opposite signs. The simplest of these is the structure of rock salt (*see* fig. 13), where sodium and chlorine ions occupy alternate corners of a cubic lattice. The co-ordination number is 6:6, that is, each sodium has six chlorine neighbours and vice versa. Actually, the chlorine ions are so large compared to the sodium that they form an octahedron that encloses it almost completely. Simple geometry shows that this can only be the case if R_A (radius of positive ion) : R_X (radius of negative ion) $< \cdot 73$. This relation holds for all halides of the alkaline metals with the exception of the chloride, bromide and iodide of caesium where the ratios $R_A:R_X$ are ·91, ·84 and ·75 respectively. Now these last three are the only alkaline halides which do not belong to the sodium chloride type but to the caesium chloride type. (*See* fig. 14.) Here the co-ordination number is 8:8 and there is, so to speak, more room for the larger caesium ion inside the cube of chlorine ions. Where $R_A:R_X$ is very small, the factor of polarisation comes in, and the structure becomes adamantine or molecular.

If we pass to the next simpler series, AX_2, a similar situation occurs. Where $R_A:R_X$ is greater than ·73, the structure is of the fluorite type. (*See* fig. 15.) Here the co-ordination number is 8:4, the calcium ions being surrounded by a cube of eight fluorine ions, just as the caesium by the chlorines. A great number of compounds belong to this type, which includes the chlorides of the alkaline earths and the oxides of zirconium, thorium and uranium. If $R_A:R_X$ lies between ·73 and ·41, a structure is formed

analogous to rock salt. This is the rutile structure. (*See* fig. 16.) Here the co-ordination number 6:3 cannot be satisfied in the cubic system and the octahedron of oxygen ions is placed on its

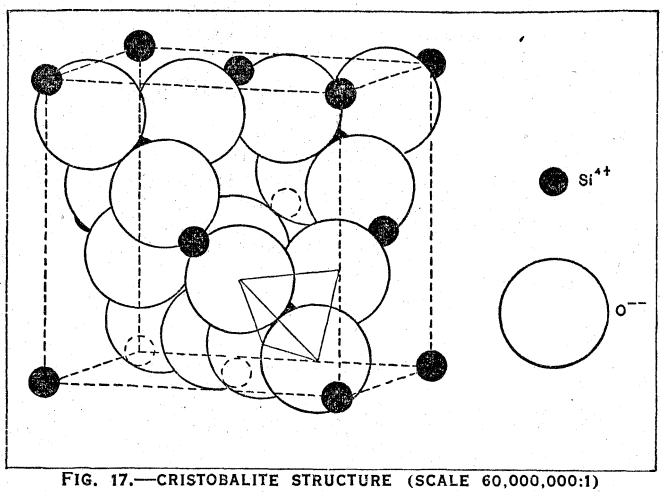


FIG. 17.—CRISTOBALITE STRUCTURE (SCALE 60,000,000:1)

side in a tetragonal structure. The two other forms of TiO_2, anatase and brookite, are also built with the same co-ordination but with the octahedra distorted and differently placed. A great number of substances belong to the rutile structure. The fluorides

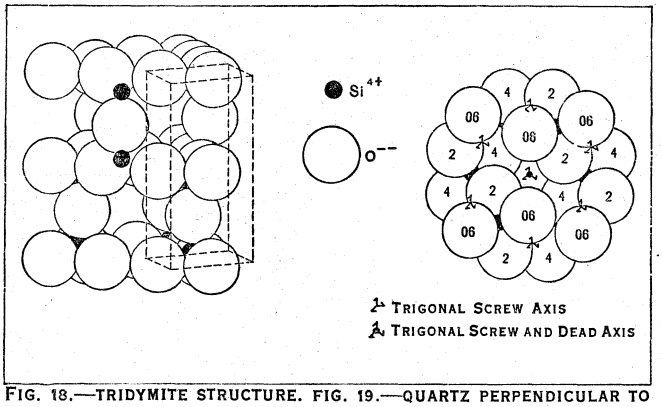


FIG. 18.—TRIDYMITE STRUCTURE. FIG. 19.—QUARTZ PERPENDICULAR TO THE TRIGONAL AXIS THE NUMBERS 0246 FOR THE O^{--} ATOMS AND 135 FOR THE Si^{4} ATOMS REFER TO DEPTHS BELOW PLANE OF PAPER (SCALE 30,000,000:1)

of Mg., Mn., Co., Fe., Ni., Zn. and the dioxides of Mn., Mo., Sn., W. and Pb., as well as several others.

When $R_A:R_X$ lies between ·41 and ·22, the co-ordination number is 4:2, which is approaching an adamantine structure. This is the

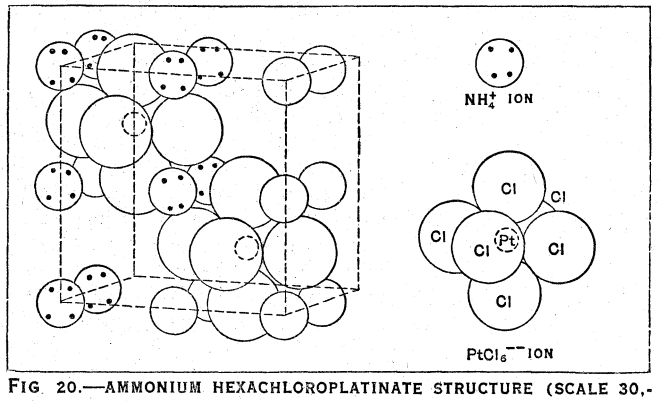


FIG. 20.—AMMONIUM HEXACHLOROPLATINATE STRUCTURE (SCALE 30,000,000:1)

case for the different forms of silica, SiO_2, Cristobalite, Tridymite and Quartz. These are shown in figs. 17, 18 and 19. Though apparently different, these structures have the essential point in common that they are built from silicon ions completely surrounded by four oxygens in a tetrahedron. Each oxygen is shared between two tetrahedra and the different forms of structure are merely due to different arrangements of these tetrahedra. Thus the polymorphism of silica is not due to any change in the molecule.

So far we have dealt only with crystals with simple ions, but those with complex ions are essentially similar. When the ion is

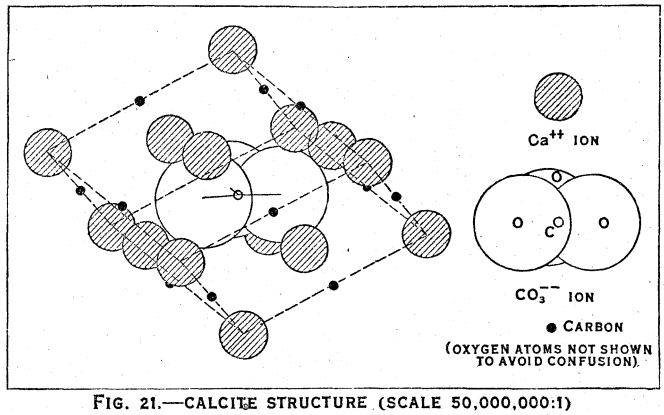


FIG. 21.—CALCITE STRUCTURE (SCALE 50,000,000:1)

approximately spherical, as is ammonium NH_4^+, or highly symmetrical as $Ni(NH_3)_6^{++}$,$PtCl_6^{--}$ it can take its place in a crystal exactly like a simple ion of the same size. Ammonium, NH_4^+, is practically indistinguishable in its compounds from Rb^+. Such

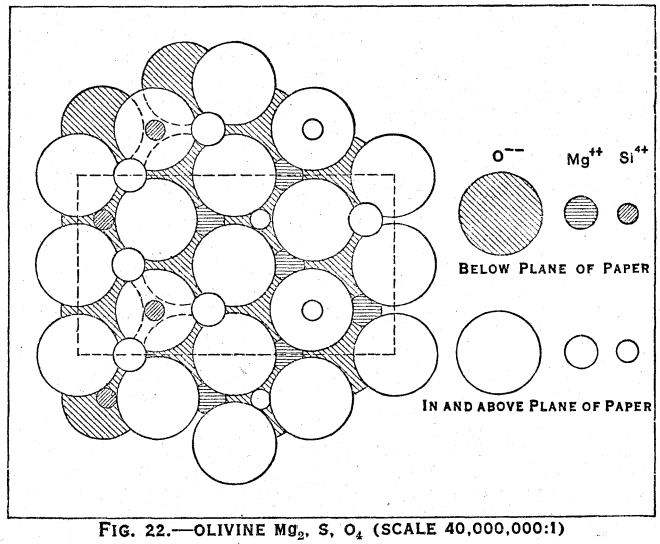


FIG. 22.—OLIVINE Mg_2, S, O_4 (SCALE 40,000,000:1)

a compound as $(NH_4)_2$ $(PtCl_6)$ (*see* fig. 20) is, except for its larger size, essentially the same as fluorite. When the compound ion is not nearly spherical, loss of symmetry results. In the case of calcite (*see* fig. 21), for instance, the ions are arranged very much as in rock salt, but owing to the flatness of the CO_3^{--} ion, one trigonal axis is shortened, leading to a rhombohedral crystal. A number of crystals, such as $FeCO_3$ and $NaNO_3$, belong to the calcite class. With ions of the type BX_4, such as BF_4^-, ClO_4^-, SO_4^{--}, PO_4^{---}, the structures are of even lower symmetry, though in all of these the tetrahedral arrangement of oxygen atoms is maintained.

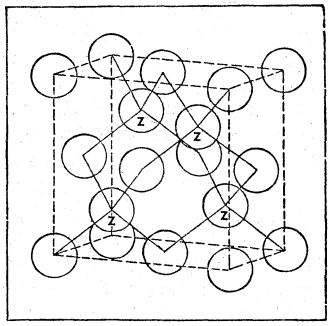


FIG. 23.—DIAMOND STRUCTURE; IF ATOMS MARKED Z ARE REPLACED BY ZINC AND THE REMAINING BY SULPHUR, ZINCBLENDE STRUCTURE IS GIVEN (SCALE 50,000,000:1)

Silicates.—There are a great number of ionic crystals which are neither of the simple ionic or complex ionic types, which may be grouped together as a silicate type, though not all contain silicon. The structure of the silicates are complex but, as W. L. Bragg has shown, they consist essentially of oxygen ions in a close-packed arrangement, either cubic or hexagonal (*See* figs.

31 and 33.) These ions are held together by strongly charged metallic ions, which occupy the spaces between them. In the tetrahedral spaces are found the smallest and most highly charged ions Si^{4+} Be^{++}. In the octahedral spaces larger ions with smaller charges, such as Ti_4^+, Al^{3+}, Mg^{++}, Fe^{++}. Still larger ions, such as Ca^{++} Na^+ or K^+, introduce distortions into the structure. The

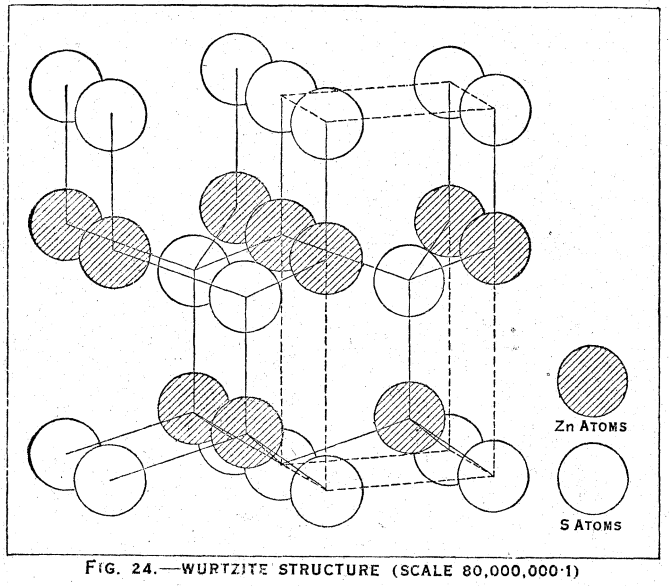


FIG. 24.—WURTZITE STRUCTURE (SCALE 80,000,000·1)

symmetry of the silicates adjusts itself to fit these ions with the minimum distortion, which leads to large and complicated cells, generally of low symmetry. One of the simplest of these olivine Mg_2SiO_4 is shown in fig. 22. Other silicates of known structure include cyanite Al_2SiO_5, phenacite Be_2SiO_4, beryl $Be_3Al_2Si_6O_{18}$ and

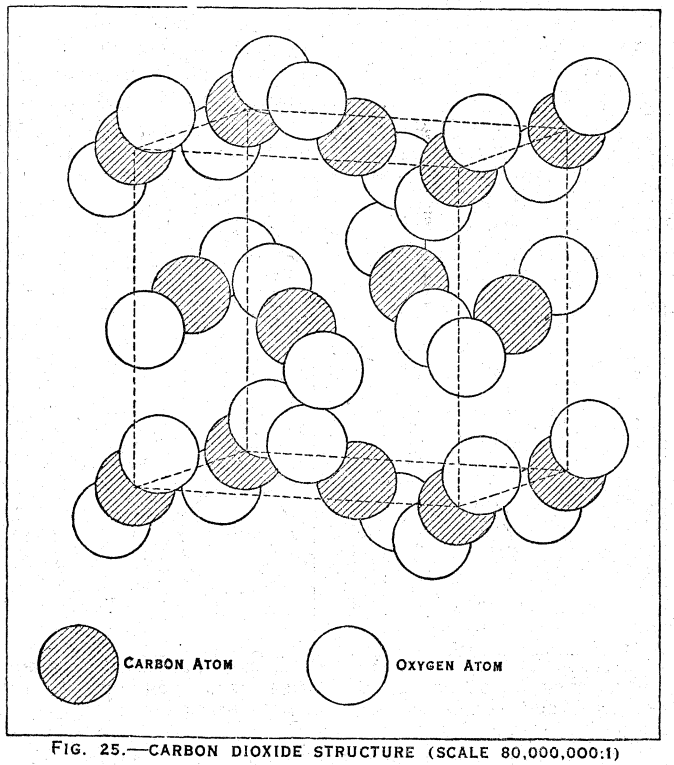


FIG. 25.—CARBON DIOXIDE STRUCTURE (SCALE 80,000,000:1)

the garnets $R_3''R_2'''$ Si_3O_{12}. Two non-silicate types are also built from close-packed oxygens, the corundum type Al_2O_3, including haematite Fe_2O_3 and $MgTiO_3$, and the spinel type Al_2MgO_4, including magnetite Fe_2FeO_4 and Ag_2MoO_4.

Adamantine Crystals.—In adamantine crystals the forces binding the whole crystal together are homopolar, so it may be considered that they are single molecules. The typical adamantine crystal is the diamond. (*See* fig. 23.) Here each carbon is joined to four others (co-ordination 4:4) by a homopolar electron sharing bond in a tetrahedral fashion, alternate tetrahedra pointing in opposite directions. If we replace alternate carbon atoms with zinc and sulphur, we arrive at the zinc blende structure, which is typical for adamantine compounds. Such compounds are chiefly found in the fourth group of the periodic table and in compounds between elements of the neighbouring groups on either side. For instance, we have

Compound	GeGe	GaAs	ZnSe	CuBr	
Atomic Numbers	32 32	31 33	30 34	29 35	
Interatomic dist.	2.43	2.435	2.45	2.46	A

all with diamond structure. It should be noticed that here, unlike the case of KCl and CaS, there is little change in interatomic distance. Another 4:4 is represented by Wurtzite (*see* fig. 24), the other form of zinc sulphide. The relations and the distances of neighbouring atoms are the same in both cases, but in Wurtzite, the symmetry is hexagonal instead of cubic. The three forms of carborundum represent a compound diamond-Wurtzite structure.

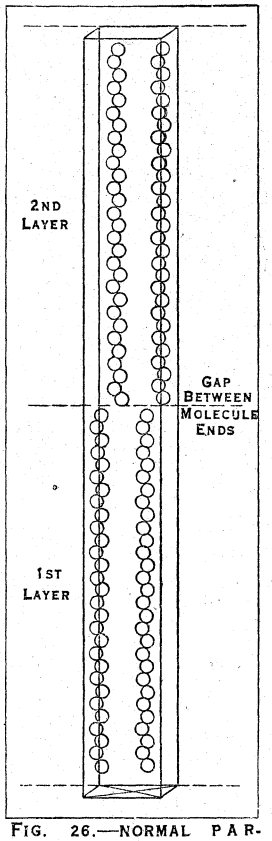


FIG. 26.—NORMAL PARAFFIN STRUCTURE (ONLY C ATOMS SHOWN) (SCALE 14,000,000:1)

Molecular Crystals.—In molecular crystals, the units of structure are neutral atoms or molecules, and as the forces are so much weaker, the determining factor is the shape of the molecules. The most ideally simple cases are the crystals of the inert gases, which are cubic close-packed. (*See* fig. 30.) The similar structures are found for symmetrical molecules such as CH_4, SnI_4 and more or less distorted for molecules N_2, O_2, I_2, NH_3 or CO_2 (*see* fig. 25), none of which are strongly polar. Another simple case is when the molecules are long, straight structures, such as those of the paraffins. (Fig. 26). Here they lie together like bundles of sticks, forming loosely connected layers. A study of compounds with benzene rings: benzene, naphthalene, hexamethylbenzene, shows that this ring of carbon atoms has a real existence and is probably plane, while studies of structures with quadruply substituted carbon atoms as tetraphenyl methane shows that the carbon bonds are arranged almost tetrahedrally.

If a molecule possesses unbalanced electrical poles, these arrange themselves in the crystal so as to neutralize each other as much as possible, either by polymerising or forming pseudionic crystals; thus ice formed from the strongly polar $_+H\diagup\overline{\underline{O}}\diagdown H_+$ has tridymite structure (*see* fig. 18), in which each oxygen is surrounded by four hydrogens, or calomel $\overset{-}{Cl}\overset{+}{Hg}\overset{+}{Hg}\overset{-}{Cl}$ (*see* fig. 27), in which the mercury atoms are surrounded by chlorines.

Layer Crystals.—A small but very interesting class are the layer crystals, in which the forces binding the atom extend only in two dimensions, forming large sheets which are held together by weaker molecular forces. The typical layer lattice is that of graphite. (*See* fig. 28.) Here the sheets are hexagons of carbon atoms, bound together in 3:3 co-ordination, 1·42 A, apart while the layers bound molecularly are 3·4 A apart. Another example is cadmium iodide. Here the polarisation of the large iodide ions prevents the normal ionic fluorite structure. To this type belong the hydroxides $Ca(OH)_2Mg(OH)_2$ and the sulphides ZrS_2, SnS_2.

Metals.—Metallic crystals differ from the previous classes by the presence of free electrons, the attraction between which and the positive ions gives the structure its stability. The basis of the

structure of pure metals and alloys is one of close packing, but the radii of atoms in metals are much greater than those of the corresponding ions in ionic crystals. (*See* fig. 12.) The pure metals have very simple structures: face centred cubic for Cu, Al, Feγ(*see* fig. 30); body centred cubic for Na, Feα, Feδ (*see* fig. 31) and close packed hexagonal cubic for Mg, Zn, W (*see* fig. 32). Several metals have phases with different structure. Iron, for instance, between the temperatures 1100° and 1425°, has a face centred cubic structure. Both above and below this temperature, its structure is body centred. Manganese has two forms with very complicated cubic structures, and tin, at low temperatures (grey tin) is like diamond, while at ordinary temperatures (white tin) it has a distorted diamond structure.

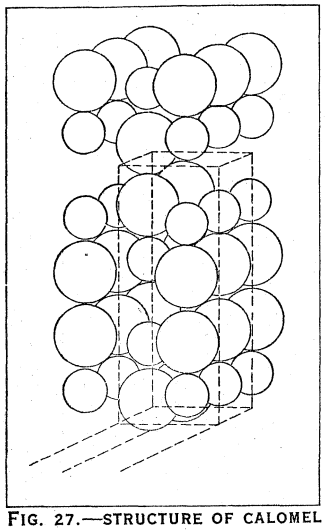


FIG. 27.—STRUCTURE OF CALOMEL Hg_2 Cl_2 (SEE FIG. 1) (SCALE 30,000,000:1)

Our knowledge of the real constitution of alloys is immensely furthered by X-rays. They are essentially of two types, solid solutions and compounds. In solid solutions, the atoms of one metal are replaced by another, distributed by chance throughout its structure. This is shown by an X-ray pattern similar to the pure metal but with a different size of cell. In inter-metallic compounds on the other hand, the atoms of the different metals have definite positions similar to those in ionic compounds, such as CuZn, which is like CsCl but usually more complicated, with a tendency to large cells of high symmetry. δ Bronze $Cu_{31}Sn_8$, for instance, has a cell of side 17·9 A. and 416 atoms. The laws of combination in metallic compounds are quite different from those of ordinary chemistry, but seem to depend on electron numbers.

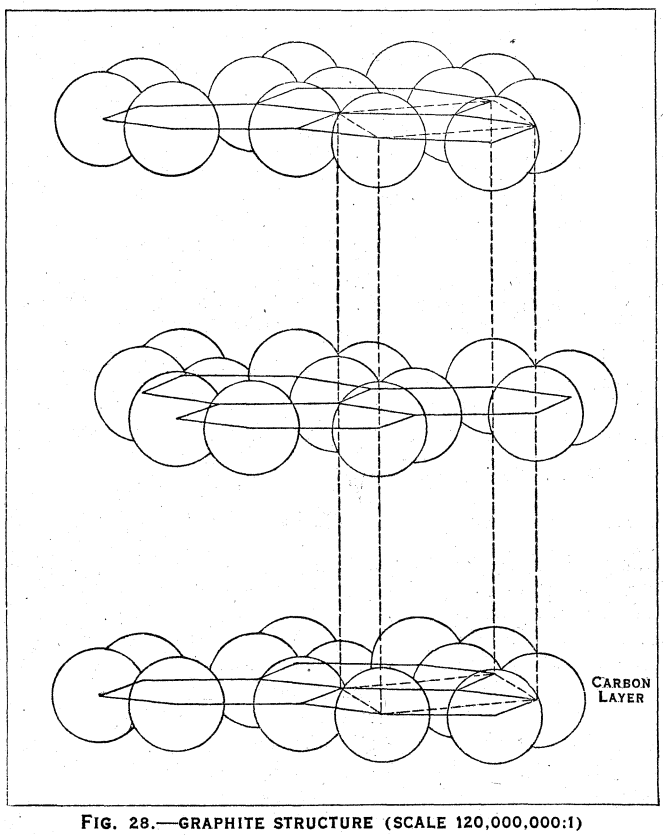


FIG. 28.—GRAPHITE STRUCTURE (SCALE 120,000,000:1)

Metalloidal Crystals.—There are a number of substances which show resemblances to both metallic, adamantine and ionic crystals. They may be roughly classed together as metalloidal These include the semi-metals Se, Te, As, Sb, Bi and a great number of simple and complex arsenides, antimonides, sulphides, selenides, etc. They resemble the metals in having free or loosely bound electrons, which makes them in a lesser degree opaque and conducting, and also by the complexity and indefinite composition of many compounds such as the fahlerz group, which contain Cu, Ag, Hg, Pb, Fe, As, Sb+S, in varying proportions The structures, however, are much less close-packed and resemble adamantine structures. Some, however, are more like ionic structures. Typical are pyrites (*see* fig. 33), which is a rock salt structure with Fe^{++} in the place of Na^+ and the complex ion S_2^{--} in that of Cl^-. Another is the nickel arsenide structure, hexagonal with 6:6 co-ordination, to which many substances belong.

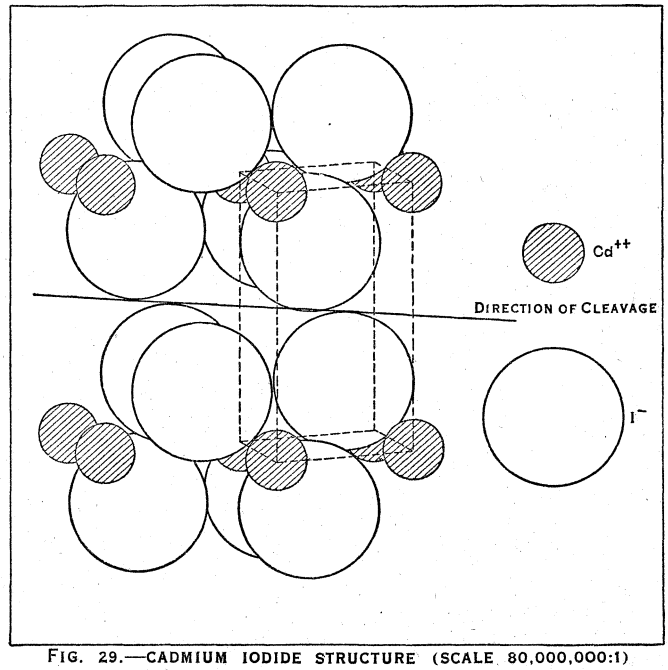


FIG. 29.—CADMIUM IODIDE STRUCTURE (SCALE 80,000,000:1)

Technical Applications.—This completes the systematic account of the structures of crystals, but X-rays have proved useful, not only in determining the positions of atoms in crystals, but of the arrangement of minute crystals in materials. It is possible by means of X-rays to find the position of the crystal axes of crystals far too small to be seen microscopically and to study their arrangement in relation to the properties of the material. This has been done in textiles, ceramics and metals.

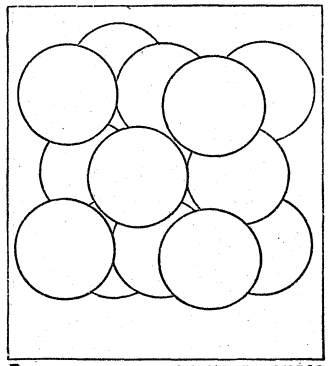


FIG. 30.—FACE CENTRED CUBIC STRUCTURE OF γ IRON AND COPPER AND OF ARGON (SCALE 60,000,000:1)

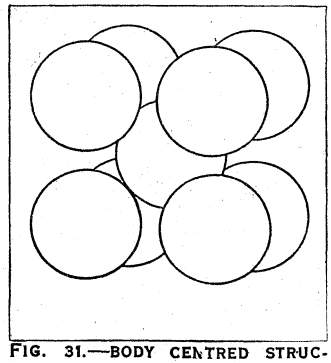


FIG. 31.—BODY CENTRED STRUCTURE OF α IRON (OR SODIUM) (SCALE 60,000,000:1)

Apart from their hardness, the chief mechanical property of metals is that of neither fracturing nor cleaving when overstressed, but deforming by the slipping of atoms along the glide planes, with consequent increase in hardness. This enables metals to be successfully worked, rolled, drawn, etc. Pure metals form

glide planes very easily, but the presence of another metal in solid solution interferes with the regularity of the lattice and makes gliding much more difficult, thus increasing hardness. The effect of alloying is greater, the more highly charged the alloying ion. Carbon has more effect, for instance, on iron than the same amount of cobalt. A piece of metal when cast has its small crystals of which it is composed oriented at random towards each other. On rolling or drawing, the crystals are not only elongated but they tend to take up positions with some crystallographic axis in the direction of the rolling. This is shown on a Debye diagram by the splitting up of the uniform rings into patches indicative of these preferred directions. On heating a rolled or a drawn metal, it recrystallises and the random orientation of the particles is restored. But at the same time, the hardness is lost. The explanation of these processes of hardening and annealing is energetically sought, largely by X-ray methods, and this has led to important technical results. The practical importance of X-ray analysis has only begun to be felt. *See* also SPECTROSCOPY; X-RAY; X-RAYS, NATURE OF; CRYSTALLOGRAPHY; SOLID STATE, THEORY OF.

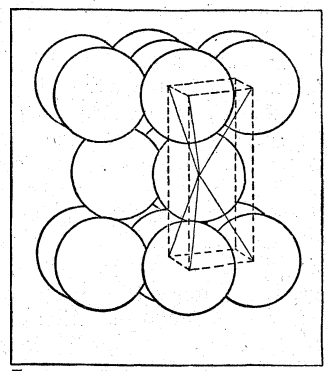


FIG. 32.—HEXAGONAL CLOSE PACKED STRUCTURE OF ZINC (SCALE 40,000,000:1)

BIBLIOGRAPHY.—*General:* Sir W. H. Bragg and W. L. Bragg, *X Rays and Crystal Structure* (1915, 4th ed. 1924); Sir W. H. Bragg, *An Introduction to Crystal Analysis* (1928); R. W. Wyckoff, *The Structure of Crystals* (1924); F. Rinne, *Crystals and the Fine Structure of Matter* (trans., 1924); P. P. Ewald, *Krystalle und Röntgenstrahlen* (1923); H. Mark, *Die Verwendung der Röntgenstrahlen in Chemie und Technik;* Maugin, *La Structure des Crystaux* (1924). *Structure Theory:* H. Hilton, *Mathematical Crystallography* (Oxford, 1903); Schoenflies, *Theorie der Krystallstructur* (Leipzig, 1925); P. Niggli, *Geometrisches Krystallographie des Discontinuums* (Leipzig, 1919); *Structurtheoretische Grundbegriffe;* Wiener Harms, *Handbuch der Experimentalische Physik,* Teil VII. (1), 1928. *Space Group Tables:* R. W. Wyckoff, *Analytical Theory of Space Groups* (Washington, 1922); W. T. Astbury and K. Yardley, *Philosophical Transactions of the Royal Society,* V. 224, p. 221. *Crystal Physics:* Born, *Atomtheorie des festen Zustandes* (1923); Born and Bollnof, Ewald and Grimm, *Handbuch der Physik,* Band XXIV. (1927); Joffe, *The Physics of Crystals* (1928). *Crystal Chemistry:* V. M. Goldschmidt, *Verteilungsgesetz der Elemente,* VII., VIII. (Oslo, 1927); P. P. Ewald und Hermann, *Zeitschrift fur Krystallographie,* "Structurbericht" 1913–1926 (Leipzig, 1927); Morse, *Bibliography of Crystal structure* (Chicago, 1928).

(J. D. BE.)

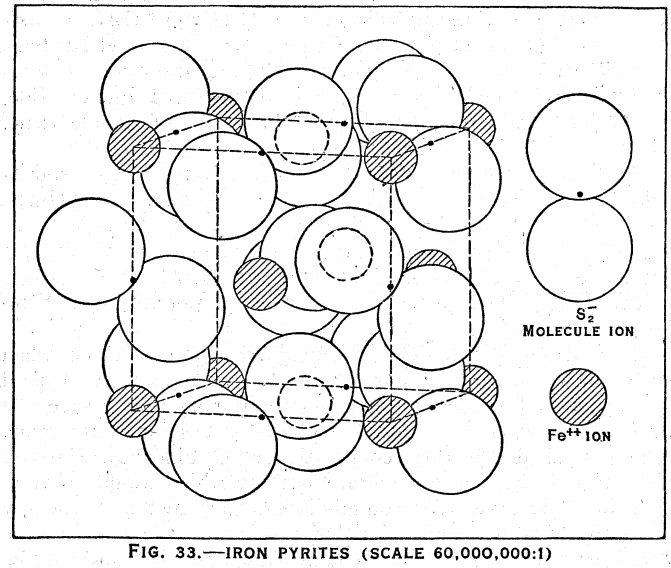


FIG. 33.—IRON PYRITES (SCALE 60,000,000:1)

X-RAY TREATMENT (*see* RADIOLOGY; RADIOTHERAPY). The X-rays are used extensively in medical treatment. They are valuable in many forms of skin disease, particularly those of a chronic character. They have a favourable influence upon enlargements of the lymphatic glands, of the spleen and of the thyroid gland. They give useful palliative effects in certain forms of malignant disease, and some permanent cures of cancerous conditions have been obtained by their use. In rodent ulcer, which presents features allied to cancer, there is no doubt of the efficacy of X-ray treatment for bringing about a complete cure in the majority of cases, provided that the disease has not advanced too deeply into the tissues.

The idea of using X-rays in the treatment of disease arose from recognition of the injurious effects which followed prolonged application of the rays for diagnostic purposes. Many early workers with X-rays noted the production of an inflammation of the skin, or a falling out of the hair over parts which had been subjected to X-rays, and Leopold Freund, of Vienna, has stated that his first attempts to utilize X-rays in treatment were made in 1896 to cure a hairy mole and were prompted by what he had read of such occurrences. A definite action of the rays upon the skin having been observed, their employment in the treatment of skin diseases followed as a natural corollary. Amongst the earliest investigators of the possible therapeutic effects of X-rays the names of Schiff, Freund, Kienböck, Holtzknecht, Sjögren and Stenbeck may be mentioned. In Great Britain C. R. C. Lyster, Sir Malcolm Morris, E. Dore and J. H. Sequeira were amongst the earliest investigators.

Therapeutic Dosage.—For operating successfully with an agent capable of producing decidedly harmful effects when given in large doses it is necessary to have a method of measurement, and the need for this quickly became apparent when X-rays were used for treatment. The results of X-ray photography had already shown that the tubes employed were capable of emitting radiations of varying powers of penetration, and that the tubes were by no means constant in this respect; and the question whether highly penetrating rays or rays of feeble penetration were to be preferred for therapeutic use became the subject of much discussion. It is now recognized that the choice depends upon the object of the treatment. So too the problem of measuring the quantity of rays emitted by a tube during a given time began to call for a solution. In 1901 Benoist designed an apparatus by which the quality of the rays emitted by a tube at any moment could be determined, and in 1902 Holtzknecht brought out the first quantitative device, a chromo-radiometer, which enabled the dose administered to a patient to be observed, and recorded for future guidance. Holtzknecht also drew up a scale of units by means of which the indications of his apparatus could be interpreted. The units of Holtzknecht are still used to express the dosage of X-rays, though his apparatus has been superseded. Holtzknecht's method of measurement consisted in observing the change of colour in certain pastilles when exposed to X-rays, and his apparatus consisted of a scale of tints, and a number of pastilles of a yellow tint which acquired a green colour during exposure. The composition of these was kept a secret, but analysis revealed in them the presence of potassium sulphate combined with celluloid or gelatine. The pastilles were laid upon the surface under treatment, and their change of colour was compared at intervals with the scale of standard tints.

Quantitative Measurement.—It was next thought that under suitable conditions the measurement of the current passing through the X-ray tube might serve as a guide to the quantity of X-rays emitted by the tube, but, although this is the case to a certain extent, the method of quantity measurement employed almost universally in X-ray treatment was that devised by Sabouraud and Noiré, and used with signal success by them in an enormous number of cases of ringworm, in which disease measurement of dose is of the most critical importance, for the following reason. The cure of ringworm by X-rays requires that all the hair of the affected region shall be caused to fall out, but, nevertheless, it is necessary for obvious reasons that the hair should grow again after the disease has disappeared. Now if the dose of X-rays be insufficient the hair does not come out and no cure results, while if the dose be too great the hair comes out but does not grow again; and the margin of safety is quite a narrow

one. The method of Sabouraud and Noiré which proved itself reliable for such critical measurements of dosage as are required for ringworm treatment, has to-day the universal acceptance of all X-ray workers for other forms of superficial X-ray treatment, although the use of their pastilles has certain disadvantages, notably that they react ill to highly penetrating or "hard" rays.

Sabouraud's pastilles consist of small disks of platino-cyanide of barium. This chemical compound has a bright yellow-green colour when freshly prepared, and changes through gradations of yellow to a brown colour when exposed to X-rays. The pastilles are supplied in a book with which a permanent tint of colour is supplied, to indicate the colour change in the pastille which corresponds with a quantity of X-rays equal to the maximum dose which the healthy skin will stand without inflammatory consequences. This is often spoken of as a "pastille dose." As the amount of irradiation needed to produce the change of colour is considerable, the salt is fixed, during the treatment, at a point halfway between the source of the rays and the skin surface under treatment. During an exposure the chemical salt, in the form of a small disk of the material on cardboard, is adjusted in the required position by means of a pastille holder, and it is examined at intervals during the course of the exposure, until it has reached the required tint. When in the holder the pastille must be protected from light, and should have a piece of metal as a backing.

In X-ray treatment some protection of the surrounding healthy parts is usually necessary. With this object various methods of shielding were devised, either covering the patient by impermeable materials, or enclosing the tube in an impermeable box with suitable windows for the passage of the pencil of rays which is to fall upon the part under treatment.

Effect on Tissues.—The effect of the rays on healthy tissues is in the main a destructive one, but some of the cells of the tissues are more sensitive to the rays than are others; and this permits of a selective effect being obtained, with the destruction of some cells and not of the whole tissue. Young cells, and actively growing cells, are the most susceptible, and for this reason it is possible to influence the glands of the skin and the papillae of the hairs with a dose which will not destroy the skin itself. The art of successful working with X-rays is based upon a careful adjustment of the dose so as to secure a selective destruction of the morbid elements, and to avoid wholesale damage to the part treated. The effects of excessive doses of X-rays is to produce an inflammation which may result in painful sores which obstinately refuse to heal for many weeks or months. In the case of "soft" rays a quantity up to double that of the usual maximum or pastille dose may be employed in urgent cases without risk of any serious inflammation. In the treatment of ringworm the exact pastille dose must not be exceeded or the fall of the hair is likely to be followed by permanent baldness.

The distance of the skin surface from the centre of the tube must be known, and the pastille arranged in place accordingly. Fifteen centimetres is a usual distance, and at this distance a tube working with a current of a milliampere should give the full therapeutic dose or "pastille dose" in about 15 minutes. In general X-ray treatment it is quite usual at the present time to proceed by the method of full doses at rather long intervals. From the experience obtained by Sabouraud in numerous cases of ringworm it has been found that a full dose must not be repeated until a month has elapsed.

Treatment of Abnormal Growths.—A great amount of work has been done with X-rays for the treatment of cancer, but it is now recognized that the X-rays do not cure a cancer, although they are of value for the relief of pain. Diminution of size in cancerous growths has frequently been observed, and in some instances sarcomatous tumours have completely disappeared under X-ray treatment. Sooner or later, however, the cancer or sarcoma returned either in the original site or elsewhere, and the patient died of the disease. How far the use of intensely hard X-rays produced by currents of some 150 KV, as in the Erlangen method of treating cancer, will prove effective, is doubtful.

X-ray treatment is of service for the treatment of enlarged "strumous" glands in the neck. When these glands are in the early stages, and there has not been any softening or breaking down of the gland tissue, the application of X-rays, a few times repeated in moderate doses, will determine the subsidence of the enlargement and may effect a complete cure.

In the massive glandular enlargements of lymphadenoma a great reduction of the tumours can be brought about by heavy doses of X-rays, but the results are to give a symptomatic rather than a real cure, for fresh glandular growths take place internally, and the usual course of the disease is not fundamentally modified

So too in leukemia, the symptom of excessive abundance of white cells in the circulating blood can be surprisingly altered for the better by X-rays, but generally without real cure of the underlying condition. The effect appears to be due to a direct destructive action upon the leucocytes of the blood.

The use of X-rays in fibroid tumours of the uterus has been advocated, particularly in France and in Germany. The action of the rays seems to be in part due to their influence upon the activity of the ovaries and in part to a direct effect upon the growing fibroids themselves, causing decrease of activity, relief of symptoms and reduction of the tumours. Not all varieties of fibroid are suitable for this kind of treatment. (H. L. J.)

XYLENE, the name given to certain hydrocarbons, the dimethylbenzenes, of which three forms exist with the same formula, $C_6H_4(CH_3)_2$ (*see* ISOMERISM); they occur in the light oil fraction of the coal tar distillate, but cannot be separated by fractional distillation owing to the closeness of their boiling points. The mixture can be separated by shaking with sulphuric acid, whereupon the ortho- and meta- compounds are sulphonated, the para- compound remaining unattached. The ortho and meta acids may be separated by crystallization of their salts or sulphonamides. The principal constituent of the light oil is *meta*-xylene, which is successively nitrated and reduced to commercial *m*-xylidine, (4-amino-1:3-xylene). From *para*-xylene a similar base, *p*-xylidine (2-amino-1:4-xylene), is prepared. Both xylidines are employed in colour making. *Keta*-xylene is also used in making artificial musk which is trinitro-*tert.*-butyl-*m*-xylene. (*See* PERFUMES.) Ortho-xylene is obtained from ortho-bromotoluene, methyl iodide and sodium as a colourless mobile liquid boiling at 142°, melting at −28°, and having a specific gravity of 0·8932 at 0°. Meta- or iso-xylene, the most important isomeride, has been obtained from Borneo petroleum (*see* TOLUENE), or by distilling with lime mesitylenic acid, $C_6H_3(CH_3)_2CO_2H$, an oxidation product of mesitylene, $C_6H_3(CH_3)_3$. Meta-xylene boils at 139°, melts at −54°, and has a specific gravity of 0·8812. Para-xylene obtained when camphor is distilled with zinc chloride, is best prepared from *para*-bromotoluene or dibromobenzene, methyl iodide and sodium.

The three xylenes are oxidized by nitric acid to the corresponding coluine acids. Further oxidation leads to ortho-, meta (iso)-, and para (tere)-phthalic acids. (*See* PHTHALIC ACIDS.)

XYLOPHONE, a small musical instrument, consisting of a graduated series of bars of wood, which are struck by a hammer.

XYSTUS, Greek term for the covered portico of a gymnasium.

X Y Z CORRESPONDENCE, the letters which when made public in 1798 nearly involved France and the United States in war. By orders of the French Directory fully a thousand U. S. vessels had been stopped on the high seas for examination. President Adams sent three commissioners, C. Pinckney, Marshall and Gerry, to France to negotiate a treaty which would do away with this annoyance. The commissioners were met in France by three agents who demanded a large sum of money before the Directory would receive the commission and also notified the commission that France would expect a loan from the United States if satisfaction of any other kind was to be given. The commissioners upon rejecting these overtures were ordered out of France. Their report was published at once in the United States and in it the French agents were labeled X, Y and Z, from which the correspondence took its name. The United States increased its army and navy, and hostilities were actually begun, when Talleyrand disavowed any connection with the agents and agreed to receive any minister the United States might send.

THE 25th letter of the modern alphabet dates only from Roman days in its present position. The Latin alphabet as adapted from the Chalcidic and Etruscan ended with X. The two final letters Y and Z were introduced after the conquest of Greece for use in Greek words transliterated and borrowed. Y was the form taken by the letter *upsilon* in the Ionic alphabet, which by the time of the Roman conquest had become generally used in Greece. The letter in the western or Chalcidic alphabet was in the form V in which form it had passed into Latin with the vocalic value of *u* and the consonantal value of modern English *w*. In the Greek *κοινή* based upon Attic the letter Y had the value of French *u* or German *ü*. This sound was unknown in the Latin language, and if pronounced in borrowed Greek words passed quickly into that of *i*.

In Old English and Middle English the letter was frequently used in place of *i*, e.g., in words such as *cyng*. In modern English its value is identical with that of *i* both long and short, its most frequent use being perhaps as final in the adverbial termination (e.g., *widely; strongly*). In addition it represents a palatal spirant most frequently when initial (*e.g.*, in words such as *yacht, yoke, young*). (B. F. C. A.)

YABLONOI or **YABLONOVOI** ("Apple Mountains"), known to the Mongols as *Dynze-Daban*, a range of the eastern part of Asiatic Russia. The range is really the eastern slope of a narrow north-northeast extension of the Malkan horst, which rises from eruptive rocks near Kiakhta. The Ingoda river flows along the foot of the range, which is 5,000–6,000 ft. above sea level, the highest point being Mount Sokhondo, near the Mongolian frontier. The descent of the Yablonoi to the trough of the Ingoda is 800 to 1,000 ft. and the slope is mainly rocky débris, with scattered patches of forest. The scarp cuts across the Archaean rocks, which strike to the east-northeast; all the horsts and ridges lying to the east of the Yablonoi are thus cut through by the Ingoda-Shilka valley, their waters flowing across the grain of the country in their course towards the Khingan range. The Yablonoi slope is part of the watershed between the Arctic-flowing and the Pacific-flowing streams and it also forms the boundary between the Siberian and the Daurian flora. The trans-Baikal railway crosses the range at 3,137 ft. above sea level.

YACHOW (YAAN, YACHOWFU), a city near the western borders of Szechwan, China, in 30° N., 103° E. Pop. about 30,000. It is situated on the banks of the river Ya, where tea is grown. The city is walled and is about 2 mi. in circumference. It is first mentioned during the Chow dynasty (1122–255 B.C.).

YACHT, a light and comparatively small vessel, propelled by sail or power and used for racing purposes or for pleasure exclusively. Boats propelled by oars or paddles are not considered as yachts. For sailing yachts *see* YACHTING. After the decade 1840–50, when steam began to replace sail in commercial vessels, this type of power, and later the internal combustion engine, was increasingly used in pleasure vessels. Large steam and power yachts were developed to a high degree and long-distance cruising became a favourite pastime of the rich. While the earliest power-driven yachts were paddle boats, this type of propulsion has been entirely abandoned in favour of the screw or propeller. In the transition from sail to power, steam auxiliaries carrying both sail and power were the fashion for many years. Steam engines were later replaced by the internal combustion engine and in the decade between 1930–40 practically all cruising yachts were auxiliaries, or else were strictly power yachts using gasoline or Diesel engines.

Among the early large auxiliary cruisers perhaps the highest development was reached in the "Valhalla," a ship-rigged auxiliary with triple expansion steam engines, built in 1892, of 1,490 tons Thames measurement. During the last decade of the 19th century there was a boom in the construction of large steam yachts, and conspicuous among these was the "Lysistrata" of 2,082 tons, and the "Mayflower" of 1,844 tons, which for a number of years was the official yacht of the president of the United States.

As internal combustion engines were developed they were built in increasingly larger sizes and good sized yachts were soon using them for power purposes. The development of the Diesel engine, using heavy oil for fuel, made great strides during World War I and in the decade that followed there was a boom in large power yacht building, which reached its climax about 1930 in the "Nourmahal" (1928), 1,969 tons, "Savarona" (1928), 2,076 tons, and "Orion" (1930), 3,097 tons. In the auxiliary fleet the largest yacht built during that period was the four-masted steel barque-rigged "Sea Cloud," of 2,323 tons, built in 1931.

The building of large power yachts began to decline after 1932. In the racing fleet the trend was toward classes of one-design sailing yachts not over 40 ft. in length; for cruising, auxiliaries of about 50 ft. became very popular, while in the straight power cruiser field, boats from 30 to 75 ft. in length were being turned out in ever increasing numbers. (H. L. ST.)

YACHTING, the sport of racing in yachts and also the pastime of cruising for pleasure in sailing, steam, or motor vessels. Yacht racing dates from the beginning of the 19th century; for, although there were sailing yachts long before, they were but few, and belonged exclusively to princes and other illustrious personages. During the reign of Elizabeth a pleasure ship was built (1588) at Cowes (Isle of Wight), so that the association of that place with the sport goes back a very long time. In 1660 Charles II was presented by the Dutch with a yacht named the "Mary," until which time the word "yacht" was unknown in England. He was fond of sailing, for he designed a yacht of 25 tons called the "Jamie," built at Lambeth in 1662, as well as several others later on. In that year the "Jamie" was matched for £100 against a small Dutch yacht, under the duke of York, from Greenwich to Gravesend and back, and beat her, the king steering part of the time—apparently the first record of a yacht match and of an amateur helmsman.

The first authentic record of a sailing club is in 1720, when the Cork Harbour Water club, now known as the Royal Cork Yacht club, was established in Ireland, but the yachts were small. Maitland, in his *History of London* (1739) mentions sailing and rowing on the Thames as among the amusements then indulged in; and Strutt, in his *Sports and Pastimes* (1801), says that the Cumberland society gave yearly a silver cup to be sailed for near London. The boats usually started from Blackfriars bridge, went up the Thames to Putney, and returned to Vauxhall, being no doubt mere sailing boats and not yachts or decked vessels. From the middle to the end of the 18th century yachting developed very slowly: although matches were sailed at Cowes as far back as 1780, very few yachts of any size, say 35 tons, existed in 1800 there or elsewhere. In 1812 the Royal Yacht squadron was established by 50 yacht owners at Cowes and was called the Yacht club, altered to the Royal Yacht club in 1820.

EARLY TYPES OF BRITISH YACHTS

Early English Yachts.—Among the earliest of which there is any record were the "Pearl," 95 tons, built by Sainty at Wyvenhoe near Colchester in 1820 for the marquess of Anglesey, and the "Arrow," 84 tons, originally 61 ft. 9½ in. long and 18 ft. 5¼ in. beam, built by Joseph Weld in 1822, which for many years remained a racing yacht, having been rebuilt and altered several times. The Thames soon followed the example of the Solent and established the Royal Thames Yacht club in 1823, the Clyde founding the Royal Northern Yacht club in 1824, and Plymouth the Royal Western in 1827. In this year the Royal Yacht squadron passed a resolution disqualifying any member who should apply steam to his yacht. In 1830 one of the largest cutters ever constructed was launched, viz., the "Alarm," built by Inman at

Lymington for Joseph Weld of Lulworth Castle, from the lines of a famous smuggler captured off the Isle of Wight. She was 82 ft. on the load line by 24 ft. beam, and was reckoned of 193 tons, old measurement, in which length, breadth and half-breadth (supposed to represent depth) were the factors for computation. Some yachtsmen at this time preferred still larger vessels and owned square-topsail schooners and brigs like the man-o'-war brigs of the day, such as the "Waterwitch," 381 tons, built by White of Cowes, in 1832, for Lord Belfast, and the "Brilliant," barque, 493 tons, belonging to J. Holland Ackers, who invented a scale of time allowance for competitive sailing. In 1834 the first royal cup was given by William IV to the Royal Yacht squadron. In 1836 the Royal Eastern Yacht club was founded at Granton near Edinburgh; in 1838 the Royal St. George's at Kingstown and the Royal London; in 1843 the Royal Southern at Southampton and the Royal Harwich; in 1844 the Royal Mersey at Liverpool and the Royal Victoria at Ryde. The number of vessels kept pace with the clubs, the 50 yachts of 1812 increasing nearly tenfold before the middle of the century.

First Alteration in Type.—In 1848, after J. Scott Russell had repeatedly drawn attention to the unwisdom of constructing sailing vessels on the "cod's head and mackerel tail" plan (*i.e.*, full bow and forebody and a long clean afterbody and run), and had enunciated his wave-line theory, Mare built at Blackwall an entirely new type of vessel, with a long hollow bow and a short afterbody of considerable fulness. This was the iron cutter "Mosquito," of 59 ft. 2 in. water line, 15 ft. 3 in. beam, and measuring 50 tons. Prejudice against the new type of yacht being as strong as against the introduction of steam, there were no vessels built like the "Mosquito," with the exception of the "Volante," 59 tons, by Harvey of Wyvenhoe, until the eyes of English yachtsmen were opened by the Americans three years later. About this period yacht racing had been gradually coming into favour in the United States. (*See* below.) John C. Stevens, who played a leading part in the development of boats for pleasure sailing and racing in the United States, commissioned George Steers of New York, builder of the crack pilot schooners, to construct a racing schooner to visit England in the year of the great exhibition, and the result was the "America," of 170 tons. She crossed the Atlantic in the summer of 1851, but failed to compete for the Queen's cup at Cowes in August, as her owner declined to concede the usual time allowance for difference of size, being desirous of obtaining a match race against only one yacht. The members of the Yacht squadron, not wishing to risk the reproach of denying the visitor a fair race, decided that their race for a cup given by the club, to be sailed round the Isle of Wight later in the same month, should be without any time allowance. The "America" entered and competed against 15 other vessels. The three most dangerous competitors being put out through accidents, the "America" passed the winning post 18 minutes ahead of the 47-ton cutter "Aurora," and won the cup; but, even if the time allowance had not been waived, the American schooner yacht would still have won by fully a couple of minutes. The prize was later given to the New York Yacht club and constituted a challenge cup, called "the America's cup," for the yachts of all nations, by the deed of gift of the owners of the winner. (*See* below for a complete account of these races.)

The First Great Era of Yacht Racing.—Between 1870 and 1880 there were some very notable additions to the racing fleet, including the schooners "Gwendolin," "Cetonia," "Corinne," "Miranda" and "Waterwitch"; the large cutters "Kriemhilda," "Vol au Vent," "Formosa," "Samoena" and "Vanduara," a cutter built of steel; the 40-tonners "Foxhound," "Bloodhound," "Myosotis"; and the yawls "Florinda," "Corisande," "Jullanar" and "Latona." The "Jullanar" may be noted as a specially clever design. Built in 1874 from the ideas of Bental, an agricultural implement maker of Maldon, Essex, she had no dead wood forward or aft, and possessed many improvements in design which were embodied and developed by the more scientific naval architects, G. L. Watson, William Fife, Jr., and others in later years. Lead, the use of which commenced in 1846, was entirely used for ballast after 1870 and placed on the keel outside.

No fewer than 400 matches took place in 1876, as against 63 matches in 1856, with classes for schooners and yawls, for large cutters, for 40-tonners, 20-tonners and 10-tonners. The Yacht-Racing association, established in 1875, drew up a simple code of laws for the regulation of yacht races, which was accepted by the yacht clubs generally. The association adopted the rule for ascertaining the size or tonnage of yachts which had been for many years in force, known as the Thames rule; but in 1879 they altered the plan of reckoning length from that taken on deck to that taken at the load water-line, and a few years later they adopted an entirely new system of calculation.

The Plank-on-edge.—These changes led to a decline in yacht-racing in England, the new measurement exercising a prejudicial effect on the sport, as it enabled vessels of extreme length, depth and narrowness, kept upright by enormous masses of lead on the outside of the keel, to compete on equal terms with vessels of greater width and less depth, in other words, smaller yachts carrying an inferior area of sail. The new type was known as the "lead mine" or plank-on-edge type.

Revival of Yacht-racing Under Length and Sail Area Rule.—Dixon Kemp in 1887 induced British yachtsmen to abandon the system of measuring yachts by tonnage and to adopt a new system of rating them by water line length and sail area. The new system contained no taxes or penalties upon beam or depth nor upon "over-all" length. The only factors measured were the water line and the area of the sails. All the old tonnage rules taxed the length and the breadth. This change of the system measurement crushed the plank-on-edge type completely.

Yachtsmen were greatly pleased with the broader and lighter types of yachts that designers began to turn out under the length and sail area rule. They were more comfortable and drier in a seaway than the old vessels. The first large cutters built with considerable beam were "Yarana" and "Petronilla" in 1888, and in 1889 the first of Lord Dunraven's "Valkyries" was a vessel that was much admired.

The Second Great Era in Yachting.—The seasons following 1892 are identified with the big cutter racing. The revival under the length and sail area rule had so far extended to "Iverna," "Tarana," "Petronilla," and "Valkyrie I" being built in the first class, but then there had been a pause of some years during which large numbers of 40-raters, 20-raters and the Solent classes had been built. Just when the critics were declaring that in the future no yachtsmen would build a class racer larger than a 40-rater (60 ft. L.W.L. with 4,000 sq.ft. of sail), the prince of Wales (afterward Edward VII) gave an order for the cutter "Britannia," while Lord Dunraven built "Valkyrie II," A. D. Clarke "Satanita" and Peter Donaldson "Calluna"; and in this same season (1893), an American yachtsman took the Herreshoff yacht "Navahoe" over the Atlantic. Yacht designing and building now became a science demanding the highest tax upon the skill and ingenuity of the naval architect. The cutter "Valkyrie II" visited the United States in 1893, but Lord Dunraven's vessel was beaten by the "Vigilant." Curiously enough, when the crack Herreshoff cutters "Navahoe" and "Vigilant" visited the British Isles they were severely beaten by the British yachts. During the years that followed the "Britannia" held a wonderful record.

After some years of designing to the length and sail area rule it became apparent that the "skimming dish" type the designers were producing under the rule would have no cabin accommodation or head room, and that the evolution of such type would be as bad for the sport as the development of the old plank-on-edge had been in 1885. It seemed strange that while the old tonnage rule had evolved the plank-on-edge ten years previously, the sail area measurement now evolved a plank-on-side, balanced by a fin. The fact was that designers had solved the problem. The rule measured only the length and the area of canvas. Taking the length of the vessel on the water line as constant, then the vessel with the smallest possible weight could be driven with less sail at the same speed as vessels with greater weight and greater sail. This solution of the problem was not apparent to designers from 1880 to 1885, because of the difficulty of obtaining stability. From 1880 to 1885 stability was obtained by means of very heavy keels. In 1895 the

stability was obtained by means of a light piece of lead placed at the bottom of a deep steel fin.

The First Linear Rating Rule.—To endeavour to check the tendency to build skimming dishes the Yacht-Racing association (Great Britain) introduced in 1896 a new system of measurement which was proposed by R. E. Froude. The novelty of this rule consisted of a tax upon the skin girth of the yacht, whereby a vessel with hollow midship section was penalized by her girth being measured round the skin surface. Froude's first system of rating began on Jan. 1, 1896, and ended at the close of the year 1900. The measurement of the yacht was obtained by the following formula:—

$$\frac{\text{Length L.W.L.} + \text{beam} + \frac{3}{4}\text{ skin girth} + \frac{1}{2}\sqrt{\text{(sail area)}}}{2} = \text{linear rating.}$$

This rule partially failed in its object. It was hoped that the skin-surface measurement would prevent the fin-bulb type being successful, but Froude and his colleagues had underestimated the possible developments of exaggerated pram bows, immense scow-shaped shoulders and stern-lines, all of which could be introduced into the skimming-dish type with great success. So, notwithstanding the small premium on displacement this rule contained, the dishes could still beat the full-bodied yachts.

The Second Linear Rating Rule.—This rule, also suggested by Froude, was introduced on Jan. 1, 1901. The Y.R.A. agreed to fix this rule for a period of seven years. The object of the rule was to ensure a big-bodied vessel. The formula was:—

$$\frac{\text{Length} + \text{breadth} + \frac{3}{4}\text{ girth} + 4\bar{d} + \frac{1}{2}\sqrt{\text{(sail area)}}}{2.1} = \text{linear rating.}$$

Now the novelty of this rule was the new tax $\bar{d}$. This $\bar{d}$ represents the difference in feet between the measurement of the girth of the yacht's hull taken round the skin surface and the girth at the same place measured with a string pulled taut. This measurement was taken $\frac{6}{10}$ the distance from the fore end of the water line. It is easy to see that in a full-bodied yacht $\bar{d}$ = a small unit, while in a hollow-bodied yacht $\bar{d}$ = a larger unit. Four times $\bar{d}$ being taken, it followed that hollow-bodied yachts were heavily penalized.

Class Racing, Handicapping and Cruiser Racing.—Yacht racing may be subdivided under these three heads. Yacht racing by rating measurement or tonnage, when either the first yacht to finish is the winner, or the yacht saving her time by a fixed scale of time allowance in proportion to the rating of the vessel and the length of the course, is called class racing, and it obviously tends to encourage the fastest possible vessel under the current rating rule to be produced. It has always been regarded as the highest form of the sport. It is naturally, however, the most expensive form, because only the most up-to-date and perfectly equipped vessels can keep in the first flight.

From time to time, chiefly from about the years 1884 and 1885 onwards, handicaps framed according to merits have been fashionable among yachtsmen. They were originally devised to afford amusement and sport to out-classed racers and cruisers. Owing to the expense of class racing, handicap racing thrived greatly during the period of the first and second girth rules. During these periods, too, the third style of yacht racing came into vogue, namely, cruiser racing; either very fast cruisers were built specially for the purpose of handicap racing, or a number of yachts of exactly similar design were built specially to the owner's orders for the purpose of racing in a class together. The fast handicap cruisers had the great advantage over class racers from 1896 up to 1906, inasmuch as they were much more strongly built.

The First International Rules Introduced.—In April 1904 B. Heckstall-Smith drew the attention of German, French and British yachtsmen to the fact that the yacht measurement rules (then different in the various countries) were generally due to terminate about the end of 1907, and suggested that many advantages would accrue if an international rule could be agreed upon. The Yacht-Racing association agreed to take the matter up, and at two international conferences, held in London in January and June 1906, an international rule of yacht measurement and rating was unanimously agreed to by all the nations of Europe. America alone did not attend the conference. R. E. Froude, a nephew of the historian, struck the keynote of the object of the conference by a statement that the ideal yacht should be a vessel combining "habitability with speed." Old plank-on-edge types under the tonnage rules were habitable but slow. Skimming dishes attained the maximum speed, but were uninhabitable. A good form was attained in 1901 with "Magdalen," but since that year the bane of light construction had become harmful to yachting. Hence the conference aimed at a rule which would produce a yacht combining habitability with speed. They adopted a form of linear rating comprising certain penalties upon hollow midship section (*i.e.*, Benzon's $\bar{d}$ tax) and also upon full pram (spoon shaped) bows. The following was adopted as the rule by which all racing yachts in Europe were rated:—

$$\frac{L + B + \frac{1}{2}G + 3\bar{d} + \frac{1}{3}\sqrt{S - F}}{2} = \text{rating in linear units, } i.e., \text{ either feet or metres.}$$

Where L = length in linear units.
" B = extreme beam in linear units.
" G = girth in linear units.
" $\bar{d}$ = girth difference in linear units.
" S = sail area in square units.
" F = freeboard in linear units.

The length L for the formula was the length on the water line, with the addition (1) of the difference between the girth, covering board to covering board, at the bow water line ending, and twice the freeboard at that point, and (2) one-fifth of the difference between the girth, covering board to covering board, at the stern water line ending, and twice the freeboard at that point. The additions (1) and (2) penalized the full overhangs and the bow overhang in particular. The girth, G, was the chain girth measured at that part of the yacht at which the measurement is greatest, less twice the freeboard at the same station, but there were certain provisions allowing the measurement of girth generally to be taken 0.55 from the bow end of the water line. The girth difference, $\bar{d}$ in the formula, was the difference between the chain girth, measured as above described, from covering board to covering board, and the skin girth between the same points, measured along the actual outline of the cross section.

For racing the yachts were divided into 11 classes. Class A for schooners and yawls only, above 23 metres (75.4 ft.) of rating, with a time allowance of four seconds per metre per mile. All the yachts in this class were classed A1 at Lloyd's. In racing, yawls sailed at their actual rating and schooners at 12% less than their actual rating. The other classes were ten separate classes for single-masted vessels only in which there was no time allowance.

The new rule produced the type of yacht desired—a vessel combining habitability with speed. Among the handsomest examples were the German emperor's schooner "Meteor IV" (1909), and the schooner "Germania" (1908), 400 tons or $31\frac{1}{2}$ metres measurement, Class A, both built by Krupp's at Kiel. German designed, German built and Germain rigged and manned, they demonstrated the wonderful strides made by Germany in yachting. A few years before there were not a dozen smart yachts in Germany, and, indeed, the Kaiserlicher Yacht club at Kiel was only founded in 1887. The "Germania" holds the record over the old "Queen's course" at Cowes, having in 1908 sailed it a quarter of an hour faster than any other vessel. Her time over the distance of about 47 to 48 nautical miles was 3 hours 35 min. 11 sec., or at the rate of 13.1 knots. The success of the international rule was remarkable. The Table on page 866 gives the racing yachts built under it in all countries from its foundation in 1907 to the outbreak of World War I in 1914.

The total does not include the big schooners of Class A, such as "Meteor IV," "Meteor V," "Germania," "Waterwitch," "Westward" and "Margherita," enormous vessels of 400 tons, and a number of small yachts built in Scandinavia and neutral countries early in the war, from 1915 to 1917, when the first international rule came to an end. There were thus upwards of 800 yachts built to this rule for international racing.

Much of the finest racing in the whole history of yachting took place from 1908 until 1914. The International Yacht Racing

Class in metres	Length in feet	Number of yachts built
23	75·4	3
19	62.3	6
15	49.2	19
12	39.4	35
10	32.8	54
9	29.5	25
8	26.2	174
7	23.0	86
6	19.7	328
5	16.4	41
Total	..	771

union was established under the chairmanship of the British Yacht Racing association and consisted of all the European nations and the Argentine republic. British yacht building was flourishing, German yachting was at its zenith under the kaiser. International regattas on a big scale were held at Spithead in 1911, at Kiel in 1912, at Le Havre in 1913, and in the Oslo fjord in 1914. America was attracted to European yachting, and in 1910 an American racing schooner came to Europe, the "Westward," 323 tons, designed and built by Herreshoff. She started in 11 races and won them all. Sir Thomas Lipton's 23-metre cutter "Shamrock" remained the best British cutter during these seasons.

The End of the First International Rule.—The yachting season of 1912 was notable for the appearance of a new 15-metre yacht, the "Istria," designed on novel lines by C. Nicholson for Sir Charles Allom, and the first of a series of yachts by the same clever designer which quickly began to defeat the purpose of the international racing rule. In 1912 and 1913 his great schooner "Margherita" and the cutters "Istria," "Pamela," "Paula III" and others were of an undesirable type, but so efficient as racers that they outsailed the yachts of all other designers.

The Second International Rule.—When World War I broke out in the summer of 1914, it put an end to all yacht racing in Great Britain, Europe and, later, in the United States, and the sport was only revived in 1919–20. At the end of the war, the Scandinavian nations purchased many of the best of the British racing yachts and the cost of building new yachts in Britain was prohibitive. But in 1919 the International Yacht Racing union was re-formed, and a new rating rule was adopted in 1920 by those countries which then adhered to that international racing body. This rule, with some modifications made at subsequent conferences, is the rule which has remained in force ever since, and which was adopted by the North American Yacht Racing union in 1927, after a meeting of its delegates and those of the International Yacht Racing union in London. It was essential in framing this rule to keep in view (1) Froude's ideals combining "habitability and speed" in the new yachts built for racing, and (2) the economy of labour in handling the yachts, *i.e.*, to reduce the sail area utilized to propel the hull. The object was to try to produce a habitable vessel of medium size which, instead of requiring enormous sails to drive the hull and that would require a crew of, say, eight men to work her, to produce a racing yacht with the equivalent accommodations that could be driven with one-third less canvas and would require a crew of, say, only four men. The international conferences of 1919, 1924 and 1926 framed two separate rules, one for yachts up to 12 metres and another for those above 12 metres. These were as follows:

Part I. For classes of 6-, 8-, 10- and 12-metres:

$$\frac{L+\frac{1}{4}G+2d+\sqrt{S}-F}{2.5}=\text{rating.}$$

Part II. For yachts above 12-metres:

$$\frac{L+\sqrt{S}-F}{2.3}=\text{rating.}$$

L = the "sailing length" being the length L.W.L. (length on water line) with certain additions, including measurements of the length of the overhangs at the bow and stern, and also the fullness or girth of the said overhangs.
G = the chain girth.
d = the difference between the skin and chain girths, but not taken round the bottom of the keel.
S = the sail area.
F = the freeboard.

A limit in each rule was placed upon draught of water and height of masts or sail plans.

Amendments adopted at subsequent International Conferences in London altered this measurement formula to the one that was in force in 1939 when the European War broke out, and again put a stop to yacht building and racing. This formula is, for the 6-, 8-, 10-, 12-, and 14½-metre classes:

$$\frac{L+2d+\sqrt{S}-F}{2.37}=\text{rating in linear units}$$

Where L = length in linear units.
" d = girth difference in linear units.
" S = sail area in square units.
" F = freeboard in linear units.

This, until altered, is the present (1944) international rule.

By far the most important innovation, however, in both rules was a limit upon the displacement of the yacht in proportion to her length. For many years there had been a "limit" or "penalty" upon the displacement of yachts under the universal rule in America. In 1919–20 the International Yacht Racing union of Europe adopted the American limit upon displacement. It has already been explained how, in the year 1895, the lack of displacement of the skimming dish fin and bulb raters killed the original English length and sail area rule, there being, of course, no limit upon the *minimum* displacement then permitted.

These new international rules are, in effect, nothing more nor less than length and sail area rules *plus* the all-important addition of a limit upon the minimum displacement. This is an actual fact, because L and S are the predominant factors of the rules, and the G, d and F amount to a very trifling percentage of the total.

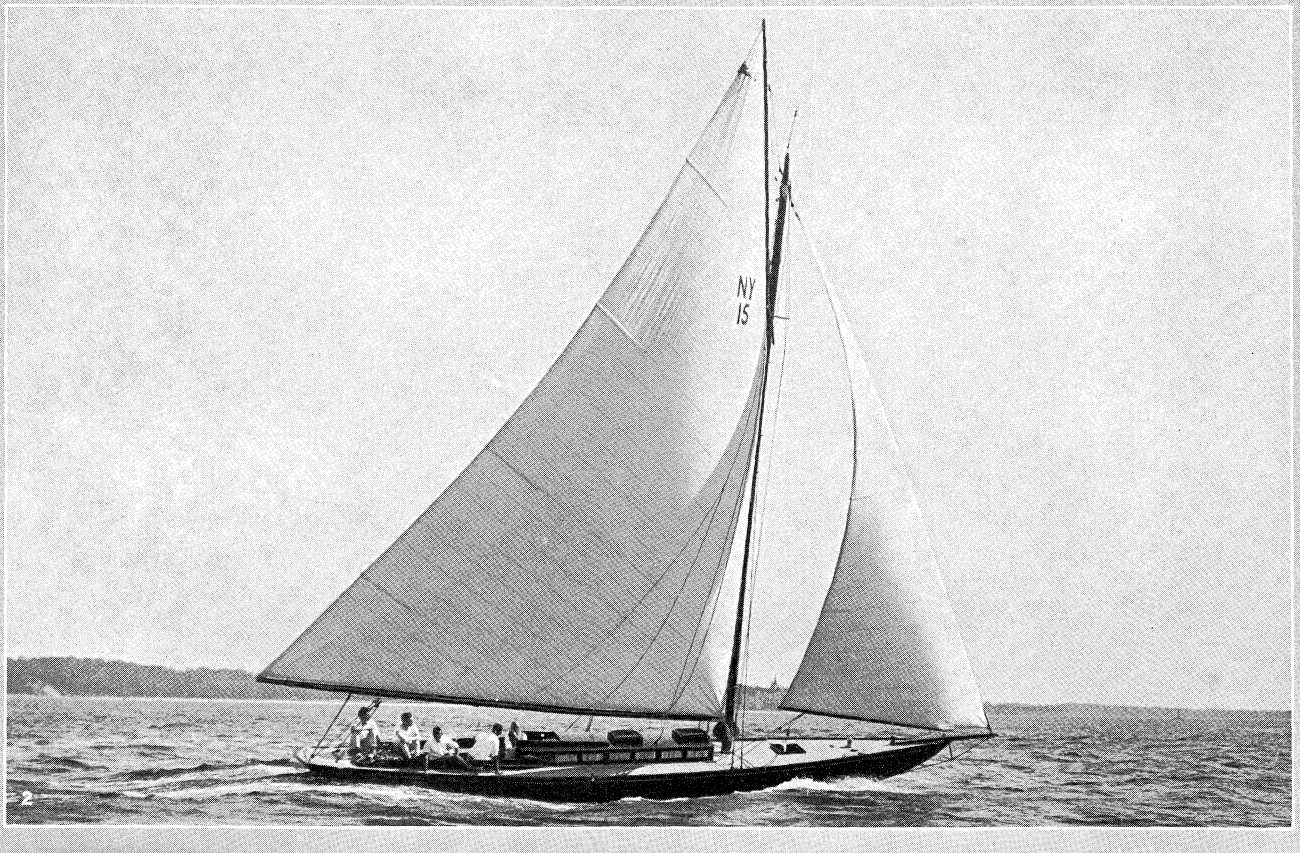
The Bermudian Rig.—A direct outcome of the new international rule was the evolution of the Bermuda rig (*q.v.*).

The Development of Yachting After 1919.—Owing to the increased cost of the sport, the progress of yachting from 1919 until the year 1944 has been gradual. For a few years class racing for new yachts under the international rule was chiefly confined to the smaller classes of 12 metres and under. A 6-metre yacht built in 1914 cost about £500, and in 1928 it cost about £1,100. The 75-foot or 23-metre "White Heather" and "Shamrock," built in 1907 and 1908, cost about £9,000 or £9,500. The 23-metre yachts "Astra" and "Cambria," built in 1928, cost between £24,000 and £25,000. It is, therefore, not a matter for surprise that yachtsmen now cruise and race in yachts of smaller tonnage than in former times. Notwithstanding the cost of building, an enormous number of racing yachts were built to the second international rule from 1920 to 1928, as is shown by the following table:

Class in metres	Length in feet	Number of yachts built
23	75	3
12	39·3	24
10	32.8	20
8	26.2	60
6	19.7	200
Total	..	307

These yachts were built in Great Britain, Scandinavia, America, France, Italy, Belgium, Holland and Spain. The British 23-metres (built in 1928) are the "Astra," built by Nicholson for Sir Mortimer Singer, and the "Cambria," by Fife, for Sir William Berry. The most famous 12-metres was the "Vanity," built by Fife for J. R. Payne, and the "Norisca," built by Johan Anker at Oslo.

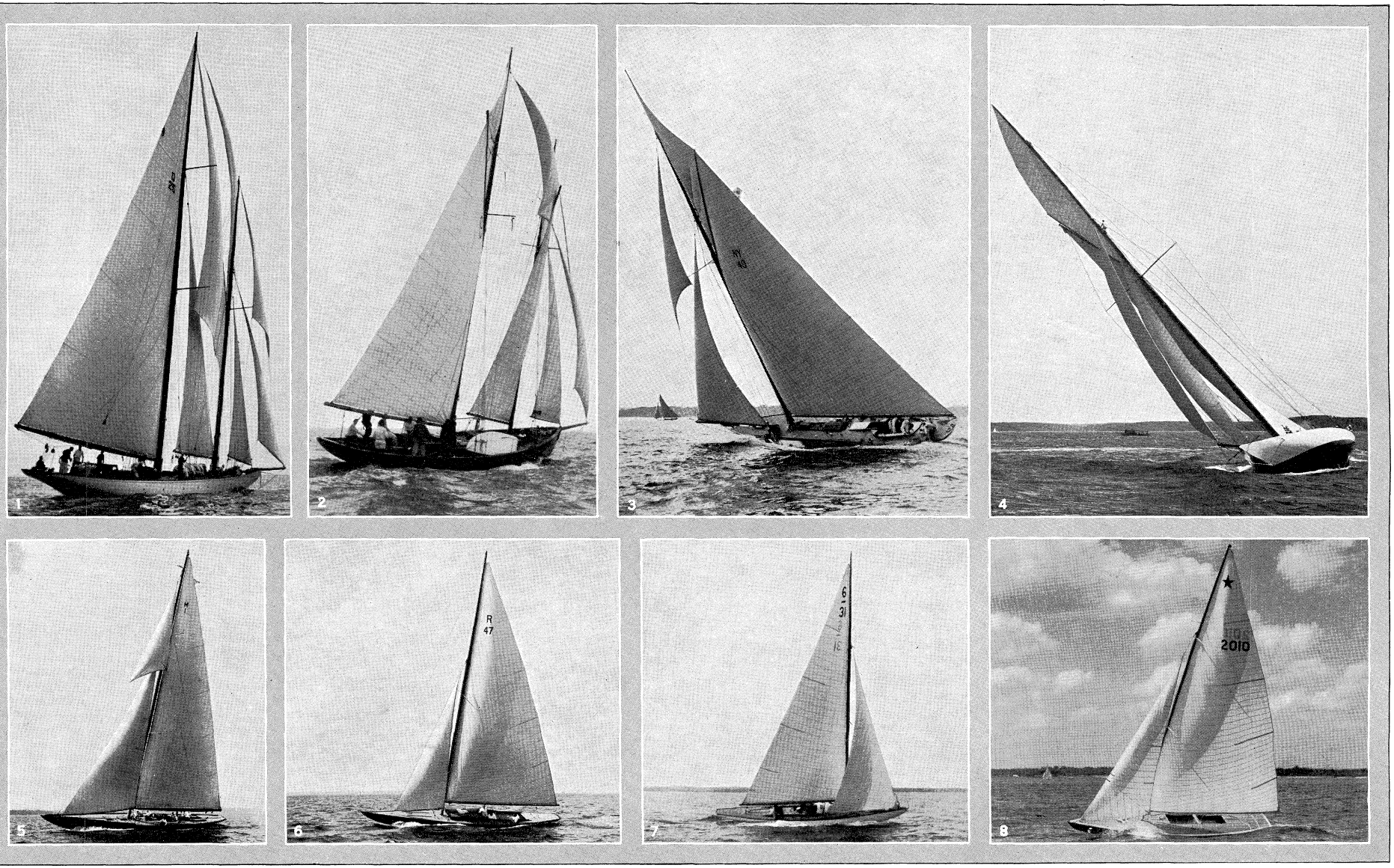
In the United States the 6-metre and 12-metre classes became popular, and in the latter class Olin J. Stephens designed the "Vim" for Harold S. Vanderbilt in 1938. In 1939 this yacht was taken to England where she raced with success in her class. In the 6-metre class international competition was spurred by the contests for the British-American cup, inaugurated in 1921 and sailed until 1924 between teams of British and American sixes. Each country was represented by four yachts selected to form its



PHOTOGRAPHS, MORRIS ROSENFELD

SOME AMERICAN ONE-DESIGN CLASS YACHTS

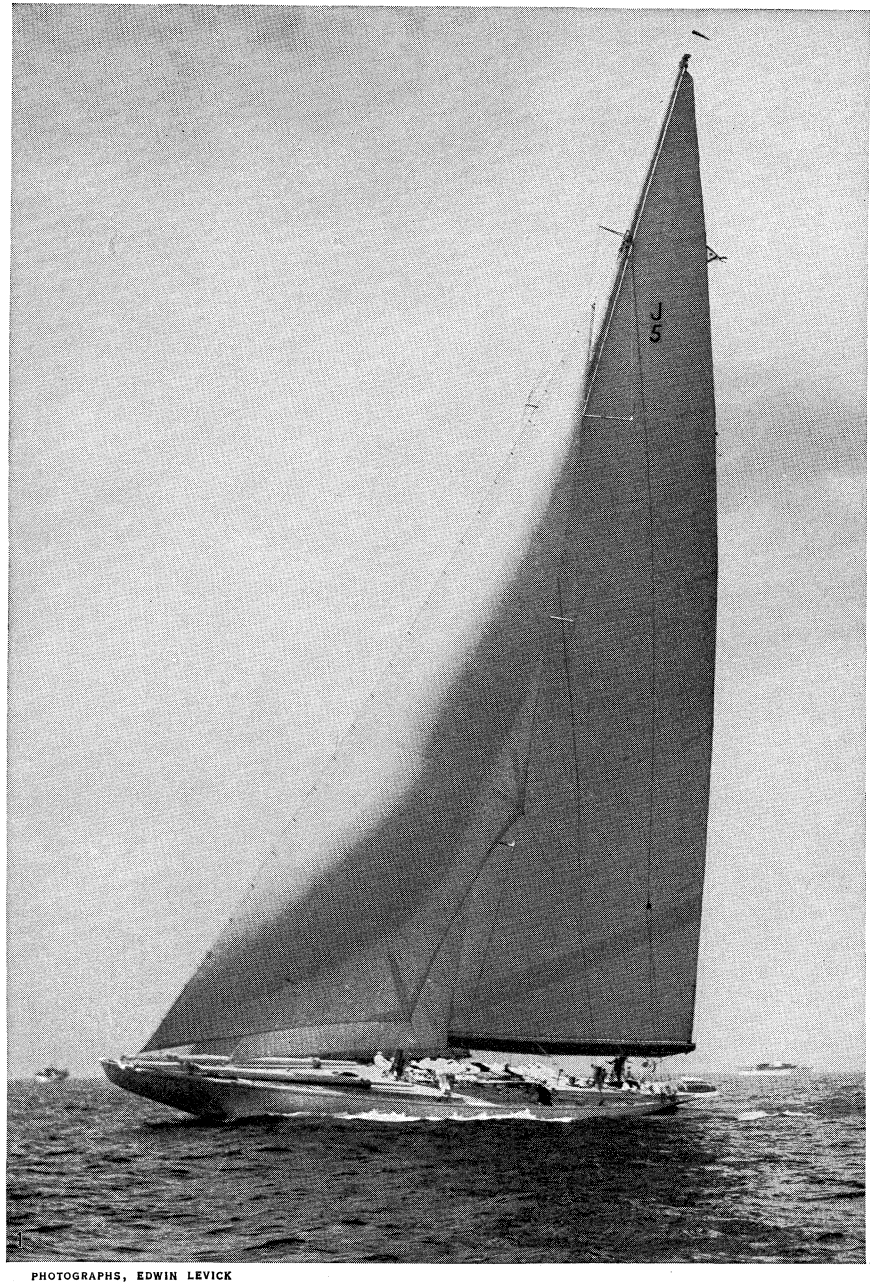
1. Start of the International One-design Class during a regatta off Larchmont. Designed by Bjarne Aas of Norway, about 50 of these boats were taken to the United States in 1937. They are 32'2" overall, 21'5" waterline and draw 5'4" of water. 2. The "Banzai," a 30' class boat of the New York Yacht club designed by N. G. Herreshoff and representative of a famous class of one-design boats built in America in the early 1900s

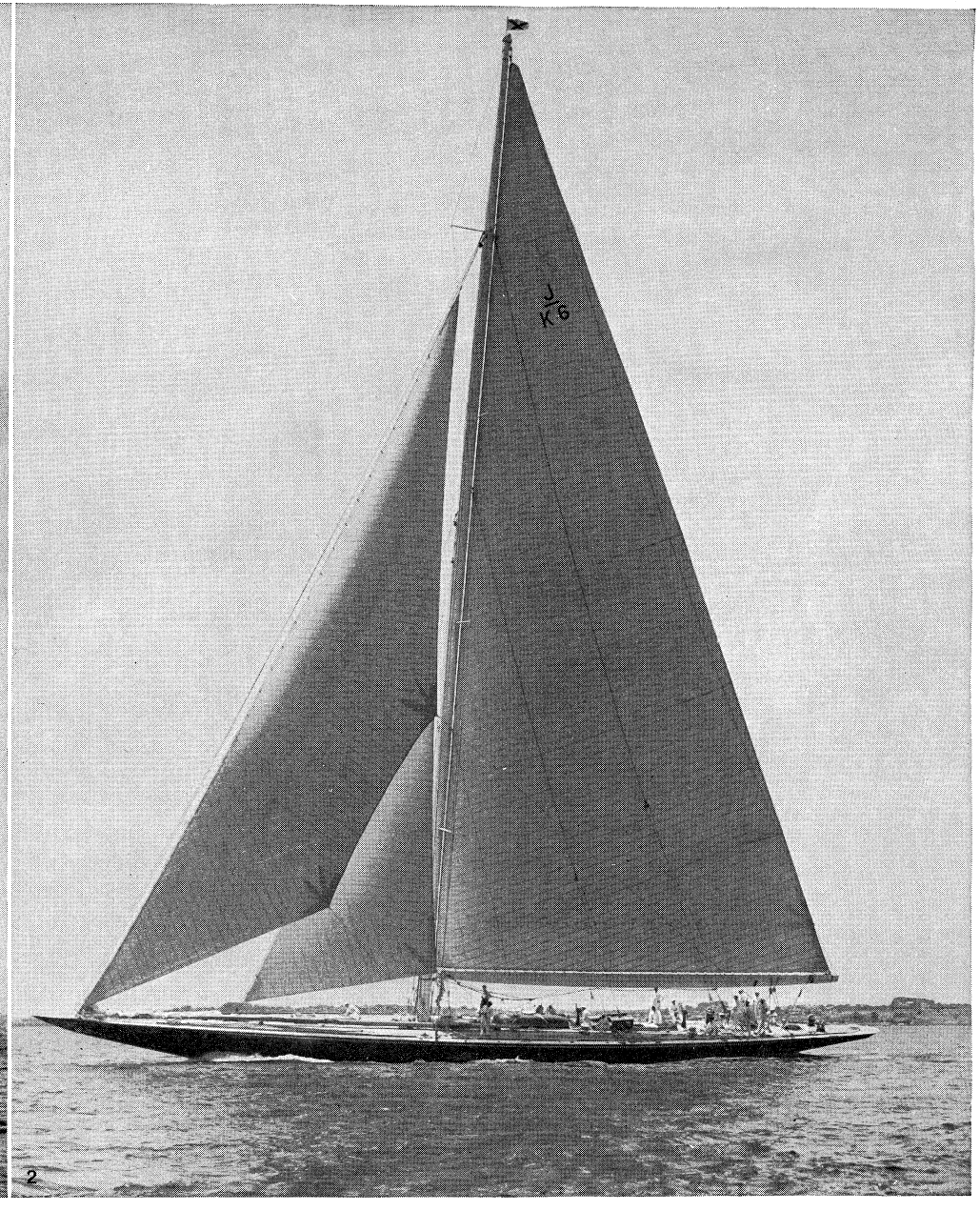


PHOTOGRAPHS, MORRIS ROSENFELD

FAMOUS AMERICAN YACHTS

1. The 88′ schooner yacht "Advance" with staysail rig. One of the most successful types turned out, designed by Burgess, Swasey and Paine
2. The "Malabar 9," designed by John G. Alden. Typical of large fleet of small ocean cruising schooners
3. One of the New York Yacht Club 40′ class hard on the wind. A type of yacht designed by Herreshoff
4. The "Resolute," America's Cup Defender (1920), in a fresh breeze. Starboard rail awash
5. "Prestige," a class M. sloop turning to windward. An example of a Universal rule yacht
6. Speedy little class R. sloop with sheets down. Popular type of yacht
7. The "Frieda," American six metre class of the type designed by Clinton H. Crane
8. Star class yacht in brisk going. One of the largest one-design class ever promoted, over 2,000 built and raced in various parts of the world

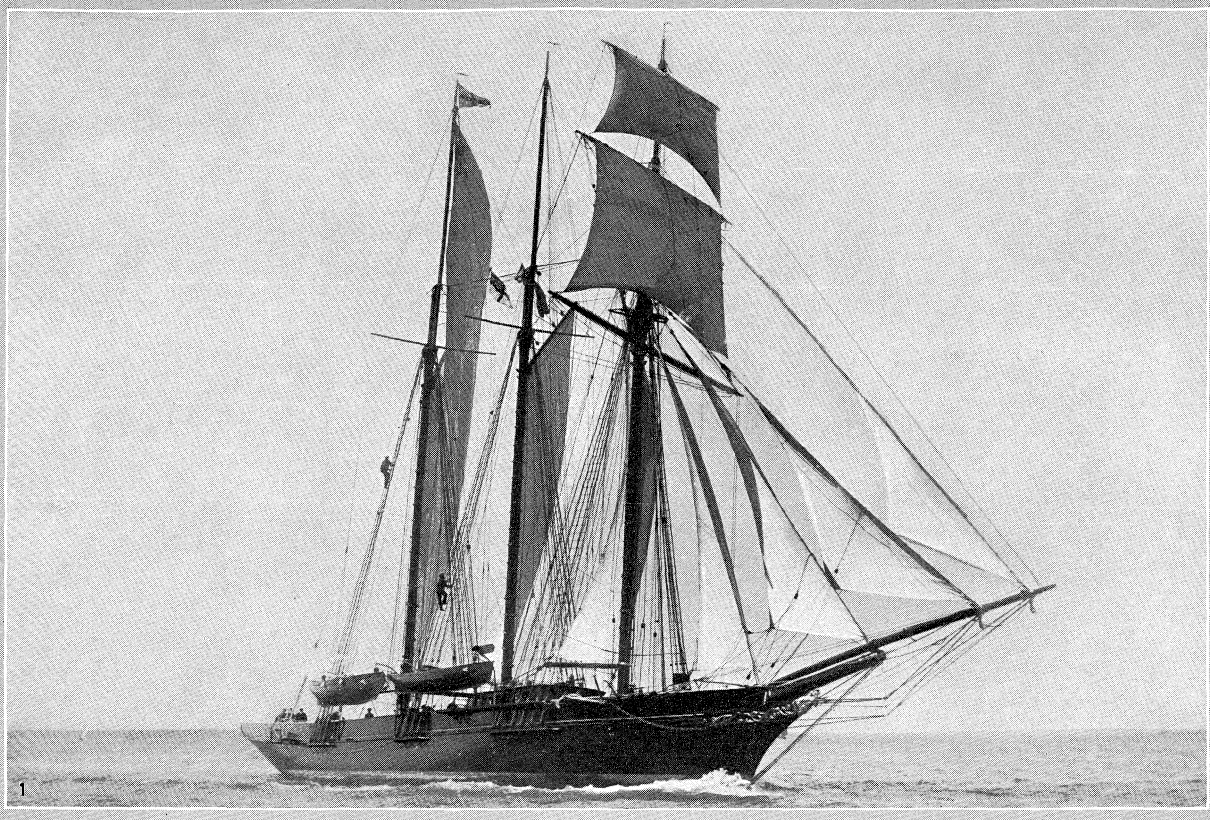


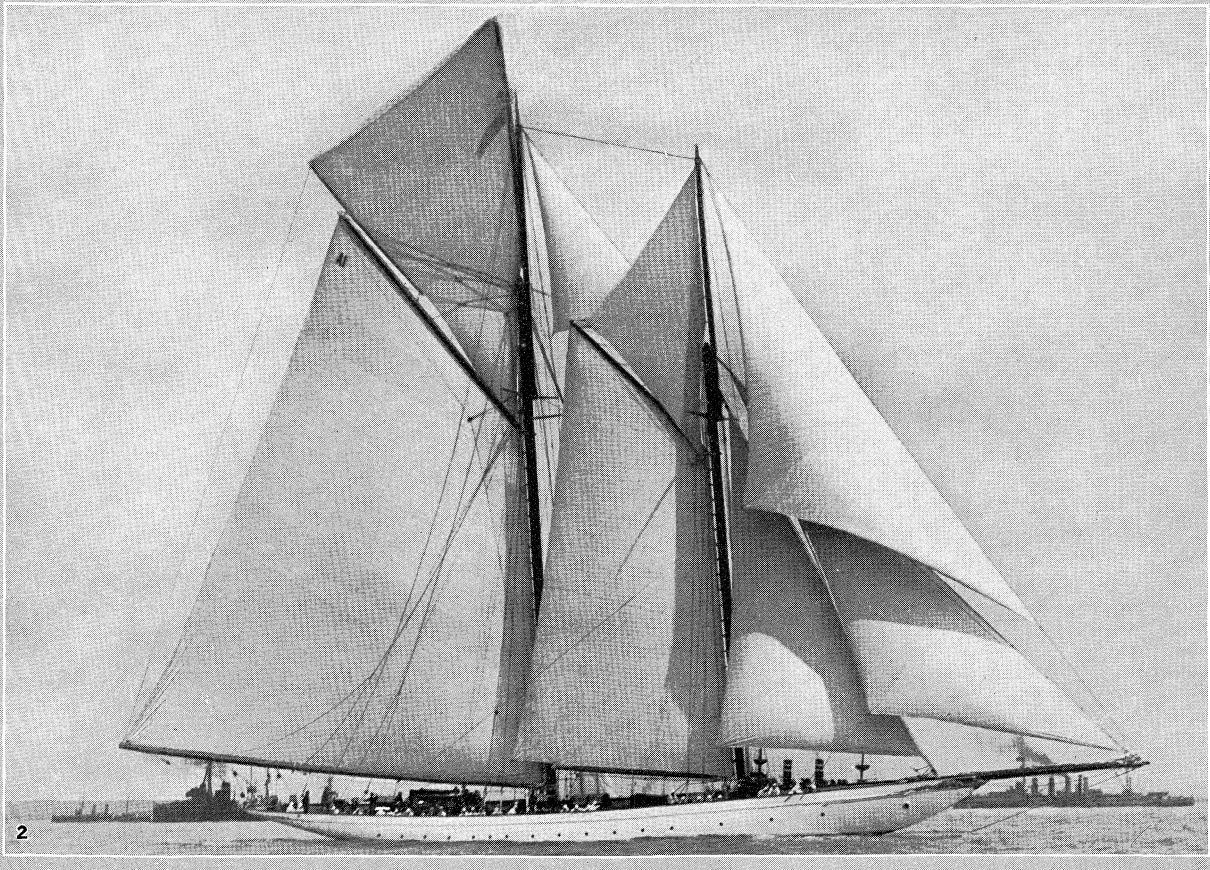


PHOTOGRAPHS, EDWIN LEVICK

Harold Sterling Vanderbilt's "Ranger" (left) which won 4 straight races of 30 miles each in the America's Cup yacht races on the Atlantic off Newport, R. I., in August, 1937, from Thomas O. M. Sopwith's "Endeavour II" (right)

YACHTING





PHOTOGRAPHS, STEPHEN CRIBB

LARGE EUROPEAN YACHTS

1. A three masted topsail schooner yacht with the wind over her quarter. In this rig square yards are carried on the foremast
2. A schooner yacht close hauled on the wind off Cowes, Isle of Wight, yachting centre of the south coast of England

team. The contests were sailed alternately in each country. Britain finally obtained the trophy by winning three of the four races. This was followed in succeeding years by international races for the Scandinavian gold cup and the Seawanhaka cup in the 6- and 8-metre classes. Under the second international rule, however, no individual country has carried off the palm. Norway, Sweden and the United States have shared the honours with Britain. For the first time in the history of yachting it appeared that yacht designers were unable to make certain of defeating an old yacht, under the rules, with a new vessel.

The King's Yacht "Britannia."—Encouragement was given to the pastime of yacht racing after 1920 by the king's taking the lead in the sport in British waters and refitting the old cutter "Britannia" for racing. This yacht, designed by G. L. Watson, and built in the year 1893, had a hull form very similar to that fostered and developed by the new rating rules of 1920. The chief difference between the "Britannia's" hull form and that of modern yachts was that the latter have greater freeboard, and are consequently able to develop higher speed when pressed by fresh wind. The form of modern yachts is also somewhat more elongated and more easily driven in light winds. Nevertheless, with the aid of a small handicap allowance in her favour, the "Britannia" was raced with much success from 1920 to 1935 when, after the death of King George V, at the end of a long and honourable career she was retired from racing and in 1936 taken out and sunk in the waters of the British channel. The "Britannia" thus had two distinct careers. First, from 1893 to 1897, and second, from 1920 to 1935. No other vessel in the world has won so many prizes or sailed so many races. The following is her complete record:

Year	Number of starts	Number of first prizes	Number of other prizes	Total
1893 to 1922	299	151	37	188
1923	26	11	11	22
1924	19	7	5	12
1925	36	6	6	12
1926	23	4	7	11
1927	24	8	8	16
1928	34	9	10	19
1930	26	5	5	10
1931	20	6	7	13
1932	32	9	14	23
1933	39	12	12	24
1934	27	3	7	10
1935	20	0	0	0
	625	231	129	360

The Speed of Sailing Yachts.—It may be said that the speed of sailing yachts of normal dimensions varies according to the square root of their length. In judging the speed of modern yachts a comparison thereof is usually made through the "rating measurement." A yacht of 20 metres or 65.6 rating length, in a strong wind can maintain a maximum speed of about 12 knots. The time allowance in seconds per mile between yachts of different "sizes," "ratings" or "lengths" is usually found by the formula:

$$\frac{2{,}160}{\sqrt{r}} - \frac{2{,}160}{\sqrt{R}}$$

where R is the rating length of the large yacht and r that of the smaller yacht.

It is interesting to recall some old records of speed over courses inside the Isle of Wight.

Date	Yacht	Distance	Time	Remarks
1858	The Arrow	45 miles	4 hr. 19 min.	Cutter|Same
1872	The Arrow	50 ,,	4 hr. 40 min.	Cutter/vessel.
1872	Kriemhilda	50 ,,	4 hr. 37 min.	Cutter.
1883	Marjorie	50 ,,	4 hr. 26 min.	Cutter.
1883	Samoena	50 ,,	4 hr. 15 min.	Cutter.
1885	Lorna	50 ,,	4 hr. 14 min.	Yawl.
1885	Irex	50 ,,	4 hr. 7 min.	Cutter.
1870	Egeria	50 ,,	4 hr. 27 min.	Schooner.
1875	Olga	50 ,,	4 hr. 25 min.	Schooner.
1879	Enchantress	50 ,,	4 hr. 18 min.	American schooner.
1902	Meteor	47 ,,	3 hr. 50 min.	American schooner.
1908	Cicely	46 ,,	3 hr. 43 min.	British schooner.
1908	Shamrock	47 ,,	4 hr. 0 min.	British cutter, only 75 ft. L.W.L.
1908	Germania	47 ,,	3 hr. 35 min.	German schooner.

The First Contest for the America's Cup.—This international trophy was originally a cup given by the Royal Yacht squadron at Cowes, Isle of Wight, on Aug. 22, 1851, for a race open to all yachts, with no time allowance of any kind, the course being "round the Isle of Wight, inside the No Man's buoy and Sand Head buoy and outside the Nab." Fifteen vessels took up their stations off Cowes and started from moorings. In the table following are the names of the competitors.

Yacht	Rig	Tons	Owner
Beatrice	Schooner	161	Sir W. P. Carew.
Volante	Cutter	48	J. L. Craigie.
Arrow	Cutter	81	T. Chamberlayne.
Wyvern	Schooner	205	The duke of Marlborough.
Ione	Schooner	75	A. Hill.
Constance	Schooner	218	The marquis of Conyngham.
Gipsy Queen	Schooner	160	Sir H. B. Hoghton.
Alarm	Cutter	193	J. Weld.
Mona	Cutter	82	Lord Alfred Paget.
America	Schooner	170	J. C. and E. A. Stevens, *et al.*
Brilliant	3-masted schooner	392	G. H. Ackers.
Bacchante	Cutter	80	B. H. Jones.
Freak	Cutter	60	W. Curling.
Eclipse	Cutter	50	H. S. Fearon.
Aurora	Cutter	47	T. Le Marchant.

The fleet started at 10 o'clock. Abreast of Ventnor the American schooner was a mile ahead of "Aurora," which was the last British craft to keep her in sight in a thick haze that blew up from the southwest late in the afternoon. At the Needles the wind dropped until it was very light, and the "America" was then some 6 mi. ahead of "Aurora," the time being about 6 P.M. The finish was:—

America (winner)	8.37 P.M.	Aug. 22
Aurora	8.55 P.M.	Aug. 22
Bacchante	9.30 P.M.	Aug. 22
Eclipse	9.45 P.M.	Aug. 22
Brilliant	1.20 A.M.	Aug. 23

The "America" was built at New York at the yard of William H. Brown, from the design of, or a model by, George Steers, for the special purpose of competing with British yachts. The principal dimensions of the "America" were: tonnage 170; registered length 94 ft.; on the keel 82 ft.; beam 22 ft. 6 in.; foremast 79 ft. 6 in.; mainmast 81 ft. (with a rake of $2\frac{7}{8}$ in. to the foot in each mast); hollow bowsprit 17 ft. outboard only; foregaff 24 ft.; maingaff 28 ft.; mainboom 56 ft., sail area 5,263 sq.ft. She was ballasted with pig iron; 21 tons of the iron were permanently built into the vessel and the rest stowed inside. Below deck she was comfortably fitted for the living accommodation of the owner, guests and crew, and a cockpit on deck was a feature that few English yachts of the period possessed.

The cup won at Cowes by the "America," although not originally intended as a challenge cup, was given to the New York Yacht club in 1857 by the owners of the "America" as a challenge trophy and named the "America's cup." In 1887 the sole surviving owner of the cup, George L. Schuyler, attached to the trophy a deed of gift which sets forth the conditions under which all races for the cup must take place. In brief the conditions are: (1) that the races must be between one yacht built in the country of the challenging club and one yacht built in the country of the club holding the cup; (2) that the size of the yachts, if of one mast, must be not less than 65 ft. L.W.L. and not more than 90 ft. L.W.L. If of more than one mast, not less than 80 ft. L.W.L. and not more than 115 ft. L.W.L.; (3) the challenging club must give ten months' notice of the race, and accompanying the challenge must be sent the name, rig and the following dimensions: length L.W.L., beam and draught of water of the challenging vessel (which dimensions shall not be exceeded) and, as soon as possible, a custom-house registry of the vessel; (4) the vessel must proceed under sail on her own bottom to the place where the contest is to take place. In addition, there was a clause in the deed of gift which allowed the holding and the challenging clubs to make, by mutual consent, any arrangements they might agree upon for the terms of the match, even to the waiving of the ten months' notice. Most of the races after 1920 were arranged through

this mutual consent clause, and many of the strict provisions and requirements of the deed have been waived. After the match of 1930 all the races have been sailed without time allowance. For results of these contests *see* table, p. 870.

HOW A YACHT IS SAILED

The method and principle upon which a yacht race is sailed may be described in a way easily understood by any landsman. The course is usually a triangle, to windward and return, or a square. Suppose the starting and finishing line is between the two mark boats X, Y (fig. 1); and suppose the start to be in an easterly direction. Suppose also the direction of the wind to be north. Then the course would be from the starting line round the marks or buoys placed at B, C, D, A, and back to finish across the line XY. The start of a yacht race is at a fixed hour, say 11 A.M. Two signal guns are fired, one at 10:55 to prepare, and the other at 11 A.M. to start. During the five minutes' interval between the guns, the yachts may sail about anywhere they like, "jockeying," so as to try to get into the best position as the second gun fires. The object of the steersman is to sail his yacht across the line XY at full speed immediately after the starting gun has fired.

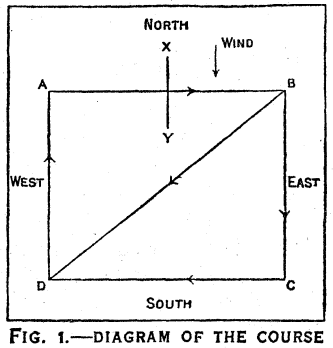
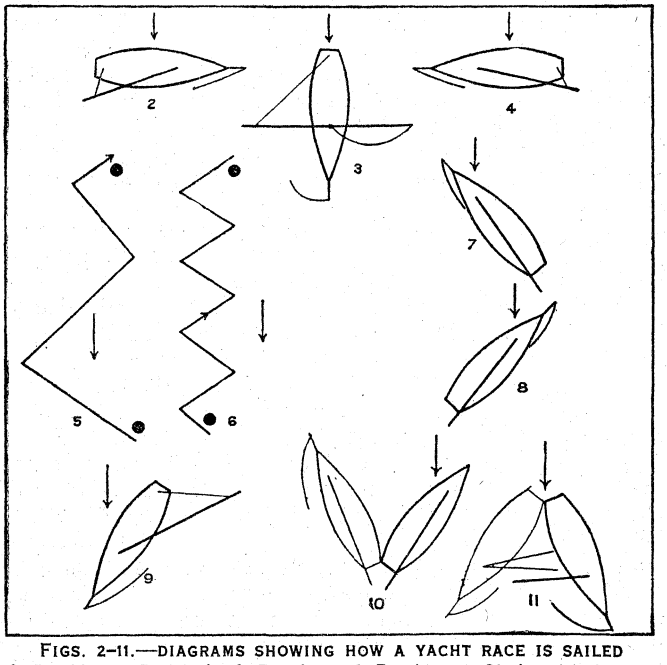


FIG. 1.—DIAGRAM OF THE COURSE OF A YACHT RACE

The first leg of the course is easterly, from the line XY to the point B. This is sailing at right angles to the wind and is called "reaching." The yacht sailing from XY to B is said to be "reaching on the port tack" because the wind is blowing upon her "port" or left-hand side. When reaching, the sails are trimmed as in fig. 2. The next course is from B to C. This is dead before the wind and is called "running." When the wind is dead aft, and the yacht is running before it, the balloon sail called the spinnaker is set. The spinnaker must be taken in before the yacht gets to C. When running, the sheets are eased right off as in fig. 3. The third course is from C to D; this is again reaching, as from A to B, but the yacht is now "reaching on the starboard tack" because the wind is blowing upon her "starboard" or right-hand side (fig. 4).



FIGS. 2–11.—DIAGRAMS SHOWING HOW A YACHT RACE IS SAILED
2. Reaching on Port tack. 3. Running. 4. Reaching on Starboard tack. 5 & 6. Course tacking to windward. 7. Starboard. 8. Port tack. 9. "A Quartering Wind." 10. Tacking. 11. Gybing

The yacht having reached to D, now has to sail from D to A. This is absolutely dead against the direction of the wind. The yacht cannot sail dead against the wind but only at an angle of rather less than 45° from it. The yacht, therefore, has to "tack to windward," or "turn to windward," making a zig-zag course. She may either make long tacks (fig. 5), or short tacks (fig. 6), whichever method will take her quickest from D to A. This turning to windward is the greatest test of the yacht's ability, and also of the ability of the helmsman. Much more distance and time may be gained or lost during the zig-zag than at any other period of the race. When sailing to windward the sheets are hauled in very close. In fig. 7 the yacht is close hauled on the starboard tack, and in fig. 8 she is close hauled on the port tack. Having arrived at A, the course is next a reach on the port tack, with the wind on the left side, from A to the finishing line XY. As the bowsprit (or mast) of the winning yacht crosses the finish line, her winning gun is fired. A gun is usually fired for the first three yachts. If the course had been a triangular course from the start to B, D, A and back to the finish, then the leg of the course BD would have been at an angle "between running and reaching." To sail off the wind from B to D in this manner is called "a free reach" or "a quartering wind," or to sail with "wind on the quarter." Sailing on a reach is usually the fastest point of sailing. With a quartering wind the sheets are trimmed as in fig. 9. A yacht is said to "tack" when she changes her course from port tack to starboard tack, or vice versa, when sailing toward the wind. Similarly, she is said to "gybe" when she changes her course from port tack to starboard tack, or vice versa, when sailing "off" or away from the wind. The boom in "tacking" and "gybing" passes from one side to the other, as in figs. 10 and 11. (B. H.-S.; H. L. St.)

YACHTING IN THE UNITED STATES

Early History.—Organized yachting and yacht racing in America began about 1840 with the formation of the first yacht or boat clubs for the promotion of pleasure-boating and the racing of yachts for sport. While a number of boats had been built in the United States and used solely for pleasure-sailing previous to that date, and hence could be classed as yachts, they were few in number, and in type they were more or less similar to the commercial or fishing craft of the same size in the locality in which they were to be used. The country, at that time, was too new and the people along the seaboard too busy in developing the trade and commerce of the newly formed states, and in opening up the land, to have either the leisure or the means for the development of pleasure-boating.

Yachts had been used in both Great Britain and Holland since the 17th century, and in the history of the Dutch colony of New Amsterdam, which later became the English colony of New York, there is mention of a yacht, or boat built for pleasure-boating, named the "Onrust" (Restless), which is claimed to be the first decked vessel built in America. She was about 44 ft. in length and followed the characteristics and proportions of the Dutch boats used in Holland. It is probable that this craft was used also for commercial purposes when not used for pleasure-sailing. While the "Onrust" was spoken of as a yacht, there is no authentic data relating to other yachts, or to the sport of racing boats, before the beginning of the 19th century. Except for the "Onrust," the earliest mention of a boat used exclusively for pleasure in New York waters was of a 20-ft. sailboat owned by John C. Stevens, named the "Diver," and built some time prior to 1809. The name of Stevens is one intimately connected with the development of yachting in America for many years.

On the New England coast, where the population was largely seafaring, there was built in 1801, for Captain George Crowninshield, a wealthy shipowner and merchant, a large sloop of 22 tons called the "Jefferson," which her owner used largely as a yacht until the War of 1812, when she was fitted out as a privateer and took several prizes. Later she was sold into the fisheries. Following this venture, Crowninshield had built in 1816 a vessel called "Cleopatra's Barge," intended solely for pleasure-cruising, and so luxuriously fitted and furnished as to entitle her to rank as a yacht even according to present standards. The builder of this

boat was Retire Becket, a well-known shipbuilder of Salem, Mass. In her, Crowninshield made a pleasure voyage to the Mediterranean and back in 1816–17, probably the first American yacht to go abroad. "Cleopatra's Barge" was 83 ft. long on the water, 23 ft. breadth of beam, and her tonnage was 191 tons.

It was in New York harbour, however, that most of the early yachting was done, and the first comprehensive attempt made to develop boats for pleasure-sailing and for racing. In this development the Stevens family, of which John C. Stevens was one of four brothers, played a leading part. Inheriting a love of the sea and mechanical tastes, they did much experimenting, and built successively larger yachts, following the "Diver" and the "Trouble." From 1830–40, sailing and racing boats for pleasure became common among men of means, and a good-sized, though mixed, fleet of boats was to be found in New York waters.

Organized Yachting.—It was not until yacht clubs were organized, bringing together those who were interested in the sport, that yachting and racing began to develop along lines that tended to make it a popular pastime, or that yacht design began to show much improvement. As early as 1811 the Knickerbocker Boat club of New York was formed, but it died the following year. After several other clubs, both in New York and Boston, had been formed and had died, the New York Yacht club was organized on July 30, 1844, aboard John C. Stevens' new schooner-yacht "Gimcrack," anchored off the Battery. Among its original members were most of the leading yachtsmen of New York, and it was the first club that survived. In its centennial year, 1944, the New York Yacht club was in point of age and prestige, the foremost yacht club in America, and much of the development of yachting can be traced to the influence of the club itself, or its members. In 1849 the Southern Yacht club, of New Orleans, was organized, followed in 1854 by the North Carolina Yacht club, and in 1857 by the Brooklyn Yacht club, but for 20 years the New York Yacht club was representative of American yachting and was the forerunner of the many yacht clubs that sprang up after the Civil War (1861–65) in all parts of the country wherever there was pleasure-sailing, until in 1944 there were over 800 organized yacht clubs in the United States and Canada.

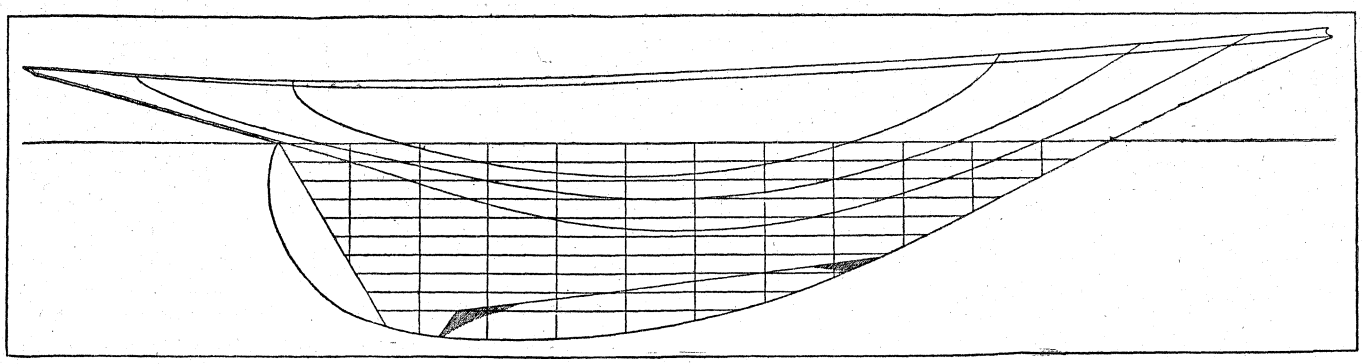
Development of Design.—At the time of the formation of the New York Yacht club, and for many years thereafter, the designing of yachts was not pursued as a science. Most of the yachts were turned out by local builders, working by "rule-of-thumb," each builder having his own particular fad or fancy for some particular type or model, these models being influenced largely by the environment and water conditions. With the shoal waters of the Atlantic coast, American yachtsmen as a whole preferred broad, shoal, centreboard craft, with great initial stability, which enabled them to carry a large spread of sail without a great amount of ballast. These boats were very fast in smooth water. The centreboard was an adaptation of the leeboards of Holland, but was lowered through the keel instead of over the side.

On New York waters, therefore, under the stimulus of the New York Yacht club, a large fleet of light draft centreboard yachts soon made its appearance, the boats being modelled by such noted builders as J. B. Van Deusen and "Pat" McGiehan, or such well-known boat sailors as Phil and Joe Ellsworth, or the Van Buskirks. These men had practical experience, but little technical knowledge of designing, and little real development was made during this period, it being an easier matter to rely on beam for stability and great sail area for speed, rather than on refinement of design. In New England, also, the centreboarder was becoming the popular type when speed was the consideration. All of the yachts of the period were then built on the accepted theory of full bow and fine, easy run, or the "cod's head and mackerel tail" principle, and design had not progressed as far as in England. Even very large yachts were centreboarders. In 1845 John C. Stevens built the "Maria," a centreboard sloop 92 ft. in length, which proved very fast.

During the winter of 1850–51, George Steers modelled for a syndicate of six American yachtsmen, headed by John C. Stevens, and all members of the New York Yacht club, a schooner of about 170 tons to go to England in the summer of 1851 and race there at the time of the world's fair of that year. The yacht, named the "America," won the Hundred Guinea cup at Cowes, in a Royal Yacht Squadron race around the Isle of Wight (*see* page 867). In 1857 the surviving owners presented the cup to the New York Yacht club to be held as a perpetual challenge cup for friendly competition between foreign countries. Under its new name, the America's cup became the most coveted yachting trophy in the world. Sportsmen from England and Canada have ventured forth with challenging yachts, but, as the table shown on p. 870 reveals, with no success.

In 1876, the advocates of the shoal-draft boat were given a rude jolt when the new 140-ft. centreboard schooner "Mohawk," built for Commodore W. T. Garner, of the New York Yacht club, was capsized off Staten Island, drowning her owner and several guests. She was lying at anchor with her sails up and sheets made fast when she was struck by a squall and heeled down on her beam ends, where she filled and sank. A few years after the "Mohawk" disaster, A. Cary Smith turned out the sloop "Mischief," called a "compromise sloop," a centreboard boat, but deeper than the skimming dishes, with more shape, and relying not alone on beam for stability. "Mischief," 67 ft. long, successfully defended the America's cup in 1881 against the Canadian centreboard challenger "Atalanta." That same year there arrived in New York from Scotland a little cutter that was to exert a powerful influence on the future of yacht design in America, and that strengthened the growing band of yachting enthusiasts who were looking for something better in design than the wide, shoal centreboarders. This was the "Madge," designed by George L. Watson, a young British designer, and owned by James Coats, of Paisley, who had recently lived in America. "Madge" was a typical British cutter, 46 ft. long over all, 38½ ft. on the water, and only 7 ft. 9 in. beam. She was shipped to New York. That first summer she won nearly all her races against the crack centreboarders, most of them being won without calling on her time allowance. The success of the "Madge" put centreboard advocates on the defensive.

The discussion was still acute when the next challenge for the America's cup was received, in 1885, from the British yacht "Genesta," a typical narrow cutter. There was much difference of



COURTESY OF "YACHTING"

Lines of "Gloriana," designed by Nathanael Herreshoff in 1891, in which the forefoot was cut away entirely, and the forward and after overhangs lengthened.

RECORD OF THE AMERICA'S CUP RACES

Date	Name	Tonnage	Course	Allows	Elapsed time	Corrected time	Wins by
				m. s.	h. m. s.	h. m. s.	m. s.
Aug. 22, 1851	America	170.	From Cowes around Isle of Wight (Aurora Second)	..	10.37.00	10.37.00	18.00
	Aurora	47.			10.55.00	10.55.00	
Aug. 8, 1870	Magic	97.2	N.Y.Y.C. Course (Cambria Tenth)	..	4.07.54	3.58.26	39.12.7
	Cambria	227.6			4.34.57	4.37.38	
Oct. 16, 1871	Columbia	220.	N.Y.Y.C. Course	..	6.17.42	6.19.41	27.04
	Livonia	280.			6.43.00	6.46.45	
Oct. 18, 1871	Columbia	220.	20 m. to windward off Sandy Hook Lightship and return	..	3.01.33½	3.07.41¼	10.33¾
	Livonia	280.			3.06.49½	3.18.15½	
Oct. 19, 1871	Livonia	280.	N.Y.Y.C. Course (Columbia disabled)	..	3.53.05	4.02.25	15.10
	Columbia	220.			4.12.38	4.17.35	
Oct. 21, 1871	Sappho	310.	20 m. to windward off Sandy Hook Lightship and return	..	5.33.24	5.36.02	33.21
	Livonia	280.			6.04.38	6.09.23	
Oct. 23, 1871	Sappho	310.	N.Y.Y.C. Course	..	4.38.05	4.46.17	25.27
	Livonia	280.			5.04.41	5.11.44	
Aug. 11, 1876	Madeleine	151.49	N.Y.Y.C. Course	..	5.24.55	5.23.54	10.59
	Countess of Dufferin	138.20			5.34.53	5.34.53	
Aug. 12, 1876	Madeleine	151.49	20 m. to windward off Sandy Hook Lightship and return	..	7.19.47	7.18.46	27.14
	Countess of Dufferin	138.20			7.46.00	7.46.00	
Nov. 9, 1881	Mischief	79.27	N.Y.Y.C. Course	..	4.17.09	4.17.09	28.20¼
	Atalanta	84.			4.48.24½	4.45.29¼	
Nov. 10, 1881	Mischief	79.27	16 m. to leeward from Buoy 5 off Sandy Hook and return	..	4.54.53	4.54.53	38.54
	Atalanta	84.			5.36.52	5.33.47	
Sept. 14, 1885	Puritan	140.	N.Y.Y.C. Course	..	6.06.05	6.06.05	16.19
	Genesta	80.		0.28	6.22.52	6.22.24	
Sept. 16, 1885	Puritan	140.	20 m. to leeward off Sandy Hook Lightship and return	..	5.03.14	5.03.14	1.38
	Genesta	80.		0.38	5.05.20	5.04.52	
Sept. 9, 1886	Mayflower	171.74	N.Y.Y.C. Course	..	5.26.41	5.26.41	12.02
	Galatea	171.14		0.38	5.39.21	5.38.43	
Sept. 11, 1886	Mayflower	171.74	20 m. to leeward off Sandy Hook Lightship and return	..	6.49.00	6.49.00	29.09
	Galatea	171.14		0.39	7.18.48	7.18.09	
Sept. 27, 1887	Volunteer	209.08	N.Y.Y.C. Course	..	4.53.18	4.53.18	19.23¾
	Thistle	253.94		0.05	5.12.46¾	5.12.41¾	
Sept. 30, 1887	Volunteer	209.08	20 m. to windward off Scotland Lightship and return	..	5.42.56¼	5.42.56¼	11.48¾
	Thistle	253.94		0.06	5.54.51	5.54.45	
Oct. 7, 1893	Vigilant	96.78	15 m. to windward off Scotland Lightship and return	..	4.05.47	4.05.47	5.48
	Valkyrie II.	93.11		1.48	4.13.23	4.11.35	
Oct. 9, 1893	Vigilant	96.78	Course—Equilateral Triangle—30 miles	..	3.25.01	3.25.01	10.35
	Valkyrie II.	93.11		1.48	3.37.24	3.35.36	
Oct. 13, 1893	Vigilant	96.78	15 m. to windward off Scotland Lightship and return	..	3.24.39	3.24.39	0.40
	Valkyrie II.	93.57*		1.33	3.26.52	3.25.19	
Sept. 7, 1895	Defender	100.36	15 m. to windward off Scotland Lightship and return	0.29	5.00.24	4.59.55	8.49
	Valkyrie III.	101.49		..	5.08.44	5.08.44	
Sept. 10, 1895	Defender	100.36	Course—Equilateral Triangle—30 miles	0.29	3.56.25	3.55.56	0.47
	Valkyrie III.	101.49		..	†3.55.09	3.55.09	
Sept. 12, 1895	Defender	100.36	15 m. to windward and return from Sandy Hook Lightship	0.29	4.44.12	4.43.43	
	Valkyrie III.	101.49		..	‡	..	
Oct. 16, 1899	Columbia	102.135	15 m. E.S.E. from Sandy Hook Lightship and return—30 miles	..	4.53.53	4.53.53	10.08
	Shamrock	101.092		0.06	5.04.07	5.04.01	
Oct. 17, 1899	Columbia	102.135	10 m. Triangular from Sandy Hook Lightship—30 miles	..	3.37.00	..	
	Shamrock	101.092		0.06	§		
Oct. 20, 1899	Columbia	102.135	15 m. S. by W. from Sandy Hook Lightship and return—30 miles	0.16	3.38.25	3.38.09	6.34
	Shamrock	102.565		..	3.44.43	3.44.43	
Sept. 28, 1901	Columbia	102.355	15 m. E. by S. from Sandy Hook Lightship and return—30 miles	0.43	4.31.07	4.30.24	1.20
	Shamrock II.	103.79		..	4.31.44	4.31.44	
Oct. 3, 1901	Columbia	102.355	Course—Equilateral Triangle—30 miles	0.43	3.13.18	3.12.35	3.35
	Shamrock II.	103.79		..	3.16.10	3.16.10	
Oct. 4, 1901	Columbia	102.355	15 m. S.S.E. from Sandy Hook Lightship and return—30 miles	0.43	4.33.40	4.32.57	.41
	Shamrock II.	103.79		..	4.33.38	4.33.38	
Aug. 22, 1903	Reliance	108.41	15 m. to windward and return—30 miles	..	3.32.17	3.32.17	7.03
	Shamrock III.	104.37		1.57	3.41.17	3.39.20	
Aug. 25, 1903	Reliance	108.41	Course—Equilateral Triangle—30 miles	..	3.14.54	3.14.54	1.19
	Shamrock III.	104.37		1.57	3.18.10	3.16.13	
Sept. 3, 1903	Reliance	108.39	15 m. to windward and return—30 miles	..	4.28.00	4.28.06	
	Shamrock III.	104.37		1.57	Did not finish.		
July 15, 1920	Resolute	83.5	15 m. to windward off Ambrose Channel Light-vessel and return—30 miles	...	¶Did not finish.		
	Shamrock IV.	93.8		6.40	4.24.58	4.24.58	
July 20, 1920	Resolute	83.5	Course—Equilateral Triangle—distance 30 m. off Ambrose Channel Light-vessel	..	5.31.45	5.24.44	
	Shamrock IV.	94.4*		7.01	5.22.18	5.22.18	2.26
July 21, 1920	Resolute	83.5	15 m. to windward off Ambrose Channel Light-vessel and return—30 miles	..	4.03.06	3.56.05	7.01
	Shamrock IV.	94.4		7.01	4.03.06	4.03.06	
July 23, 1920	Resolute	83.5	Course—Equilateral Triangle—distance 30 m. off Ambrose Channel Light-vessel	..	3.37.52	3.31.12	9.58
	Shamrock IV.	93.8		6.40	3.41.10	3.41.10	
July 27, 1920	Resolute	83.5	15 m. to windward off Ambrose Channel Light-vessel and return—30 miles	..	5.35.15	5.28.35	19.45
	Shamrock IV.	93.8		6.40	5.48.20	5.48.20	
Sept. 13, 1930	Enterprise	128.5	Leeward—windward course 30 m.	No time allowance		4.03.48	2.52
	Shamrock V.	135.				4.06.40	
Sept. 15, 1930	Enterprise	128.5	Triangular course 30 m.			4.00.44	9.34
	Shamrock V.	135.				4.10.18	
Sept. 17, 1930	Enterprise	128.5	Windward—leeward " "			3.54.16	
	Shamrock V.	135.				Did not finish.	
Sept. 18, 1930	Enterprise	128.5	Triangular course " "			3.10.13	5.44
	Shamrock V.	135.				3.15.57	
Sept. 17, 1934	Endeavour	140.	Windward—leeward " "			3.43.44	2.09
	Rainbow	138.				3.45.53	
Sept. 18, 1934	Endeavour	140.	Triangular course " "			3.09.01	0.51
	Rainbow	138.				3.09.52	
Sept. 20, 1934	Rainbow	138.	Leeward—windward " "			4.35.34	3.26
	Endeavour	140.				4.39.00	
Sept. 22, 1934	Rainbow	138.	Windward—leeward " "			3.15.38	1.15
	Endeavour	140.				3.16.53	
Sept. 24, 1934	Rainbow	138.	Leeward—windward " "			3.54.05	4.01
	Endeavour	140.				3.58.06	
Sept. 25, 1935	Rainbow	138.	Triangular course " "			3.40.05	0.55
	Endeavour	140.				3.41.00	
July 31, 1937	Ranger	166.	Windward-leeward " "			4.41.15	17.05
	Endeavour II	165.				4.58.20	
Aug. 2, 1937	Ranger	166.	Triangular course " "			3.41.33	18.32
	Endeavour II	165.				4.00.05	
Aug. 4, 1937	Ranger	166.	Windward-leeward " "			3.54.30	4.27
	Endeavour II	165.				3.58.57	
Aug. 5, 1937	Ranger	166.	Triangular course " "			3.07.49	3.37
	Endeavour II	165.				3.11.26	

*Remeasured. †Disqualified for fouling Defender. ‡Withdrew on crossing line. §Carried away topmast, withdrew. ¶Throat halyard rendered on winch drum, withdrew.

opinion in America as to what type to build to meet the challenger; but a group of Boston yachtsmen, less committed to shoal draft than those around New York, went to a young Boston naval architect, Edward Burgess, and commissioned him to design a large

sloop to defend the cup. Burgess was familiar with the cutter type, recognized its good points, and also knew the centreboard boats as they had developed around Cape Cod. Discarding all tradition, he decided to strike out in a radical way and design a yacht that to him appeared best suited to the conditions to be met, and combining the best points of the cutter with the wider beam and shoaler hull of the centreboard sloops. The result was the "compromise cutter," "Puritan," 81 ft. long on the water. On this length, "Puritan" had a beam of 22½ ft., draft of 8 ft. 8 in., and a centreboard. She had the plumb stem of the cutter and was deep enough to get a beautifully modelled underbody. "Puritan" proved most successful, beating the shoal-draft defender built in New York handily and defeating the cutter "Genesta," the challenger.

These victories made Burgess the most successful designer in America, and the type originated by him grew rapidly in popularity and soon became the recognized American type. "Puritan" was followed in the next two years by the "Mayflower" and the "Volunteer," both by Burgess and each a successful defender of the America's cup. Unfortunately, Burgess died in 1891, at the height of his career, and while still a comparatively young man.

The year that Burgess died, Nathanael G. Herreshoff, of Bristol, R.I., had turned out a yacht that focused the attention of American yachtsmen on the plant at Bristol, owned by him and his brother, John B. Herreshoff, and that was destined again to revolutionize yacht design and to bring fame to American yachts and to the Herreshoff family, which had been building boats on Narragansett bay since Civil War days. This yacht was "Gloriana," in which Herreshoff boldly cut away the forefoot, so that the profile showed an easy sweep from the stem head to the bottom of the keel.

When the next challenge for the America's cup (1893) was received from the Royal Yacht squadron, Herreshoff designed the successful defender, the sloop "Vigilant," 85 ft. on the water. While practically a keel boat, she carried a centreboard, which worked through a slot in the lead keel. After the "Vigilant," N. G. Herreshoff designed the successive defenders for the America's cup up to and including the contest in 1920, when the "Resolute" successfully defended, and Herreshoff became the foremost yacht designer in America, for either large or small yachts.

During this period the length and sail area rule $\frac{\text{L.w.l.}+\sqrt{\text{S.A.}}}{2}=$ rating was in use in America, but the same tendency was apparent in that country, as in England, to develop flat-bodied hulls with long overhangs and light displacement, producing an extreme skimming dish or scow type. This reached its limit in the America's cup defender "Reliance" (1903), which had 53 ft. of forward and after overhangs on a water-line length of 89 ft. Following this match, a conference of yachting organizations, under the lead of the New York Yacht club, adopted (1905) a rule which, while retaining length and sail area as the chief factors, used displacement in the formula and controlled overhangs, draught, freeboard, etc., by penalties. This was called the universal rule. This rule produced a much more wholesome vessel, and while it has been amended several times, it is still (1944) in use in the United States, and all of the America's cup matches since 1930 have been sailed under it. The formula is: 18% of the product of length multiplied by square root of sail area divided by the cube root of displacement = rating.

By 1930, N. G. Herreshoff had retired and the defender that year, "Enterprise," was designed by W. Starling Burgess, a son of Edward Burgess who designed the defenders of 1885, 1886 and 1887. The "Rainbow," successful defender of 1934, was also designed by W. Starling Burgess. When the 1937 defender was built, a young designer, Olin J. Stephens, was called upon to collaborate with Burgess, and the result of their collaboration, "Ranger," was the fastest Class J yacht that had been built up to that time.

The Scow Type and the Seawanhaka Cup.—On certain waters of Canada, notably the St. Lawrence river, and on the lakes of Minnesota and Wisconsin, where conditions are not suited to keel boats, the universal rule is not used, and in these localities the scow type has been developed to a very high state. These boats are extremely flat, drawing but a few inches, having two bilge boards instead of one centreboard, double rudders, and are sailed without ballast. On a reach they are exceedingly fast, and it is claimed that the larger boats sometimes attain a speed as high as 25 mi. per hour in a strong breeze and smooth sea. They are usually sailed in 28-ft., 32-ft. and 38-ft. classes.

The contests for the Seawanhaka cup between 1895 and 1912 did much for the development of the scow type. This trophy was put up by the Seawanhaka-Corinthian Yacht club, of Oyster Bay, in 1895, for international competition between small yachts, when the first race was sailed against an English challenger, "Spruce III," a "half-rater," the defender being the "Ethelwyn," designed by W. P. Stephens. The following year the cup was won by the Royal St. Lawrence Yacht Club of Canada, with an extreme scow named the "Glencairn," designed by G. Herrick Duggan, a young engineer who later became one of Canada's foremost designers. A long series of races followed between U.S., Canada, Great Britain and several European countries.

Later Development of Yacht Design.—During World War I there was very little yacht building in America, and no marked development in design. But following the readjustment period there was a marked increase in interest in all forms of yachting, and larger fleets were to be seen at the principal regattas than previously. In this development the small yacht predominated, due somewhat to the greatly increased cost of running large sailing craft, and to the fact that yacht racing was making a strong appeal to those who wanted to handle their own craft. Therefore, the smaller racing classes were promoted, principally the 31-rating (Class P), 25-rating (Class Q) and 20-rating (Class R) classes, and numerous one-design classes. About 1927 several international rule classes appeared in the United States, the most popular being the 6-metre and 12-metre classes.

One-Design Classes.—As early as the late '90s several racing classes in which the boats of each class were identical in design were formed, and proved popular, both because the boats were, theoretically, of equal speed, and because there was considerable economy in building many boats exactly alike at one time. Some of the earlier of these one-design classes were the Newport 30-ft. class of fin-keel sloops and the 70-ft. class of large sloops, both designed by Herreshoff. There followed, then, a great demand for such classes of yachts of one design. Among the important one-design racing classes in the first 40 years of the 20th century are:

Class	Load water line	Designer
	Feet	
Bar Harbor 31-footers	31	Herreshoff
New York Yacht Club 30-ft. class.	30	"
New York Yacht Club 50-ft. class.	50	"
New York Yacht Club 40-ft. class.	40	"
Larchmont O class	38	Wm. Gardner
Seawanhaka Schooner class	38	Cox & Stevens
Class S One-design	20½	Herreshoff
Victory class	21	Wm. Gardner
Interclub class	19	C. D. Mower
Star class (over 2,000 boats have been built to this class).	16	Wm. Gardner
Marblehead-Beverly (M-B) class	17½	Frank C. Paine
International One-designs	21½	B. J. Aas
10-metre class	36	Burgess & Morgan
Atlantic Class	21¼	Burgess & Morgan
New York Yacht Club 32-ft. Class	32	Sparkman & Stephens
Pacific Coast One-Design	21	G. W. Kettenburg, Jr.
And many smaller classes under 20-ft. water line length		

The North American Yacht Racing Union.—Legislation affecting yacht racing, the rules under which yachts were raced, and measurement rules, up to about 1900, had been in the hands of individual yacht clubs, or local yacht-racing organizations composed of a number of clubs in the same locality. There was thus great lack of uniformity in different sections of the country. At the time of the agitation for a new measurement rule to supersede the "length-and-sail-area" rule, the New York Yacht club took the lead and called a conference of yachting organizations of the Atlantic coast and the Great Lakes to find out what was wanted and to bring about uniformity by getting the other sections to adopt the new rule (the universal rule) that was then being formulated. This was a step forward, but the conference was not permanent in character, and there was no real governing body on yachting affairs in America. To remedy this situation, there was formed in 1925 a union of most of the local yacht-racing associations, and a number of prominent yacht clubs, the guiding spirits in the movement being Clifford D. Mallory and Commodore W. A. W. Stewart, of the Seawanhaka-Corinthian Yacht club. This organization, called the North American Yacht Racing union, was the first permanent legislative and governing body of national scope in America, and through it both the racing and measurement rules have been standardized, and an appeals body for its members formed. In 1927 delegates from this union met with delegates of the International Yacht Racing union, in London, to bring about closer co-operation internationally in yachting affairs. Sensing the value to the sport of international racing, the union recognized, in addition to the universal rule of measurement, the international rule used in European countries, with the result that several international classes such as the 6-metre, 8-metre, and 12-metre were built and became popular in the United States.

Development of Rig.—Probably no one thing has contributed more to the evolution of yachting and the speed of yachts than the development of rigs. Between 1920 and 1940 the science of aerodynamics was applied by naval architects to the design of sail plans, so that the period brought a revolutionary change in yacht rigs. Tall, narrow, triangular sail plans, with a long efficient leading edge, displaced the older gaff rig where the base was longer than the perpendicular. Mainsails became triangular in shape (called Bermudian or jib-headed) and were set on very tall masts with a ratio of hoist to foot of 2 or 2½ to 1. In the case of the Class J yachts (America's cup class), masts were as high as 165 ft. on a water line length of 80 ft. Large fore-triangles and overlapping head sails followed as a natural consequence, and tremendous jibs that overlapped the mainsail by as much as one-third the length of the boom, and were cut flat so as to be used on the wind, came into use. These were called Genoa jibs because the first one used was on a small Swedish yacht racing off Genoa, Italy. So efficient were the new rigs that yachts carrying from 25 to 40% less sail area would have as much or more

driving power and speed as with the larger sail spread. The new rigs were also easier to handle and required a smaller crew to work, while the elimination of the gaff, and the topmast with its fittings, saved weight aloft. Large, full spinnakers, cut like a parachute and with a lot of cloth in them, also replaced the smaller flatter spinnakers, and had tremendous pulling power. As an example of the efficiency of the new rigs, the 1937 America's cup yacht "Ranger" carried only 7,500 sq.ft. of sail, as against the 16,000 sq.ft. of the "Reliance" (1903), yet her average speed around a course was equal to or better than that of the larger yacht.

Cruising Yachts.—The development of cruising yachts in America has followed in a general way the development of the racing type. While no measurement rule had to be considered in their design, it was natural that in hull design the boats should take the same characteristics as the racing craft, especially as they were sailed on more or less protected waters, or along the coast where harbours were frequent. However, shortly after World War I, several designers, notably John G. Alden and William H. Hand, Jr., developed a type of small seaworthy yacht for cruising, embodying many of the characteristics of the New England fishing schooners. These boats were good offshore cruisers, and they quickly became popular, and were soon taking part successfully in long distance and ocean races, such as the one from New London to Bermuda, while several boats of this design, from 50 to 55 ft. long over all, made the Atlantic passage with safety and comfort. This led to the development by designers of a greatly improved type of yacht for ocean and coastwise cruising, with greater seaworthiness and speed.

Ocean Racing.—Long distance racing along the coast, and ocean races, were, until 1930, more popular among American yachtsmen than among those of the European yachting nations. The first transatlantic race was sailed in 1866, between three American schooners, in the month of December, one of them being a centreboarder, and the others keel yachts. The schooners were the "Henrietta," "Fleetwing" and "Vesta," the first winning in the fast time of 13 days 21 hr. and 45 min. The greatest ocean race ever sailed was in 1905, when 11 large yachts raced from Sandy Hook to Land's End, England, two being British, one German, and the rest American. It was won by the American three-masted schooner "Atlantic" in 12 days 4 hr. 1 min., for the course of 3,013 mi., still the record in 1944.

About 1905 ocean racing in small yachts was inaugurated by the late Thomas Fleming Day to demonstrate that small boats, properly designed, built and handled, could keep the sea with safety. He inaugurated the race from New York to Bermuda, and later, one to Havana for power craft. Interest lapsed after 1909, but in 1923 the Bermuda race was revived and was sailed every two years until World War II put a stop to ocean sailing. The race grew in popularity, and between 1930 and 1938 no fewer than 35 to 45 small yachts sailed in every race, including entries from Great Britain and several of the European countries. The race was responsible for the development of a special type of ocean-racing yacht, largely due to the success of "Dorade" and "Stormy Weather" designed by Olin J. Stephens, and to yachts of other designers who were turning out boats for these races that were both seaworthy and fast. The Cruising Club of America has been chiefly instrumental in fostering this type of racing in America, and has developed a measurement rule for ocean racers under which the yachts are rated. In Great Britain the Royal Ocean Racing club was formed in 1926 and the following year inaugurated a 600-mi. ocean race around Fastnet rock, off the southern coast of Ireland, called the Fastnet race, which did much to promote interest in the sport in that country. On the Pacific coast the principal ocean race, for which a permanent cup has been put up, is one from the California coast to Honolulu, Hawaiian Islands, a distance of about 2,200 mi. This is sailed every two years. In 1928 a transatlantic race from New York to Spain was sailed, with nine entries. In 1931 a race from the United States to Plymouth, England, brought out 10 entries under 72 ft. in length and was won by "Dorade," only 39 ft. long on the water, which made the phenomenal time of 17 days 2 hr. In 1935 a race from Newport to Norway was won by the "Stormy Weather," 40 ft. on the water, over a course of 3,118 mi. in 19 days 5 hr. During the decade 1930–1940 while interest in yacht sailing increased in all the yachting countries, those years saw a gradual change in the aspect of the sport, with a great increase in the popularity of the small yacht and the passing of the large yacht requiring a big professional crew. More and more the sport was becoming Corinthian in character and yachtsmen were sailing their own boats, dispensing as far as possible with paid hands on whom they were dependent to handle the yacht. The day of the large yacht has passed, and in its place many small or medium sized yachts up to some 70 ft. overall length are bringing many more men into the sport of both racing and cruising. Also, the day of the large steam and power driven yachts seems to have passed, and in the place of these expensive vessels yachtsmen are turning to smaller, standardized or custom-built power boats and cruisers, either diesel or gasoline (petrol) powered, that are economical to operate and seaworthy, and offer comfortable accommodations in small sizes. (H. L. St.)

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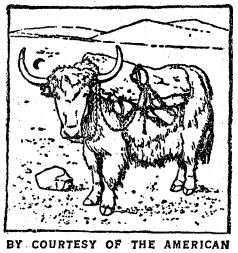
YAHGAN, an Indian tribe, now almost extinct, that occupies the south coast of Tierra del Fuego and the adjacent islands southward to Cape Horn. Hence they are the southernmost people in the world. That they have lived in the same region for many centuries is attested by great middens which cover their camping places. Yahgan life before the European settlement was extremely simple. In spite of the cold climate their chief garment was a single seal or other skin, which they wore on the windward shoulder. Their houses were usually small domed affairs of saplings covered with bark and grass or sealskins. Their canoes, peculiar for their high pointed ends and a fireplace amidships, were constructed of the bark from a beech tree. Their manufactures included baskets of several weaves, harpoons, spears, shell necklaces and simple tools. Their diet embraced shellfish, seal, whale, various birds, a few berries and several kinds of fungi. The Yahgan had no organized tribal life or recognized leaders. Each family, often including several wives, was a law unto itself, wandering at will and rarely camping in one place for more than a few days. At times, groups of relatives would assemble to perform elaborate initiation ceremonies for both the boys and the girls, who were forced to undergo various privations, to have their courage tested by masked apparitions, and to learn the tribal lore. It has been asserted that the Yahgan have no religion. However, they believe in evil spirits, who must be propitiated by their medicine men, and they also reverence a supreme God. Their mythology is surprisingly rich. (S. K. L.)

THE WILD YAK (BOS GRUNNIENS)

YAK, the wild (and domesticated) ox of the Tibetan plateau; a species allied to the bison group. The yak, *Bos grunniens,* is one of the largest of oxen, characterized by the growth of long shaggy hair on the flanks and under parts of the body and the well-known bushy tail. The wild species is black in colour. Domestic yaks are often black and white, and small-sized breeds exist. The magnificent half-tamed animals kept by the natives of the elevated Rupsu plateau, south of the Indus, afford the only means of transport by this route between Ladak and India. But even these are inferior to the wild yak, which stands nearly 6 ft. at the shoulder and is confined to the arid plateau of Tibet.

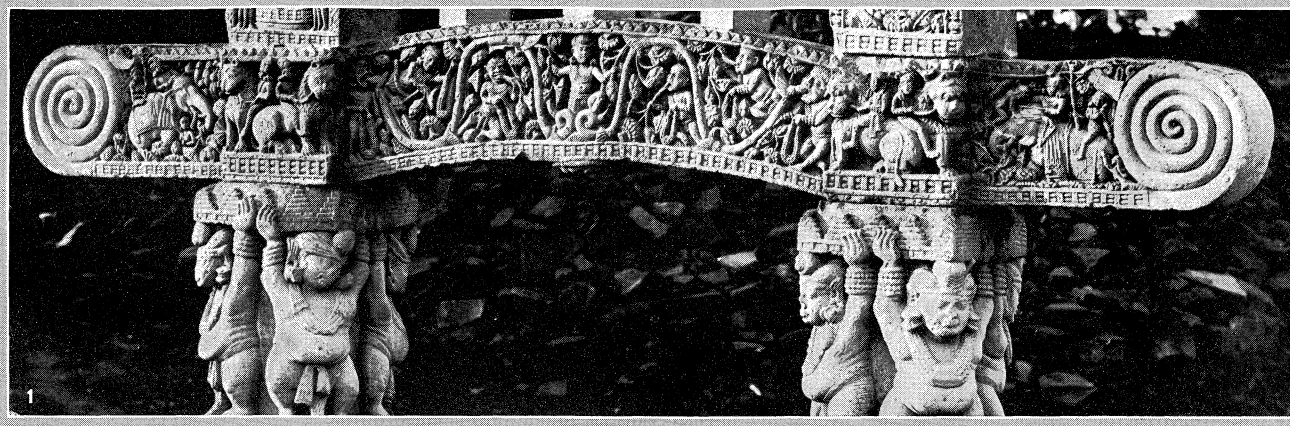


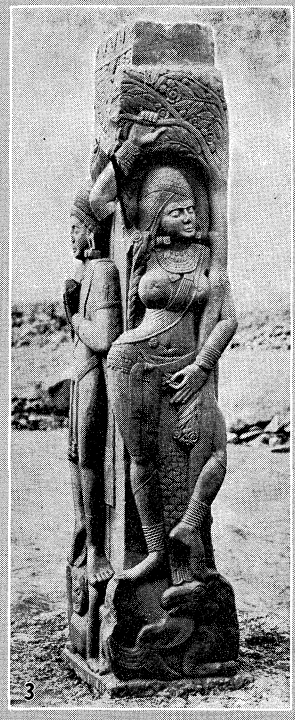
BY COURTESY OF THE AMERICAN MUSEUM OF NATURAL HISTORY

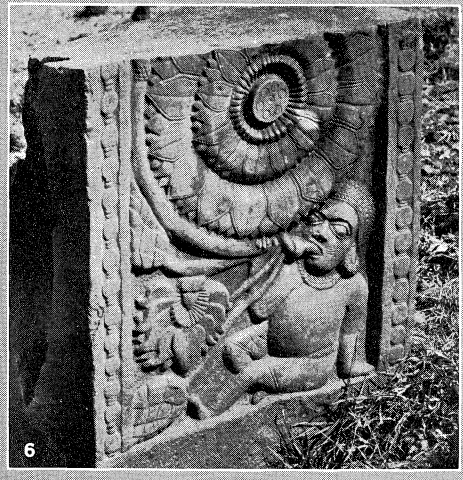
DOMESTICATED YAK

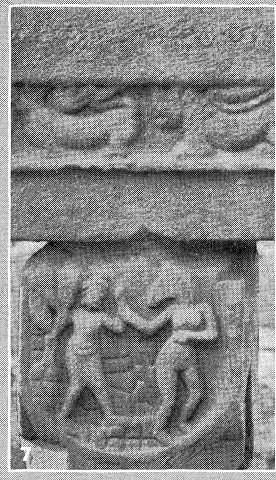
YAKIMA (yăk'ĭmą), a city of south-central Washington, U.S.A., on the Yakima river, at an altitude of 1,065 ft.; the county seat of Yakima county. It is on federal highways 97 and 410; has a municipal airport of 360 ac.; and is served by the Northern Pacific and the Union Pacific railways, and by electric interurban and motorcoach lines. Pop. 1940 by federal census 27,221 (92% native white). Yakima is the metropolis of a productive region of diversified agriculture, formerly a sagebrush desert, which owes its prosperity to reclamation by federal and private projects with 500,000 ac. under irrigation and an additional 72,000 ac. under construction. Apples and other fruits are leading crops, but potatoes, green vegetables, livestock, grain, hay and dairy products are also important. The ten-year average of farm and industrial products shipped out of Yakima county amounts to 48,000 carloads, valued at $38,000,000. The county has cold-storage facilities with a capacity for 12,000 carloads, and manufacturing industries including lumber

YAKṢAS









BY COURTESY OF (2) THE MUSEUM OF FINE ARTS, BOSTON, (8-10) A. K. COOMARASWAMY

STATUES OF YAKṢAS OR INDIAN DEITIES

1. Yakṣas, or deities, spouting lotus rhizome and flowers, and as Atlantes (Sāñcī 1st cent. B.C.). 2. Yakṣī, or dryad, under a tree (1st cent. A.D.—Museum of Fine Arts, Boston). 3. Chāndī Yakṣī (2nd cent. B.C.—Indian Museum, Calcutta). 4. Gangita Yakṣa (2nd cent. B.C.—Indian Museum, Calcutta). 5. Yakṣas Atlantes forming capital of column supporting arch of gate (Sāñcī 50 B.C.). 6. Yakṣa spouting lotus rhizome and flowers (from Bharhut 2nd cent. B.C.—Indian Museum, Calcutta). 7. Assamukhī Yakṣī (Bodhgaya 100 B.C.). 8. Kubera Yakṣa (1st–2nd cent. A.D.—Archaeological Museum, Mathurā). 9. Yakṣī carrying food and water (1st–2nd cent. A.D.—Archaeological Museum, Mathurā). 10. Yakṣa under tree (1st–2nd cent. A.D.—Archaeological Museum, Mathurā)

and canneries produce over 90 different commodities having an output during 1939 valued at $10,150,000. Bank clearings in 1940 totalled $57,975,277. The Central Washington District fair is held at Yakima annually in September. Ten miles south of the city is the northern border of the Indian reservation, and the entrance to Rainier national park is 50 mi. N.W. The city was incorporated in 1886 under the name of North Yakima. In 1900 the population was 3,154, and this increased to 14,082 by 1910. "North" was dropped from the name in 1917.

YAKṢAS. The Sanskrit designation *Yakṣa,* of uncertain derivation, is applied upon occasion to practically every Indian deity, and even to the Buddha, in an honorific sense. Later, in sectarian and especially in Buddhist literature, the Yakṣas are represented in the interests of edification either as devoted assistants and defenders of the faith, or as inferior beings of an ogre type. More generally we may say that Yakṣas are supernatural beings, deities of varying rank, who have once been men, and will be reborn again on earth. Generally speaking benevolent, they are closely connected with vegetation, human fertility and wealth; they are essentially tree spirits, others being more like gnomes; they possess magic powers, especially that of concealment.

The cult of Yakṣas seems to have been at one time the dominant aspect of popular religion in India; it may be described as an early form of devotional Hinduism, perhaps going back to a period in history contemporary with the Vedas. In the Atharva Veda and in certain Upaniṣads the Brahman itself is called "a great Yakṣa," and the indwelling spirit in Man a "self-like Yakṣa." The individual Yakṣas are for the most part local and tutelary deities; the Śākyas, for example, worshipped the Yakṣa Śākyavardhana. "He who prospers the Śākyas." Other Yakṣas are the guardian angels (*ārakkhadevatā*) of individuals. Others called Guhyakas are earth spirits who function as the bearers of vehicles and as supporters of buildings, like Atlantids. The chief of the Yakṣas is Kubera or Vaiśramaṇa, who is mentioned already in the Atharva Veda, and is best known as the great king who is regent of the north, where are his heaven, palaces and groves. He is essentially a god of wealth; his chief symbols are a lotus and a conch represented as fountains of money; as a tree-spirit he is associated with the banyan (*see* Plate, fig. 8). Another great Yakṣa is his generalissimo, Maṇibhadra. A group of 28 Yakṣa kings is mentioned in more than one place, but the total number of Yakṣas mentioned in the literature is very large. Many have come to be regarded as local manifestations of higher Brahmanical deities, especially Śiva. Kāmadeva, the god of love, belongs appropriately to the Yakṣa class; his symbol, the *makara* (mythical crocodile), represents the waters, or rather an essence in the waters, identical with the sap of trees, the water of life (*amṛta*).

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YAKUB KHAN (1849–1923), ex-amir of Afghanistan, son of the amir Shere Ali, was born in 1849. He showed great ability at an early age, and was made governor of Herat by his father, but broke into open rebellion against him in 1870, and was imprisoned in 1874 in Kabul. However, when Shere Ali in 1878 fled before the British, he handed over the government to Yakub, who, on his father's death in the following February, was proclaimed amir, and signed a treaty of peace with the British at Gandamak. He agreed to receive a British resident, and was in turn to receive a subsidy and support against foreign attack. But in September of the same year his revolted troops attacked the British residency, and the resident, Sir Louis Cavagnari, and his staff and suite were cut to pieces. This outrage was instantly avenged, for in October Earl (then Sir Frederick) Roberts with a large force defeated the Afghans on the 6th and took possession of Kabul on the 12th. Yakub Khan thereupon abdicated, took refuge in the British camp, and was sent to India on Dec. 13. He died at Dehra in the United Provinces on Nov. 15, 1923.

YAKUTSK, an autonomous S.S.R. formed in 1922, stretching from the Krasnoyarsk territory on the west to the Khabarovsk territory on the east, and from the Arctic ocean on the north to about lat. 54° N.

It covers 1,169,927 sq.mi. and is therefore almost equal in size to European Russia, but its total population in 1939 was roughly 400,544.

The region is the least explored in the U.S.S.R., and has a tragic history of disaster overtaking many scientists whose efforts to investigate this inhospitable region have given us what information is available.

A geological expedition sent out to the Aldan watershed by the soviet government in 1926 nearly perished of starvation and records that the price of salt was 4 grams of gold for 400 grams of salt and that meat cost 30 to 40 grams of gold per kilogram.

Physical Features.—Much of Yakutsk is occupied by the basin of the Lena (*q.v.*). The Lena forms the eastern marginal river to that ancient block along the edge of which the Yenisei (*q.v.*) flows in the west.

It flows in a true valley of erosion of very great age and is not confined by mountains except near its mouth, where the Khara-ulakh range, a spur of the folded mountains of the Verkhoyansk arc, rises on its right bank and deflects its course, while subsidiary fold lines affect the lower courses of the Olenek and the Anabar to the west.

To the north lies a broad tundra belt sloping to the Arctic, from which rise four domes of basic eruptive rock.

Climate.—The soils of the republic are not favourable to cultivation; a broad belt south of the Arctic consists of dry clayey, stony tundra soil, merging southwards into forest tundra soil and then into the ash coloured alkali forest soils of the south, while there are belts of silty bog soils on the mountains. Along the banks of the Lena and Olekma, are strips and patches of fertile alluvial soils.

The climate is severe and extreme, and Verkhoyansk (67° 50′ N., 133° 50′ E.) has the greatest annual range of temperature in the world; its average January temperature is −59° F., absolute minimum −94° F., average July temperature 60° F., absolute maximum 93° F.

The fact that this cold pole lies so far east shows that the Atlantic has much more moderating influence than the Pacific, the latter being shut off by mountains, and also having strong prevailing off-shore winds. The change of temperature between the seasons is sudden and there is a drop of 40° F. between October and November.

At Yakutsk in lat. 62° 1′ N., winter is still extremely long and severe. The average January temperature is −46° F. and the river is frozen from Nov. 12 to June 10 in most years.

Occupations.—The Skoptsi, an exiled religious sect, settled in Yakutsk in the '60s of the 19th century and introduced agriculture in the neighbourhood of Olekminsk and Yakutsk. The clean, well-built Skoptsi villages are in striking contrast to the dirty Yakutsk settlements.

Barley occupies 53%, spring rye 27% and wheat 11% of the grain harvest. Potatoes, turnips and cabbages thrive and cultivation is slowly spreading in the alluvial patches of the Lena and Aldan, though the disturbed post-1917 conditions temporarily checked progress.

The limit of cultivation here extends to 63.5° N. and during 1898–1917 the sown area was trebled, many of the Yakuts sowing patches of grain.

Meadowland is important. Cattle and horse breeding is successful as far north as Yakutsk; both horses and cattle are short, long-haired and very hardy. The milk yield is small, but of good quality. There are no sheep or pigs.

North of this agricultural region is the region of the nomad reindeer breeders, relying entirely on their herds, while in some regions there is no reindeer-breeding and the natives rely on fish.

Ivory.—An important product is mammoth ivory. The mammoth (*Elephas primigenius*) existed in comparatively recent times in great numbers in the polar region of Siberia and entire carcasses, with flesh, skin, fur and congealed blood in the veins have

been found in the region.

Mammoth ivory is mentioned by Pliny and its existence was known to the Russians in 1582.

Mines.—Gold is the main product of the republic. It has been known to the Russians since the mid-19th century, when it was worked in the Olekma mines, later abandoned. The Aldan mines were re-opened in 1923. The gold here is easily worked, being on or near the surface, but there are great difficulties of transport and the miners are often unable to procure the necessities of life.

In 1914 a fresh source at Nyukhinsk was discovered.

Iron ore is worked in an entirely primitive way and smelted by the Yakuts to make hunting knives. They were capable smiths long before the coming of the Russians. Coal of recent origin and poor quality extends over a belt of 1,200 mi. north and south of Yakutsk, but is little used.

There is an area of curative mud on the Lena river with a high percentage of iron and aluminum, and a health resort is planned. Sulphur springs exist in many places, especially near Parsheva, and jasper and carneol are found below Zhigansk, where there is iron, coal and platinum.

Spars, amber, graphite, gypsum, crystal and emerald are reported, but unworked.

Population.—The Yakuts are a Turkic branch of the Ural-Altaic stock and their language closely resembles that of the Turks. A Yakut grammar by Boethlingk was published in 1851. They are thick set, brachycephalic, with dark eyes and hair, narrow foreheads, broad noses and long narrow eyes.

The Yakuts form 85% of the population, and the Russians, mainly in the Aldan mining region and in Yakutsk, form 11%. There are also Chinese and Koreans in the mining district. Half the population of the republic live in or near Yakutsk. In former times *brodyagi* or escaped convicts were a great terror in the district, and there has been much intermixture with Russian exiles, convicts and traders.

The Tungus are another branch of the Ural-Altaic group, as are the Lamuts.

The Yukaghir are a Palaeo-Siberian tribe, mainly found now between the Kolyma and Indigirka rivers and occupied in hunting and fishing. They are very short, with yellow or brown complexion, dark eyes and hair, and scanty beards. They are fast dying out, especially since the advance westwards of the Chukchee has lessened the number of wild reindeer. The latter tribe is spreading westward from the Khabarovsk territory (*q.v.*).

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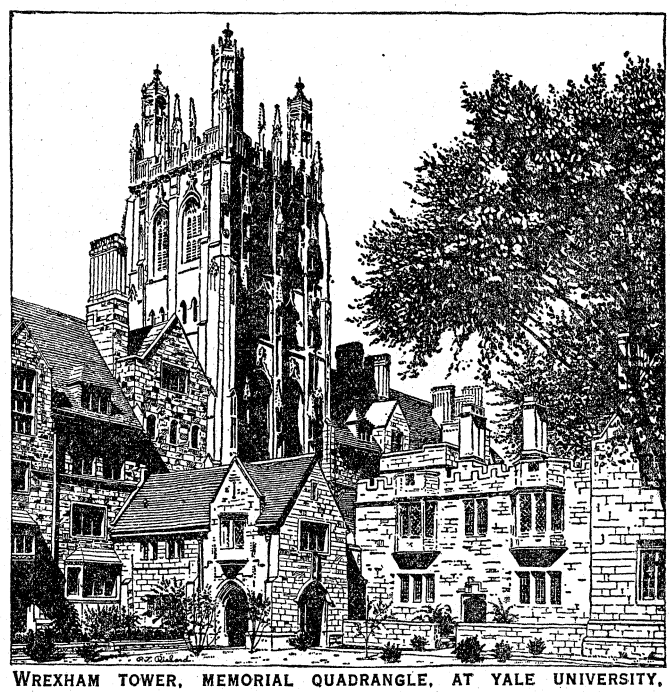
YAKUTSK, a town of Asiatic U.S.S.R., the administrative centre of the Yakutsk A.S.S.R., situated 2 mi. from the river Lena, here 9 to 11 mi. wide, on its left bank, in 62° 5′ N., 129° 4′ E. Pop. (1939) 23,000. The alluvial soil on which it is built is frozen all the year round, but thaws to a depth of 3 or 4 ft. in summer, when the streets become quagmires. Many mud huts exist, though there are some brick houses, and the schools, churches and official buildings are of brick; some wooden houses are built on high platforms as a protection against the June floods, when the ice breaks on the river, which remains open till November.

Winter sledge tracks radiate from the town to the sea of Okhotsk, Vilyuisk, the Kolyma and to Irkutsk (1,165 mi.). There are no good roads. Air communication with the town, however, lessened its isolation. Between the town and the Aldan are meadow lands with sandy sub-soil and scattered clumps of birch, willow and spruce.

The fort was founded in 1632, and the town later became a centre for the trade in furs, mammoth ivory, reindeer hides and cattle.

The policy of education in the vernacular has been encouraged.

YALE UNIVERSITY, the third oldest institution of higher education in the United States, situated at New Haven, Conn. In 1700 the needs of New England in the way of higher education were supplied by Harvard college, at Cambridge. Massachusetts Bay Colony was naturally the chief patron of Harvard, but Connecticut bore her full share in support of the enterprise. The two commonwealths, however, diverged to some extent in their theo-



WREXHAM TOWER, MEMORIAL QUADRANGLE, AT YALE UNIVERSITY, DESIGNED ON THE LINES OF WREXHAM CHURCH IN WALES, WHERE ELIHU YALE, FIRST DONOR TO THE COLLEGE, IS BURIED

logical and political development and there arose the desire for a separate college in Connecticut. The first distinct traces of this scheme appear in the early summer of 1701, in the neighbourhood of New Haven. The Rev. James Pierpont (Harvard, 1681), minister of the New Haven church, was the chief promoter.

The General Court of the Colony met at New Haven on Oct. 9, 1701, and a charter was granted (probably on Oct. 16) "for the founding, suitably endowing and ordering a Collegiate School within his Majesty's Colony of Connecticut." The founders chose the Rev. Abraham Pierson of their number as rector of the Collegiate school and it was at his parsonage in Killingworth that the first scholar sought admission in March 1702.

The school continued at Killingworth, with the annual commencements at Saybrook, until the death of Rector Pierson on March 5, 1707. From 1707 to 1716, although the commencement exercises were held annually at Saybrook, the students resided in the several towns where their tutors were established. It was not until a gift of nearly 1,000 volumes of great value was secured by Jeremiah Dummer, the agent for Connecticut at London, that a building for the school became necessary. After much argument it was decided to establish the institution at New Haven. A cargo of gifts for the Collegiate school, from Elihu Yale, former governor of Ft. St. George, Madras, India, and a native of Boston, including, besides books, East India goods which were sold in Boston for £562.12s., led the trustees to use the name Yale college at the first commencement (1718) in the completed college building.

President Clap secured the passage in 1745 of a new charter which legalized the name "Yale College" and in general provided a more explicit and liberal statement of powers and privileges conferred in 1701 and 1723. The organization of a College Church in 1757 provoked much criticism and revived the struggle to bring the college under the control of the legislature.

The charter drawn up by President Clap is still in force. In 1792 the governor and lieutenant governor of the State and six senior State senators were made *ex officio* members of the cor-

poration. In 1872 the six senators were replaced by six graduates, chosen by the alumni. The act authorizing the name Yale university was passed in 1887.

The curriculum of the college changed but little before the administration of Timothy Dwight the Elder (1795–1817), who expanded the usefulness of the college by the organization of professional schools. Benjamin Silliman, Sr. (1779–1864), was appointed to the first chair in chemistry, mineralogy and geology in the United States in 1802. In 1810 a medical department was established, and the theological and law departments were organized in 1822 and 1824.

Under the administration of Theodore Dwight Woolsey (1846–71) graduate courses were organized in 1846 and the Graduate school (under the title Department of Philosophy and the Arts) was established the following year. The degree of Doctor of Philosophy was first conferred in the United States by Yale in 1861. In 1847 courses in applied chemistry were offered and in 1852 instruction in engineering. Two years later these courses were distinguished as a separate section with the title "Yale Scientific School," which was changed in 1863 to "Sheffield Scientific School" in appreciation of the assistance of Mr. Joseph E. Sheffield, of New Haven, who endowed the school in 1860. From 1863 to 1892 this school was also the State college of agriculture and applied arts. The School of Fine Arts, established through the generosity of Augustus R. Street, was opened to students in 1869, the first of its kind to come within the scope of any university. The elective system of instruction in Yale college was substituted for the fixed curriculum in 1876.

During the presidency (1886–99) of Timothy Dwight, grandson of the former President Dwight, the institution more than doubled in resources, faculty and student enrolment. The School of Music was established in 1894, and its resources have been augmented through the patronage of Joseph Battell, Albert Arnold Sprague and his daughter, Mrs. Elizabeth Sprague Coolidge.

An outstanding feature of the administration of Arthur Twining Hadley (1899–1921) was the development of the university idea co-ordinating the various schools and departments. The School of Forestry, the oldest forest school in continuous operation in the United States, was founded in 1900, as the result of the gifts of James W. Pinchot and his family.

Under President James Rowland Angell (1921–37) the university expanded rapidly. A School of Nursing was established in 1923 by a gift from the Rockefeller foundation; in 1924 endowment was provided by Edward S. Harkness for a department of drama and a university theatre; the Institute of Human Relations was organized in 1929; and in 1932 the School of Engineering was re-established. In 1937 Pres. Angell resigned and was succeeded by Charles Seymour. The establishment in 1933 of residential colleges, designed to regain for undergraduates in a large university the educational and social advantages inherent in small groups of students, is the most important recent development at Yale. This was made possible by gifts from a Yale graduate, Edward S. Harkness. There are nine colleges (Berkeley, Branford, Calhoun, Jonathan Edwards, Pierson, Saybrook, Timothy Dwight and Trumbull), each providing accommodations for from 160 to 200 undergraduates during the last three years of the course. The Master of each college lives in a house attached to the college quadrangle. He is assisted in the work and life of the college by a group of faculty members who are Fellows of the college and have their studies and, if unmarried, their living quarters in the quadrangle. The Master and Fellows assist in guiding the undergraduate in his choice of courses, in his supplementary reading, and in general preparation for the examinations at the end of senior year.

The board of trustees, called the Yale corporation, consists of the president of the university, the governor and lieutenant governor of Connecticut, ten Fellows known as the successors of the original trustees, and six graduates elected for six-year terms. The corporation has five administrative officers, the president, provost, secretary, treasurer and associate treasurer and controller. The general administration of each school of the university is in the hands of a dean and a board of professors on permanent appointment, subject to the approval of the corporation. The teaching in the university is divided among 40 departments of study which serve the various schools. All members of these departments who are of professorial grade are grouped in four divisions: language, literature and the arts; history and the social sciences; mathematics and the natural sciences; and engineering. Courses of study in candidacy for degrees in course are offered in eleven schools: Yale College, Sheffield Scientific School, School of Engineering, Graduate School, School of Medicine, School of Law, Divinity School, School of the Fine Arts, School of Music, School of Forestry, School of Nursing.

The course of study in Yale College is designed to provide for substantial mastery of some one field of liberal arts together with an intelligent acquaintance with allied subjects. The Sheffield Scientific School provides for concentration in the principal fields of science, and the School of Engineering offers training in chemical, civil, electrical and mechanical engineering and metallurgy. In addition to preparation for the practice of medicine the School of Medicine offers courses leading to degrees in public health. The School of the Fine Arts offers four professional courses, architecture, drama, painting and sculpture, in which lectures are combined with technical practice. The School of Music admits those who intend to become musicians by profession, or to enter the field of musical criticism and literature of music. The curriculum of 32 months in the School of Nursing is open to women graduates of approved colleges and leads to the degree of Master of Nursing. Properly qualified women are admitted to all schools except the undergraduate schools and the School of Forestry.

The University library, including departmental collections, had a total (1936) of over 2,500,000 volumes and pamphlets. Besides gifts in the early years of the college, particular mention should be made of the Aldis collection of American *belles lettres,* the Elizabethan Club library of Shakespeare quartos and folios, the Henry R. Wagner collection of British and Irish economic and historical tracts, the William S. Mason collection of Benjamin Franklin and the Ezra Stiles manuscript diaries and itineraries. Other important collections are the Penniman library of education, the William A. Speck collection of Goetheana, the Albert S. Wheeler Roman law library, the Lowell Mason music library, the Frederick S. Dickson collection of Fielding's works, the Scandinavian library of Count Riant, the Curtius and Seymour libraries of classical literature, the Robert von Mohl library of political science, the Edward M. House collection of historical papers and the J. Sumner Smith Russian library. Among its rare volumes the library has a copy of the Gutenberg 42 line Bible.

The collections of the Gallery of Fine Arts include the Jarves collection of Italian primitives (13th to 17th centuries); the Trumbull collection of paintings and miniatures; the Rebecca Darlington Stoddard collection of Greek vases; *objects discovered at Gerasa and Dura-Europos;* the Mabel Brady Garvan collection of American arts and crafts; and the Achelis, Herr, and Callender collections of prints. The collections of the Peabody museum (1866) embrace the major fields of natural history.

The Yale university press was founded in 1908 for the publication of works having permanent interest and value. Since 1926 the Yale university press has published the *Yale Review* (1892), a national quarterly owned by the university. The university also publishes the *American Journal of Science* (1818), the oldest scientific publication in the United States, founded by Prof. Benjamin Silliman. The publications which are under the direction of students are the *Yale Law Journal; Yale Literary Magazine* (founded in 1836), the first undergraduate publication in the country; the *Yale Daily News* (1878), the oldest daily; the *Yale Record,* a humorous monthly; and the *Yale Scientific Magazine.*

In 1936 there were 865 officers and instructors and 732 assistants in instruction and administration. The students registered as candidates for degrees numbered 5,096; of this total 3,057 were undergraduates and 1,939 students in the graduate and professional schools. There were also 397 students who were not enrolled as candidates for degrees or certificates. The buildings number about 100. Connecticut hall (1752), a four-storey brick

building with gambrel roof, called South Middle college, is the only building remaining from the 18th century. The university funds on June 30, 1936, amounted to $99,993,785.21 ($21,181,302.17 in 1918), exclusive of land and buildings valued at $70,000,000 and of funds and property amounting to $1,082,488.30 held by the Sheffield trustees. The total income in 1935–36 was $6,769,371.46.

In 1936 there were 31,003 living degree holders and 11,906 non-graduates, the majority resident in the North Atlantic division, but other sections of the country were well represented, as well as foreign countries. The division according to occupations shows a preponderance in the fields of law, education, medicine, ministry, engineering, banking, industry and commerce.

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YALU, BATTLE OF THE. This was the opening battle on land of the RUSSO-JAPANESE WAR, and is described under that heading. Fought on May 1, 1904, by Gen. Kuroki's I. Army, advancing from Korea, the Japanese success was a valuable moral tonic and created a profound impression in Europe.

YAM, a term usually applied to the tubers of various species of *Dioscorea* of the monocotyledonous family Dioscoreaceae. These are plants with thick tubers (generally a development of the base of the stem), from which protrude long, slender, annual climbing stems, bearing alternate or opposite, entire or lobed leaves and unisexual flowers in long clusters. The flowers are generally small and individually inconspicuous, though collectively showy. Each consists of a greenish, bell-shaped or flat perianth of six pieces, enclosing six or fewer stamens in the male flowers, and surmounting a three-celled, three-winged ovary in the female flowers. The ovary ripens into a membranous capsule, bursting by three valves to liberate numerous flattish or globose seeds. The species are natives of the warmer regions of both hemispheres.

D. sativa and *D. alata* are the species most widely diffused in tropical and subtropical countries. *D. esculenta,* grown in India, Cochin China and the South Sea islands, is one of the best kinds. *D. batatas,* the Chinese yam, or Chinese potato, is hardy in Great Britain, but the great depth to which its enormous tubers descend renders its cultivation unprofitable. It has deeply penetrating, thick, club-shaped, fleshy roots, full of starch (about 13% of the fresh weight) which when cooked acquire a mild taste like that of a potato; they grow 3 ft. or upwards in length, and sometimes weigh more than 1½ lb. The plant grows freely in deep sandy soil, moderately enriched. The tubers of *D. alata* sometimes weigh 100 lb. Most of the yams contain an acrid principle, which is dissipated in cooking. The only European species is *D. pyrenaica,* a native of the Pyrenees, a remarkable instance of a species growing at a long distance from all its congeners. In North America there is a single native species, *D. villosa,* called wild yam-root or colic-root. This is found from Rhode Island to Ontario and Minnesota and southward to Florida and Texas, but is of no economic value. True yams must not be confounded with the sweet potato, *Ipomoea batatas.* "Moist-fleshed" varieties of sweet potato are often erroneously called yams in the United States. True yams are rarely grown in the United States, and then only in the southernmost part.

For the history of the yam, and its cultivation and uses in India, *see* G. Watt, *Dictionary of the Economic Products of India,* iii. (1890).

YAMA, in Vedic Hindu mythology the twin of his sister Yamī, and with her the first human pair. Yama is king of the dead, and later, their judge. The word is Sanskrit for "twin."

YAMAGATA, ARITOMO, PRINCE (1838–1922), Japanese field-marshal, was born in Choshu. He began life as an ordinary *samurai* and rose steadily in reputation and rank, being created a count in 1884, a marquess in 1895 (after the war with China) and a prince in 1907 (after the war with Russia). He twice held the post of premier, and was the leader of Japanese conservatism, being a staunch opponent of party cabinets. He died at Odawara on Feb. 1, 1922.

YAMAMOTO, TATSUO, BARON (1856–), Japanese statesman, was born in Oita-ken, and educated at Keio. After some time in a business career he entered in 1890 the Bank of Japan of which he was appointed director and then governor (1898–1903). In 1910 he became governor of Hypothec Bank of Japan. He was made minister of finance in 1911–1912, minister of agriculture and commerce in 1913–1914, and again in 1918–1922. At that time he belonged to the Seiyukai Party, but in 1924 he seceded and established a new party, Seiyuhonto, with Tokonami, as leader, becoming himself the adviser to the party. When the Kenseikwai and Seiyuhonto parties united to form the Minseito, in 1927, he became adviser to the new party. He was made crown member of the house of peers in 1903, created baron in 1920, and was minister for home affairs (1932–34).

YAMBOL, a town of Bulgaria, on the river Tunja, 49 m. W. of Burgas by rail, and an important corn growing centre. Pop. (1934) 25,125. In the town are the remains of old fortifications, and the ruins of a fine mosque. Yambol is first mentioned in the 11th century, when it was known by the Byzantines as Hyampolis.

YAMETHIN, a town and district in the Mandalay division of Burma. The town has a station on the railway 275 m. N. of Rangoon on the main line to Mandalay. It is an important centre of trade with the Shan States. The district lies between the Shan States and the Meiktila, Magwe and Toungoo districts and comprises the Sittang valley in the centre, the Pegu Yomas on the west and the forested Shan hills on the east. Area, 4,196 sq.m.; pop. (1931) 390,820, showing an increase of 67,631 in the decade. The staple crop is rice, which is irrigated from tanks and canals. Millets and oil-seeds are grown in the north, where drought has more than once caused distress. Besides the chief town, Pyinmana and Pyawbwè, both also on the railway, carry on an active trade with the Shan States. Pyinmana has a forest school, and from Pyinmana a branch railway now crosses the forested Pegu Yomas to the Magwe district.

YANCEY, WILLIAM LOWNDES (1814–1863), American political leader, son of Benjamin Cudworth Yancey, lawyer of South Carolina, was born in Warren county, Ga., on Aug. 10, 1814. He attended Williams college for one year, studied law at Greenville, S.C., and was admitted to the bar. He was elected in 1841 to the State house of representatives, became State senator in 1843 and in 1844 was elected to the national House of Representatives to fill a vacancy, being re-elected in 1845. In 1846 he resigned his seat, and devoted himself to the resistance of anti-slavery aggression. In 1848 he secured the adoption by the State Democratic convention of the so-called "Alabama Platform," declaring that it was the duty of Congress not only to allow slavery in all the territories but to protect it, that a territorial legislature could not exclude it, and that the Democratic Party should not support for president or vice president a candidate not openly opposed to the exclusion of slavery from the Territories. When the Democratic convention in Baltimore refused to incorporate his ideas into the platform, Yancey with one colleague left the convention. He opposed the Compromise of 1850, and went so far as openly to advocate secession. In 1858 he advocated the appointment of committees of safety, the formation of a league of united southerners, and the repeal of the laws making the African slave-trade piracy. He attended the Charleston convention of the Democratic Party in April 1860, and again demanded the adoption of his ideas. Defeated, he again left the hall, followed by the delegates of Alabama, Mississippi, Louisiana, South Carolina, Florida, Texas and two of the three delegates from Delaware. On the next day the Georgia and a majority of the Arkansas delegation withdrew.

In the Baltimore convention of the seceders he advocated the nomination of John C. Breckinridge, and made a tour of the country on his behalf. When the South seceded, he delivered the address of welcome to Jefferson Davis on his arrival at Montgomery, but declined a place in President Davis's cabinet. On March 31, 1861, he sailed for Europe as the head of a commis-

sion sent to secure recognition of the Confederate government, but returned in 1862 to take a seat in the Confederate senate. On account of his failing health, he left Richmond early in 1863, and on July 27 died at his home near Montgomery.

See Joseph Hodgson, *The Cradle of the Confederacy* (1876); J. W. Du Bose, *Life and Times of W. L. Yancey* (1892); W. G. Brown, *The Lower South in American History* (1902); J. W. Du Bose, "Yancey: A Study," *Gulf States Hist. Mag.*, vol. i., pp. 239–252, 311–324 (Montgomery, Ala., 1903); and G. Petrie, "What Will Be the Final Estimate of Yancey," *Alabama Hist. Soc., Reprint* No. 14 (1904).

YANGCHOW (KIANGTU), an important city in the province of Kiangsu on the Grand canal, north of the Yangtze river. Population about 100,000. The walls are between 3 and 4 mi. in circumference. It was the ancient capital of the Yang kingdom. It possesses an early historical connection with foreigners, for Marco Polo ruled over it for three years by appointment from Kublai Khan (?1282–85). It was a cultural rather than an industrial centre and was captured by the Japanese in 1938.

YANGTZE KIANG (Yahng-ts-Ke-ahng), the principal commercial river of China. This river, the length of which is estimated at some 3,000 miles, is known as the Yangtze by Europeans throughout its course, but among the Chinese this term indicates only the last three or four hundred miles where it flows through a region known in ancient times as "Yang." The ordinary official name for the whole river is Ch'ang Kiang or Ta Chiang, meaning the "long river" or the "great river." Popularly in the upper reaches every section has its local name. As it enters China it is known as the Kinsha Kiang (river of golden sand) and farther down as the Pai-shui Kiang; in Szechuan after its junction with the Min it is for some distance called the Min-kiang.

The beginnings of the river are somewhat indefinite but may be located in the high and difficult country between Tibet, Sinkiang and Kuku-nor. The river flows in a southeasterly direction not far removed from some of the headwaters of the Hwang-ho. Proceeding southeastward the Yangtze follows one of those narrow longitudinal valleys separated from one another by lofty ridges that mark the bending southward of the eastern extensions of the Himalayan folds against the older core of southeast China. At Batang in this section of the course the river is 8,540 ft. above sea level. Its entrance into China proper is marked by bends in its course as it bursts through lines of weakness in the sides of the corridor valleys. The river then begins a long southwest to northeast course through the Red basin of Szechuan. As the Yangtze cuts across the longitudinal valleys it receives many tributaries (flowing in parallel valleys), all naturally on the left-hand bank. At Wa-Wu in Szechuan the height of the river is 1,900 ft. above sea level, a fall of about 8 ft. per mile from Batang. Through the Red basin of Szechuan the Yangtze flows at first with fairly low banks, but towards the east it becomes deeply encased and the rapids are many and dangerous. This is due to the fact that Szechuan is tilted down against the upthrust of the fault line of the west and thus the river cuts with ease through its western half but gets through on the east by means of deep gorges. (*See* SZECHUAN.) At Chungking, where the Kialing enters on the left, the river is only 630 ft. above sea level. After receiving the Wu-kiang on the right the river enters deep gorges and emerges at Ichang (130 ft. above sea level). In its subsequent course the river skirts the north side of the old land block of southeast China. Here the physical features are mostly set north-northeast to south-southwest or west-northwest to east-southeast. The Yangtze follows these directions alternately in successive sections. Below Ichang it is in the Hupeh basin, the Han flows in from the northwest and the basin focuses on Hankow (*q.v.*).

From Ichang to the sea, a distance of 1,000 miles, the fall of the river is exceedingly small, being as far as Hankow at the rate of $2\frac{1}{2}$ inches and from Hankow to the mouth at the rate of little more than 1 inch per mile. The last 200 miles of the Yangtze course are practically a dead level.

The drainage area in Szechuan and below is about 650,000 sq.mi., of which more than four-fifths lie above Hankow. The period of low water is from December to March. Melting snows in Tibet together with the summer monsoon cause an annual rise in the river of from 70 to 90 ft. at Chungking and from 40 to 50 ft. at Hankow. The mean volume of water discharged into the sea is estimated at 770,000 cu.ft. per second and the quantity of sediment at the mouth at 6,428 million cu.ft. per annum.

The Yangtze forms a commercial highway of first class importance. Except in winter low water, vessels of between 5,000–6,000 tons can reach Hankow. Sandbanks between Hankow and Ichang make navigation more difficult and above Ichang the gorges add to the dangers. But on the whole the Yangtze as a highway is the collecting and distributing centre of half the commerce of all China. Various "agreements" between China, Britain and other powers from 1898 have given Britain political influence over most of the Yangtze basin.

The great towns and centres of trade on the banks of the river are Chinkiang at the junction with the Grand Canal; Nanking; An-king; Hankow and Wuchang, Ichang, King-chow; Kwei-chow; Chungking, and Sui-fu.

YANKEE. The term means properly a citizen of New England, but by extension, chiefly by Europeans, it is often used to indicate any native of the United States. The origin of the word is uncertain, but according to a common statement the Massachusetts Indians are reported to have given the name, *Yenkees,* or *Yenghees,* to the English colonists, the term being a corruption of the word English; or as some think, a corruption of the French word, *anglais,* in which case the word must have originated in Canada, as the early Canadian Indians were the only ones in contact with the French. The British soldiers seem to have used it as a term of reproach for the New Englanders about 1775, who afterwards took up the word and used it in reference to themselves. During the Civil War the southerners used it in a derisive sense to indicate inhabitants of the northern states.

YANKTON, a city of South Dakota, U.S.A., on the high bank of the Missouri river, near the mouth of the James, 1,200 ft. above sea level, and 60 mi. from the S.E. corner of the state; the county seat of Yankton county. It is on federal highway 81 and is served by the Chicago and North Western, the Chicago, Milwaukee, St. Paul and Pacific, and the Great Northern railways, and by motor coach lines to many points. Pop. 6,798 federal census 1940. In 1780 Pierre Durien reached the Indian village then occupying the site of Yankton, and married into the tribe. He guided the Lewis and Clark expedition from St. Louis to Yankton, and in 1811 his son accompanied the Astoria expedition up the river and on to the coast. In 1858 a permanent trading post was established there. The city was laid out in 1859, chartered in 1869, and in 1910 adopted a commission form of government. From 1861 to 1882 it was the capital of the territory of Dakota.

YAOS or **AJAWA,** a Bantu-Negroid people of east-central Africa, whose home is the country around the upper reaches of the Rovuma river, and the north of Portuguese East Africa. They have spread into the territory south of Lake Nyasa and throughout the Shiré districts. They are the tallest and strongest of the natives in the Mozambique country. They were formerly slave traders, but were reduced to submission by the English in 1896.

See Miss A. Werner, *The Natives of British Central Africa* (1906); Sir H. H. Johnston, *British Central Africa* (1897); H. L. Duff, *Nyasaland under the Foreign Office* (1903).

YAP. This island of the Caroline group, formerly owned by Germany, is situated in the Pacific ocean, south of Japan and east of the Philippines, and north of the equator, in lat. 9·35 N., long. 138·15 E. It has an estimated population of 6,652, almost entirely of Malay origin.

The importance of Yap arises from its cable connections, since it is a station on the direct line from the United States to the Dutch East Indies via Guam, while another cable runs from Yap to Shanghai. On May 7, 1919, Japan was given a mandate over the islands north of the equator previously owned by Germany, including Yap. The United States government protested, and asked for a reopening of the subject on the ground that at the Peace conference it had reserved the right to object to exclusive control of the cable landings by Japan and taken the position

that the island should be internationalized for cable purposes. Further, it was contended, the United States, not having ratified the Treaty of Versailles, was not bound by it. The supreme council of the Allies expressed its inability to reopen the matter. The controversy was finally disposed of at the Washington conference, Dec. 12, 1921, by an agreement between the two powers, wherein the United States recognized the Japanese mandate and Japan agreed that the United States should have free access to the island on a footing of entire equality with Japan or any other nation in respect to the Yap-Guam cable and any other cables which might be laid by the United States or its nationals, and also similar rights and privileges in regard to radio-telegraphic service. The United States was also granted free entry and exit for persons and property. The United States senate ratified the convention embodying this agreement March 1, 1922. (*See* WASHINGTON CONFERENCE.)

YAPOCK: *see* WATER-OPOSSUM.

YA'QŪBĪ [Aḥmad ibn abī Ya'qūb ibn Ja'far ibn Wahb ibn Wāḍiḥ] (9th century), Arab historian and geographer, was a great-grandson of Wāḍiḥ, the freedman of the caliph Manṣūr. Until 873 he lived in Armenia and Khurasan; then he travelled in India, Egypt and the Maghrib, where he died in 891. His history is divided into two parts. In the first he gives a comprehensive account of the pre-Mohammedan and non-Mohammedan peoples, especially of their religion and literature. For the time of the patriarchs his source is now seen to be the Syriac work published by C. Bezold as *Die Schatzhöhle*. In his account of India he is the first to give an account of the stories of Kalila and Dimna, and of Sindibad (Sinbad). When treating of Greece he gives many extracts from the philosophers (*cf.* M. Klamroth in the *Zeitschrift der deutschen morgenländischen Gesellschaft*, vols. xl. and xli.). The second part contains Mohammedan history up to 872, and is neither extreme nor unfair, although he inherited Shi'ite leanings from his great-grandfather.

Edition by T. Houtsma (2 vols., Leiden, 1883). Ya'qūbī's geography, the *Kitāb ul-Buldān*, contains a description of the Maghrib, with a full account of the larger cities and much topographical and political information (ed. M. de Goeje, Leiden, 1892). (G. W. T.)

YAQUI, the best known and sturdiest Indian tribe of Sonora, Mexico. Their language, generally called Cahita by older authors, belongs to the Piman division of the Uto-Aztecan family. The Yaqui were, and in part remain, settled agriculturists, but offered a stubborn resistance to the first Spanish invaders. They gradually came under mission influence, but in the 19th century Mexican encroachments on their lands and water rights led to a series of uprisings which were quelled with difficulty only to flare up anew, and since the final subjugation of the Apache, left the Yaqui the one unsubdued and feared tribe in North America. They pass as the best labourers in Sonora, and several thousand have recently settled in Arizona. They number about 30,000.

YĀQŪT or YAKUT (Yāqūt ibn 'Abdallah ur-Rūmī) (1179–1229), Arab geographer and biographer, was born in Greece of Greek parentage, but in his boyhood became the slave of a merchant of Hamah (Hamath), who trained him for commercial travelling and sent him two or three times to Kish in the Persian Gulf. After his master's death he became a bookseller, and he travelled in Persia, Syria, Egypt and visited Merv, Balkh, Mosul and Aleppo. About 1222 he settled in Mosul and worked on his geography, the first draft of which was ready in 1224. After a journey to Alexandria in 1227 he went to Aleppo, where he died in 1229. In his large geography, the *Mu'jam ul-Buldān* (ed. F. Wüstenfeld, 6 vols., Leipzig, 1866–73), the places mentioned in the literature or the stories of the Arabs are given in alphabetical order, with the correct vocalization of the names, an indication whether they are Arabic or foreign and their locality. A sketch of their history and of their monuments follows.

The parts of this work relating to Persia have been extracted and translated by Barbier de Meynard under the title *Dictionnaire géographique, historique et littéraire de la Perse* (1871). Yāqūt wrote a dictionary of geographical homonyms, the *Mushtarik* (ed. F. Wüstenfeld, Göttingen, 1846). Yāqūt also wrote an important dictionary of learned men, the *Mu'jam ul-Udabā'*. Vol i. has been edited by D. S. Margoliouth, *Irshād al Arib Il ā Ma'rifat al Adīb* (London, 1908).

YARKAND (Chinese name SOCHE), is the largest town in one of the two chief oases of the Tarim basin in the dominion of Sinkiang, 38° 25′ N. and 77° 16′ E., 3,900 ft. above sea level. The oasis lies along several rivers of the southwest part of the Tarim basin and, as these streams come from the glaciers of high Pamir, they are strong and give a good water supply. The Kashgar oasis lies to the northwest and the Khotan oasis (across a desert belt) to the southeast. In the Yarkand oasis irrigation is highly developed and the soil at the foot of the mountains is largely fertile loess, on which wheat, barley, rice, beans, and oil plants are grown, while there are also many fruit orchards. Among the mountains there is good pasture and large herds of camels, yaks, goats, sheep and cattle are kept. Cotton and silk (mulberry) are cultivated to some extent.

Marco Polo visited Yarkand between 1271 and 1275 and Goes went there in 1603. Schlagintweit passed through Yarkand a few days before he was killed at Kashgar in 1857.

The town is surrounded by a great earth wall with towers of Chinese type and has mosques and madrasas (colleges) of great fame, though less well known than those of Bukhara and Samarkand. Estimates of the population, all some years old, vary from 50,000 to 100,000, probably according to the extent to which suburbs have been reckoned with the city. There are several smaller towns in the Yarkand oasis: Tashkurgan on the Pamirs, Yangi-hissar, Posgam, Kargalyk, at the bifurcation of ways to Khotan and Ladakh, Sanju, Tagarchi, Kartchum, Besh-taryk and Guma: The city is a centre of caravan trade along routes from Cadakh, Khotan, Kansu and Trans-Caspian regions, as well as India and Russia generally. Horses, cotton, skins and leather and leather goods, carpets, silk, etc., are dealt in, and carpets as well as woven stuffs in silk, cotton and wool are made.

YARMOUTH, a seaport town and port of entry, Yarmouth county, Nova Scotia, Canada, on the Dominion Atlantic and Canadian National railways, 218 mi. from Halifax. Pop. (1941) 7,790. Steamers run to Boston, Mass., and to St. John, N.B., and Halifax. Fish and lumber are exported.

YARMOUTH, a port at the western extremity of the Isle of Wight, England, on the Solent, where the estuary of the Yare debouches. Pop. (1931) 948. Steamers connect it with the S.R. at Lymington on the mainland. It appears in the Domesday Survey of 1086 under the name of Ermud.

YARMOUTH (GREAT YARMOUTH), a municipal, county and parliamentary borough, watering-place, and seaport of Norfolk, England (with a small portion in Suffolk), 121 mi. N.E. from London by the L.N.E.R., served also by the M. and G.N.R. Pop. (1938) 53,780. Area 7 sq.mi.

Yarmouth (*Magna Gernemutha*), which lies near the site of the Roman camp of Garianonum, is believed to have been the landing-place of Cerdic in the 5th century. Not long afterward, the convenience of its situation having attracted many fishermen from the Cinque Ports, a permanent settlement was made, and the town numbered 70 burgesses before the Conquest. Henry I placed it under the rule of a reeve. The charter of King John (1208), which gave his burgesses of Yarmouth general liberties according to the customs of Oxford, a gild merchant and weekly hustings, was amplified by several later charters asserting the rights of the borough. In 1552 Elizabeth granted a charter of admiralty jurisdiction, afterward confirmed and extended by James I. In 1668 Charles II incorporated Little Yarmouth in the borough by a charter, which with one brief exception remained in force till 1703, when Anne replaced the two bailiffs by a mayor. In 1943 there were 12 aldermen and 36 councilmen. Yarmouth returned two members to parliament from 1300 to 1868 and one after 1885. Yarmouth claims to be the largest herring port in the world. This trade used to be carried on at an annual fair between Michaelmas and Martinmas.

Yarmouth lies on a long and narrow peninsula of sand between the North sea and the Breydon Water (formed by the rivers Yare and Waveney) and the river Bure. The old town of Great Yarmouth was built chiefly along the east bank of the Yare, but the modern town has extended beyond its ancient walls, of which some

remains exist, to the seashore. On the landward or Suffolk side of the estuary is the suburb of Southtown, and farther south that of Gorleston. The principal features of Yarmouth are the north and south quays, and the straight narrow lanes called "rows," 145 in number, running at right angles to them. The Haven bridge over the Yare between Yarmouth and Southtown, connecting Norfolk and Suffolk, was opened in 1930, replacing one built in 1854. The church of St. Nicholas, founded in 1101 by Herbert Losinga, and consecrated in 1119, was destroyed by incendiary bombs in 1942. It was the largest parish church in England. The town suffered greatly through air raids in World War II, and up to the end of 1941 about 11,500 houses had been damaged.

Yarmouth roads, off the coast, afford excellent anchorage except in E. or N.E. winds. The channel to the quays was made by Joost Jansen, a Dutch engineer, in 1567, and affords a depth at the bar of 12 ft. at low water. The herring industry is the most important, Yarmouth bloaters being famous, but there are numerous malting houses.

See *Victoria County History, Norfolk;* H. Swinden, *History of Great Yarmouth* (1772); C. J. Palmer, *History of Great Yarmouth* (1854): Marlowe, *People and Places in Marshland* (1927)

YARN. The derivation of this word from *"garn,"* a word common to the Scandinavian languages, meaning "guts," is interesting since today "cat-gut," which may be the drawn-out "guts" of the silk-worm, is a well-known commodity; and the same "guts" spun by the silk-worm itself into a fine filament are the basis of the best silk yarn produced. The silk-worm, however, in its "spinning" simply thins-out the silk fluid to a double microscopic strand some 500 to 1,000 yards long, several of which are combined by mechanical means to form a yarn; while the human spinner usually combines a number of much shorter fibres or filaments, also by mechanical means, into a continuous strand often much longer than the 1,000 yards filament of the silk-worm; and this also is spoken of as a yarn.

Materials.—The materials from which yarns are constructed or spun markedly influence the processes of production. In the case of the best silk yarn the worm itself does what is termed the spinning and the later running-together of several of the long silk filaments is not spoken of as spinning but as "throwing." In the case of a typical short fibre—say the cotton fibre ½″–2″ long—the spinning process is the binding together of many thousands of cotton fibres into a fine regular, continuous thread—usually spoken of as "yarn." Two or more of these threads or single yarns may be combined together by "twisting" to produce a thicker, stronger yarn. Of the true long fibres there are only two types, the natural silk reeled from the cultivated silk-cocoon and the synthetic artificial silks.

Of the short fibres there are many classes. The longest are the waste silks just mentioned; then come the animal fibres including hairs and wools up to 18″ long, short wools down to, say, 2″ long and broken-up wool fibres (variously termed shoddy, mungo, extract, flocks, etc., according to their source and manner of breaking up from the virgin wool clothes, knitted garments, etc.) which (it is popularly said) can be spun into yarn if they possess two ends; next come the "stem-fibres" such as flax (producing linen yarn), hemp, jute and china-grass which may vary in length from several inches down to fractions of an inch; lastly come the cotton fibres and cotton wastes often under one inch in length along with which should perhaps be ranked the mineral fibre asbestos, which may be spun into a yarn from which fireproof cloths are woven.

Structures.—Yarn structures may be considered from two points of view. In the first case particular fibres lend themselves only to particular "fibre combinations." Thus long silk filaments can only be "thrown" together with or without "twist." But the twisting of silk filaments is an art in itself. Thus several filaments may be reeled together from separate cocoons and these given a suitable "combining-twist" to produce what is known as singles; then several of these singles may be thrown together with little twist to produce almost a "paralleled-fibre" thread termed "tram," the most lustrous yarn known, or with much twist to produce a strong, fairly lustrous yarn termed "organzine" which is employed as "warp." On the other hand one inch cotton fibres after being drawn into a fairly fine "paralleled sliver" termed a "roving" can only be spun out into a fine thread by means of "supporting twist" which no doubt binds the fibres more or less concentrically in the thread or yarn: this is said to be the true form of spinning—draft (that is, drawing-out thinner) against twist.

Fancy Twists.—These naturally group themselves into three classes, viz., structural twists; colour twists; and structural-and-colour twists. Of the first class the two most important are the knop yarn—in which knops are formed at any required intervals on an otherwise level thread by holding one thread tightly and allowing the second thread to run in slackly to form knops of the required size, after which equal delivery of the two threads for the required length is followed again by the varied delivery to form the knop; and the curl yarn—in which a knop yarn is first formed and then this two-fold yarn twisted, in the opposite direction, with a third thread, this opening out the knops into loops which may be produced at more or less regular intervals or "spaced," *i.e.,* a length of the thread without loops and then a series of loops, which in turn are followed by a length of the thread without loops. Of fancy colour twists the simplest is the corkscrew twist which is formed by first twisting, say, a dark and a light thread in the normal manner and then twisting this two-fold yarn in the reverse direction, with a third dark thread, this producing the special appearance which gives its name to the yarn.

Other Fancy Yarns.—Fancy yarns of an effective character may also be produced with simple modification in the normal carding and spinning processes. Thus "knicker yarns" are produced by throwing little bits of highly coloured material into the last cylinders of the card so that instead of being broken up by carding they are carried forward as "knickers" into the spun thread. "Random yarns" are produced by feeding the card with alternate stripes of dark and light material and taking the condensed slivers off with a zig-zag or moving-laterally doffer which takes sections of the lengths of its slivers from first one and then the other stripes. "Marl yarns" are produced by running two differently coloured slivers together on the roving frame just prior to the worsted spinning process, so that the colours are "regularly irregularly" mixed together.

If on the other hand a very level mixture effect is required dark and light coloured tops are mixed together in the worsted drawing processes, or, better still, the "tops" are printed the required colours in bands and then passed through the worsted drawing processes this producing the extraordinary level mixture effect termed a "melange." Of the simple twofold yarns the best known is the "granderelle" in which a dark and light thread—usually of similar material, but not necessarily so—are finely twisted together as perfectly as possible. Another twofold twist termed a "spiral yarn" is formed by two single threads twisted in opposite directions being combined with twofold twist which necessarily shortens one of the threads by adding twist and markedly lengthens the other by taking out twist. Thus the slack thread "spirals" round the tight thread.

Yarn Effects and Special Properties.—The effects which may be produced by suitable selection of materials and yarn structure may be grouped into three classes, viz., light-reflective effects; form effects, and colour effects. Light reflection from the surface of a woven fabric depends upon the material or materials employed, upon the fibre arrangement in the thread, upon the thread interlacings and upon such modifications as may be introduced in the finishing processes. Thus some wools are lustrous—the Wensleydale wool, for example—and some are opaque and dull—the Down wools. Ordinary cotton is dull, mercerized cotton is lustrous. A lightly twisted net silk yarn ("tram") is the most lustrous yarn known, while a specially hard twisted net silk yarn (crape) is the dullest yarn produced. Tram silk yarn interlaced on the "satin" principle produces the most lustrous fabric and crape silk yarn interlaced on the "crape" principle produces the dullest fabric known.

Merino wool spun on the woollen principle when woven into a normal fabric gives a dull surface but if the fibres are "raised" from the surface and laid parallel in the "finishing" processes then

a brighter fabric may result than that produced from a merino wool spun on the worsted principle in which the fibres are laid parallel in the thread structure only.

The "form" effects will have been appreciated from the descriptions already given of knop, curl, spiral, etc., yarns. These yarns specially coloured as already described offer the designer the opportunity of producing a never-ending array of novel fabrics. Should specially white fabrics be required a "bleached" yarn is employed but it is more usual to bleach the material in the fabric state. Should a yarn which may be spun white but later—either in the yarn or cloth state—dyed two distinct colours be sought for, cotton may be blended with wool in the carding or in the drawing processes, or strands of wool and of cotton may be twisted together and dyed distinctive colours later.

Yarn Counting and Numbering.—The numbering or "counts" of varns, 30's, 40's, 80's, etc.—may be explained best by the counting of woollen yarns. The basic weight is the "wartern" of six lb. the "quartern" of the old 24 lb. stone. This appears to have been a convenient weight for the spinners to take away to their homes for hand or "jenny" spinning. If this weight was spun in 1,536 yd.—that is each dram spun out to one yard—it was termed "one skeins." If one dram was spun to 2 yd., it was termed "two skeins"; if to 20 yd., it was "twenty skeins." Later it was found more convenient to deal with the unit weight of 1 lb., so that it has come to be usual to reckon the woollen "skein" as 256 yd. and the number of skeins to which a pound of this material is drawn out as the "counts," spoken of as "skeins" in the woollen districts. Thus if 1 lb. is drawn out to 5,120 yards (256×20) the yarn is a "20 skeins." Unfortunately the woollen industry was spread over the whole of the known world before the unifying mechanical era dawned with the result that not only each country but each manufacturing district has adopted its own system of woollen yarn counting. Thus 200, 300, 420 yd. skeins are to be found and there is a still further complication in the United States where in one case the length is fixed and the count or skeins is given by the number of times the unit weight (the grain) is contained in this unit length. This method is that natural to the net silk industry in which the drams per 1,000 yards, or the deniers (or ½ deci-gram) per 450 metres gives the count spoken of as the "deniers."

The cotton spinning industry which started from England adopted from the first a hank (or skein) of 840 yards and the hanks per lb. as the "count" and this has obtained world-wide acceptance. The worsted industry, apparently an off-shoot of the cotton industry, taking a yard instead of a 1½ yard reel has adopted a hank of 560 yards and the hanks per lb. give the count. An attempt is now (1928) being made to adopt a universal system of counting yarns. The kilogram and the kilometre (or gram and metre) are suggested as the universal bases for everything excepting "thrown" silk and artificial silk yarns for which a base length of 500 metres is suggested and the weight of this in decigrams to give the "deniers" or "count."

The yards to which one pound of material may be spun naturally vary with the fineness and nature of the material. Thus cotton has been spun on a commercial basis to 588,000 yd. per lb., linen to 180,000 yd. per lb., worsted yarn to 56,000 yd. per lb., and woollen yarn to 15,000 yd. per lb.; while net silk yarns, if required, may even be thrown finer than the finest cotton.

Sometimes to obtain a fine, straight-fibred thread, wool is spun or twisted with cotton and later the cotton is "carbonized" by acid treatment. The reverse process may also be employed. Special note should be made that in twisting threads together the count number of the yarn will be lessened in proportion to the added weight of the thread or threads. Thus two threads of a 40's count twofolded give a 20's count—written 2/40's. There is, however, an exception to this in spun silk yarn in which a 2/40's yarn (often written 40/2) is a 40's but twofold, *i.e.*, two threads of 80's are twisted together giving a folded yarn with 40 hanks (each 840 yd.) to the pound. The twisting of varied count numbers is really simple but mystifying to the uninitiated. Thus a 10's count twisted with a 40's count does not give an intermediate count number (say 25's) but naturally a thicker count than 10's and consequently a lower count number, viz., 8's count; and this is true in whatever denomination the count may be stated—cotton, linen, woollen, worsted, etc. (A. F. B.)

YAROSLAVL, a region of the Russian S.F.S.R., surrounded by those of Kalinin, Vologda, Gorky (Nizhegorod), Ivanovo and Moscow. Area 23,507.4 sq.mi. Pop. (1939) 2,271,307 (rural 1,474,778; urban 796,529). Thick deposits of boulder clay, remains of the bottom-moraine of the ice-cap of the Glacial period, cover the Jurassic clays, and patches of Triassic "variegated marls" outcrop in some places, while Upper Carboniferous limestones crop out only in the north-west and towards the east. Coniferous forest, with firs predominating, occupies 39% of the region, and marshes are extensive, especially between the Sheksna and Mologa, and in the Rostov district. Dwarf birch, the Arctic raspberry (*Rubus arcticus*) and *Linnaea borealis* are widespread. The climate is severe, the rivers being frozen 118 to 183 days per annum, average January temperature 6.5° F., average July 61.5° F. The prevailing south-west and west winds make the rainfall heavier than in central Russia.

Of the land free from forest and marsh, only 25% is under plough culture, with rye (36.9%), oats (23.4%) and flax (7.4%). Potatoes, barley, grass, vegetables, chicory and herbs are grown, the latter especially in the Rostov district. Meadow and grassland prevail and the region has a flourishing dairy industry, with exports of butter and cheese. In the years 1926–27 a peat fuel electric station was opened at Liapinsk near Yaroslavl. Bog iron ores, copper sulphate and pottery clay are obtained and there are salt and mineral springs. The principal river is the Volga, which is connected with the Neva by the Mariinsk and Tikhvinsk canals through its tributaries the Sheksna and the Mologa. The Kotorost, flowing from Lake Nero to the Volga, is navigable in spring, and the Kostroma, flowing along the north-eastern boundary, is a channel for the export of timber and peat fuel. Of the rivers, 39% are available for steam navigation; the railway net is poor, and good roads are absent, except for the Moscow-Yaroslavl road. Yaroslavl and Rybinsk (*q.v.*) are the chief towns.

Yaroslavl, the chief town of the above region on the right bank of the Volga, at its confluence with the Kotorost, in 57° 38′ N., 39° 50′ E. Pop. (1939) 298,065. It is a productive centre with textile factories, and tobacco, leather and lacquer industries. Founded in 1026–36, it was the chief town of the principality from 1218 to 1417, when it was annexed by Moscow. The Uspenskiy cathedral was begun in 1215 and rebuilt 1646–48, and there are remains of 15th and 17th century monasteries.

YARROW, river and parish of Selkirkshire, Scotland. The river, issuing from St. Mary's Loch, flows for 14 mi. E. by N. to the Tweed, which it joins about 3 mi. below the county town. The stream and vale are famous in poetry. Pop. (1931) 459.

YARROW (*Achillea millefolium*), a plant of the family Compositae, also called milfoil, native or naturalized throughout the northern hemisphere. It has white or, rarely, rose-red flowers, borne in flat-topped clusters, and very finely divided leaves. Legend ascribes the discovery of its healing virtues to Achilles, in whose honour it was named. The leaves, anciently in great repute for use in the treatment of wounds, are said to be occasionally so employed in domestic medicine. In lawns it sometimes makes a solid turf, being more resistant to drouth than most lawn grasses. The closely allied *A. ptarmica,* the sneezewort or sneezewort yarrow, so named because of the use of the root for snuff, native to Europe and northern Asia and found in the British Isles, is naturalized in eastern North America.

YARURAN, a small group of tribes of South American Indians, constituting an independent linguistic stock. The Yaruros lived in Venezuela, on the Orinoco river between the Meta and the Capanaparo; in recent times they have spread somewhat further down stream to the Arauca and beyond.

See J. Chaffanjon, *L'Orenoque et la Caura* (Paris, 1889).

YATES, RICHARD (1818–1873), American political leader, born at Warsaw, Kentucky, Jan. 18, 1818. He graduated at the Illinois College at Jacksonville in 1838, was admitted to the bar, and entered politics as a Whig. From 1842 to 1845 and again in 1849 he served in the state House of Representatives. He was a

representative in Congress in 1851–1855, but having become a Republican, was defeated for a third term.

From 1861 to 1865 he was governor of Illinois, and was successful in enlisting troops and in checking the strong pro-Southern sentiment in the state. He was a member of the United States Senate in 1865–71, and was prominent in Reconstruction legislation. He died at St. Louis, Missouri, on the 27th of November 1873. His son Richard (b. 1860) was governor of Illinois from 1901 to 1905.

YAUCO, a prosperous and progressive town situated in the southwestern part of Puerto Rico. Its population by federal census of 1930 was 8,607; 1940, 9,985; the municipal district 1930, 27,787; 1940, 30,533. It is located on the main line of the belt line railroad and on the main highway which connects Ponce with Mayaguez. It is the southern terminus of a newly constructed highway connecting the town with Lares and other northern towns. The largest centre for the manufacture of cane-sugar is in this part of the island at the port of Guánica. This port was the first landing place of the American troops under command of Gen. Miles on July 25, 1898.

YAWS, the name in use in the British West Indies for a contagious inoculable tropical disease, running a chronic course and characterized by a peculiar eruption, together with more or less constitutional disturbance. It is known by various local names in different parts. The name *framboesia* was first given to the disease by Sauvages in 1759 from the likeness of the typical excrescences to a raspberry. Yaws was long thought to be peculiar to the African negro, but a disease the same in every respect has long been known in the East Indies, affecting the Malays rather than the negroes, its chief seats being Amboyna, Ternate, Timor, Celebes, Java and Sumatra. It has been identified by De Rochas and other observers in New Caledonia and Fiji.

The general course of the disease is as follows. In children (who form a large part of the subjects of yaws) there will probably be early rheumatic pains in the limbs and joints, in adults the eruption is often the first sign. The eruption begins as small pimples that have a whitish speck on their tops, grow rapidly and reach some half-inch in diameter. The pustules then break and a thick viscid ichor exudes and dries upon them as a whitish slough and around their base as a yellowish-brown crust. Beneath the slough is the raspberry excrescence or yaw proper, a reddish fungous growth with a nodular surface. The favourite seats of the eruption are the forehead, face, neck, arm-pits, groin, genitals, perinaeum and buttocks. Hairs at the seat of a yaw turn white. In young children or infants the corners of the mouth ulcerate, as in syphilis, and the perineal excrescences resemble condylomata.

Aetiology.—Yaws is a highly contagious disease. It is neither hereditary nor congenital. The disease spreads by contact with previously infected cases, and it has been proved by experiment that infection may be conveyed by flies, carrying infective material from a yaws sore to an ordinary ulcer. The virus must be introduced directly through a breach of the skin or mucous membrane; an attack in childhood gives a large degree of immunity for the rest of life. In 1905 Aldo Castellani demonstrated in yaws the presence of a slender spirillum, which he named the *Spirochaeta pertenuis* or *Spirochaeta pallidula.* It was also experimentally proved by him (1) that the material taken from persons suffering from yaws and containing the *Spirochaeta pertenuis* is infective to monkeys; (2) that when the *Spirochaeta pertenuis* is removed by filtration the material becomes inert; (3) that the injection of blood from the general circulation of a yaws patient gave positive results in monkeys; (4) by means of the Bordet-Gengou reaction it is possible to detect specific yaws antibodies and antigen.

The prophylaxis consists in the segregation of the patients suffering from the disease, the antiseptic dressing of the eruption, the application of a covering to protect it from flies, and the thorough cleansing and disinfection of infected houses and clothing, even the demolition of houses in endemic centres, and finally compulsory notification to the local sanitary authority.

As regards treatment, the malady in a person of good constitution runs its course and disappears in a few weeks. When the eruption is declared, iodide of potassium and arsenic are very beneficial. As external applications, weak lotions of zinc or carbolic acid may be used, and, if the excrescences are irritable, a watery solution of opium. In 7,157 West Indian cases treated in various hospitals there were only 185 deaths, a mortality of 25·8 per thousand (Nicholls).

YAZDEGERD ("made by God," *Izdegerdes*), the name of three Sassanid kings of Persia. (1) YAZDEGERD I., son of Shapur III., 399–420, called "the sinner" by the Persians, was a highly intelligent ruler, who tried to emancipate himself from the dominion of the magnates and the Magian priests. He punished the nobles severely when they attempted oppression; he stopped the persecution of the Christians and granted them their own organization. With the Roman Empire he lived in peace and friendship, and is therefore as much praised by the Byzantine authors (Procop. *Pers.* i. 2; Agath. iv. 26) as he is blamed by the Persians. After a reign of twenty years he appears to have been murdered in Khurasan. (2) YAZDEGERD II., was the son of Bahram V. Gor, 438–457. He persecuted the Christians and Jews, and had a short war with Rome in 441. He tried to extend his kingdom in the East and fought against the Kushans and Kidarites (or Huns). (3) YAZDEGERD III., a grandson of Chosroes II., who had been murdered by his son Kavadh II. in 628, was raised to the throne in 632 after a series of internal conflicts. He was a mere child and never really ruled; in his first year the Arabic invasion began, and in 637 the battle of Kadisiya decided the fate of the empire. Ctesiphon was occupied by the Arabs, and the king fled into Media. Yazdegerd fled from one district to another, till at last he was murdered at Merv in 651.

The Parsees, who use the old Persian calendar, continue to count the years from his accession (era of Yazdegerd, beginning June 16th, A.D. 632). (ED. M.)

YAZOO CITY, a city of western Mississippi, U.S.A., about midway between Memphis and New Orleans, on the (navigable) Yazoo river; the county seat of Yazoo county. It is on federal highway 49, and is served by the Illinois Central railroad. Pop. 5,244 in 1920 (52% Negroes); 7,258 in 1940 by the federal census. At the eastern entrance to the rich "Delta" between the Yazoo and the Mississippi rivers, it is an important market and shipping point. The city was founded about 1830.

YEAR-BOOK, a term applied to annual summaries either of events throughout the world during the previous year or of general or local progress in some one department of administration, art, science or industry. Examples are *The Britannica Book of the Year, The Statesman's Year-Book, Annual Register, Whitaker's Almanack, The World Almanac,* biographical records like *Who's Who,* genealogical records such as those of Debrett and Burke, and the Continental *Almanach de Gotha,* a scientific and scholastic publication of the type of the *Index Generalis,* and the innumerable specialized economic and industrial publications.

The English legal *Year Books,* described by Pollock as "our glory, for no other country has anything like them," are reports of cases covering the period 1292 to 1534, written in provincial French. Abridgments of these *Year Books* were made by Sir Anthony Fitzherbert in 1516 and by Sir Robert Brooke in 1568. The first systematic printer of them was Richard Pynson, from 1510; the principal publisher, from 1553, was Richard Tottell. In 1863 A. J. Horwood was commissioned by the then master of the Rolls to edit the unpublished *Year Books* of Edward I. This Rolls series was continued by L. O. Pike. The work has been supplemented by Maitland and others working for the Selden Society. The most convenient brief discussions of the *Year Books* are in *Holdsworth's History of English Law* (1903–09), vol. ii., pp. 444–462, and W. C. Bolland's *The Year Books* (1921). They are now thought to have had an official or even semi-official character.

YEAST. The botanist and microbiologist apply the term yeast to a group of plants many of which exhibit a marked ability to change sugar into alcohol and carbon dioxide. The characteristics of the group, which includes hundreds of species, are quite restricted. These, together with discussion of taxonomy,

are given under FUNGI and FERMENTATION. To the layman, untrained in botany, the term yeast suggests the cakes of pressed yeast available in almost every hamlet. The ability of certain yeasts to form carbon dioxide from sugar has caused some of them to be used for leavening bread. For centuries, other species have been used in the making of wine, alcohol, beer, etc.

Yeasts probably have as early origin as the bacteria. Grüss examined some fossil remains of Devonian plants and obtained striking evidence of the existence of budding fungi in this early age. This same investigator on examination of the sediment from a beer jar in Theban tomb of the XIth dynasty (2000 B.C.) isolated a yeast which was named *Saccharomyces Winlocki.* Examination of "beer bread" found among the offerings in other tombs also yielded the same yeast. It is now known that yeasts are widely distributed in nature and that those species concerned in fermentation pass the winter in the soil. They are disseminated by bees, dust and other agents in the spring.

The use of yeast in such fermentations as that of bread has made it convenient to have a constant supply of fresh active yeast. While in former days the by-product of certain fermentation industries was used, pressed (or compressed) yeast is now available to those who desire it. To this end the organism is grown in suitable media and the crop harvested when a sufficient crop of cells has appeared. The medium, according to an older method, consists of wort prepared from grains mashed in water. The mash prepared from grains is inoculated with lactic acid bacteria to "sour" it; the acid prevents putrefaction and also serves as food for the yeasts. The clear wort is passed into fermenters where it receives the seed yeast. The temperature is kept constant and rapid growth takes place. The yeast cells are then separated from the fluid in which they have grown by filter presses. They are mixed with starch and pressed into large cakes. These are sent to distributing centres, where they are cut and wrapped in the small size package commonly used in the home. In more recent times, yeast has been cultivated in mineral salt-sugar solutions instead of the wort described above. The cells are also incorporated in corn meal which is pressed into cakes.

Besides the application of yeasts in fermentology, they have been widely heralded as therapeutic agents. Their application to the cure of disease goes back to very early times. Many of the statements on the use of yeasts in this manner rest upon uncontrolled experiments, if indeed they may be called experiments. We are told that the monks used yeast for curing plague and that Hippocrates advised its use in leucorrhea. Since 1917 great interest was aroused by a publication of Hawk, et al. who reported beneficial results in furunculosis, acne vulgaris, constipation and certain other gastro-intestinal and cutaneous diseases.

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YEATS, WILLIAM BUTLER (1865–1939), Irish author was born at Sandymount near Dublin on the 13th of June 1865. His father J. B. Yeats was a distinguished Irish artist and member of the Royal Hibernian Academy, his mother's family was from County Sligo. Soon after his birth his parents moved to London but his early years were largely spent in Sligo and even when, at the age of nine or ten, he went to school in London he returned to Sligo for his holidays and his early work is full of allusions to its mountains and little lakes, indeed this beautiful county has coloured all his writing. He studied painting for a short time but at the age of twenty-four published his first book of poems *The Wanderings of Oisin* (1889) and from that time forward gave his whole attention to literature. He was now living in London and a member of the group of young writers whose work appeared in *The Yellow Book.* A friend of William Morris and W. E. Henley and a frequent contributor to *The National Observer,* he was one of the founders of the Rhymer's Club and a close friend to Arthur Symons and Lionel Johnson. Years later he published two books, *Reveries over Childhood and Youth* (1915) and *The Trembling of the Veil* (1922)—now brought together in the volume called *Autobiographies*—and in these will be found the history, fascinatingly told, of the first thirty years of his life. In 1892 his first poetic play *The Countess Cathleen* was published; it was followed two years later by another play *The Land of Heart's Desire* and in the previous year appeared his first volume of essays *The Celtic Twilight.* With Edwin J. Ellis he edited the *Works of William Blake* (1893) and also edited *A Book of Irish Verse* (1895). Three books of prose appeared in 1897: *The Secret Rose, The Tables of the Law* and *The Adoration of the Magi;* the last two were published privately but subsequently appeared publicly. By 1897 he had become interested in the formation of an Irish theatre and with the help of Lady Gregory, Edward Martyn and other friends the first performance of the Irish Literary Theatre took place in Dublin in 1899. This Theatre gradually developed, attracting to itself writers such as Mr. George Moore and "A.E." and creating new writers such as J. M. Synge and Mr. Padraic Colum and by 1904 had established itself in the Abbey Theatre of which theatre Yeats was a Director until his death and contributed to its repertory many noble plays in verse and prose. Side by side with playwriting went the writing of lyrics and the rewriting of much of his early work—for he had always been his own harshest critic. After 1897 his most noteworthy volumes of poems are *The Wind among the Reeds* (1899), *Responsibilities* (1914), *The Wild Swans at Coole* (1917), *Later Poems* (1922) and *The Tower* (1927). His literary and critical essays are of importance, they are to be found in the volumes *Ideas of Good and Evil* (1903), *The Cutting of an Agate* (1912), *Per Amica Silentia Lunae* (1918) and a number of witty and profound essays on the art of the theatre now collected into the volume *Plays and Controversies* (1923). The private publication of a philosophic book *A Vision* (1925) must be noted. Owing to his habit of rewriting, versions of his work are many and various and the *Collected Edition* in eight volumes published in 1908 has long ago been superseded. The volumes at present published by Macmillan & Co. are practically a collected edition of the work which he wished to preserve, but in the opinion of many he had discarded or grievously altered many beautiful early poems. His first three plays in prose *Kathleen ni Houlihan* (1902), *The Pot of Broth* (1902) and *The Hour Glass* (1903) are entirely successful stage plays. It is difficult to speak with certainty of the stage success of his verse plays because, owing to the absence of a verse-theatre in England, the number of performances of them has not been large. He hoped in starting the Irish Literary Theatre to found amongst other things a verse-theatre in Ireland and during its early years a number of his verse plays were performed there but later the dramatic genius of Ireland emphatically declared itself to be realistic and not poetic and his dream of a verse-theatre had to be abandoned. But certainly *The Countess Cathleen* has proved itself a very successful stage play, the story is swift and dramatic, the incidents are full of variety, the verse is limpidly clear. The one-act play *The Land of Heart's Desire* (1894) is very popular and frequent performances of it are given by non-professional theatrical companies in England and America. His later plays demand great tragic acting, a demand met by Mrs. Patrick Campbell in her performance in *Deirdre* (1907) when the play showed itself to be of perfect construction and of intense passionate beauty. Given a great tragic actor *The King's Threshold* (1904) is as fine a stage-play as *Deirdre.* Other plays belonging to this period are *The Shadowy Waters* (1900), *On Baile's Strand* (1904) and *The Green Helmet* (1910). By this time he had despaired of finding a verse-theatre and his next play *The Player Queen* was in prose. It is a delightful phantasy and successful on the stage. Later still, influenced by the Japanese, he was to write four curious *Plays for Dancers* (1921) and, in the same mood, *The Cat and the Moon* (1924). Three of these plays have been performed and with success. He found in this unrealistic form freedom from stage conventions and an opportunity for phantasy.

In all probability these plays for dancers will never have popular appeal but to some they will seem the most beautiful work he has done for the stage. Considered as a poet his poetry falls into three periods, the early, the middle and the late. His early poetry was elaborate and richly wrought, influenced in some de-

gree by the Pre-Raphaelites, yet side by side with these possibly over-decorated poems can be found beautiful lyrics as simple as an Irish country ballad. By 1910 he had wearied of elaboration, he had been too much imitated, and he turned and attacked his own "embroideries." He had found, too, a new inspiration, a national one, and *Poems written in Discouragement* (1913) are the result of that inspiration. A year later with the publication of *Responsibilities* the new note in his verse is firmly struck, the last shred of embroidery for embroidery's sake has been discarded and the beauty of these poems is "like a tightened bow." He is struggling with a new, austere method, he has not entirely mastered it but he triumphantly emerges from the contest in his next volume *The Wild Swans at Coole* (1917). This book and each succeeding book mark his third period, the latest volume being *The Tower* (1927). Some poems in these volumes are obscure but only because they are part of his own difficult philosophy; if that be understood the poems are clear. The sweep and range of his art from *The Wanderings of Oisin* to *The Tower* are amazing and it is difficult to think of any other poet writing in English who is so varied and so developed. In 1928 appeared translations of Sophocles' *Oedipus the King* and *Oedipus at Colonus*. They are translations made specially for the Abbey Theatre; they are in prose and aim at simple, effective speech rather than meticulous verbal accuracy, the choruses are in rhymed verse. In 1929 he published a book of verse, *The Winding Stair;* his *Collected Poems* were published in 1933, and *Collected Plays* in 1934. As one of the founders of the Irish Literary Society Yeats had early shown his practical concern with the intellectual life of his country; and it was natural for the Government of the Irish Free State to nominate him in 1922 as one of its first Senators. He was awarded the Nobel Prize for literature for 1923. (L. Ro.)

YELLOWBIRD, a name applied in the United States to the American goldfinch (*Astragalinus tristis*) and to the yellow warbler (*Dendroica aestiva*). (*See* GOLDFINCH, WARBLER.)

YELLOW FEVER, a specific infective tropical fever, the virus of which is transmitted by a mosquito. The disease occurs endemically in certain limited areas. The area of distribution includes the West Indies, Mexico, part of Central America, the W. coast of Africa and Brazil.

The incubation period of yellow fever is generally four or five days, but may be as short as twenty-four hours. The illness usually starts like any other febrile attack. But there soon occurs a peculiar look of the eyes and face, which is characteristic: the face is flushed, and the eyes suffused at first and then congested or ferrety, the nostrils and lips red, and the tongue scarlet—these being the most obvious signs of universal congestion of the skin, mucous membranes and organs. There is high fever and albumen will nearly always be found in the urine. After two or three days the temperature falls below the normal; the pulse becomes slow and feeble, the skin cold and of a lemon-yellow tint, the act of vomiting effortless, the first vomit being clear fluid, but afterwards black from admixture of blood. This prostration may end in recovery, with copious flow of urine, which even then is very dark-coloured from the presence of blood or may increase and end in death. Much blood in the vomit and in the stools, together with all other haemorrhagic signs, is of evil omen.

The case mortality averages from 12 to 80%. In Rio in 1898 it reached the appalling height of 94·5%. In cities where it is endemic the case mortality is usually lower.

Modern Researches.—The dreaded "vomito negro" which for four centuries claimed more than 50% mortality among its victims, has been relegated to a place of secondary importance since the institution, in 1901, of the anti-mosquito campaign. Since 1910 no epidemic invasion of yellow fever into temperate regions has occurred, and some of the most noted endemic centres in Ecuador, Mexico and Brazil have been freed of the disease, probably forever; no case has been reported in the entire Western Hemisphere for many months. The use of oil for destroying mosquito larvae has now been practically abandoned in favour of placing in the tanks which serve as water supply for houses in the tropics one or two small fish, which eagerly devour the "wrigglers."

Connor, in Guayaquil, first used this method successfully in 1919, and it has since been used in other countries with excellent results. The fish must be of small size and able to withstand handling and transportation. Those chiefly used are the minnows, *Gambusia affinis, Dormitator latifrons* and *Fundulus heteroclitus* and the common "lefa" of South America (*Pygidium piurae C.*) some being top-feeding and others bottom-feeding fish.

Bacteriological Investigations.—While the transmitter of the yellow fever germ had been experimentally proved, by the American Army Board under Reed, to be the mosquito, *Aedes aegypti* (formerly known as *Stegomyia fasciata* or *S. calopus*), the microbe which produced the disease had remained unknown until 1918 when a minute spiral organism, subsequently named *Leptospira icteroides,* was isolated from the blood and organs of yellow fever patients, in Guayaquil, Ecuador. Inoculation of cultures of this organism reproduced all the characteristic symptoms and lesions of yellow fever in guinea pigs, marmosets and young puppies. Yellow fever was also transmitted directly to guinea pigs with blood taken from yellow fever patients and the same micro-organism from experimentally infected animals.

Investigations previously conducted by the American Army Board in Havana had demonstrated that the germ of yellow fever could pass through the pores of certain bacteria-proof filters (*see* FILTER-PASSING VIRUSES), and this fact alone had been sufficient to disprove the relation to yellow fever of a dozen or more different bacteria. *Leptospira icteroides,* on the other hand, proved to be a filter-passer and to conform with other well-known characteristics of the yellow fever virus; thermal death-point; transmissibility by *Aedes aegypti;* ability to produce typical fever, extensive haemorrhages into the gastro-intestinal tract, resulting in the "black vomitus" and melaena, severe nephritis, general jaundice and the characteristic changes of liver and kidney (fatty degeneration and necrosis). Another important proof that connects *Leptospira icteroides* with yellow fever is that this micro-organism is killed by the blood serum of persons who have just recovered from yellow fever but not by that of healthy persons or persons recovering from other diseases.

Leptospira icteroides was subsequently isolated from cases of yellow fever in Mexico, Peru and Brazil. It is actively motile, measures 4–9 μ long and 0·2 μ wide and there are two spirals for each micron. The ordinary microscope does not reveal its presence in the living condition, but it is easily seen by means of dark-ground illumination. It grows only on special culture media. The isolation of *Leptospira icteroides* has made it possible to prepare a preventive vaccine, similar in type to that in use for protection against typhoid fever, and a curative serum. While a given locality may be freed from yellow fever by destruction of mosquito larvae, this type of preventive work requires some months. Newcomers meantime are in danger, and protection, even of a temporary nature, is welcome. Injection of a small quantity of killed cultures of *Leptospira icteroides,* as first shown in experimental animals, confers temporary protection from the yellow fever infection, the inoculation taking effect within about two weeks. The results of prophylactic inoculation of 20,000 or more individuals since 1919 indicate that if persons are satisfactorily vaccinated they are protected against yellow fever for about six months. The curative serum has been tried in several hundred cases. When it has been used early in the disease, *i.e.,* before the fourth day of illness, the death-rate has been comparatively small (16% as compared with the usual 50% or more in yellow fever). It is without appreciable benefit when given later in the illness, when the micro-organisms have done irreparable injury to the liver and kidneys.

Since 1925 doubt has been thrown on the causal relationship of *Leptospira icteroides* to yellow fever by discovery of the fact that the common rhesus monkey (*Macacus rhesus*) and to a lesser degree the Indian crowned monkey (*M. Sinicus*) are very susceptible to the disease which may be transmitted to them by the bites of infected mosquitoes or inoculation with blood of a yellow fever patient. Material from such infected animals or from yellow fever cases is without effect upon guinea pigs which are extremely susceptible to *L. icteroides.* Since *L. icteroides* is serologically identi-

cal with *L. icterohaemorrhagia* it is thought probable that the organism described by Noguchi as the cause of yellow fever had been obtained from cases of Weil's disease or possibly from patients with a double infection. Working with a strain of yellow fever isolated in Senegal and rhesus monkeys A. W. Sellards and E. Hindle advanced matters further in favour of a filterable virus theory by showing that like some other filterable viruses yellow fever infective material is unaffected by cold and if frozen will maintain its virulence for at least twelve days.

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YELLOW RIVER: *see* HWANG-HO.

YELLOWROOT, a small North American shrub (*Xanthorhiza simplicissima* or *Zanthorhiza apiifolia*) of the crowfoot family (Ranunculaceae, *q.v.*) found in woods from western New York to Kentucky and Florida. It has smooth stems, 1 to 2 ft. high, with yellow wood, long yellow roots, parsley-like leaves, and small purplish flowers in slender drooping clusters. It is sparingly planted for ornament. Yellowroot is also applied to the golden-seal (*Hydrastis canadensis*) and goldthread (*Coptis trifolia*).

YELLOWSTONE NATIONAL PARK, a national American public park, the first and most noted of a number of such national reserves set apart by the U.S. Government to preserve, for the benefit and enjoyment of the people, certain regions of extraordinary or unique natural grandeur and impressiveness. Yellowstone National Park includes about 3,350 sq.m.—62 m. long and 54 m. wide—lying largely in the north-west corner of Wyoming but extending a little over 2 m. northward into Montana. National forests surround the park on all sides—the Gallatin, Absaroka and Beartooth to the northward; the Shoshone to the eastward; the Teton and Targhee to the southward; and the Targhee, Madison, and Gallatin to the westward.

A broad volcanic plateau with an average elevation of 8,000 ft. occupies the centre of the park. The park is enclosed on its northern and north-western border by the Gallatin range, a bold picturesque sierra of which Electric peak, elevation 11,000 ft., constitutes the culminating crest. The Teton range, one of the most spectacular features of the northern Rockies, looms high upon the southern horizon, but only its bold spurs and foot-hills enter the park. East of the Tetons stretch the wild Gros Ventre and Wind river ranges well up toward the southern boundary of the park. The majestic Absaroka range, connected at the south with the Wind river range, forms an unbroken barrier along the whole eastern side of the park, its western side and many of its rugged peaks and canyon-grooved mountain masses lying within the park. A confused mass of mountains near the north-eastern part of the park connects the Absaroka with the Snowy range.

The general high elevation of the park is reflected in the climate, the mean annual temperature being considerably lower than that of the surrounding lower areas, and the amount of precipitation, both rainfall and snowfall, higher. At the Yellowstone Park weather station, elevation 6,200 ft., the mean temperature for the year is 38·7° F, ranging from 18·0° F in January to 61·3° F in July. The average annual snowfall at the Yellowstone Park station has been 100·5 in., varying from traces in July and August to 20·6 in. in January. The mean relative humidity varies from 53% at noon to 75% at 6 A.M. The annual percentage of sunshine is 56.

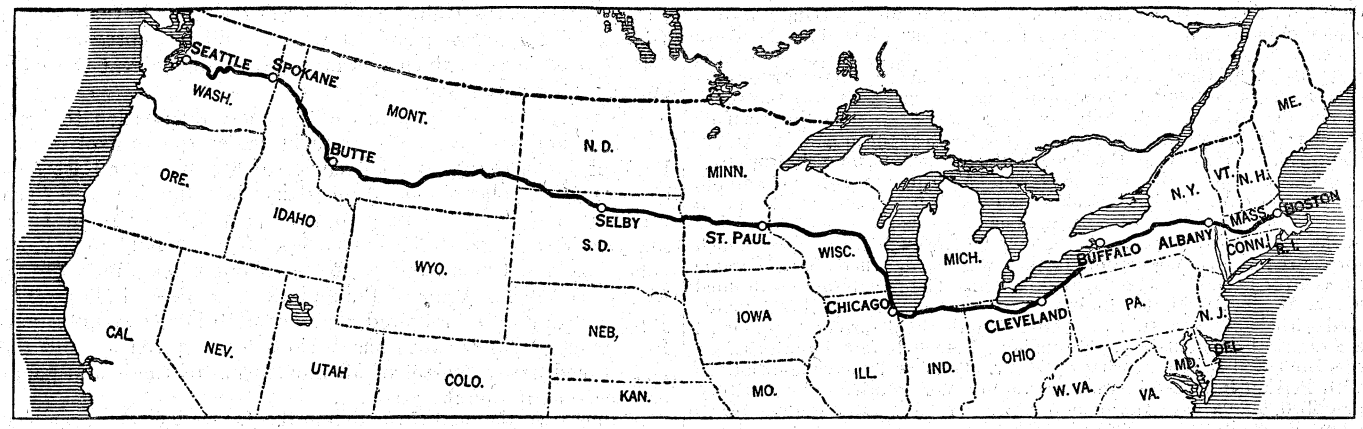
Such climatic conditions favour forest development and the growth of luxuriant grasses together with a varied alpine verdure. The whole of the park lies within the limits of the lodge-pole pine forest characteristic of the high Rockies though the higher slopes of the Absarokas and other high ranges are clothed with belts of spruce-fir forests and the crests of the mountains themselves are above timber line. The lodge-pole pine is a pioneer tree which invades terrain left open by other species, chiefly as the result of forest fires. Sunny, rocky slopes are in places occupied by the Douglas fir. Aspen and Engelmann spruce and a few limber pines are intermingled with the lodge-pole pines. Beautiful intermontane meadows where numerous grasses and sedges carpet the ground, and saxifrages, valerians, cinquefoils, senecios, orchises, betonies, gentians, grass of Parnassus and many other brilliant flowers blossom during the summer are interspersed with the rocky forest-clad ridges, while the banks of many pools, lakes and streams abound in water-lilies, buttercups, cresses, reeds and rushes. A few salt-loving plants grow about the hot springs and geysers, while in the hot waters issuing from them an interesting series of low plant forms is found.

The native fauna of the park area has been jealously guarded and preserved. Many elk and deer, a few antelope, bison, moose and mountain sheep; bears, foxes, coyotes, even wolves, lynxes and panthers; many species of squirrels, ground squirrels, mice, shrews, gophers, rabbits; the beaver, muskrat, otter, marten, skunk, weasel, badger, wolverene, marmot, mink; and several others less common wander in larger or fewer numbers into or about the park, though most of them may be encountered only in the remoter, less frequently visited, sections of the park. Proportionally as richly numerous and varied as the mammal life, the bird forms include over 200 species, some permanently resident, many only migrant. The streams are well stocked with fish, particularly trout, of which the native redthroat (*Salmo clarkii*) is one of the gamest and most eagerly sought.

Perhaps the most amazing spectacle of the park is its display of over 100 geysers and 4,000 hot springs. The geysers are concentrated in three adjoining groups upon the middle-west side, but hot springs occur everywhere at widely separated points, one steam jet even issuing from the Grand Canyon depths, more than 1,000 ft. below the rim. The most famous geyser is Old Faithful, which may be taken as typical. The regularity of its eruptions, the violence of its explosions, and the grace and beauty of its water column make it one of the most admired of the park geysers. The interval between eruptions averages 65 minutes, the period of eruption lasts 4½ minutes, and it throws into the air a column of water from 95 to 130 ft. in height. The Excelsior geyser, which ceased erupting in 1888, hurled aloft a greater volume of water with appalling fury of action. The Giantess geyser, when in action, is far more powerful than Old Faithful, but plays with less regularity, with intervals of nearly three weeks' duration. Another titanic geyser unexpectedly broke forth in 1928 with furious activity. It hurls water in all directions, some columns to a height of 100 feet. Two major eruptions every 24 hours form its schedule, each eruption lasting for three hours or more, with outbursts at 15 to 20 second intervals.

The Grand Canyon of the Yellowstone is also one of the truly wonderful features of the park. It is a magnificent and picturesque gorge penetrating deep into the volcanic rocks of the park plateau. It presents on a grand scale a remarkable picture of recent canyon cutting by the Yellowstone river, which, leaving Yellowstone lake at its broad outlet, flows northward through an open valley for about 15 m. and then plunges by two impressive falls, respectively 110 and 312 ft. in height, into the Grand Canyon. The walls of the canyon rise abruptly 800 to 1,100 ft. above the rushing turbulent stream which cuts the gorge. Much of the exquisite beauty and impressive grandeur of the region comes from the brilliantly-coloured canyon walls, with their bizarre bands and stripes of soft pink and salmon to blazing Indian red, deep orange in masses, and yellow and green blotches all gayly intermingled. Yellowstone lake is large—20 m. north to south, and 15 m. east to west—irregular in outline, and wooded to the water's edge.

The first recorded visit to Yellowstone Park was made by John Colter in 1810 when he took refuge there from hostile Indians. His story was wholly discredited, as was the story of the next visitor, Joseph Meek, a trapper who visited the region in 1829. The first description of the Firehole geyser basin was written by Warren Angus Ferres, a clerk in the American Fur Company, between 1830 and 1840, but not until 1852 was the region defined and described in its entirety by Father De Smet, the famous Jesuit missionary, who derived his information from the noted Indian scout and frontiersman, Jim Bridger. The first Government



THE YELLOWSTONE TRAIL

expedition sent out in 1859 under the command of Capt. W. F. Reynolds, brought back little authentic information regarding the section, and the reports of private explorers were discredited. Finally the well-equipped expedition under Henry D. Washburn and N. P. Langford, in 1870, established the facts and led to the creation of the Yellowstone National Park.

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YELLOWSTONE TRAIL, an American highway leading from Plymouth Rock, on the Atlantic, to Seattle, on Puget sound. It is 3,400 mi. long. The roadway is paved or hard from Plymouth to Oshkosh, and improved over most of the rest, with some hard surfacing and pavement to the Pacific. This highway is one of the finest across the United States. It touches Albany and Buffalo, N.Y., Cleveland, O., Chicago, Ill., St. Paul, Minn., Selby, S.D., Butte, Mont., and Spokane, Wash.

YELLOW-THROAT, the name given to a species, with several sub-species, of North American birds of the Passerine family Mniotiltidae, the American wood warblers. The best known is the Maryland yellow-throat (*Geothlypis trichas*) which ranges over the greater part of the United States and southern Canada. About 5 in. long, this bird is olive green above, yellow below, with black forehead and cheeks in the male. Its sub-species the tule yellow-throat (*G. t. scirpicola*) is resident in southern California. The western yellow-throat (*G. t. occidentalis*) is found in southeastern California and southwestern Arizona.

YELLOWWOOD, AMERICAN (*Cladrastis lutea*), a handsome North American tree of the family Leguminosae, called also yellow locust, gopherwood and virgilia. Though somewhat rare in the wild state, being found only locally in rich soils, chiefly along mountain streams, from North Carolina to Missouri, it is widely cultivated for ornament. It has a short trunk branching into a graceful crown, sometimes rising 50 ft. high, with smooth bark, pinnate leaves, and fragrant, pea-like, white flowers, 1 in. long, borne in loose, drooping clusters, 10 in. to 20 in. long, blossoming in June. The hard strong wood yields a yellow dye.

YEMEN (*Yaman*), an extensive region forming the southwestern portion of Arabia. In 1934 Yemen lost its northern province 'Asir to Saudi Arabia; the boundary line lies north of the seaport Maidi and south of Samta. On the east its limits merge with the desert, while on the south they abut on Hadhramaut. Yemen may be looked upon as possessing two centres: the British protectorate of Aden (*q.v.*) in the south and the domains of the Imam Yahya, whose capital is Sana (*q.v.*).

The Imam Yahya is ruler of Yemen proper, and his lands include those abandoned by the Turkish power in 1918 and consequently the limits of his power are in line with those of the Anglo-Turkish boundary of 1902–04. He governs an area of some 75,000 sq.mi., with a population of some 1,600,000.

Ptolemy and the ancient geographers in general include the whole peninsula under the name of Arabia Felix (εὐδαίμων), in which sense they translate the Arabic *Yaman,* literally "right hand," for all Arabia south of the gulf of 'Aqaba was to the right from their standpoint of Alexandria; the Moslem geographers, however, viewing it from Mecca, confine the term to the regions south of Hejaz, including 'Asir, Hadhramaut, Oman and part of southern Nejd. Yemen occupies the uptilted edge of a block of ancient land forming Arabia.

The uptilted edge of the old block is known as the Jibal or highlands of Yemen, with an average height of 9,000 ft., the highest measured point being 12,336 ft.

The principal town of the Jibal is Ta'izz (pop. about 4,000). It was formerly a large city, and from its position in the centre of a comparatively fertile district at the junction of several trade routes it retained its importance. Some 30 mi. farther north are the small towns of Ibb (6,700 ft.) and Jibla, about 5 mi. apart, typical hill towns with their high stone-built houses and paved streets. Manākha produces the best coffee in Yemen. Another group of hill towns lies still farther north in the mountain mass between the Wadi Maur and Wadi Laja, where the strongholds of Dhāfir, 'Afār, Haja and Kaukabān have long been known for their independence. The last-named was once a city of 20,000 inhabitants, and the capital of a small principality which preserved its independence during the earlier Turkish occupation between 1536 and 1630. The lowland strip of Yemen is known as the Tihama and is hot and generally sterile. The lowland strip is from 20 to 30 mi. wide. There are oases, however, near the foot of the mountains, fertilized and irrigated by hill streams and supporting many large villages and towns. The most important of these are Zaidiya, Bait al Faqīh and Zabīd in the western Tihama, the latter a town of 20,000 inhabitants. Hudaida (*q.v.*) and Aden (*q.v.*) are the only ports of commercial importance, while Mokha is the old centre of the coffee trade. Beyond the crest of the uptilted edge of the old block stretches the third natural region of Yemen—the great desert. As it lies entirely to the east of the high crest, it has a smaller rainfall than the Jibal. Its general character is that of a steppe increasing in aridity towards the east where it merges in the desert, but broken in places by rocky ranges, some of which rise 2,000 ft. above the general level, and which in the Hamdan district north of Sana show evidence of volcanic action. It is intersected by several wadi systems, of which the principal are those in the north uniting to form the Wadi Najran, in the centre the Wadi Khārid and Shibwān running to the Jauf, and in the south the Wadi Bana and its affluents draining to the Gulf of Aden. The plateau has a gradual fall from the watershed near Yarim, 8,500 ft. above sea level, to less than 4,000 ft. at the edge of the desert.

The northern part nearly down to the latitude of Sana, is the territory of the Hāshid and Baqīl tribes, which never submitted to the Turks. Sa'da is an important town on the old pilgrim road 120 mi. N. of Sana, Khaiwan and Khamr. To the northeast, bor-

dering on the desert, lies the district of Najran, now in Saudi Arabia, a mountainous country with several fertile valleys including the Wadi Najran, Badr and Habuna, all probably draining northeast to the Rub' al-Khali. Farther south is the oasis of Jauf, a hollow or depression, as its name signifies, containing many villages. It was the focus of the old Minaean and Sabaean kingdoms, known to the ancients through their control of the frankincense trade of south Arabia. Ma'in, identified by Halévy as the seat of the former, is on a hilltop surrounded by walls still well preserved. Ma'rib, the Sabaean capital, had a great dam to whose breaking between A.D. 542 and 570 tradition ascribes the final decay of Yemen. The city was abandoned, probably owing to the deterioration of the country through desiccation, which forced the settled population farther westward, where Sana became the centre of the later Himyaritic kingdom. The Arhab district drained by the Wadi Khārid and Shibwān between Sana and the Jauf is covered with Himyaritic ruins, showing that the land formerly supported a large settled population. Throughout Yemen is found the *mijal*—a cemented well for the storing of water. These wells have associations with Persian influence in the 6th century A.D. South of the territory described above are 'Amran and Shibām on the road leading north from the capital Sana; Dhamar (the seat of an ancient university) and Yarim are on the road leading south to Aden; and two days' journey to the east is Rada.

The inhabitants of Yemen are settled, and for the most part occupied in agriculture and trade, the conditions which favour the pastoral or Bedouin type found in Hejaz and Nejd hardly existing. The people may be considered under four groups: (1) The Saiyids or Ashrāf, descendants of the prophet, forming a religious aristocracy; (2) the Qabail, or tribesmen, belonging to the Qahtanic or original south Arabian stock, who form the bulk of the population; (3) the trading class, and (4) a mixed group mostly of African descent and including a number of Jews.

In Sept. 1934, in the treaty between Britain with India, and the Yemen, the Zaidi Imam Yahya Ibn-Mohammed Ibn-Hamid-al-Din was acknowledged "king." On his defeat by Ibn Sa'ud in 'Asir, Yahya accepted on May 13, 1934, peace conditions and was left fully independent in Yemen.

See C. Niebuhr, *Travels and Description of Arabia* (Amsterdam, 1774); D. G. Hogarth, *Penetration of Arabia* (London, 1904); E. Glaser, *Geschichte und Geographie Arabiens* (Berlin, 1890), and in *Petermann's Mitt.* (1886); R. Manzoni, *Il Yemen* (Rome, 1884); A. Deflers, *Voyage en Yemen* (Paris, 1889); H. Burchardt, *Z. d. Ges. für Erdkunde* (Berlin, 1902), No. 7; Ameen Rihani, *Arabian Peak and Desert* (Boston, 1930); Hugh Scott, *In the High Yemen* (London, 1942). (P. K. H.; X.)

YEN. The yen, monetary unit of the Japanese empire, is divided into 100 sen and 1,000 rin. Under the Gold Standard law of 1897 the yen has a theoretical gold content of 750 milligrams of fine gold, but Japan's gold reserves are valued under the Gold Reserve Revaluation law of 1937 on the basis of a gold content of 290 milligrams per yen. The obligation of the Bank of Japan to convert its notes into gold was suspended by the Gold embargo of Dec. 13, 1931, and repealed by the Law of the Bank of Japan of 1942.

The currency in circulation in the Japanese empire at the middle of 1945 consisted of banknotes in denominations of 1 yen or higher, and of state coins and bills in denominations of 50 sen or lower, as follows: (1) Bank of Japan notes, issued in accordance with articles 29 to 32 of the Law of the Bank of Japan of 1942, which had superseded the Convertible Bank Note law of 1884 and the law of 1941 concerning Extraordinary Exceptions from the Convertible Bank Note law; (2) Bank of Chosen notes, issued in accordance with articles 21 to 25 of the Law of the Bank of Chosen of 1911 as amended; (3) Bank of Taiwan notes, issued in accordance with articles 8 and 9 of the Law of the Bank of Taiwan of 1897 as amended; (4) coins of copper, tin, aluminum, nickel or silver, issued by the government in accordance with the Coinage law of 1897 and the Emergency Currency law of 1938 as amended; and (5) bills, issued by the government in accordance with imperial ordinance no. 202 of 1917 and the Emergency Currency law of 1938. State coins and bills were legal tender throughout the empire up to fixed amounts only. The privilege of issuing bank notes with legal tender character throughout the empire was reserved exclusively to the Bank of Japan. The Bank of Chosen notes constituted legal tender only in Korea, and the Bank of Taiwan notes only in Formosa. In addition, from 1938 on the Japanese government issued special notes, denominated in "military yen," for use by the Japanese forces in China; after 1941 their use was extended to Hongkong and other territories under Japanese military administration, where they circulated as legal tender side by side with the local currency. Similarly, United States forces operating in the Ryukyu Islands in 1945 were provided with a military currency, also denominated in yen, which was intended to supplement the local currency, but not to replace it.

From 1936 on, the extension of Japanese domination to parts of China and southeast Asia brought under the control of the Bank of Japan the various currencies of the "Greater East Asia Co-prosperity Sphere," and resulted in the formation of a "yen monetary bloc." At the time of its largest expansion, in 1944, the yen bloc included the currencies of "Manchoukuo," Mongolia, northern China, central and southern China, Indo China, Malay, Thailand, Burma, Philippines and East Indies. The Japanese authorities followed a policy of bringing about a uniform value (1:1) between the various local currencies and the yen through strict control of all movements of funds and goods between countries of the yen bloc.

In June 1941, the total circulation in the Japanese empire amounted to 5,900 million yen, consisting of: Bank of Japan—4,197 million, Bank of Chosen—509 million, Bank of Taiwan—198 million, state bills—363 million, and coins—600 million (est.). Bank of Japan notes in circulation reportedly had risen to more than 20 billion yen by March 1945. Externally, the yen was pegged to the pound sterling at 1*s.* 2*d.* from 1931 to 1939 and to the dollar at $0.234 from 1939 to 1941; after the outbreak of World War II the finance ministry fixed the official exchange rate of the yen at 0.989 Swiss franc, the equivalent of the former sterling and dollar bases. United States forces operating in the Ryukyu Islands in 1945 used a provisional rate of 1 yen=$0.10 for accounting purposes. (F. M. T.)

YENISEI (from a Tungus word meaning Great River), a river of Asiatic Russia, rising in Mongolia and flowing into the Arctic Ocean, having a total length of 2,700 mi. and a basin extending over a million square miles. It marks a structural boundary of great antiquity in the history of the continent. The western plain, extending from the Urals and covered by quaternary alluvial deposits, with a few isolated remnants of friable Tertiary sandstones, forms, apart from the smaller rivers of the Arctic tundra, a catchment area for the Ob. Near the left bank of the Yenisei there is a slight rise in the plain which deflects a few short tributaries to the Yenisei, but most of its drainage area lies to the right, on the ancient plateau remnant of Angara land, the middle of which forms a watershed, with drainage either to the Arctic, or to the east and west. Thus the Yenisei and the Lena are marginal rivers of an ancient block. Contrasts between the land to the west and that to the east of the Yenisei, north of Krasnoyarsk, are sharp, orographically, geologically, in soil formation and in climate, the winter isotherms curving southward on the higher land. The effects are that the plateau population is scanty, and that the limit of possible cultivation, which from the Urals to long. 50° E. remains considerably north of lat. 60° N., on the plateau lies considerably farther south. North of the Arctic circle, the difference disappears, the whole region being tundra.

Towards the south the plain forms an amphitheatre west of Lake Baikal; within it lie the courses of the Angara, the Stony or Middle Tunguska, the upper courses of the Lower Tunguska and of the Lena. It is bounded by the Archaean masses on the Middle Yenisei, cut off by a fracture along the river between the confluences of the Angara and the Stony Tunguska, and by the pre-Cambrian fold mountains to the south. Bogdanovich supposes that a great inland lake existed in the amphitheatre during the Angara epoch of the Mesozoic. The Yenisei is thus a mountain river of composite character. In Chinese Mongolia it flows through a longitudinal valley at the northern foot of the Tannu-ola; it then cuts through the western Sayan mountains and passes through portions of successive transverse valleys to Krasnoyarsk and its confluence with the Angara. It then flows along the western base of the Archaean range and finally enters the most northwesterly part of the Palaeozoic plateau. The Yenisei is formed by the junction of the Bei-kem and Chua-Kem streams in the Uryankhansk district of Chinese Mongolia, and is known as the Ulukem or Upper Yenisei. It receives the Kemchik river on the left and the town of Kemchik at the junction is much visited by Russian traders, who also have quarters in Krasniy at the junction of the Bei-kem and Chua-kem (or Little Yenisei).

After crossing the frontier it receives the Us on the right bank and there is a Russian settlement at Usinskoe. Eighty-two miles

north of the frontier are formidable rapids, the limit of raft navigation. This part of its course is through coniferous mountain forest, with some meadow land along the banks. Gold, asbestos, salt, coal, magnesia and iron occur in the mountains, but are little worked; the inhabitants are mainly nomad Finno-Tatar hunters, though Russian colonization is slowly spreading. The river now enters a prairie region, with the Abakan draining it on the left and the Tuba on the right. Minusinsk (*q.v.*) lies 8 m. from the confluence of the Abakan and Yenisei; and the Minusinsk black earth region, sheltered by the West Sayan mountains, the Siberian Urals and the Abakan range, is noted for its fertility and its mild climate and has been settled from prehistoric times. Gold and coal are found. Iron is found on the Irba, a tributary of the Tuba. At Novo-Selovsk 55° 5′ N., 91° 16′ E., the Chulim, a tributary of the Ob is only 6 m. distant, but canalization is impracticable owing to difference of level. At Krasnoyarsk (*q.v.*) the railway crosses the river, which here flows through a plain with mountains to the south and west, whose red sandstone and marl have given Krasnoyarsk its name.

South of the Pit mountains (the northern limit of corn growing land), the Angara or Upper Tunguska enters the Yenisei, after flowing 1,100 m. from Lake Baikal. The Selenga and the Angara were probably once united and Lake Baikal is of later formation. A rich gold-bearing region extends from the Angara to the Stony Tunguska, and the Pit enters the Yenisei on the right in this district. The Stony Tunguska, 1,000 m. long, is almost uninhabited, and here the deciduous forest merges into the coniferous. From the Stony Tunguska to Turukhansk is dense coniferous forest, with a few settlements on the right bank mainly. The Bakhta, north of the Stony Tunguska, flows through a marshy, uninhabited country. Above the confluence of the Stony Tunguska, the Yenisei broadens and reefs of rock known as the "Seventy Islands" rise above its waters.

The Lower Tunguska, 2,000 m. long, rising in lat. 57° N., 20 m. from the Lena, winds through a marshy forest country, with no settlements except in its upper course, where the villages are linked with the easily reached Lena. Coal, graphite and asbestos exist, but are not worked. The Turukhan enters from the left and is used by the Samoyedes to link with the Taz. The town of Turukhan, 10 m. from the Yenisei on the delta of the Turukhan, is now derelict and Monastir Turukhan (Troitskoe Monastir) on the right bank has replaced it. The Kureika river enters from the left and is linked with Obdorsk by a western track. There is unworked graphite in the Kureika valley. In lat. 69°–70° N., the scattered larches and birches give way to treeless tundra. There is a Russian trading settlement at Dudinsk, at the confluence of the Dudina and 60 m. E. coal of good quality is found in the Novil mountains, and platinum is reported. A scattered population, descendants of Russian exiles and natives, extends from Dudinsk to the Khatanga river. The Yenisei delta and gulf are not fully explored. The west is low and marshy and the east steep. Fish abound and native fishermen migrate north in summer. Golchikha, a Samoyede village on an island in the delta in 71° 45′ N., 84° E., has steamer communication with Krasnoyarsk and Minusinsk, fish and fur going upstream and corn, meat and manufactured goods downstream. Yenisei navigation is less important than that of the Ob, owing to the scantier population and more difficult environment. In winter the frozen river serves as a good road. At the delta the river is usually frozen from Oct. 30 to June 23; at Turukhansk, from Nov. 11 to June 8, at Krasnoyarsk from Dec. 5 to May 12; and at Minusinsk from Nov. 29 to May 11. There are floods in mid-May and mid-June, and huge blocks of ice collect in and near the mouth after the thaws.

Exploration and Settlement.—The Yenisei was first reached by Cossack bands in 1618 to 1620, who came from the Ob via the portage between the Ket tributary of that river and the Kaz tributary of the Yenisei which is now linked by canal. They met with much opposition from the Tungus and Buriat tribes and it was not till 1648 that the Russians penetrated to Lake Baikal via the Angara river. The exploration of the delta was much delayed, for though English and Russian navigators visited the Kara Sea in the 16th century, the upper course of the river, 6 m. wide near the delta, and with a delta opening into a gulf 40 m. wide, presents great difficulties when the warmer waters from the south undermine the ice and huge ice floes swell up and burst away, forming ice hills sometimes 50 to 60 ft. high on the banks, while the pack ice blocks on the current travel northwards at 20 m. an hour, crashing against one another with deafening reverberations.

After 1853, a wealthy Siberian, Sidoroff, agitated for 20 years to establish links between Europe and the mouths of the Arctic rivers of Siberia and in 1874 an English vessel reached the mouth of the Ob, while Nordenskjöld, the famous Swedish explorer, in 1875 entered the mouth of the Yenisei. In 1876 an English vessel reached Kureika on the Yenisei and in the following year Sidoroff reached the delta from Yeniseisk, and sailed to Leningrad. In 1878, the *Fraser* and *Express,* two ships of Nordenskjöld's "Vega" expedition ascended the Yenisei. A company was formed to establish trade via this route, but was unsuccessful and was dissolved in 1900. The project is now being revived and in 1928 a Kara Sea expedition, consisting of three British and five Norwegian vessels, set out from Hamburg on Aug. 1, sailing via the North Sea, Barents sea, through the Novaya Zemlya islands and the Kara sea to the mouths of the Ob and Yenisei, taking 15,000 tons of agricultural machinery, metals, drugs and coal, to exchange for timber, flax, cow-wool, hides and horsehair, brought down the rivers on barges towed by steamers.

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YENISEISK, a town in the Krasnoyarsk territory of the Russian S.F.S.R., in 58° 39′ N., 92° 4′ E., on the right bank of the Yenisei river at an altitude of 285 ft. It is a centre for fur trading and gold mining; pop. (1926) 5,957, about 50% of that in 1913. There is not much wharf accommodation, though there is regular steamer connection to Krasnoyarsk. The river at Yeniseisk is a mile wide and navigation opens about May 19 and closes about Dec. 1. The town was founded in 1618.

YEOMAN, a term meaning, first, a class of holders of land and second, a retainer, guard, attendant or subordinate official. The word appears in M.E. as *3eman, 3oman* and *yeman;* it does not appear in O.E. It is generally accepted that the first part is the same word as the Ger. *Gau,* district, province, and probably occurs in O.E. as *géa* in *Súðri-géa,* Surrey; *i.e.,* southern district, and other place-names. "Yeoman" thus meant a country-man, a man of the district, and it is this sense which has survived in the special use of the word for a class of landholders.

The extent of the class covered by the word "yeoman" in England has never been very exactly defined. One of the earliest pictures of a yeoman is that given by Chaucer in the Prologue to the *Canterbury Tales.* Here, represented as a forester, he follows the esquire as a retainer or dependant. The yeomen of later ages, however, are practically all occupied in cultivating the land, although, doubtless from its younger sons, the class furnished retainers for the great lords, men-at-arms and archers for the wars, and tradesmen for the towns. Medley (*Eng. Const. Hist.*) describes the yeomen of the 15th century as representing on the whole "the small freeholders of the feudal manor." Holinshed, in his *Chronicle,* following Sir T. Smyth (*De republica Anglorum*), and W. Harrison (*Description of England*), describes them as having free land worth £6 annually, and in times past 40s., and as not entitled to bear arms. They formed the intermediate class between the gentry and the labourers and artisans.

YEOMANRY, the name given to the volunteer mounted troops of the home defence army of Great Britain, ever since their original formation; it indicated that recruiting, organization and command were upon a county basis, the county gentlemen officering the force, the farmers and yeomen serving in its ranks, and all alike providing their own horses. Although the yeomanry was created in 1761, it was not organized until 1794. Under the stimulus of the French War recruiting was easy, and 5,000 men were quickly enrolled. A little later, when more cavalry were needed, the Provisional Cavalry Act was passed, whereby a sort of revived knight-service was established, every owner of ten

horses having to find and equip a horseman, and all who owned fewer than ten, grouped by tens of horses, similarly finding one. A great stimulus to yeomanry recruiting was given by an amending act which was soon passed by which yeomanry cavalry could be substituted for provisional cavalry in the county quota. At the peace of Amiens, the yeomanry was retained, although the provisional cavalry was disbanded. There was thus a nucleus for expansion when Napoleon's threatened invasion (1803–5) called out the defensive powers of the country, and as early as December 1803 there were in England, Scotland and Ireland, 44,000 yeomen. At the same time the limitations as to place of service in Great Britain were abolished.

From the extinction of Chartism to the South African War the history of the yeomanry is uneventful. The strength of the force gradually sank to 10,000. But when it became apparent that mounted troops would play a decisive part in the war against the Boers, the yeomanry again came to the front. Of its 10,000 serving officers and men, 3,000 went to South Africa in newly formed battalions of "Imperial Yeomanry," armed and organized purely as mounted rifles, and to these were added over 32,000 fresh men, for whom the yeomanry organization provided the cadres and training. In 1901 the yeomanry was remodelled; the strength of regiments was equalized on a four squadron basis, fresh regiments were formed and the strength of the force was more than trebled. In 1907 the yeomanry became part of the new Territorial Force.

At the outbreak of the World War in 1914, 53 regiments of yeomanry mobilized. The first to see active service was the Oxfordshire Yeomanry who accompanied the Royal Naval Division in the Antwerp campaign, but it was not until the spring of 1915 that the employment of yeomanry was seen on any considerable scale. In France four regiments of yeomanry were brigaded with regular cavalry in the cavalry corps and proved in every way worthy of this distinction.

Only in the Palestine campaign was opportunity found for the successful employment of large cavalry formations. Fourteen regiments of yeomanry, nine of which had formed part of an improvised dismounted force in Gallipoli, served in the various divisions of the Desert Mounted Corps and contributed very materially to Allenby's success. The actions of Huj and El Mughar following the third battle of Gaza, both executed entirely by yeomanry, provided classic examples of the employment of the mounted attack in mobile warfare. In the spring of 1918 eight of these regiments were grouped into machine gun battalions and sent to France.

One complete infantry division, the 74th, was formed in Palestine in early 1917 entirely from 18 yeomanry regiments, 12 of which had previously seen service in Gallipoli; it was first engaged as a division at the second battle of Gaza, served with considerable distinction till after the capture of Jerusalem and in the spring of 1918 was sent to France and Flanders. The Scottish Horse and Lovat's Scouts Brigade served as infantry in Gallipoli, Macedonia and France and Flanders. The remaining yeomanry regiments were employed as divisional cavalry.

After 1918 much attention was given to the territorial force, and on its reconstruction in 1920 (*see* TERRITORIAL ARMY) the greater portion of the yeomanry was mechanized. Of the 53 regiments, 25 were converted into units of the Royal Artillery, and 8 into Armoured Car companies of the Royal Tank Corps; one became a regiment of Cavalry Divisional Signals, and another an infantry regiment; while the 1st and 2nd Lovat's Scouts and the Scottish Horse with 14 other regiments were retained for their original purposes. This was the position when the territorials were merged into the regular army in September 1939. (E.F.LA.;X.)

YEOMEN OF THE GUARD, originally "Yeomen of the Guard of (the body of) our Lord the King"—"Valecti garde (corporis) domini Regis"—the title maintained with but a slight variation since their institution in 1485, of a permanent military corps in attendance on the sovereign of England, as part of the royal household, whose duties, now purely ceremonial, were originally those of the sovereign's personal bodyguard. They are the oldest existing body of the kind. The first warrants to individual "Yeomen of the Guard" date from Sept. 16, 1485, immediately after the victory of Henry VII. at Bosworth (Aug. 22).

The first official recorded appearance of the king's bodyguard of the Yeomen of the Guard was at the coronation of its founder Henry VII. at Westminster Abbey on Oct. 31, 1485, when it numbered 50 members. That number was rapidly increased, for there is an authentic roll of 126 attending the king's funeral in 1509. Henry VIII. raised the strength of the Guard to 600 when he took it to visit Francis I. of France at the Field of the Cloth of Gold (*q.v.*). In Queen Elizabeth's reign it numbered 200. The corps was originally officered by a captain (a post long associated with that of vice-chamberlain), an ensign (or standard-bearer), a clerk of the cheque (or chequer roll, his duty being to keep the roll of every one connected with the household), besides petty officers, captains, sergeants or ushers. In 1669 Charles II. reorganized the Guard and gave it a fixed establishment of 100 yeomen, officered by a captain, a lieutenant, an ensign, a clerk of the cheque and four corporals, which is the present organization and strength. The captaincy is now a ministerial appointment filled by a nobleman of distinction under the lord chamberlain, and the old rank of "corporals" has been changed to "exon," a title derived from "exempt," *i.e.*, exempted from regular regimental duty for employment on the staff. Formerly officers on the active list were given these appointments in addition to their own.

The original duties of the Guard were of the most comprehensive nature. They were the king's personal attendants day and night at home and abroad. They were responsible for his safety not only on journeys and on the battlefield, but also within the precincts of the palace itself. In Tudor times the Yeomen of the Guard alone were entrusted with the elaborate formality of making the king's bed. Another of their duties still retained is the searching of the vaults of the houses of parliament at the opening of each session, dating from the "Gunpowder plot," in 1605, when the Yeomen of the Guard seized Guy Fawkes and his fellow-traitors and conveyed them to the Tower.

The dress worn by the Yeomen of the Guard is in its most striking characteristics the same as it was in Tudor times. It has consisted from the first of a royal red tunic with purple facings and stripes and gold lace ornaments. Sometimes the sleeves have been fuller and the skirts longer. Red knee-breeches and red stockings (white in Georgian period only), flat hat, and black shoes with red, white, and blue rosettes are worn. Queen Elizabeth added the ruff. The Stuarts replaced the ruff and round hats with fancy lace and plumed hats. Queen Anne discarded both the ruff and the lace. The Georges reintroduced the ruff, and it has ever since been part of the permanent dress. Up to 1830 the officers of the Guard wore the same Tudor dress as the non-commissioned officers and men, but under William IV. the officers were given the dress of a field officer of the Peninsular period. The weapons of the Guard are a steel gilt halberd with a tassel of red and gold and an ornamental sword.

The real fighting days of the Guard ended with the Tudor period, but it was only with the final appearance of an English King in battle (Dettingen 1743) that the Guard's function of attending a sovereign on the battlefield ceased. For a brief period during the Georgian era the Guard lost to a certain extent its distinctive military character and a custom crept in of filling vacancies with civilians, who bought their places for considerable sums, the appointments being of great value. William IV. put a stop to the practice, the last civilian retired in 1848, and the Guard regained its original military character. Every officer (except the captain), non-commissioned officer, and yeoman must have served in the Home or Indian army or Royal Marines. They are selected for distinguished conduct in the field, and their pay is looked upon as a pension.

The nickname "Beef-eaters," which is sometimes associated with the Yeomen of the Guard, had its origin in 1669, when Count Cosimo, grand duke of Tuscany, was in England, and, writing of the size and stature of this magnificent Guard, said, "They are great eaters of beef, of which a very large ration is given them daily at the court, and they might be called 'Beef-eaters.'"

In 1509, Henry VIII., envying the magnificence of the body-guard of Francis I. of France, decided to have a noble guard of his own, which he accordingly instituted and called "The Gentlemen Speers." It was composed of young nobles gorgeously attired. In 1539 the guard was reorganized and called "Gentlemen Pensioners." That title it retained till William IV.'s reign, when the corps regained its military character and received their present designation, "The Honourable Corps of Gentlemen-at-Arms."

See *The History of the King's Body Guard of the Yeomen of the Guard,* by Colonel Sir Reginald Hennell, D.S.O., Lieutenant of the Yeomen of the Guard (1904).

YEOTMAL, a town and district of India in Berar. It stands on an elevated plain at about 1,400 feet. The population in 1931 was 20,967. It was formerly the headquarters of the Wun district but in 1905 the new district of Yeotmal was established, the old Wun district being renamed with additions from the district of Basim. Cotton ginning and pressing are the main industries. The town is also the chief trading centre of the district, being connected by a road, 29 miles long, with Dhamangaon on the G.I.P. railway, while a narrow gauge line recently constructed connects it through Darhwa and Karinja with Murtizapur on the main G.I.P. line.

The DISTRICT OF YEOTMAL has an area of 5,238 square miles. Yeotmal is a large cotton producing district, but its upland is less fertile than the average of Berar. The greater part of the district is drained by the Penganga River, which joins the Wardha in the south-east corner. There are large forest reserves in the south and south-east in which game abounds. There is a considerable aboriginal element of Gonds and Kalams in the wilder portions. The 1941 population was 887,738. There is coal at Pisgaon in the Wun *taluq* near the Wardha River. The climate in the uplands is cool and the rainfall (41″) plentiful.

YEOVIL, a market town and municipal borough in the Yeovil parliamentary division of Somersetshire, England, on the G.W. and S. railways, 127 mi. S.W. of London. Pop. (1938) 20,110. Area 3.5 sq.mi. The town lies on the river Yeo, and is a thriving place, with a few old houses. The town is famous for its manufacture of gloves (dating from 1565). It has also brick works, a brewery, and large engineering works. Its agricultural trade is considerable. Yeovil (*Gyoele, Evill, Ivle, Yeoele*) before the Conquest was part of the private domains of the Anglo-Saxon kings.

YERBA BUENA (*Micromeria chamissonis*), a pleasantly aromatic North American herb of the mint family (Labiatae, *q.v.*), found in woods from British Columbia to southern California. It is a slender perennial, with trailing stems ½ ft. to 2 ft. in length, roundish, short-stalked leaves, ½ in. to 1 in. broad, and delicate, two-lipped, white flowers, borne on hair-like stalks usually singly in the leaf-axils. Medicinal properties were ascribed to it.

YERBA MANSA (*Anemopsis californica*), a North American herb of the lizard's-tail family (Saururaceae), found in wet saline places from western Texas to central California and southward to Mexico. It is a perennial with upright stems, ½ ft. to 2 ft. high, springing from aromatic, creeping rootstalks, and astringent, slightly spicy foliage. The flowers are borne in terminal spikes, ½ in. to 1½ in. long, surrounded at the base by a circle of conspicuous white bracts; the fruit is a capsule, splitting open from the top. The Spanish-Californians used the plant medicinally.

YERBA MATÉ: *see* MATÉ.

YERBA SANTA (*Eriodictyon californicum*), a North American balsamic shrub of the water-leaf family (*Hydrophyllaceae*), native to dry slopes and mountain ridges from south central California to southern Oregon. It grows from 2 ft. to 8 ft. high, bearing narrowly lanceolate leaves, which are very glutinous-resinous above and densely white-woolly below, and bluish or white flowers in loose clusters. The Indians and early Spanish settlers made extensive medicinal use of the bitter-aromatic leaves; the Indians also chewed and smoked them.

YERSIN, ALEXANDRE ÉMILE JOHN (1863–1943), Swiss bacteriologist, was born at Rougemont, Switzerland, on Sept. 22, 1863, and studied at Lausanne, Marburg and Paris. He was associated with Roux in his researches on the diphtheria serum at the Pasteur institute, and then continued his researches in China and Indo-China, where he explored the Mois country. He introduced the culture of rubber into Indo-China. The plague bacillus was discovered by him in Hongkong in 1894, Kitasato simultaneously making the same discovery. The next year Yersin prepared a serum to combat the disease. Under the auspices of the Chinese government a branch of the Pasteur institute was founded by him at Canton. Yersin established a similar institution at Nha Nang, Annam, in the same year, of which he became director. Yersin was awarded le grand prix Leconte by the Paris Académie des Sciences in 1927. He died in Indo-China, March 2, 1943.

YEW (*Taxus baccata*), a tree which belongs to the family Taxaceae (*see* GYMNOSPERMS), in which the ordinarily woody

FROM COOPER AND WESTALL, "TREES AND SHRUBS OF THE BRITISH EMPIRE" (J. M. DENT & SONS, LTD.)

YEW (TAXUS BACCATA), TWIGS WITH (A) STAMINATE AND (B) CARPELLATE FLOWERS

cone of the pines and spruces is represented by a single seed surrounded by a fleshy berry-like cup. Usually it forms a low-growing evergreen tree of very diverse habit, but generally with dense spreading branches, thickly covered with very dark green linear leaves, which are given off from all sides of the branch, but which, owing to a twist in the base of the leaf, become arranged in two ranks.

The trees are usually dioecious, the staminate flowers being borne on one individual and the carpellate on another. The staminate and the carpellate flowers are placed each separately in the axil of a leaf, and consist of a number of overlapping scales. In the carpellate flower these scales surround a cup which is at first shallow, green and thin (the so-called aril), but which subsequently becomes fleshy and red, while it increases so much in length as almost entirely to conceal the single straight seed. It is clear that the structure of the carpellate flower differs from that of most conifers, from which it is separated in a distinct family, Taxaceae.

The poisonous properties, referred to by classical writers such as Caesar, Virgil and Livy, reside chiefly if not entirely in the foliage. This, if eaten by horses or cattle, especially when it has been cut and thrown in heaps so as to undergo a process of fermentation, is very injurious. As a timber tree the yew is used for cabinet-work and axle-trees, where strength and durability are required. It was once largely used for the English long-bow.

The European yew, *T. baccata,* is a native of Europe, north Africa, and Asia as far as the Himalayas and the Amur region. The yew is wild in Great Britain, forming a characteristic feature of the chalk downs of the southern counties and of the vegetation of parts of the Lake District and elsewhere. The evidence of fossil remains, antiquities and place-names indicates that it was formerly more widely spread in Europe than at the present day. The varie-

ties grown in the United Kingdom are numerous, one of the most striking being that known as the Irish yew—a shrub with the pyramidal or columnar habit of a cypress. The yew is a favourite evergreen tree, either for planting separately or for hedges, for which its dense foliage renders it well suited. Its dense growth when pruned has led to its extensive use in topiary work, which was introduced by John Evelyn and became very prevalent at about the beginning of the 18th century. In the United States and Canada the best known native yews are the American yew or ground hemlock (*T. canadensis*), a low, straggling shrub rarely over 5 ft. high, found in woods from Newfoundland to Manitoba and southward to Virginia and Iowa, and the western or Pacific yew (*T. brevifolia*), a tree sometimes 50 ft. high, with a trunk diameter of 2 ft., which grows from California to Alaska and eastward to Montana. The hard, heavy, very fine-grained, exceedingly durable wood of the Pacific yew, one of the best woods used by the Indians for making bows, is especially suitable for tool-handles and similar purposes. Two other North American species occur: the Florida yew (*T. floridana*), a rare tree of western Florida, and the Mexican yew (*T. globosa*), found in the mountains of Mexico. Numerous dwarf forms and leaf-colour variants of the Japanese yew (*T. cuspidata*), a tree sometimes 50 ft. high, native to northeastern Asia, are planted for ornament.

For further details *see* Elwes and Henry, *Trees of Great Britain and Ireland* (1906); C. S. Sargent, *Manual of the Trees of North America* (1905, new ed. 1933); L. H. Bailey, *Manual of Cultivated Plants* (1924); G. B. Sudworth, "Check List of the Forest Trees of the United States," *U.S. Dept. Agric. Misc. Cir. 92* (1927); W. Dallimore and A. B. Jackson, *Handbook of Coniferae* (1931).

YEZD or YAZD, a province and town of Iran. The former is bounded on the west by the province of Isfahan, on the north by Samnan-Damghan, on the east by Khurasan and on the south by Kerman and Fars. Much silk is produced in this district, but not sufficient for the requirements of the looms of Yezd, and quantities are imported from Gilan. Other products are opium, madder, almonds and grain, of which last, however, only one-third of the supply required for local consumption is grown, the surplus requirements being brought from the adjacent province of Khurasan. The eastern part of the province bordering on the Dasht-i-Lut (desert) is much exposed to moving sands.

Yezd, the chief town of the province, is in 31° 54′ N. and 54° 22′ E. at an elevation of 4,390 ft., 162 mi. S.E. of Isfahan and 192 mi. N.W. of Kerman; pop. est. 60,000. When the Arabs invaded Persia, many of the Zoroastrians fled toward Yezd and Kerman where they remained. The highest and lowest temperatures are respectively 106° F. in July and 20° in December. Commercially, Yezd occupies an important central position in Iran, whence a number of routes radiate: to Isfahan to Meshed on the N.E. via Tabas and the desert and to Kerman on the west and Zahidan on the S.E. connecting with the Indian railhead. There is also an important direct caravan track to Bandar Abbas.

Since Sassanian times Yezd has been famous for beautiful silk textiles, rivalled in later periods only by Kashan and Isfahan. It is still the most productive centre of silk weaving, with approximately 8,000 weavers. Besides part of the imposing city wall, built in the 12th and 14th centuries, the most interesting mediaeval fortifications surviving in Iran, there are many important mosques and mausolea, dating from the Duwaz dah Imam (1035). The Masjid-i-Jami (cathedral or Friday mosque) is distinguished by the highest minarets in Iran, mosaic faïence, a superb mihrab dated 1375, and two oratories, Gothic in appearance, with deep transverse vaults. Some of the other mosques and mausolea are decorated with extremely delicate and rich stucco relief or are polychromed with tones of pale blue, rose and yellow. The sky line is picturesque, with minarets and many tall towers devised to bring moving air down to the many small chambers which are a necessary refuge from the intense heat of summer.

See G. N. Curzon, *Persia and the Persian Question* (1892); E. G. Browne, *A Year amongst the Persians* (1893 and 1926); *Survey of Persian Art* (1938), for the monuments especially vol. iv, Pls. 273, 4; 438, 449 and vol. ii *passim*. Textiles, vol. iii, pp. 1995–2220 *passim*, and vol. vi, Pls. 1032–1106 *passim*. (P. Z. C.; X.)

YEZIDIS, a religious sect, numbering about 50,000 persons, dwelling chiefly in the neighbourhood of Mosul. Their own name for themselves is Dasni, but they are called by their neighbours Yezidi; the origin of both names is uncertain, but the latter is probably derived from the Persian *Yazdān,* God. Their religion was probably originally an offshoot of Mazdaism, but it has absorbed elements from Christianity and Islam, for they regard Christ as an angel in human form and recognize Mohammed as a prophet with Abraham and the other prophets, and practise circumcision and baptism. They regard the devil as the creative agent of the Supreme God, and seek to propitiate him as the author of evil; they avoid mentioning his name and represent him by the peacock. Their sacred books have been translated by F. Nau *Recueil de textes et de documents sur les Yézidis* (1918).

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YEZO (HOKKAIDO), the most northerly of the five principal islands forming the Japanese empire, the five being Yezo, Honshu, Shikoku, Kyushu and Formosa. It is situated between 45° 30′ and 41° 21′ N. and between 146° 7′ and 139° 11′ E.; its coast line measures 1,423.32 mi., and it has an area of 30,148.41 sq.mi. On the north it is separated from Sakhalin by Soya strait (La Pérouse) and on the south from Nippon by Tsugaru strait. Its northern shores are washed by the Sea of Okhotsk, its southern and eastern by the Pacific ocean, and its western by the Sea of Japan. While Yezo is the old Japanese name, the correct modern designation is Hokkaido (Northern Sea circuit) as a separate administrative division, which however includes adjacent islands.

Orography.—The highest mountain in the island is Ishikari-dake (6,955 ft.) and the next in importance is Tokachi-dake (6,541 ft.). Yubari-take in Ishikari has a height of 6,508 ft., and in the province of Kushiro are O-akan-dake (4,470 ft.) and Meakan-take (4,500 ft.). Near Hakodate are two conspicuous volcanic peaks, Komaga-take (3,822 ft.) and Tokatsu-dake (3,800 ft.); and 24 mi. from Kushiro (by rail) is a volcano called Atosanobori, or Iwo-zan (sulphur mountain), whence quantities of first-rate sulphur are exported to the U.S. Rishiri, an islet on the extreme N.W., has a peak of the same name rising to 6,000 ft.

Rivers.—Yezo boasts the largest river in the Japanese empire, the Ishikari-gawa, which is estimated to measure 275 mi. Its other large rivers are the Teshio-gawa (192 mi.), the Tokachi-gawa (120 mi.), the Shiribeshi-gawa (88 mi.), the Kushiro-gawa (81 mi.), the Toshibetsu-gawa (64 mi.) and the Yubetsu-gawa (64 mi.). The valley of the Ishikari is the most fertile part of the island; the Tokachi is navigable to a point 56 mi. from its mouth, but the Teshio has a bar which renders its approach extremely difficult. Nearly all the rivers abound with salmon.

Lakes.—There are no large lakes, the most extensive—Toyako, Shikotsuko and Kushiroko—not having a circumference of more than 25 miles. Lagoons, however, are not uncommon. The largest of these—Saruma-ko in Kitami—is some 17 mi. long by 7 wide. It abounds with oysters nearly as large as those for which the much smaller lagoon at Akkeshi is famous, the molluscs measuring about 18 in. in length.

Climate.—The climate differs markedly from that of the main island of Japan, resembling the climate of the British Isles, though the winter is longer and more severe, and the atmosphere in the warm season contains a greater quantity of moisture. For five months the country is under snow, its depth averaging about 2 ft. in the regions along the southern coast and more than 6 ft. in the northern and western regions. An ice-drift, setting from the north and working south as far as Nemuro, stops all sea trade on the east coast from January through March, though the west coast is protected by the warm current of the Kuro-shiwo. Fogs prevail along the east coast during the summer months, and it is not uncommon to find a damp, chilly atmosphere near the sea in July, whereas, a mile inland, the thermometer stands at 80° or 90° F. in the shade, and magnolia trees are in blossom.

Fauna.—Tsugaru strait has been shown to form a line of zoological division. Pheasants and monkeys are not found on the Yezo side of this line, though they abound on Honshu, and, on the other hand, Yezo has grouse and solitary snipe which do not

exist in Honshu. The Yezo bear, too, is of a distinct species.

Population.—The island seems to have been originally peopled by semi-barbarous pit-dwellers, whose modern representatives are found in the Kuriles or their neighbours of Kamchatka and Sakhalin. These autochthons were driven out by the Ainu, who, in turn, succumbed to the Japanese. Yezo and 68 adjacent small islands included in the administrative area of Hokkaido had 3,272,718 people in 1940, largely due to emigration from Japan proper to Yezo. Yezo is divided into ten provinces, the names of which, beginning from the south, are Oshima, Shiribeshi, Ishikari, Teshio, Kitami, Iburi, Hidaka, Tokachi, Kushiro and Nemuro. Of these, Oshima, Shiribeshi and Ishikari are the most important. Three towns had a large 1940 population, viz., Hakodate (203,862), Sapporo, the seat of government (206,103) and Otaru (164,282).

Industries and Products.—Marine products constitute the principal wealth of Yezo. Great quantities of salmon, sardines and codfish are taken. The salmon are salted for export to Nippon and other parts of Japan; the sardines are used as an agricultural fertilizer and the codfish serve for the manufacture of oil. An immense crop of edible seaweed is also gathered and sent to Chinese as well as to Japanese markets. This *kombu,* as it is called, sometimes reaches a length of 90 ft. and a width of 6 in. The herring fishery, too, is a source of wealth, and the canning of Akkeshi oysters as well as of salmon gives employment to many hands. Vast tracts are covered with a luxuriant growth of ash, oak, elm, birch, chestnut and pine, but, owing to difficulties of carriage, this supply of timber has not yet been much utilized.

Communications.—The roads are few and in bad order, but there is a railway which, setting out from Hakodate in the extreme south, runs, via Sapporo and Iwamizawa, to the extreme N. with branches from Iwamizawa, S. to Muroran and E. to Poronai, and from Oiwake N.E. to the Yubari coal mines. There is also a line W. along the S. coast from Nemuro.

History.—Yezo was not brought under Japan's effective control until mediaeval times. In 1604 the island was granted in fief to Matsumae Yoshihiro, whose ancestor had overrun it, and from the close of the 18th century the east was governed by officials sent by the shogun, whose attention had been attracted to it by Russian trespassers. In 1871 the task of developing its resources and administering its affairs was entrusted to a special bureau, which employed U.S. agriculturists to assist the work and U.S. engineers to construct roads and railways; but in 1881 this bureau was abolished, and the government abandoned to private hands the various enterprises it had inaugurated. The modern government departments attend to the development of the island as an integral part of Japan proper; but the Japanese from the mainland do not like to settle there and its resources seem not to be fully exploited. *See* the *Annual Report* of the Japanese government.

YGGDRASIL, in Scandinavian mythology the mystical ash tree which symbolizes existence, binds together earth, heaven and hell, and is the tree of life, knowledge, fate, time and space. Its three roots go down into the realms—(1) of death, where, in the well Hvergelmer, the dragon Nidhug (Niðhöggr) and his brood are ever gnawing it; (2) of the giants; (3) of the gods, Asgard. Its stem upholds the earth, its branches overshadow the world and reach up beyond the heavens. Honey-dew falls from the tree, and on its topmost bough sits an eagle. G. Vigfusson and York Powell (*Corpus Poeticum Boreale,* Oxford, 1883) see in Yggdrasil not a primitive Norse idea, but one due to early contact with Christianity.

YIDDISH LANGUAGE AND LITERATURE. The word Yiddish is derived from the modern German *Jüdisch Deutsch* or Jewish German. It is the language spoken by the Polish and Russian Jews whose forbears, early in the middle ages, were invited to Poland from the Rhineland, to form a trading class in between the nobles and the serfs. They have kept their Low German tongue, writing and printing it in Hebrew characters to this day. Yiddish, though based on a Low German vocabulary and construction, was cut off from living German, whence its irregularities of grammar and spelling. It continued to absorb Hebrew and Aramaic words and expressions, together with Slav ones, Polish or Russian, and has a few of older Romance origin. The Hebrew and Aramaic came from the Hebrew Bible and its huge commentary the Talmud, which is largely Aramaic (*q.v.*). For the women, notably in the *Tzènah Urènah!* (Heb. "Come out and see!"), there were prayers and legends in Yiddish, or Màmelòshen (class. Heb. *lashòn*="tongue") or *Zhargòn,* in modern Hebrew: *Yehudīt*="Jewish" (*s.* Judith), *Yiddit, Zhargòn.* Yiddish is essentially a folk-tongue, it had no written grammar, it eludes all strict grammatical analysis, though efforts are now being made to bring about uniformity in its grammar and spelling in view of its continued existence among the Jews of east Europe.

Yiddish Literature is merely the reflection of the segregated, intense Jewish world of Eastern Europe which has been broken up, never to be reconstructed. It enshrines a distinct phase of Jewish history, one which began when the first Jews migrated to Poland from the Rhinelands in the middle ages, and which lately closed in a darkness still hard to penetrate. It is a literature rich in folksongs and tales. A wealth of folk-lore, still in course of discovery, gathered on the long road from Ur of the Chaldees to Pinsk and Minsk, passed into Yiddish from Talmudical and European sources. This legendary material remained common to the Jews of Poland and Germany.

The literature of the latter differed at all times little from that of their Gentile neighbours except for the Hebrew lettering. The Oppenheim collection in the Bodleian library contains many publications of these earlier periods. Across the Polish frontier the literary cleavage between Jew and Gentile was complete. Intercourse with Germany grew ever less. Yiddish literature came to mean one or two chapbooks of legends and the still familiar devotional work for women, the *Tzènah Urènah,* delightful in its renderings of Talmudical traditions.

Early in the 19th century the Haskalah, a movement for the enlightenment of the Jewish masses, initiated in Berlin by Moses Mendelssohn, began to creep across the Russo-Polish frontiers. The young Talmud student deciphered his first German book, frequently the poems of Schiller, in secret and in fear—woe betide him were he found with a volume of secular recreation, and in the tongue spoken by so many heretic Jews! Still he read and then came the wish to express his own feelings in Yiddish, to speak to the people in their every-day language. Lefin translated the Psalms and Ecclesiastes, Linetzki wrote his autobiography, the *Polish Boy,* J. L. Gordon his few powerful verses.

Revival in Russia.—Round the '60s and '70s, when Russian schools and culture were made accessible to Jewish youth, Yiddish literature suffered a decline. After the persecutions of the '80s it took on fresh life. The Jewish people, re-awakened to the fact that they were not Jewish Russians but Russian Jews, said in the words of Peretz: "We also want to bring our sheaf to the universal harvest." The people needed comfort and guidance. Spektor wrote his tales, sweet and simple in style, priceless in observation; Frug, till then a Russian poet, his melodious verse; J. Dienensohn his pathetic *Jossele.* Abramovitch laid aside his fluent Hebrew pen and wrote novels in a rich Yiddish, dealing with evil inside as well as outside the community; I. L. Peretz and "Sholem Alechem," both now dead, wrote abundantly. Peretz produced tales, poems and dramas. The two last have a spectral charm, but his *Stories and Pictures* is his great achievement. "Sholem Alechem," the humourist, is even more of a household word in the humblest home where Yiddish is spoken. His *Tovie der Milchiger* (Tobias the Milkman) is an immortal type. David Frishman is a distinguished critic. Among other later and gifted story-tellers, much of whose work was published in New York, are Sholem Asch, A. Reisin, Libin and Peretz Hirschbein.

Leo Wiener's *History of Yiddish Literature in the 19th Century* (1899), is invaluable to the student. Some English translations are: *Jewish Children* (Sholem Alechem), by Hannah Berman; *One Act Plays from the Yiddish,* by Etta Block; *A Lithuanian Village* (Leon Kobrin), by I. Goldberg, who has also translated the *Haunted Inn* of Peretz Hirschbein and other plays; *Stories and Pictures* (I. L. Peretz) and *Yiddish Tales* (20 different authors), by H. Frank. (H. F.)

BIBLIOGRAPHY.—Abramovitch, *Die Kliatshe, Fistike der Kàlike* (*The Cripple*), *Das kleine Menshele* (*The Little Man*), etc.; S. Asch, *Blätter* (*Leaves*), *Junge Johren* (*Youthful Years*); Frug, *Lieder* (*Poems*); Libin, *Gekliebene Skizzen* (*Selected Sketches*), *Modne Menshen* (*Queer Folk*); Opatosho, *Die Pölishe Wälder* (*The Polish Woods*) and other novels; I. L. Peretz, *Erzählungen und Bilder* (*Stories and*

Pictures); Reisin, *Collected Works;* Sholem Alechem, *Collected Works* (including *Stempenyu, Menachem Mendel* and *Tovie der Milchiger*); Spektor, *Collected Tales* including *Die zwei Chevertes (The two Companions)*; Yehoash, *Collected Poems* and *From New York to Rehovoth.*

The United States.—Yiddish literature in America developed under a combination of influences. On the one hand Russian literature—the writings of Tolstoi, Turgeniev, Dostoievski and Chekhov—played a decisive rôle in its growth for the obvious reason that nearly all Yiddish writers came from Russia and it was they who founded the Yiddish press, wrote the plays for the theatres, started weekly and monthly publications.

The distinctive contribution of the United States to Yiddish literature of the world has been the Yiddish language press. During the past four decades Yiddish journalism has swallowed up the ablest writers. There has never been a profitable market for Yiddish books in America on account of the poverty of the Jewish masses. Nine-tenths of the novelists, short story writers, poets, playwrights and critics have been obliged to eke out a livelihood as practising newspapermen. Hence the Yiddish press has been more than a purveyor of news and political comment. The man who has created modern Yiddish journalism is Abraham Cahan. From the founding of the *Jewish Daily Forward* in 1897 Cahan has been guide and mentor of the Yiddish press.

In addition to *The Forward* there are three other dailies in New York, viz., *Jewish Morning Journal, Day-Warheit* and *Freiheit.* The *Morning Journal* (edited by Peter Wiernik) is a conservative paper in politics no less than in religion. The *Day-Warheit* espouses the cause of Jewish nationalism, while *Freiheit* advocates communism. The total circulation of the several papers is in the neighbourhood of 400,000. Among the leading journalists in addition to those already mentioned are Zivion, Hillel Rogoff, Dr. A. Coralnik, M. Olgin, Dr. S. Margoshes, Jacob Fishman. The name of the late Louis E. Miller, one of the founders of *The Forward* and for years editor-publisher of *Warheit* and other publications, must be included in this list. Also S. Yanofsky, long the editor of *Freie Arbeiter Shtimme* (Free Workmen's Voice), an influential literary weekly of anarchist tendencies.

Much of the best modern Yiddish poetry has been written in the United States. Morris Rosenfeld was the most popular and most versatile poet produced in America. He was lyricist, satirist, polemicist. Yehoash, regarded by some as superior to Rosenfeld, was less popular. His poetry is cerebral, much of it obscure. Yehoash wrote magnificent nature poems; he translated Longfellow's "Hiawatha," devoted long years to the translation of the Old Testament from the original Hebrew into Yiddish and was the author of a *Dictionary of Hebraic Elements* in the Yiddish language, a pioneer work. A. Liesin, for years editor of the monthly magazine *Zukunft* (Future) is a poet of great power and originality as well as a foremost publicist. Excellent poetry has also been written by M. Winchevsky, Mani Leib, Rolnik, Joel Slonim, M. L. Halpern, Zisha Landau, Dilon, Nochem Yud.

The earliest writers of short stories were Z. Libin, Jacob Gordin and Leon Kobrin. Libin's career dates from the '90s. His sketches are full of a peculiar humour tinctured with sadness inspired by the hardships of life of the early immigrants. Libin has written extensively for the stage not without success. Kobrin was a prolific playwright and translator. Gordin's fame rests on the seventy-odd plays which he wrote for the stage during the last 20 years of his life rather than his earlier sketches. He was the reformer of the Yiddish stage in America.

Only two or three of the many plays which David Pinski has written proved successful on the stage, notably *Yekel the Blacksmith* and *The Treasure.* Some of his plays, short stories and a novel have been translated into English. Strongly under the influence of the Russian realists, Z. Levine occupies a unique position as a writer of grim stories unrelieved by humour. Highly esteemed by some critics, his reading public remains limited.

Along about 1914 and 1915 there emerged a group of young writers who challenged the supremacy of the older men. Fifteen years later, their position was being challenged by a still younger group. The most notable of the young writers were Opatosho, Ignatev and Raboi.

Many of the leading writers of Europe have lived in America for shorter or longer periods but have remained distinctly European writers for the most part. None of the sketches or poems which Reisin, for instance, has written in America are equal to his best European work. Asch, who is indubitably one of the two or three greatest living Yiddish writers, is the author of two novels of American life: *Uncle Moses* and *Lederer.* His fame, however, will rest on *Motke Ganef, Kidush Hashem, Gott fun Nekomah* and *Dos Shtetel*—all written in the old country.

Next to the press the stage has been the most potent cultural influence in the life of the Jewish immigrants. Long under the domination of Shomer, Lateiner and "Professor" Hurwich, it was devoted to the presentation of vapid musical comedies, operettas and blood-curdling melodramas. Jacob Gordin, and after him Libin, Kobrin, Asch, Pinski, Sackler, Gottesfeld and Leiwick, rescued the stage from the doldrums. Asch's *God of Vengeance,* though dealing with life in Warsaw, was first produced in New York and is perhaps the greatest single Jewish drama of modern times. Of plays dealing essentially with American conditions, Leiwick's *Shmattess* (Rags) ranks near the top. In recent years Gottesfeld has written delightful comedies of American life. Peretz Hirschbein's idyllic plays (*Dos Fervorfen Winkel, Grinne Felder,* etc.) have been extremely successful and have vastly enriched the repertoire of the American Yiddish stage. There are approximately 20 Yiddish theatres in the country, fully half of them in greater New York. Second avenue in New York is the Yiddish "Great White Way." (N. Z.)

YLANG-YLANG (*Cananga odorata*), a medium-sized tree of the custard-apple family (Annonaceae), found in southern India, Java and the Philippines and planted in warm regions for its exceedingly fragrant flowers, which yield the widely-prized perfume of the Pacific islands, known as ylang-ylang among the Malays. The tree has somewhat drooping branches; large, ovate, sharp-pointed leaves; numerous greenish or yellowish flowers, about 2 in. long, and oblong, greenish fruits about 1 in. long. It has been sparingly cultivated in southern Florida.

YOCHOW (YOYANG), a city in Hunan province, China, standing on high ground east of the outlet of Tungting lake. Population (1931) 4,800. The actual settlement is at Chinling-Ki, a village 5½ mi. below Yoyang and ½ mi. from the Yangtze. From Yoyang the cities of Changsha and Changteh are accessible, for steam vessels drawing 4 to 5 ft. of water, by means of the Tungting lake and its affluents the Siang and Yuan rivers. The district in which Yoyang stands is the ancient habitat of the aboriginal San Miao tribes who were deported into southwest China. The city, which was built in 1371, is about 3 mi. in circumference, and is surrounded by a wall. It was entered by the T'aip'ing rebels in 1853 and opened to foreign trade in 1899. The Japanese used it as a military centre for dominance of northern Hunan areas after 1938.

YODEL, a peculiar kind of singing consisting of alternations of high falsetto notes with ordinary chest tones. It is practised by the Swiss and Tirolese in the singing of their native melodies.

YOGA, "diversion of the senses from the external world, and concentration of thought within" (Sanskrit "yoking"). The Yoga system in Hindu philosophy is a branch of the Sankhya (*q.v.*), but loosely inserted into it is the conception of a personal God, who is indissolubly connected with the subtlest form of matter. Union with him was not the original object of *yoga.* By its practices of hypnotism and self-mortification the Yogi (mod. Jogi) could attain miraculous powers and control of nature itself. Siva (*q.v.*), was essentially the great Yogi.

YOKOHAMA, a seaport of Japan on the west shore of Tokyo Bay, 18 m. south of Tokyo by rail. It stands on a plain shut in by hills, one of which, towards the south-east, terminates in a promontory called Honmoku-misaki or Treaty Point. The temperature ranges from 95° to 43° F, and the mean temperature is 57·7°. The cold in winter is severe, owing to north winds, while the heat is great in summer, though tempered by southwest sea breezes. The rainfall is about 70 in. annually. Pop. (1940) 968,091. In 1859, when the neighbouring town of Kanagawa was opened to foreigners under the treaty with the United States,

Yokohama was an insignificant fishing village; and notwithstanding the protests of the foreign representatives the Japanese government shortly afterwards chose the latter place as the foreign settlement instead of Kanagawa. This settlement, which developed under the administration of foreign residents enjoying extraterritorial rights until 1899, formed the nucleus of a flourishing city, prospering with the growth of Japan's foreign trade and shipping. The harbour, which is a part of Tokyo bay, is good and commodious. It is somewhat exposed, but enclosed by two substantial breakwaters. The average depth in the harbour is about 46 ft. at high water, with a tide falling about 8 ft.

The city was almost obliterated by an earthquake in 1923, some 80% of its houses destroyed and many thousands of its inhabitants killed, mostly by fire.

Subsequent reconstruction under a comprehensive government plan had made good progress by 1930. The docks and the waterfront area, formerly known as the Bund, were much improved. Little now remains of the old foreign settlement.

Yokohama depended for its growth upon foreign trade and shipping, particularly the silk trade. The decline of the importance of silk in Japan's exports, together with a rapid growth of manufactures and foreign trade in other centres, notably Nagoya, Kobe and Osaka, tended to diminish the relative importance of Yokohama, and the city was showing signs of depression in the decade 1930–40.

YOKOHAMA SPECIE BANK, LTD., THE (*Yokohama Shokin Ginko*). This bank was founded in 1880 with an authorised capital of Yen 3,000,000 with the object of affording financial facilities in respect of the foreign trade of Japan. Subsequently, its capital was increased several times until it stood at Yen 100,000,000, all paid up by December 1920.

The business carried on by the bank consists of (1) foreign exchange, (2) inland exchange, (3) loans, (4) deposits of money and custody of articles of value, (5) discount and collection of bills of exchange, promissory notes and other securities, and (6) exchange of coins. The bank may also buy or sell public bonds, gold and silver bullion, and foreign coins, if so required by the condition of its business. It may also be entrusted with matters relating to foreign loans and with the management of public money for international account.

The head office of the bank is in Yokohama, and there are 44 branches, 7 of which are in Japan and the remainder distributed throughout China, Manchuria, Europe, North and South America, India, Australia and the East Indies. In March 1939, the subscribed and fully paid capital of the bank amounted to Yen 100,000,000, while there was a reserve fund of Yen 138,400,000.

(D. No.)

YOKOSUKA, a seaport and naval station of Japan, on the west shore of Tokyo Bay, 12 m. south of Yokohama. The town is connected by a branch line with the main railway from Tokyo. The port is sheltered by hills and affords good anchorage. The site was occupied by a small fishing village until 1865, when the shogun's government established a shipyard here. In 1868 the Japanese government converted the shipyard into a naval dockyard, and subsequently carried out many improvements. In 1884 it became a first-class naval station. Pop. (1940) 193,358.

YOLA, a native state of British West Africa, forming the major part of the province of Adamawa, Northern Nigeria. In the partition of Africa part of Adamawa fell to Germany and was included in the Cameroons. The British part was known as the province and emirate of Yola. In 1919 the former German part of Adamawa came under British mandate and was incorporated with Yola. In 1926 the name of the province and emirate was changed to Adamawa. By the people the Fula ruler is known as the Lamido of Adamawa. The capital is Yola, a town founded by the Fula conqueror Adama about the middle of the 19th century. The town is situated in 9° 12′ N., 12° 40′ E. and is built on the left or south bank of the Benue, 480 m. by river from Lokoja. It can be reached by shallow draught steamers when the river is in flood. The Niger Company had trading relations with Yola before the establishment of British administration in Northern Nigeria.

In 1903 an exploring expedition was sent up the Gongola, which coming from the north joins the Benue below Yola, and the navigability of the river for steam launches as far as Gombe at high water was demonstrated. The Gongola valley was in ancient times extensively cultivated and after the establishment of the British protectorate it again became a prosperous agricultural region. Cotton and food crops are cultivated.

Adamawa province has an area of 33,424 sq.m. and a pop. (1926) of 549,137.

See NIGERIA; ADAMAWA, and the *Annual Report* on the Northern Provinces, Nigeria (Kaduna), first issued in 1928.

YOM KIPPUR, Jewish sacred Day of Atonement, supposedly dates back to Moses. Its annual observance on the tenth day of the seventh month, the custom of fasting, and the elaborate ceremonies of supplication all date more directly from the religious revival beginning with Ezra. Some of the scriptural texts are Lev. XVI, XXIII: 26–32, XXV: 9, and Num. XXIX: 7–11.

YONGE, CHARLOTTE MARY (1823–1901), English novelist and writer on religious and educational subjects, daughter of William Crawley Yonge, 52nd Regiment, and Frances Mary Bargus, was born on Aug. 11, 1823 at Otterbourne, Hants. She was educated by her parents, and from them inherited much of the religious feeling and High Church sympathy which coloured her work. She lived at Otterbourne all her life, and was one of the most prolific writers of the Victorian era. Her first conspicuous success was attained with *The Heir of Redclyffe* (1853). *The Daisy Chain* (1856, repr. 1911) continued the success. Other popular books include *Heartsease* (1854), *Dynevor Terrace* (1857), *The Young Stepmother* (1861), *The Trial* (1864), and *The Clever Woman of the Family* (1865). She wrote over 120 volumes, including novels, tales, school manuals and biographies, and was for more than 30 years editor of the *Monthly Packet.* She died at Otterbourne on March 24, 1901.

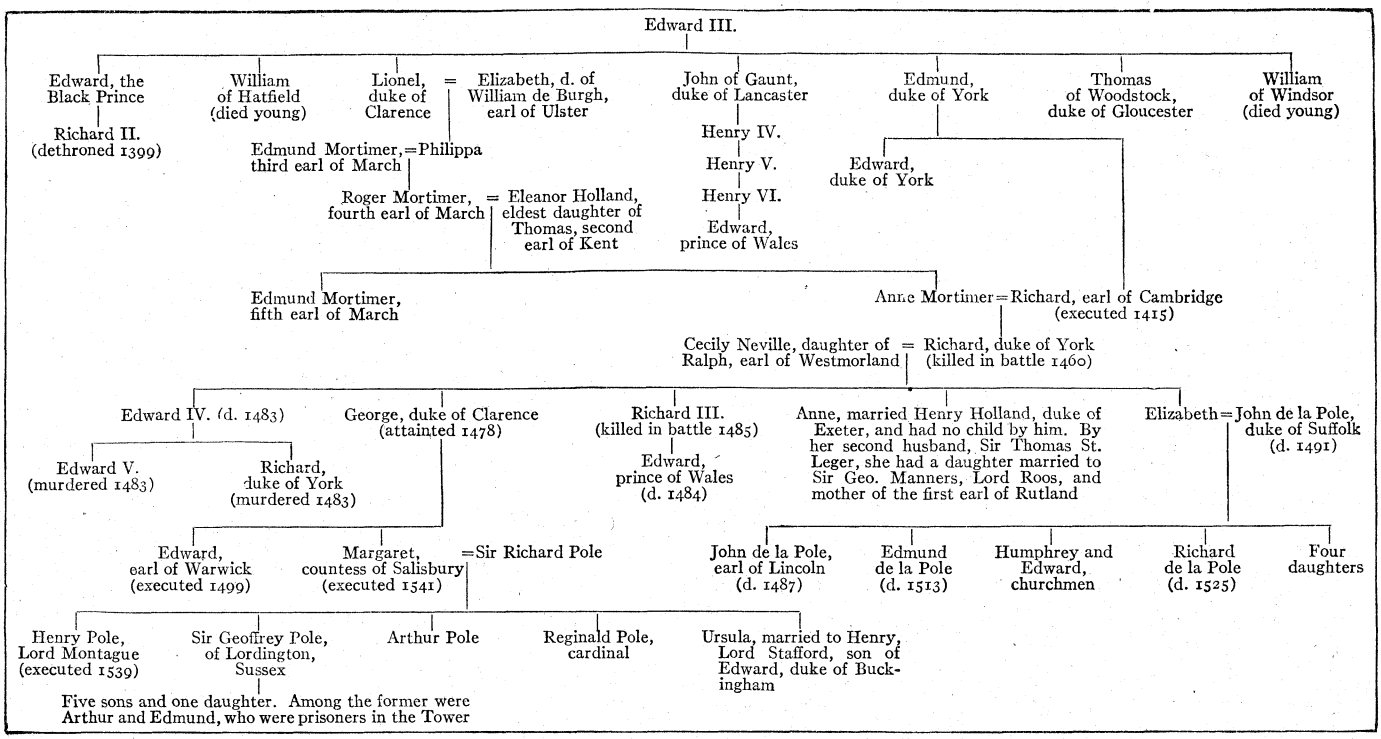
See E. Romanes, *Charlotte Mary Yonge: an Appreciation* (1908); and C. Coleridge, *Charlotte Mary Yonge, her Life and Letters* (1903).

YONKERS, a city of Westchester county, New York, U.S.A., on the east bank of the Hudson river, adjoining New York city on the north and facing the Palisades. It is served by the New York Central and electric railways, motor-bus lines, a ferry to Alpine, N.J., and river steamers. Pop. (1920) 100,176 (26% foreign-born white); 1940 U.S. census 142,598. Yonkers is an important manufacturing city as well as a popular residential suburb. There are many manufacturing establishments in the city.

In the heart of the business district stands the Philipse Manor-hall (built in 1682 and enlarged in 1745), one of the best examples of colonial architecture in America, now maintained as a State museum. In the northern part of the city (Glenwood) are the old Colgate mansion and the home of Samuel J. Tilden. There are many beautiful residential districts, commanding delightful views.

An Indian village (Nappeckameck) stood on the site of Yonkers, at the mouth of the Nepperhan creek, when the Dutch founded New Amsterdam, and the territory was within the "Keskeskick Purchase," acquired from the Indians by the Dutch West India company in 1639. In 1646 it was included in the large grant extending from the Hudson to the Bronx river, made to Adrian van der Donck, the first lawyer and historian of New Netherland. He encouraged settlers to come in, built a saw-mill near the mouth of Nepperhan creek (or Saw-Mill river), and soon the settlement came to be known as De Jonkheer's Land (the estate of the young lord), from which the name of Yonkers was gradually evolved. Later much of the estate passed into the hands of Frederick Philipse, who in 1682 built for his son the manor house mentioned above. This mansion was confiscated in 1779, as the Frederick Philipse of that time was suspected of Toryism. It came into the possession of Yonkers in 1867, and was used as the city hall from 1872 until it was bought by the State in 1908. Early in the Revolution Yonkers was occupied for a time by part of Washington's army and was the scene of several skirmishes. In 1854 the manufacture of elevators was begun in Yonkers by Elisha G. Otis. The village was incorporated in 1855 and in 1872 it became a city.

GENEALOGICAL TABLE OF THE HOUSE OF YORK



YONNE, a department of central France, formed partly from the province of Champagne proper (with its dependencies, Sénonais and Tonnerrois), partly from Burgundy proper (with its dependencies, the county of Auxerre and Avallonnais) and partly from Gâtinais (Orléanais and Île-de-France). It is bounded by Aube on the northeast, Côte-d'Or on the southeast, Nièvre on the south, Loiret on the west and Seine-et-Marne on the northwest. Pop. (1936) 271,685. Area 2,881 sq.mi. The highest elevation (2,000 ft.) is in the granitic highlands of Morvan. The department belongs to the basin of the Seine, except a small district in the southwest (Puisaye), which belongs to that of the Loire. The river Yonne flows through it from south to north-northwest, receiving on the right bank the Cure, the Serein and the Armançon, which water the southeast of the department. Farther north it is joined by the Vanne.

The department is served chiefly by the P.L.M. railway. The canal of Burgundy, which follows the valley of the Armançon, has a length of 57 mi. in the department, that of Nivernais, following the valley of the Yonne, a length of 33 miles. The department constitutes the archiepiscopal diocese of Sens, has its court of appeal in Paris, its educational centre at Dijon and belongs to the district of the VIII army corps. It is divided into 3 arrondissements (37 cantons, 486 communes), of which the capitals are Auxerre, also capital of the department, Avallon and Sens; these with Chablis, Vézelay (*qq.v.*) and St. Florentin are its chief towns. Pontigny has a Cistercian abbey, where Thomas Becket spent two years of his exile, with a 12th century church. Druyes has a 12th-century château. Villeneuve-sur-Yonne has a mediaeval keep and gateways and a church of the 13th and 16th centuries. The Renaissance châteaux of Fleurigny, Ancy-le-France, Tanlay and the château of St. Fargeau, of the 13th century, rebuilt by Mademoiselle de Montpensier under Louis XIV., are all noteworthy. At St. Moré there are remains of the Roman road from Lyons to Gallia Belgica and of a Roman fortified post. There are many megalithic monuments in the department.

YORCK VON WARTENBURG, HANS DAVID LUDWIG, COUNT (1759–1830), Prussian general field-marshal, was of English ancestry. He entered the Prussian army in 1772, but in 1779 was cashiered for disobedience. Entering the Dutch service, he took part in the operations of 1783–84 in the East Indies as captain. Returning to Prussia in 1785 he was, on the death of Frederick the Great, reinstated in his old service, and in 1794 took part in the operations in Poland. Five years afterwards Yorck began to make a name as commander of a light infantry regiment, being one of the first to give prominence to the training of skirmishers. In 1805 he was appointed to an infantry brigade, and in the Jena campaign played a successful part as a rearguard commander, especially at Altenzaun. He was taken prisoner, severely wounded, at Lübeck. In the reorganization of the Prussian army after the peace of Tilsit, Yorck took a leading part. At first major-general commanding the West Prussian brigade, afterwards inspector-general of light infantry, he was finally appointed second in command to General Grawert, the leader of the auxiliary corps which Prussia was compelled to send to the Russian War of 1812, succeeding to the command on Grawert's retirement. He conducted the advance on Riga with great skill; but his conviction that the French army was doomed led him at last to neutralize the Prussian army by the Convention of Tauroggen (Dec. 30). The step was intensely popular, and although it was officially proposed to court-martial Yorck, he was absolved when the Treaty of Kalisch ranged Prussia with the Allies. During 1813–14 Yorck led his veterans with success at Bautzen, Katzbach, Wartenburg (Oct. 4) and Leipzig (Oct. 18). In France, he distinguished himself at Montmirail and Laon. The storm of Paris was his last fight. In 1821 he was created general field-marshal. He had been made Count Yorck von Wartenburg in 1814. He died at his estate of Klein-Öls, the gift of the king, on Oct. 4, 1830.

See Seydlitz, *Tagebuch des Preussischen Armee Korps 1812* (1823); Droysen, *Leben des G. F. M. Grafen Yorck von Wartenburg* (1851).

YORK (HOUSE OF), a royal line in England, founded by Richard, duke of York (*q.v.*), who claimed the crown in opposition to Henry VI. His claim was, perhaps rightly, barred by prescription, the house of Lancaster having then occupied the throne for three generations; it was really owing to the misgovernment of Margaret of Anjou that it was advanced at all. The duke was descended from Lionel, the third son of Edward III., while the house of Lancaster came of John of Gaunt, the fourth son. The claim was derived (*see* the Table) through females; but this could not reasonably have been objected to after Edward III.'s claim to the crown of France; and the duke's claim was probably supported by the fact that he was descended from Edward III. both through his father and through his mother. (*See* Table.) The earldom of Ulster, the old inheritance of the De Burghs, had descended to him from Lionel;

the earldom of March came from the Mortimers, and the dukedom of York and the earldom of Cambridge from his paternal ancestry. Moreover, his own marriage with Cecily Neville, though she was but the youngest daughter of Ralph, 1st earl of Westmorland, allied him to a powerful family in the north of England, to whose support both he and his son were indebted.

The reasons why the claims of the line of Clarence had been so long forborne are not difficult to explain. Roger Mortimer, 4th earl of March, was designated by Richard II. as his successor; but he died the year before Richard was dethroned, and his son Edmund, the 5th earl, was a child at Henry IV.'s usurpation. Henry took care to secure his person; but the claims of the family troubled the whole of his own and the beginning of his son's reign. It was an uncle of this Edmund who took part with Owen Glendower and the Percies; and for advocating the cause of Edmund Archbishop Scrope was put to death. And it was to put the crown on Edmund's head that his brother-in-law Richard, earl of Cambridge, conspired against Henry V. soon after his accession. The plot was detected, being revealed, it is said, by the earl of March himself, who does not appear to have given it any encouragement; the earl of Cambridge was beheaded.

The popularity gained by Henry V. in his French campaigns secured the weak title of the house of Lancaster against further attack for forty years.

Richard, duke of York, seems to have taken warning by his father's fate; but, after seeking for many years to correct by other means the weakness of Henry VI.'s government, he first took up arms against the ill advisers who were his own personal enemies, and at length claimed the crown in parliament as his right. The Lords, or such of them as did not purposely stay away from the House, admitted that his claim was unimpeachable, but suggested as a compromise that Henry should retain the crown for life, and the duke and his heirs succeed after his death. This was accepted by the duke, and an act to that effect received Henry's own assent. But the act was repudiated by Margaret of Anjou and her followers, and the duke was slain at Wakefield fighting against them. In little more than two months, however, his son was proclaimed king at London by the title of Edward IV., and the bloody victory of Towton immediately after drove his enemies into exile and paved the way for his coronation.

After his recovery of the throne in 1471 he had little more to fear from the rivalry of the house of Lancaster. But the seeds of distrust had already been sown among the members of his own family, and in 1478 his brother Clarence was put to death—secretly, indeed, within the Tower, but still by his authority and that of parliament—as a traitor. In 1483 Edward himself died; and his eldest son, Edward V., after a nominal reign of two months and a half, was put aside by his uncle, the duke of Gloucester, who became Richard III. and then caused him and his brother Richard, duke of York, to be murdered.

But in little more than two years Richard was slain at Bosworth by the earl of Richmond, who, being proclaimed king as Henry VII., shortly afterwards fulfilled his pledge to marry the eldest daughter of Edward IV. and so unite the houses of York and Lancaster.

Here the dynastic history of the house of York ends. But a host of debatable questions and pretexts for rebellion remained. The legitimacy of Edward IV.'s children had been denied by Richard III. and, though the act was denounced as scandalous, the slander might still be reasserted. The duke of Clarence had left two children and the attainder of their father could not be a greater bar to the crown than the attainder of Henry VII. himself. Seeing this, Henry had kept Edward, earl of Warwick, a prisoner in the Tower of London. Yet a rebellion was raised in his behalf by means of Lambert Simnel, who was defeated and taken prisoner at the battle of Stoke in 1487. The earl of Warwick lived for 12 years later in confinement, and was ultimately put to death in 1499.

His sister Margaret married Sir Richard Pole (or Poole), and could give no trouble, so that Henry VIII. treated her with kindness. He made her countess of Salisbury, reversed her brother's attainder, created her eldest son, Henry, Lord Montague, and had one of her younger sons, Reginald, carefully educated. (*See* POLE, REGINALD and POLE, FAMILY.)

YORK, ALBERT FREDERICK ARTHUR GEORGE, DUKE OF (1895–): *see* GEORGE VI.

YORK, EDMUND OF LANGLEY, DUKE OF (1341–1402), fifth son of Edward III., was born at King's Langley in Hertfordshire on June 5, 1341. He accompanied his father on a campaign in France in 1359, was created earl of Cambridge in 1362, and took part in expeditions to France and Spain. After marrying Isabella (d. 1393), daughter of Peter the Cruel, king of Castile, he was appointed one of the English lieutenants in Brittany, whither he led an army in 1375. A second campaign in Brittany was followed in 1381 by an expedition under his leadership to aid Ferdinand, king of Portugal, against John I., king of Castile; but Edmund shortly returned to England as Ferdinand had concluded an independent peace with John. Accompanying Richard II. on his march into Scotland, he was created duke of York in Aug. 1385, and subsequently on three occasions acted as regent of England. He held a parliament in 1395, and he was again serving as regent when Henry of Lancaster landed in England in 1399. After a feeble attempt to defend the interests of the absent king, York joined the victorious invader; but soon retired from public life. He died at King's Langley on Aug. 1, 1402.

YORK, EDWARD PLANTAGENET, DUKE OF (*c.* 1373–1415), elder son of the preceding (Edmund of Langley), was created earl of Rutland in 1390. Being a friend of his cousin, Richard II, he became admiral of the fleet, constable of the tower of London and warden of the Cinque Ports. He accompanied the king to Ireland in 1394 and was made earl of Cork; arranged Richard's marriage with Isabella, daughter of Charles VI of France; and was one of the king's helpers in the proceedings against the "lords appellant" in 1397. He became constable of England and obtained the lands in Holderness previously belonging to Thomas of Woodstock, duke of Gloucester, together with other estates and the title of duke of Aumerle or Albemarle. He deserted Richard in 1399, and in Henry IV's first parliament he was denounced as the murderer of Gloucester. He was reduced to his former rank as earl of Rutland, and deprived of his recent acquisitions of land. It is uncertain what share Rutland had in the conspiracy against Henry IV in Jan. 1400, but he was probably not seriously involved. He served as royal lieutenant in Aquitaine and in Wales and became duke of York on his father's death in 1402. He was concerned in the scheme, concocted in 1405 by his sister Constance, for seizing the young earl of March and his brother Roger Mortimer and carrying them into Wales, and he was imprisoned in Pevensey castle. Released a few months later, he was restored to the privy council and regained his estates. York led one division of the English army at Agincourt, where, on Oct. 25, 1415, he was killed by "much hete and thronggid." He was buried in Fotheringhay church.

YORK, FREDERICK AUGUSTUS, DUKE OF (1763–1827), second son of George III., was born at St. James's Palace on Aug. 16, 1763. At the age of six months his father secured his election to the rich bishopric of Osnabrück. He became a knight of the Bath in 1767, a K.G. in 1771, and was gazetted colonel in 1780. From 1781 to 1787 he lived in Germany. He was appointed colonel of the 2nd horse grenadier guards in 1782, and promoted major-general and appointed colonel of the Coldstream Guards in 1784.

He was created duke of York and Albany and earl of Ulster in 1784, but retained the bishopric of Osnabrück until 1803. On his return to England he took his seat in the House of Lords, where, on Dec. 15, 1788, he opposed Pitt's Regency bill in a speech which was supposed to have been inspired by the prince of Wales. A duel fought on Wimbledon Common with Colonel Lennox, afterwards duke of Richmond, served to increase the duke of York's popularity. In 1791 he married Princess Frederica (b. 1767), daughter of Frederick William II. of Prussia. The princess was enthusiastically received in London, but the marriage was not happy, and a separation soon took place; the princess retired to Oatlands Park, Weybridge, where she died on Aug. 6, 1820.

In 1793 the duke of York was sent to Flanders in command

of the English contingent of Coburg's army. (*See* FRENCH REVOLUTIONARY WARS.) On his return in 1795 the king promoted him field-marshal, and on April 3, 1798, commander-in-chief. He then led the army sent to invade Holland in conjunction with a Russian *corps d'armée* in 1799. From the time of the duke's arrival with the main body of the army, disaster followed disaster until, on Oct. 17, the duke signed the convention of Alkmaar, by which the allied expedition withdrew after giving up its prisoners. Although unsuccessful as commander of a field army the duke devoted himself with the greatest vigour and success to reforms at home until his enforced retirement from the office of commander-in-chief on March 18, 1809. In the proceedings for bribery in connection with Mary Anne Clarke (*q.v.*) the duke was acquitted of having received bribes himself by 278 votes to 196. In May 1811, he was again placed at the head of the army by the prince regent, and rendered valuable services. He died on Jan. 5, 1827, and was buried at St. George's Chapel, Windsor.

A firm friendship existed between the duke and his elder brother, afterwards George IV., and he was also his father's favourite son. He founded the Duke of York's school for the sons of soldiers at Chelsea, and his name is also commemorated by the Duke of York's column in Waterloo place, London.

YORK, RICHARD, DUKE OF (1411–1460), was born on Sept. 21, 1411, the son of Richard, earl of Cambridge. He became duke of York in 1415, and on the death of Edmund Mortimer in 1425 he represented in the female line the elder branch of the royal family. He had been kindly treated by Henry V., and his name appears at the head of the knights made by Henry VI. at Leicester on May 19, 1426. York served in France (1430–31), and in 1432 he obtained livery of his lands and went over to Ireland to take possession of his estates there. In Jan. 1436 he was appointed lieutenant-general of France and Normandy. He showed vigour and capacity, and recovered Fécamp and other places in Normandy. He was not supported cordially by the home Government, and in 1437 applied to be recalled. York returned to England in the autumn of 1437. From this time he attached himself to Humphrey of Gloucester's party, in opposition to the Government under Cardinal Beaufort. By his marriage in 1438 to Cicely, sister of the earl of Salisbury, he allied himself to the rising family of the Nevilles. On July 2, 1440, York was again appointed to the French command. His previous experience made him stipulate for full powers and a sufficient revenue. He did not go to Rouen till June 1441. During his second governorship York maintained the English position in Normandy. Hampered by his political opponents at home, he was recalled in 1446 on the pretext that his term of office had expired.

The death of Humphrey of Gloucester in 1447 made York the first prince of the blood. Suffolk, now Henry's chief minister, found a convenient banishment for a dangerous rival by appointing York to be lieutenant of Ireland for ten years (Dec. 9, 1447). York, however, put off his departure for 18 months.

During his absence Jack Cade's rebellion occurred. In Sept. 1450 York landed in Wales, came to London with an armed retinue and forced himself into the king's presence. He declared that he desired only justice and good government. He took part in the punishment of Cade's supporters, and discountenanced a proposal in parliament that he should be declared heir to the crown. In March 1452 he came once more in arms to London, and endeavoured to obtain Somerset's dismissal. On a promise that his rival should be held in custody he disbanded his men, and, thus outwitted, found himself virtually a prisoner. However, a nominal agreement was concluded, and York accepted the king's pardon. The situation was changed by the birth of a prince of Wales and the king's illness in Oct. 1453. York secured his recognition as protector on March 27, 1454. But at the end of the year the king's sudden recovery brought York's protectorate to an end.

When it was clear that the queen and Somerset would proceed to extremities, York and his friends took up arms in self-defence. Even when the two armies met at St. Albans, York endeavoured to treat for settlement. The issue was decided by the defeat and death of Somerset on May 22, 1455. York used his success with moderation. He became constable of England, and his friends obtained office. This was no more than a change of ministers. But a return of the king's illness in Oct. 1455 made York again for a brief space protector. Henry recovered in Feb. 1456, and at Coventry, in October, the Yorkist officials were displaced. Still there was no open breach. York would not again accept honourable banishment to Ireland, but made no move till the queen's preparations forced him to act. In Sept. 1459 both parties were once more in arms. York protested that he acted only in self-defence, but the desertion of his best soldiers at Ludlow on Oct. 12 left him helpless. With a few followers he escaped to Ireland, where his position as lord-lieutenant was confirmed by an Irish parliament, and he ruled in full defiance of the English government. In March 1460 the earl of Warwick came from Calais to concert plans with his leader. York landed in England on Sept. 8, and marched on London. On reaching Westminster, he took up his residence in the royal palace, and formally asserted his claim to the throne in parliament. A compromise was arranged; Henry was to retain the crown for life, but Richard was to succeed him. On Nov. 8, he was accordingly proclaimed heir-apparent and protector. Early in December, Richard went north with a small force. On Dec. 30, he was hemmed in by a force of Lancastrians at Wakefield. Declaring that he had never kept castle in the face of the enemy, Richard rashly offered battle, and was defeated and slain. His enemies had his head cut off, and set it up on the walls of York adorned with a paper crown.

Richard of York was not a great statesman, but he had qualities of restraint and moderation, and might have made a good king. He had four daughters and four sons. Edmund, earl of Rutland, his second son, was killed at Wakefield. The other three were Edward IV., George, duke of Clarence, and Richard III.

See *The Paston Letters* with Dr. Gairdner's Introduction; *Three Fifteenth Century Chronicles,* and *Collections of a London Citizen* (published by the Camden Society); *Chronicles of London* (ed. C. L. Kingsford, 1905); J. S. Stevenson's *Wars of the English in France* (Rolls Series). The French chronicles of Matthieu d'Escouchy, T. Basin and Jehan Waurin should also be consulted (these three are published by the *Société de l'Histoire de France*). For modern accounts *see* especially Sir James Ramsay's *Lancaster and York,* and *The Political History of England,* vol. iv., by Professor C. Oman.

YORK, a county and parliamentary borough, archiepiscopal city, county town of Yorkshire and county in itself, on the L.N.E.R., 188 mi. N.W. of London. Pop. (est. 1938) 100,800; area 10.9 sq.mi. It is situated in the low lying vale of York at the junction of the Ouse with the Foss. It lies at the crossing of the two most important natural routes of the region, the north-south waterway formed by the Ouse and the east-west landway on the York moraine ridge through which the river has cut a gap. The town is thus well above flood level, and at the head of the tidal part of the Ouse before the regulation of the river in the 18th century. The tides are now felt 7 mi. downstream from York. York may have been a British settlement. As Eboracum or Eburacum it was the military capital of Roman Britain, the fortress of Legio IX and later of Legio VI. Victrix being situated near the site of the cathedral on the defensive land between the Ouse and the Foss, a municipality (*colonia*) grew up on the opposite side of the Ouse. The emperor Hadrian visited York in 120 and, according to tradition, the body of the emperor Severus, who died there in 211, was burned on Severus hill near the city. After the death of Constantinus Chlorus, which also took place in York, his son, Constantine the Great, was inaugurated emperor there. In 314, a bishop of York is mentioned together with, and with precedence of, a bishop of London, as present at the council of Arles. Nothing is known of the history of the city from the time the Romans withdrew from Britain in 410 until 627 when King Edwin was baptized there, though two years earlier, Paulinus, the first archbishop, had been consecrated. York became the capital of the Angle kingdom of Northumbria and when in the 7th century Britain was divided into two archiepiscopal provinces, York was made the capital of the northerly one, and still remains the ecclesiastical capital of the northern province which now does not include Scotland. In the years 732 to 766, York became one of the most celebrated places of education in Europe. The Danish kingdom of York was formed from that part of Angle Northum-

bria to the south of the Tees and later, when the country was organized into shires by the West Saxon kings, the remoteness of this region hindered organization which was possible in the south and it became first a vassal state and later one shire. The city was taken by Harold Hardrada in 1066. The fortress built there by William the Conqueror in 1068 was stormed by the men of the north of England who put to death the whole of the Norman garrison. In revenge, the Conqueror burned the town and laid waste the country between the Humber and the Tees. York was an important calling place on the route to Scotland, and several councils were held there by the English kings, the first being that of 1175, when William the Lion, king of Scotland, did homage to Henry II. The Council of the North was established in York in 1537 after the suppression of the Pilgrimage of Grace. During the Civil War, York was garrisoned by Royalists. It was besieged by parliament in 1642 and surrendered after Marston Moor.

York is not mentioned in Domesday survey. The first charter, which is undated, was given by Henry II granting the citizens a merchant guild and all the free customs which they had in the time of Henry I. In 1194 Richard I granted exemption from toll throughout the kingdom and in 1200 King John confirmed the preceding charters and in 1212 granted the city to the citizens at a fee-farm of £160 a year. Richard II conferred the title of lord mayor in 1389, and in 1396 the city was made a county of itself and the burgesses were given power to elect two sheriffs. The town was incorporated in 1464, and in 1473 the citizens were directed to choose a mayor from among the aldermen. As this led to constant disputes, Henry VII arranged that a common council, consisting of two men from each of the more important guilds and one from each of the less important ones, should elect the mayor. The city is governed under a charter of Charles II confirming that of 1464. It was represented in parliament by two members from 1295 to 1918, when the number was reduced to one.

Numerous remains of Roman occupation have been found, including the Multangular tower whose base is of mingled stone and brick work. It was at the western corner of the fortress and formed part of the reconstruction of Constantine in about 300. In 1925 a systematic excavation was undertaken at the eastern corner of the fortress, which had been covered by a mound since Norman times. It proved to be of older date, the earliest finds dating back probably to 71. This corner formed probably the earliest building of the fortress and around it was placed a rampart of clay, surrounded by a wooden palisade. Remains of the clay rampart and some of the post holes of the palisade have been found and in the basement chamber of the corner tower part of the rampart is still visible. The fortress was first girded with a stone wall in about 105–108 and a fragment of this may be seen. There was possibly some reconstruction in 120. In 180 a great rising against the Romans took place in the north and among other forts York suffered. Great damage was done at the east corner and the old wall had to be rebuilt. Excavations also show that towers were built along the wall, probably at intervals of 45 yards. Remains of a Roman gateway have been found in the northeast rampart.

The cathedral of St. Peter, commonly known as the minster, is in the form of a Latin cross, consisting of nave with aisles, transepts, choir with aisles, a central tower and two west towers. It occupies the site of the wooden church in which King Edwin was baptized by Paulinus on Easter Day 627. Following his baptism, Edwin began to build a church in stone, but it was partly destroyed during the troubles which followed his death. It was repaired but suffered from fire in 741. At the time of the Norman invasion the Saxon cathedral with the archbishop's library perished in the fire by which the greater part of the city was destroyed, the only relic remaining being the central wall of the crypt. It was reconstructed in 1070–1100, but of this building few portions remain. The apsidal choir and crypt were rebuilt in 1154–81, the south transept in 1216–55, and the north transept and central tower in 1228–56. With the exception of the crypt the early English transepts are the oldest portions of the building now remaining. The south transept is the richest and most elaborate in its details, one of its principal features being the magnificent rose window; the north transept contains a famous series of lancet windows called the "Five Sisters," with specially fine glass. The foundation of the new nave was laid in the last years of the 13th century and the work was completed about 1340; the chapter house was built about the same period. The Lady chapel and presbytery were begun in the early Perpendicular style in 1361. The rebuilding of the choir was begun at the same period, but was not completed until about 1400. It is late Perpendicular, with a very fine great east window. During this rebuilding, the whole of the ancient Norman edifice was removed and the only Norman architecture now remaining is the east portion of the crypt of the second period. To correspond with the later alterations the central tower was recased and changed into a Perpendicular lantern tower in 1444. The southwest tower was begun in 1432, and the northwest tower in 1470, and with the erection of this tower, the church was completed as it now stands; it was reconsecrated on Feb. 3, 1472. The woodwork of the choir was burned in 1829 and in 1840 the southwest tower was reduced to a mere shell by fire.

The stained glass, both in the cathedral and in other churches of the city, is famous; its survival may be traced to the stipulation made by the citizens, when surrendering to parliament in the Civil War, that it should not be damaged. During World War I, when some of the most precious mediaeval glass was removed to a position of safety, it was found that owing to the corrosive effect of the atmosphere, it was necessary to clean each quarry; and lead lights now in many instances replace stone mullions. All the 109 stained glass windows were later renovated, including the 13th-century grisaille glass of the "Five Sisters" window, the cost of which was borne by the women of the country as a national memorial to the women of the empire who gave their lives in World War I.

St. Mary's abbey situated in the present museum gardens was founded for Benedictines in 1078; its head ranked as a mitred abbot with a seat in parliament. The principal remains of the abbey are the north wall and the ruins of the church in Early English and Decorated styles, and the principal gateway with a Norman arch. They lie outside the walls near the cathedral. The hospitium, built in the 14th and 15th centuries with its upper part of wood, houses the collection of Roman antiquities.

York also possesses a large number of churches of special architectural interest including All Saints, North street, Early English, Decorated and Perpendicular, with a spire 120 ft. in height; Christ church with south door in Decorated style, supposed to occupy the site of the old Roman palace; Holy Trinity, Micklegate, formerly a priory church, now restored, showing Roman masonry in its walls; St. Denis, Walmgate, with rich Norman doorway and Norman tower arches; St. Margaret's, Walmgate, celebrated for its curiously sculptured Norman porch and doorway; St. Mary the Elder, Bishophill, Early English and Decorated, with brick tower, rebuilt in 1659; St. Mary the Younger, Bishophill, with a square tower in the Saxon style, rebuilt probably in the 13th century; St. Mary, Castlegate, with Perpendicular tower and spire 154 ft. in height, the body of the church dating back to transitional Norman times; St. Martin's-le-Grand, fine Perpendicular; and St. Martin's-cum-Gregory, Early English and Perpendicular.

The ancient city is enclosed by walls dating in part from Norman times, but they are, in the main, of the 14th century. Their circuit is a little over $2\frac{1}{2}$ mi. and the area enclosed is divided by the river Ouse, the larger part lying on the left bank. On the east for a short distance the Foss takes the place of a wall. The walls are pierced by four principal gates or bars. On the southwest is Micklegate bar, a square tower built over a circular, probably Norman, arch, and with embattled corner turrets on which the heads of traitors were formerly exposed. Bootham bar, the main entrance from the north, also has a Norman arch. Monk bar on the northeast, at one time known as Goodramgate bar, has borne its present name since at least as early as 1370. Malmgate bar retains the barbican which was repaired in 1648.

Of the castle built by the Conqueror, in 1068, in the angle between the Ouse and the Foss, some portions were probably incorporated in Clifford's tower, the shell of which, showing an unusual ground plan of four intersecting circles, rises from an artificial mound. From 1826 to 1936 the castle was used as a prison, but many of the prison buildings have been demolished and others are used as a museum and offices.

St. William's college, near the minster, was founded in 1453 as a college for priests holding chantries in the minster; its restoration as a church house and meeting place for convocation was undertaken in 1906. The Merchant Adventurers hall (1357), a building with half-timbered work, has been restored. York is a great railway centre and has a distinguished railway museum. Damage caused by air raids in World War II included the destruction of the Guildhall (1446) and the church of St. Martin-le-Grand, and injury to St. Peter's and Bootham schools.

The county borough was created in 1888. The division of Yorkshire into three administrative counties has deprived York of its position as a civil capital. The city and the Ainsty (a district on the southwest included in the city bounds in 1449) are, for parliamentary purposes, in the North Riding; for registration purposes in the East Riding; and for all other purposes in the West Riding. The parliamentary borough extends into the East Riding. York is the headquarters of the northern command.

See Francis Drake, *Eboracum; or the History and Antiquities of the City of York, from its origin to the present time* (1736); *Extracts from the Municipal Records of the City of York during the reigns of Edward IV, Edward V, and Richard III* (1843); *Victoria County History, Yorkshire;* J. Raine, *York* (1893); A. P. Purey-Cust, *York Minster* (1897); *Heraldry of York Minster* (Leeds, 1890); B. S. Rowntree, *Poverty: a Study of Town life* (1901) and *Poverty and Progress* (1941); Gordon Home, *Roman York* (1924); C. Wellbeloved, *Eboracum or York under the Romans* (1842); M. Sellers, *The Merchant Venturers Guild;* Handbook, Brit. Assoc., York Meeting, 1906, *York Mercers and Merchant Venturers,* Surtees Society.

YORK, a town of York county, Maine, U.S.A., on the Atlantic coast, 45 mi. S.W. of Portland; served by motorbus lines connecting with the Boston and Maine railroad. Pop. (1930) 2,532; in 1940 it was 3,283. The town embraces the widely known summer resorts of York Beach and York Harbor and several other villages. The first settlement was made about 1624. In 1641 Sir Ferdinando Gorges made it the borough of Agamenticus, which in 1642 he chartered as the city of Gorgeana. In 1652, when Massachusetts extended her jurisdiction over Maine, it became the town of York. In 1692 most of the houses were destroyed by Indians and the inhabitants killed or taken captive. York was the shire-town of Yorkshire from 1716 to 1735; of the district of Maine from 1735 to 1760 (together with Falmouth, now Portland); and a county seat of York county from 1760 to 1832. In the 18th century York had a considerable trade with the West Indies and along the coast, and as late as the middle of the 19th century it had important fishing interests. Development as a summer resort began about 1873.

YORK, a city of southeastern Pennsylvania, U.S.A., the county seat of York county; on federal highways 30 (the Lincoln) and 111, 90 mi. W. of Philadelphia and 28 mi. S. by E. of Harrisburg. It is served by the Maryland and Pennsylvania, the Pennsylvania and the Western Maryland railways. Pop. (1920) 47,512 (94% native white); 1940 federal census (excluding contiguous boroughs) 56,712. The city's area of 4.1 sq.mi. is built up closely and there are populous industrial districts just outside the corporate limits in several directions. The streets in the central part of the city (laid out in 1741 in a bend of Codorus creek, by a surveyor for the Penns) bear such names as King, Queen, Duke, Princess and George, and the city itself was named after the English York. Penn common was set aside for the public in the original plan. The Quaker meeting house was erected in 1765, and there are several old burying grounds. The building used by Gen. Wayne for his headquarters while recruiting his brigade for the march on Yorktown still stands, in the heart of the city, and in Farquhar park there is a copy of the Provincial court house in which the Continental Congress held its sessions. The city's assessed valuation for 1940 was $48,876,000. Since 1912 it has had a commission form of government. York is the commercial centre of a rich agricultural region, and it has many large and diversified manufacturing industries. In 1936 the product of 226 factories in the city was valued at $67,437,000. Bank debits in 1940 aggregated $295,086,178.

York was the first permanent settlement in Pennsylvania west of the Susquehanna. It was laid out in 1741 in the centre of Springettsbury manor, a tract of 64,000 ac. granted to Springett Penn (a grandson of William Penn) in 1722. The first settlers were chiefly Germans from the Rhenish Palatinate (Lutherans, Reformed, Mennonites and Moravians), with some English Quakers and Scotch-Irish. The village was on the Monocacy road, the main route to the South and the South-west, and grew rapidly. When York county was erected in 1749 it was made the county seat, and by 1754 it had 210 houses and a thousand inhabitants. In 1777, when the British approached Philadelphia, the Continental Congress left the city, and after holding one day's session in Lancaster, crossed the Susquehanna to York and made it the national capital from Sept. 30, 1777, to June 27, 1778. In the old county court-house (built 1754–56 and torn down in 1849) the Congress passed the Articles of Confederation, received the news of Burgoyne's surrender, issued the first national Thanksgiving proclamation, received word from Franklin in Paris that France would aid with money, ships and men, received Von Steuben and Lafayette and commissioned them as major-generals. It was in York that the Conway Cabal was frustrated by Lafayette. Here $1,500,000 in silver, lent by France, was brought in Sept. 1778, and here Benjamin Franklin's printing press, moved from Philadelphia, issued $10,000,000 of Continental money. During the Civil War Confederate troops entered the town on June 28, 1863, and a small Federal force retreated before them. York was incorporated as a borough in 1787 and as a city in 1887.

YORKE, CHARLES (1722–1770), English lord chancellor, second son of Philip Yorke, was born in London on Dec. 30, 1722, and was educated at Corpus Christi college, Cambridge. In 1745 he published a treatise on the law of forfeiture for high treason; in 1746 he was called to the bar. Yorke obtained a sinecure appointment in the Court of Chancery in 1747, and became M.P. for Reigate. In 1751 he became counsel to the East India Company, and in 1756 solicitor-general. He resigned with Pitt in 1761, but in 1762–3 was attorney-general under Lord Bute. Resisting Pitt's attempt to draw him into alliance against the ministry he had quitted, Yorke maintained that parliamentary privilege did not extend to cases of libel; though he agreed with Pitt in condemning the principle of general warrants. Yorke became recorder of Dover in 1764, and in 1765 again became attorney-general in the Rockingham administration. He supported the repeal of the Stamp Act, while urging the simultaneous passing of the Declaratory Act. He drew up the constitution for Quebec. In 1767, Yorke resigned office. In 1770 he was invited by the duke of Grafton to take Camden's seat on the woolsack, but was pledged not to take office with Grafton. However, Yorke yielded to the king's entreaty, met the leaders of the Opposition on Jan. 17, and, overwhelmed with shame, fled to his own house, where he died on Jan. 20. The patent raising him to the peerage as Baron Morden had been made out, but his last act was to refuse his sanction to the sealing of the document.

YORKSHIRE, a north-eastern county of England, bounded by Durham, the North sea, the Humber estuary (separating it from Lincolnshire), Nottinghamshire, Derbyshire, Cheshire, Lancashire and Westmorland. It is the largest county in England, having an area of 6,089.7 sq.mi. and being more than double the size of Lincolnshire, which ranks next to it. In a description of the county it is constantly necessary to refer to its three great divisions, the North (2,127.4 sq.mi.), East (1,172.1 sq.mi.) and West (2,790.2 sq.mi.) Ridings.

Physical Features.—The county of Yorkshire can be divided into four upland tracts separated by lowland areas. These lie in the south-west, north-west, north-east and south-east quadrants of the county respectively. The great Yorkshire plain, drained by the Yorkshire Ouse (*q.v.*), stretches from the river Tees, which forms the northern boundary of the county, through the Vale of Mowbray, Vale of York and Vale of Ouse to the Trent basin in

the south. The Ouse divides the county into an eastern and a western division; whilst the "Aire Gap" separates the north Pennine moors from the south Pennine moors, and on the eastern side the Vale of Pickering separates the north Yorkshire moors from the Yorkshire Wolds. The north Pennine moors, which stretch northwards beyond the limits of the county, form a high moorland tract of Carboniferous limestone and Yoredale beds capped by millstone grit. The rocks have a very small dip eastward but are fractured by a series of faults, the most important being the Craven faults from Kirkby Lonsdale by Ingleton, Stainforth and Linton. There are also inliers of Ordovician and Silurian rocks at Horton and at Sedbergh.

The chief valleys are Teesdale, Swaledale, Wensleydale, Nidderdale, Wharfedale and Airedale. The chief peaks are Mickle Fell (2,591 ft.), Whernside (2,414 ft.), Ingleborough (2,373 ft.), Buckden Pike (2,302 ft.) and Penyghent (2,273 ft.). The "Aire Gap," which forms the gateway between north Lancashire and Yorkshire, has been followed by roads, railways and canals. The south Pennine moors are formed of millstone grit, which has been arched upwards approximately along the county boundary and the coal measures are preserved along the eastern and western flanks. The uplands are bleak grouse moors in which the feeders of the rivers Aire, Calder and Don, have carved out valleys across the northern portion of the Yorkshire, Derby and Notts coal-field. Between the Yorkshire plain and the Pennines there is a belt of magnesian limestone, which, lying across various members of the Carboniferous, forms a well marked scarp-face toward them in the southern half of the county. The country along this belt forms a marked contrast with the districts of Palaeozoic rocks on the west, for the limestone produces a rich soil, the effect of which is seen in a luxuriant vegetation.

On the south the alluvium-filled Vale of Pickering marks the site of an ancient lake and the river Derwent, which drains the vale, has broken its way through the Jurassic ridge of the Howardian hills to reach the Vale of York. In this south-eastern quadrant the chalk forms the Yorkshire Wolds and has a general dip towards the south-east thus forming scarp edges from Flamborough Head, along the south side of the Vale of Pickering and sweeping round in a broad arc toward Market Weighton. This ridge of higher ground is continued southward across the Humber into the Lincolnshire Wolds. The north Yorkshire moors rise immediately from the coast and form cliffs for the most part, whilst to the south of Flamborough Head the cliffs disappear beneath the low-lying drift-covered Holderness. There are several watering-places along the coast; the principal are Redcar, Saltburn-by-the-Sea, Whitby, Robin Hood's bay, Scarborough, Filey, Bridlington and Hornsea. There are numerous mineral springs in Yorkshire, the principal being at Harrogate.

Minerals.—The coal-field in the West Riding is one of the chief sources of mineral wealth in Yorkshire, the most valuable seams being the silkstone, which is bituminous and of the highest reputation as a house coal, and the Barnsley thick coal, the great seam of the Yorkshire coal-field, which is of special value, on account of its semi-anthracitic quality, for iron-smelting and engine furnaces. Associated with the upper coal measures are iron-ores, occurring in the form of nodules. Brick-clay, pottery-clay and fire-clay are also raised, as well as gannister and oil-shale. Middlesbrough is the most important centre of pig-iron manufacture in the kingdom. Lead-ore occurs in the Yoredale beds of the north Pennine moors, and flagstones are quarried in the Yoredale rocks. In the millstone grit there are several beds of good building stone, but that most largely quarried is the magnesian limestone of the Permian series.

Archaeology.—In spite of the importance of the Creswell caves in Derbyshire for Palaeolithic remains, Yorkshire has very little to show until the end of that stage, and remains which belong typologically to this period may actually date from a considerably later period. In this connection we note objects from the Victoria cave, Settle, and from Holderness. Petch has made special studies of the pigmy flints of south Yorkshire and has found large numbers of sites all above the 1,000 ft. contour line. (*See* J. A. Petch, *Early Man in the District of Huddersfield* [Huddersfield, 1924].) Implements of Late Neolithic type are found almost all over the county, and such implements, made of finely chipped flints, are especially characteristic of the district behind Scarborough and the Yorkshire Wolds, which henceforth stands out as an especially important region in prehistoric times. The Yorkshire Wolds are one of the chief regions of Britain for round barrows and Beaker pottery, while remains of the Bronze age abound both here and in the Aire gap. The north Yorkshire moors are in process of detailed study by Elgee. On the moors above Ilkley are interesting traces of an apparently megalithic culture, with large stones decorated with cup and ring markings, supposed swastikas, etc. Three decorated chalk drums from Folkton Wold are important, showing southern and probably Iberian influence. Jet ornaments are another feature. The rarity of Bronze age finds in the central Ouse basin is a noteworthy feature. The Yorkshire Wolds yield abundant evidences of early Iron age finds, and important settlements have been located near Arras and Hessleskar farms, 3 m. E. of Market Weighton. The finds in these regions show affinities with those of the period on the English plain and in north-eastern Gaul.

History.—By Roman times the Vale of York had become important and carried the north road. From Lindum (Lincoln) the main road ran north-west to Danum (Doncaster) and thence to Legiolium and Calcaria (Tadcaster), thence branching off to Eburacum (York, *q.v.*), the Roman capital of the north. The main road continued through the Vale of York from Calcaria past Isurium to Cataractorium (Catterick Bridge) and thence over the Tees to the north.

In the 6th century, an Anglian tribe having seized the promontory at the mouth of the Humber, named by the invaders Holderness, gradually subjugated the East Riding. The earliest settlements were chiefly confined to the rich valley of the lower Derwent, but the district around Weighton became the sacred ground of the kingdom which was named Deira, and Goodmanham is said to mark the site of a temple. Ella, the first king of Deira, extended his territory north to the Wear, and his son Edwin completed the conquest of the district which was to become Yorkshire. Traces of the "burhs" by which Edwin secured his conquests are perhaps visible in the group of earthworks at Barwick and on the site of Cambodunum, but the district long remained scantily populated. The defeat of Edwin at Hatfield in 633 was followed by a succession of struggles between Mercia and Northumbria for the supremacy over Deira. After the Danish conquest of Deira, Guthrum in 875 portioned the district among his followers, under whose lordship the English retained their lands. Cleveland came under Scandinavian influence, and the division into tithings probably originated about this date, the boundaries being arranged to meet at York, the administrative centre which, by A.D. 1000, had a population of over 30,000. At the battle of Stamford Bridge in 1066 Harold Hardrada, who had seized York, and Earl Tosti were defeated and slain by Harold of England.

For many years after the harrying of the country by the Conqueror all the towns between York and Durham lay uninhabited. In 1138 David of Scotland was defeated near Northallerton in the battle of the Standard. In the barons' wars of the reign of Henry II. Thirsk and Malgeard castles were captured and demolished. Robert Bruce in 1318 destroyed Northallerton, Boroughbridge, Scarborough and Skipton. In 1322 at the battle of Boroughbridge, the rebel barons were defeated by the forces of Edward II. In 1399 Richard II. was murdered in Pontefract castle. In 1408 the rebel forces of the earl of Northumberland were defeated at Bramham moor near Tadcaster. In 1453 a skirmish at Stamford Bridge was the opening event in the struggle between the houses of York and Lancaster; in 1460 the duke of York was defeated and slain at Wakefield; in 1461 the Lancastrians were defeated at Towton. The suppression of the monasteries roused deep resentment in Yorkshire, and the inhabitants flocked to join the Pilgrimage of Grace. On the outbreak of the Civil War of the 17th century, opinion was divided in Yorkshire. Sir William Savile captured Leeds and Wakefield for the king in 1642, and in 1643 Newcastle, having defeated the Fairfaxes at Adwalton moor, held all Yorkshire except Hull. In 1644, how-

ever, the Fairfaxes secured the East and West Ridings, while Cromwell's victory at Marston moor was followed by the capture of York, and in the next year of Pontefract and Scarborough.

On the redistribution of estates after the Norman Conquest, Alan of Brittany, founder of Richmond castle, received the honour of Richmond, and Ilbert de Laci the honour of Pontefract. Earl Harold's estate at Coningsburgh passed to William de Warenne, earl of Surrey, together with Sandal castle, which in the 14th century was bestowed on Edmund Langley, duke of York. Other Domesday landholders were William de Percy, founder of the abbey of Whitby; Robert de Bruce, ancestor of the royal line in Scotland; Roger de Busli; the archbishop of York enjoyed the great lordship of Sherburn, and Howdenshire was a liberty of the bishop of Durham.

The shire court for Yorkshire was held at York, but extensive privileges were enjoyed at various times by the great landowners. In the 13th century the diocese of York included in this county the archdeaconries of York, Cleveland, East Riding and Richmond. In 1541 the deaneries of Richmond were transferred to Henry VIII's new diocese of Chester. Ripon was created an episcopal see by act of parliament in 1836, and in 1888 the area of the diocese was reduced by the creation of the see of Wakefield, now consisting of the archdeaconries of Halifax and Pontefract, while the diocese of Ripon consists of the archdeaconries of Richmond and Leeds. The diocese of York includes the archdeaconries of York, East Riding and Cleveland. The bishoprics of Sheffield and Bradford were created in 1914 and 1919 respectively, the former containing the archdeaconries of Sheffield and Doncaster and the latter those of Craven and Bradford.

The woollen industry began after the Conquest, and historical details may be found under LEEDS, BRADFORD, etc. The time of the American Revolution marked the gradual absorption by Yorkshire of the clothing trade from the eastern counties. Coal appears to have been used in Yorkshire by the Romans, and was dug at Leeds in the 13th century. The early fame of Sheffield as the centre of the cutlery and iron trade is demonstrated by a line in Chaucer. In the 13th century forges are mentioned at Rosedale and at Gisburn. In the 16th century limestone was dug in many parts of Elmet, and Huddlestone, Hesselwood and Tadcaster had famous quarries; Pontefract was famous for its liquorice, Aberford for its pins, Whitby for its jet. Alum was dug at Guisborough, Sandsend, Dunsley and Whitby in the 17th century. Bolton market was an important distributive centre in the 17th century, and in 1787 there were 11 cotton mills in the county.

Architecture.—Of ancient castles Yorkshire retains many interesting examples. The fine ruins at Knaresborough, Pickering, Pontefract, Richmond, Scarborough and Skipton are described under their respective headings. Barden tower, picturesquely situated in upper Wharfedale, was built by Henry de Clifford (d. 1523). Bolton castle, which rises above Wensleydale, is a square building with towers, erected in the reign of Richard II by Richard Scrope; it was rendered untenable in 1647. Of Bowes castle near Barnard castle, there remains only the square keep. Cawood castle, near Selby, retains its gateway tower erected in the reign of Henry VI. Conisborough castle stands by the Don between Rotherham and Doncaster. The ruins of Danby castle are of various dates. Harewood castle in lower Wharfedale contains no portions earlier than the reign of Edward III. The keep of Helmsley castle was built late in the 12th century. Other remains are:—The fortress of Middleham, Mulgrave castle, Ravensworth castle, Sheriff Hutton castle, Spofforth castle, Tickhill castle, Whorlton castle, the fortress of Wressell, the mansions Gilling, Ripley, Skelton and the Elizabethan hall of Burton Agnes.

In ecclesiastical architecture Yorkshire is extraordinarily rich. At the time of the Dissolution there were 28 abbeys, 26 priories, 23 nunneries, 30 friaries, 13 cells, 4 commanderies of Knights Hospitallers and 4 preceptories of Knights Templars. The principal monastic ruins are described under separate headings and elsewhere. These are Bolton abbey (properly priory), a foundation of Augustinian canons; Fountains abbey, a Cistercian foundation, the finest and most complete of the ruined abbeys in England; the Cistercian abbey of Kirkstall near Leeds (*q.v.*); the Cistercian abbey of Rievaulx, and the Benedictine abbey of St. Mary, at York. Separate reference is also made to the ruins of Jervaulz (Cistercian) and Coverham (Premonstratensian) in Wensleydale, and to the remains at Bridlington, Guisborough, Malton, Whitby, Easby near Richmond, Kirkham near Malton, Monk Bretton near Barnsley, and Mount Grace near Northallerton. There are fine though scanty remains of Byland abbey, of Early English date, between Thirsk and Malton. There was a house of Premonstratensians at Egglestone above the Tees near Barnard castle. Other ruins are the Cistercian foundations at Meaux in Holderness, Roche, east of Rotherham, and Sawley in Ribblesdale; the Benedictine nunneries of Marrick, and Rosedale; and the Gilbertine house of Watton in Holderness.

Agriculture and Manufactures.—Nearly 87% of the East Riding was under cultivation in 1939, but of the North and West Ridings only about 60% and 58% respectively. The boulder-clay of Holderness forms the richest soil in Yorkshire, and the chalk wolds, by careful cultivation, form one of the best soils for grain crops. The central plains bear all kinds of crops excellently. Oats are grown in all three ridings, but wheat is the principal crop, though the area planted in the North Riding is less than half that in the east. Barley is extensively grown in the East and North Ridings. The bulk of the acreage under green crops is devoted to turnips and swedes, but potatoes form an important crop, especially in the West Riding. The next crop is sugar beet, grown most in the East Riding, the total acreage in 1939 being 27,158. Liquorice is cultivated near Pontefract. The proportion of hill pasture is greatest in the North Riding and least in the East, and the North and West are among the principal sheep-farming districts in England.

The industrial district of south Yorkshire is situated on the northern half of the Yorkshire, Derby and Notts coalfield. The West Riding is the chief seat of the woollen manufacture of the United Kingdom and has almost the monopoly in the production of worsted cloths. The early development of the industry was in part due to the rearing of sheep on the moors and to the abundance of water-power, while later the presence of coal further established it, but now most of the wool used is imported from abroad. The industry engages the most important towns. Almost every variety of woollen and worsted cloth is produced at Leeds; Bradford is especially concerned with worsted stuffs and alpacas; Batley with shoddy; Huddersfield with fancy goods; Halifax and Dewsbury with carpets and a varied class of woollens; and Keighley with yarns. Linen manufacture is the staple industry of Barnsley, though it is also carried on at Leeds. Cotton spinning is done at Huddersfield and Todmorden. The people of the industrial part of Yorkshire are noted for their singing, and choral societies are numerous, the Leeds festival chorus being one of the greatest in England. The woollen industry flourishes in the soft-water area and gives place to the iron and steel industry south of the Calder valley. Sheffield is especially famous for the finest grades of steel, for heavy machinery, hardware, fine metal work, cutlery and plated goods. The development of the iron ore deposits of Cleveland dates only from the middle of the 19th century. In addition to a large amount raised locally, the smelters of the Middlesbrough district ordinarily import large quantities of ore from Sweden and Spain. The attendant industries such as the production of steel, shipbuilding, etc., also flourish. The chemical industry is important both here and in the West Riding where also a great variety of other industries has sprung up, such as the great leather industry at Leeds, the manufacture of clothing, printing and bleaching, and paper-making. Besides coal and iron ore, much clay, limestone and sandstone are mined. Excellent building stone is obtained in the West Riding. The sea-fisheries are important, the chief fishing ports being Hull, Scarborough, Whitby and Filey. Leeds has become a great business centre and almost a metropolis for the woollen area of the West Riding.

Communication.—Two main lines traverse the county, the L.N.E. line from London, passing through Doncaster, Selby, York, Northallerton, to Durham and the north; the other, the L.M.S. line from London and Derby to Sheffield, Leeds, Skipton, Settle and on to Carlisle. In addition to these there is a perfect network

of lines, the L.N.E. serving for the most part the north and east of Leeds and the L.M.S. the West Riding. The Pennines are crossed by the L.M.S. from Huddersfield to Manchester, Halifax to Todmorden, as well as through the "Aire gap," and by the L.N.E. from Penistone to Manchester, Northallerton to Hawes Junction and across the north-west of the county from Barnard castle to Kirkby Stephen. In the East Riding in 1943 there were 2,204 mi. of county roads and in the West Riding 3,796 mi. A complete system of canals links the centres of the southern West Riding with the sea, east and west.

Population and Administration.—The areas of the three administrative counties of the East, North and West Ridings are 1,150, 2,116 and 2,517 sq.mi. respectively, with populations estimated in 1938 at 184,630, 333,500 and 1,502,523. Wartime population movements reduced the population of the whole county between Sept. 1939 and Feb. 1941, the North and West Ridings by 3% each and the East Riding by 10%. The distribution of the population may be inferred from the table below. The city of York (pop., est. 1938, 100,800) is situated where the three ridings meet in the Ainsty of York. It was formerly independent of the three ridings but now constitutes a wapentake in the West Riding, for civil purposes.

District	Parliamentary divisions, each returning one member	Parliamentary boroughs	Number of members returned by parliamentary boroughs	County boroughs	Municipal boroughs	Urban districts
York City	..	1	1	1	..	..
West Riding	19	10	24	10	11	57
East Riding	3	1	4	1	3	6
North Riding	4	1	2	1	4	10
Totals for County	26	13	31	13	18	73

The county and boroughs of Yorkshire return a total of 57 members to parliament. Of the area of the West Riding the south industrial district, considered in the broadest sense as extending between Sheffield and Skipton, Sheffield and Doncaster, and Leeds and the county boundary, covers rather less than one half. Although the three ridings are separate administrative counties, there is but one sheriff for the whole of Yorkshire. The county is divided among the dioceses of York, Ripon, Wakefield, Sheffield, and Bradford with small parts in those of Manchester, Blackburn, Southwell and Durham. York is the seat of the northern archdiocese. The National Trust owned 1,160 ac. in Yorkshire in 1942.

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YORKSHIRE ELECTRIC POWER COMPANY. A group of men in the West Riding, interested in the woollen and colliery industries, promoted a bill in 1901 which incorporated The Yorkshire Electric Power company with an authorized share capital of £2,000,000. The concern was vested with powers of supplying over a large area in perpetuity and established at Thornhill, near Dewsbury, a generating station with a capacity of 4,500 kilowatts. A supply was made available in Dec. 1904, but for many years difficulties were experienced in consequence of the conservatism of manufacturers and the opposition of vested interests.

A second generating station was established at Barugh near Barnsley, where electricity is generated by means of surplus coke oven gas. A third station was started in 1927 at Ferrybridge. The three stations, which are selected stations under the Electricity Supply Act 1926, have been enlarged from time to time, and in 1939 their combined capacity was 229,000 kilowatts. It is of interest that the system of generation and supply adopted by the company in 1903, viz., 50 cycles, three-phase alternating current, has now become the British national standard.

A large number of collieries in the West Riding and many textile mills and engineering works are now supplied by the company, and in addition over 70 local authorities and other authorized distributors are taking a bulk supply for distribution in the towns and villages. This work has been greatly facilitated by associated companies, Electrical Distribution of Yorkshire Limited, formed in 1905, and the North Lincolnshire and Howdenshire Electricity Company Limited, formed in 1932. The original capital was increased by further acts in 1922 and 1927 to £6,000,000. In 1939 the capital expenditure of the company and its associated distribution companies was over £12,000,000. (L. C. M.; X.)

YORKTOWN, a town and county seat of York county, Virginia, U.S.A., on York river 10 mi. from its mouth, and about 60 mi. E.S.E. of Richmond. In 1940 the population of Nelson district, which includes Yorktown (pop., 521) was 1,175. It is served by a steamship line, and about 6½ mi. distant is Lee Hall, a station on the Chesapeake and Ohio railway. The town is now within the boundaries of Colonial National Historical park. In the main street is the oldest custom-house in the United States, and the house of Thomas Nelson (1738–1789), a signer of the Declaration of Independence. In commemoration of the surrender of Lord Cornwallis in October 1781, there is a monument of Maine granite (100ft. 6in. high) designed by R. M. Hunt and J. Q. A. Ward; its cornerstone was laid in 1881 during the centennial celebration of the surrender, and it was completed in 1883. Yorktown was founded in 1691, as a port of entry for York county. It became the county seat in 1696, and although it never had more than about 200 houses its trade was considerable until it was ruined by the Revolutionary War. In that war the final victory of the Americans and their French allies took place at Yorktown.

Baffled by Gen. Nathanael Greene in his campaign in the Carolinas, his diminished force (fewer than 1,400) sadly in need of reinforcement, and persuaded that the more southern colonies could not be held until Virginia had been reduced, Lord Cornwallis marched out of Wilmington, N.C., on April 25, 1781, arrived at Petersburg, Va., on May 20, and there, with the troops which had been under William Phillips and Benedict Arnold and with further reinforcements from New York, raised his army to more than 7,000 men. Facing him in Richmond was Lafayette, whom Washington had sent earlier in the year with a small force of light infantry to check Arnold, and who had now been placed in command of all the American troops in Virginia. Cornwallis's first attempt was to prevent the union of Lafayette and Gen. Anthony Wayne. Failing in this, he retired down the James in the hope, it is thought, of receiving reinforcements from Gen. Henry Clinton. While Cornwallis was marching from N. Carolina to Virginia, Washington learned that a large French fleet under De Grasse was to come up from the West Indies in the summer and for a brief period co-operate with the American and French armies. At a conference on May 21 at Wethersfield, Conn., with the French commanders, Washington favoured a plan for a joint attack on New York when De Grasse should arrive. An attack on the British in Virginia was, however, considered. The minutes of the conference with some suggestions from Rochambeau having been sent to De Grasse, he announced in a letter received on Aug. 14 that he would sail for the Chesapeake for united action against Cornwallis. About the same time Washington learned from Lafayette that Cornwallis was fortifying Yorktown. Sir Samuel Hood with 14 ships-of-the-line arrived at the Chesapeake from the West Indies three days ahead of De Grasse, and proceeding to New York warned Admiral Thomas Graves of the danger. Graves took command of the combined fleet, 19 ships-of-the-line, and on Aug. 31 sailed for the Chesapeake in the hope of preventing the union of the French fleet from Newport, under Count de Barras, with that under De Grasse. He arrived at the Chesapeake ahead of De Barras, but after an encounter with De Grasse alone (September 5), who had 24 ships-of-the-line, he was obliged to return to New York to refit, and the French were left in control of the coast. Leaving only about 4,000 men to guard the forts on the Hudson, Washington set out for Virginia with the remainder of his army immediately after learning of De Grasse's plan, and the French land forces followed. The allied army was transported by water from the head of the Chesapeake to the vicinity of Williamsburg, and on Sept. 28 it marched to Yorktown. Receiving, on the same day, a despatch from Clinton promising relief, and fearing the enemy might outflank him, Cornwallis abandoned his outposts during the following night and withdrew to his inner defences, consisting of seven redoubts and six batteries connected by intrenchments, besides batteries along the river bank.

The allies, 16,000 strong, took possession of the abandoned posts and closed in on the town in a semicircle extending from Wormley Creek below it to about a mile above it, the Americans holding the right and the French the left. On the night of Oct. 5–6 the allies opened the first parallel about 600yd. from the British works, and extending from a deep ravine on the north-west to the river bank on the south-east, a distance of nearly two miles. Six days later the second parallel was begun within 300yd. of the British lines, and it was practically completed on the night of the 14th and 15th, when two British redoubts were carried by assault, one by the Americans led by Alexander Hamilton and one by the French led by Lieut.-Colonel G. de Deux-Ponts. On the morning of the 16th Cornwallis ordered Lieut.-Colonel Abercrombie to make an assault on two French batteries. He carried them and spiked 11 guns, but they were recovered and the guns were ready for service again 12 hours later. On the night of the 16th and 17th Cornwallis attempted to escape with his army to Gloucester on the opposite side of the river, but a storm ruined what little chance of success there was in this venture. In grave danger of an assault from the allies, Cornwallis offered to surrender on the 17th; two days later his whole army, consisting of 7,073 officers and men, was surrendered, and American Independence was practically assured. The British loss during the siege was about 156 killed and 326 wounded; the American and French losses were 85 killed and 199 wounded.

In 1862 the Confederate defences about Yorktown were besieged for a month (April 4–May 3) by the Army of the Potomac under Gen. McClellan. There was no intention on the part of the Confederate commander-in-chief, Joseph Johnston, to do more than gain time by holding Yorktown and the line of the Warwick river as long as possible without serious fighting, and without imperilling the line of retreat on Richmond; and when after many delays McClellan was in a position to assault with full assistance from his heavy siege guns, the Confederates fell back on Williamsburg.

See T. N. Page, "Old Yorktown," in *Scribner's Magazine* (Oct. 1881); H. P. Johnston, *The Yorktown Campaign and the Surrender of Cornwallis* (New York, 1881); A. S. Webb, *The Peninsular Campaign* (New York, 1882); J. C. Ropes, *Story of the Civil War,* vol. ii. (1898); and Jean Henri Clos, *The Glory of Yorktown* (Yorktown, 1924).

YORUBA, a people inhabiting the Ilorin and Sokoto provinces of Northern Nigeria and the Abeokuta, Ijebu, Ondo and Oyo provinces, and the Lagos district, of Southern Nigeria, and comprising the following sub-tribes: Abori, Egba-Awori, Ekiti, Eko, Ijebu, Ijesha, Jekri and Oyo. The kingship was at first hereditary but later became elective, and there were numerous ministers, officials, and eunuchs. Each province, town or village also had its chief. They are divided into clans and extended family groups, but have no age-classes except among the Ekiti. Marriage is prohibited between those whose paternal or maternal kinship can be proved. Descent was formerly matrilineal but is now patrilineal, the widows being inherited by the sons, except in the case of their own mothers. The father's property is inherited by the sons, the mother's by the daughters. There are societies of a political and religious character, having secret rites, such as the *Egungun, Oro,* and *Ogboni.* The Yoruba are cultivators, and their religion is animist; they practise divination (*Ifa*).

See P. Amaury Talbot, *The Peoples of Southern Nigeria* (1926).

YOSEMITE, a deep valley forming a portion of the canyon of the Merced river, a tributary of the San Joaquin river, in central California. It lies due east of San Francisco at a distance of about 150 miles. The floor of the valley is approximately 4,000ft. above sea level, and its walls rise abruptly 3,000 to 4,000ft. to a rolling plateau region culminating in mountain peaks 10,000 to 13,000ft. in altitude. The valley itself is about seven miles long and from half a mile to a mile wide. In addition to its extraordinary form and its enormous monolithic cliffs and domes, it is remarkable for the variety and beauty of its waterfalls and for the enchanting loveliness of its woods and flowering meadows.

Principal features are the majestic rock forms—El Capitan, Three Brothers, Yosemite Point, Royal Arches, Washington Column, North Dome, Basket Dome, Cathedral Rocks, Cathedral Spires, Sentinel Rock, Sentinel Dome, Glacier Point and the superb Half Dome, which dominates the head of the valley; and the falls of clear, sparkling water which leap into the valley in spring and early summer—Bridalveil, Ribbon, Upper and Lower Yosemite, Illilouette, Vernal and Nevada. The Upper Yosemite fall has a drop of 1,430 feet. Mirror lake, a small body of water at the foot of Half Dome, where Tenaya canyon joins the valley, is famous for its reflections, especially at sunrise, although in recent years its beauty has become impaired by the accumulation of silt and debris brought down by flood and storm. The Happy isles, a little below Vernal fall, provide secluded spots from which to review the dancing rapids of the Merced river.

History.—Yosemite valley was undoubtedly seen in 1833 by members of Captain Joseph Reddeford Walker's party of trappers, but its existence was not made known to the world until 1851, when Major James D. Savage and members of his Mariposa battalion pursued marauding Indians into their secret refuge. Lafayette H. Bunnell, a young physician who accompanied the party, appears to be the only one of the group who was impressed with the magnificent scenery. He inquired of the friendly Indian guides the name of the place and was informed that it was called after the tribe that occupied it—a name which Bunnell understood to be "Yo-sém-i-ty," meaning "grizzly bear." The following year an Army officer, in writing a report, substituted *e* for *y* as the terminal letter, thinking perhaps that the name was of Spanish origin. Later visitors heard the word as "Yo-hám-i-te," or "Yo-hém-it-e." As a matter of fact, the Indians of the valley called the grizzly bear "Oo-hóo-ma-te" or "O-hám-i-te," while a neighbouring tribe called it "Oo-soó-ma-te" or "Uh-zú-mai-tuh." In a short time the name became established in print in its present form.

The first party to enter Yosemite valley solely for the purpose of viewing its marvels and enjoying its beauties was led by James M. Hutchings in 1855. For more than thirty years Hutchings was identified with the valley, as publicizer, hotelkeeper, and official guardian. An artist, Thomas Ayres, accompanied the 1855 party. Lithographs based on his sketches were published by Hutchings. They were the first representations of Yosemite scenery to reach the public and did a great deal to spread the fame of the valley throughout the world. Until 1874 the only access to Yosemite valley was by horseback or on foot over rough, steep trails. In that year two wagon roads were completed into the valley on the north side, from Big Oak Flat and Coulterville, respectively, and in 1875 the road from Mariposa brought wagons into the valley from the south. In 1907 the Yosemite Valley railroad was completed up the canyon of the Merced river as far as El Portal, where passengers and freight were transferred to stages and wagons for the remaining fifteen miles, an ascent of 2,000 feet. Although the first automobile entered the valley in 1900, it was not until 1913 that motor travel was authorized. Aeroplanes have, on a few occasions, landed on and taken off from the valley floor, but this is now prohibited. Travel to Yosemite has increased from a maximum annual number of visitors in the years up to 1885 of less than 3,000, to 8,850 in 1908, the first year of railroad travel by El Portal, to over 30,000 in 1915, to over 100,000 in 1922, and to over 400,000 annually since 1927. At the present time a large portion of the visitors come in private automobiles, but regular schedules are maintained throughout the year by motor stages connecting with the main railroad lines and with the Yosemite Valley railroad at El Portal. During the summer a stage connects Yosemite with Lake Tahoe and with the Owens Valley stage-lines by way of the Tioga road across the Sierra. Lodges, camps, and a hotel provide a variety of accommodations to the public the year round. In recent years winter travel to Yosemite has attained large proportions.

Geologic History.—The striking evidence of enormous dynamic forces of nature everywhere visible in Yosemite valley invariably prompts the question: How was the valley formed? The first discussions of this question by scientists developed widely divergent views. Josiah Dwight Whitney, head of the first State Geological Survey of California, proposed the theory that "the bottom of the valley sank down to an unknown depth, owing to its sup-

port being withdrawn from underneath, during some of those convulsive movements which must have attended the upheaval of so extensive and elevated a chain, no matter how slow we may imagine the process to have been."—*The Yosemite Guide-book,* 1869. It took years to eradicate this explanation from guide-books and other literature of the valley. At a time when Whitney and his pupil Clarence King were making the positive statements that the peculiar formation of the Yosemite was not due to the erosive action of ice and that there was no proof that glaciers had ever entered the valley, a young naturalist who had recently come to California and become enamoured of the orderly and pure beauty of the Yosemite and its surroundings, John Muir, proclaimed with enthusiasm that glacial erosion was, in fact, the key to the whole problem. As time went on Muir's views gained support, others elaborated upon them and modified them, until today the following statement by François E. Matthes, of the U.S. Geological Survey, represents the prevailing opinion: "In neither the Yosemite nor in any other valley of its type is there evidence of any dislocation of the earth's crust. In every one of these valleys, on the other hand, there is abundant proof of powerful glacial action such as Muir recognized. To be sure, the glaciers did not reach down to the foothills, nor did they excavate the canyons in their entirety, as Muir supposed. The ice age, it is now clear, was preceded in the Sierra Nevada by long periods of canyon cutting by the streams in consequence of successive uplifts of the range."—In *Sierra Club Bulletin,* 1938. Geologists of the present century have emphasized the importance of the structure of the rock, and have enormously lengthened the estimates of time involved in the erosion process. Matthes summarizes the theory as follows: "The story of the evolution of the Yosemite valley, then, is a story of several chapters—of successive periods of valley and canyon cutting by the Merced river, induced by successive uplifts of the Sierra Nevada; of vigorous glaciation, several times repeated, during the ice age, the quarrying action of the ice being controlled and guided locally by the varying structure of the granitic rocks and giving rise to exceptionally bold, clean-cut sculptural effects; and finally of a period of dismantling, resulting in greater detail and intricacy of sculpture, the production of slopes of rock waste, and the formation of level valley floors."—*Geologic History of the Yosemite Valley,* 1930.

Yosemite National Park.—Because very largely of the activities of Whitney and his associates of the State Geological Survey, Congress enacted a law in 1864 by which Yosemite valley and the Mariposa Big Tree grove were granted to the State of California with the stipulation that "the premises shall be held for public use, resort, and recreation. . . . inalienable for all time." The grant was accepted by act of the State Legislature in 1866, a step of inestimable value in the development of State and national parks. A second and even more important step was taken when Congress responded to the pleas of John Muir, Robert Underwood Johnson, of *Century Magazine,* and others, and by act of Oct. 1, 1890, reserved and withdrew from settlement a large area of forested and mountainous land surrounding the Yosemite valley grant. There was thus established a national park enclosing within its boundaries a State park. The dual administration continued until 1906, when Congress accepted the recession of the State grant enacted by the California Legislature in 1905. Since that date the entire area has constituted the Yosemite National park, which today, after several changes in boundaries, embraces over 1,100 square miles. From 1891 to 1914 the park was administered during the summer season by troops of United States Cavalry with an officer acting as superintendent. The most important duties during that period were the ousting of bands of sheep from the mountain ranges and the apprehension of poachers. Today, under the administration of the National Park Service, acting through a civilian superintendent, the duties are primarily concerned with making available to the public the opportunities for wholesome recreation and for education in natural history and science.

Most of Yosemite National park lies within the basins of the Merced and Tuolumne rivers. Outstanding features, in addition to Yosemite valley, are Little Yosemite, Merced lake and Lake Washburn at the head of the Merced; Tuolumne meadows, Benson lake, Tilden lake, Jack Main canyon; the canyon of the Tuolumne, with its Waterwheel falls; Hetch Hetchy valley, source of water and hydro-electric power for San Francisco, granted by special act of Congress in 1913; the Mariposa, Merced, and Tuolumne groves of big trees; and a galaxy of mountain peaks, including Lyell (13,090), Dana (13,050), Conness (12,556), Tower Peak (11,704), Cathedral Peak (10,933), Unicorn (10,849), Hoffmann (10,921), Clark (11,506), and Starr King (9,081). The park is crossed by the Tioga road, originally built as a wagon-road for access to mines, now regraded as a transmountain highway.

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YOSHIHITO (1879–1926), 123rd emperor of Japan, third son of the Emperor Meiji (Mutsuhito), was born at Tokyo on Aug. 31, 1879. On the eighth anniversary of his birthday the prince was proclaimed heir-apparent, the first and second sons of the emperor Meiji having died in infancy. In Sept. 1887 the prince commenced attending the Peers' school, and on Nov. 3, 1889, entered the Army and was declared imperial crown prince. Two years later he left the school to continue his studies under private tutors. In 1897 he took his seat, in accordance with prescriptive right, in the house of peers. On May 10, 1900, the crown prince married Sadako, fourth daughter of the late Prince Michitaka Kujo, and on April 29, 1901, a son, Hirohito, was born, followed by a second son, Prince Yasuhito Chichibunomiya, on June 25, 1902, and a third, Prince Nobuhito Takamatsunomiya, on Jan. 3, 1905. On July 30, 1912, on the demise of his father, the crown prince ascended the throne, but owing to the national mourning the formal ceremony of enthronement did not take place until Nov. 1914. His reign was proclaimed as the era of Taisho (Righteousness). In the following year a fourth son, Prince Takahito Suminomiya, was born on Dec. 2. Owing to the indifferent health of the emperor, whose life was a constant struggle against disease, his son Hirohito became prince regent on Nov. 25, 1921. The emperor died on Dec. 25, 1926, of heart failure following bronchial pneumonia. The reign of Hirohito, who succeeded his father as emperor, is designated the period of Showa (Light and Peace).

Prince Chichibu (Yasuhito Chichibunomiya) went to England in 1925 and studied at Magdalen college, Oxford. He married Princess Setsuko, the eldest daughter of Ambassador Matsudaira, on Sept. 28, 1928.

YOSHIZAWA, KENKICHI (1874–), Japanese diplomat, was born in Niigata-Ken. He studied English literature for his degree in the Imperial university of Tokyo. He entered the diplomatic service, was consular assistant at Amoz, South China. After two years spent at Shanghai and in London he returned to the Foreign Office in Tokyo, and was sent as secretary to the Legation in Peking. This office he held until, in 1919, he became director of the Asiatic bureau, where his experience of Far Eastern people enabled him to adjust differences between his own country and other oriental Powers. He retained this post until 1923, and was again in Peking in an official capacity when the new Russo-Japanese alliance was broached in 1924. The treaty, though opposed by many Japanese, was signed in Jan. 1925. Yoshizawa was appointed ambassador to France in 1930.

YOUGHAL (pronounced *Yawl*), a seaport and watering-place of County Cork, Ireland, on the west side of the Blackwater estuary, and on the Cork and Youghal branch of the Great Southern railway, 26¾mi. east of Cork. Pop. (1936) 5,131. Youghal was a settlement of the Northmen in the 9th century, and was incorporated by King John in 1209. The Franciscan monastery, founded at Youghal by FitzGerald in 1224, was the earliest house of that order in Ireland. Sir Roger Mortimer landed at Youghal in 1317. The town was plundered by the earl of Des-

mond in 1579. In 1641 it was garrisoned and defended by the earl of Cork. Sir Walter Raleigh was mayor of Youghal in 1588–89, and is said to have first cultivated the potato here.

YOUNG, ARTHUR (1741–1820), English writer on agriculture and social economy, second son of the Rev. Arthur Young, was born Sept. 11, 1741. After being at a school at Lavenham, he was placed in a mercantile house at Lynn, but showed no taste for commerce. He published, when only 17, a pamphlet *On the War in North America,* and in 1761 went to London to start a periodical, *The Universal Museum.* He also wrote four novels, and *Reflections on the Present State of Affairs at Home and Abroad* in 1759.

In 1768 he published the *Farmer's Letters to the People of England,* in 1771 the *Farmer's Calendar,* which went through a great number of editions, and in 1774 his *Political Arithmetic,* which was widely translated. About this time Young acted as parliamentary reporter for the *Morning Post.* He made a tour in Ireland in 1776, publishing his *Tour in Ireland* in 1780. In 1784 he began the publication of the *Annals of Agriculture,* which was continued for 45 volumes. This work had many contributors, among whom was George III, writing under the nom de plume of "Ralph Robinson." Young's first visit to France was made in 1787. Traversing that country in every direction just before and during the first movements of the Revolution, he has given valuable notices of the condition of the people and the conduct of public affairs at that critical juncture. The famous book *Travels in France* appeared in 2 vols. in 1792. On his return home he was appointed secretary of the Board of Agriculture in 1793. His sight failed, and in 1811 he had an unsuccessful operation for cataract. He died on April 20, 1820. He left an autobiography in ms., which was edited (1898) by Miss M. Betham-Edwards.

YOUNG, BRIGHAM (1801–1877), Mormon leader, born at Whittingham, Vt. (U.S.A.), June 1, 1801. He moved to Mendon, N.Y., in 1829, and three years later joined the newly organized Mormon Church. (*See* MORMONS.) He was appointed an apostle in 1835, played a leading rôle in the removal of the Mormons from Missouri to Illinois, and in 1840 was sent to Liverpool to direct Mormon missionary work in England. There he organized branch missions, established emigrating agencies and began publication of the *Millennial Star.* He returned to America two months after the death of the prophet, Joseph Smith (*q.v.*), to take over the leadership of the church. The people of Illinois having demanded the removal of the Mormons, Young was faced with the Herculean task of leading them to a new country where they would be free from interference. After organizing the groups and planning every move in detail, the migration of nearly 5,000 people was gotten under way in 1846. Early in 1847 Young, leading the advance band, reached the valley of Great Salt Lake, and there decided to settle. He founded Salt Lake City, began the cultivation of crops by irrigation and directed the dispersal of the emigrant trains as they arrived. Both in moral and economic realms his word was law and he laid down the policies of the settlement. When the Territory of Utah was organized in 1850 he was appointed governor by President Fillmore and reappointed in 1854. Though not appointed again in 1858 because of his defiance of the United States in the so-called Mormon War, he continued to be the supreme power of the Territory. He encouraged agriculture, developed natural resources, established manufactures, founded Deseret University at Salt Lake City and Brigham Young Academy at Provo, built the Salt Lake Theatre, laid the foundations of the Mormon Temple, and created the Zion's Co-operative Mercantile Institution which grew into the largest institution of its kind in the West. His genius as a leader is generally recognized, the settlement of Utah being one of the best examples of organic colonization in history. He followed the doctrine of plural marriage and at his death at Salt Lake City Aug. 29, 1877, was survived by 17 wives and 47 children.

For bibliography *see* MORMONS.

YOUNG, EDWARD (1683–1765), English poet, author of *Night Thoughts,* son of Edward Young, afterwards dean of Salisbury, was born at his father's rectory at Upham, near Winchester, and was baptized on July 3, 1683. He was educated at Winchester College and New College, and Corpus Christi, Oxford. His first publication was an *Epistle to . . . Lord Lansdoune* (1713). It was followed by a *Poem on the Last Day* (1713), dedicated to Queen Anne; *The Force of Religion: or Vanquish'd Love* (1714), a poem on the execution of Lady Jane Grey and her husband, dedicated to the countess of Salisbury; and an epistle to Addison, *On the late Queen's Death and His Majesty's Accession to the Throne* (1714), in which he made indecent haste to praise the new king. About this time began his connection with Philip, duke of Wharton, whom he accompanied to Dublin in 1717, and with whom he had a lawsuit in 1740; the upshot was that Young was awarded an annuity of £100, but failed to secure a sum of £600 which he claimed. Meanwhile, his plays, *Busiris* and *Revenge,* were produced at Drury Lane in 1719 and 1721. Between 1725 and 1728 Young published a series of seven satires on *Love of Fame, the Universal Passion.*

Young was nearly fifty when he decided to take holy orders. In 1728 he was made one of the royal chaplains, and in 1730 was presented to the college living of Welwyn, Hertfordshire. He married in 1731 Lady Elizabeth Lee, daughter of the 1st earl of Lichfield. *The Complaint,* or *Night Thoughts on Life, Death and Immortality,* was published in 1742, and was followed by other "Nights." He died at Welwyn on April 5, 1765.

Other works by Young are: *The Instalment* (to Sir R. Walpole, 1726); *Cynthio* (1727); *A Vindication of Providence . . .* (1728), a sermon; *An Apology for Punch* (1729), a sermon; *Imperium Pelagi, a Naval Lyrick . . .* (1730); *Two Epistles to Mr. Pope concerning the Authors of the Age* (1730); *A Sea-Piece . . .* (1733); *The Foreign Address, or The Best Argument for Peace* (1734); *The Centaur not Fabulous; in Five Letters to a Friend* (1755); *An Argument . . . for the Truth of His* [Christ's] *Religion* (1758), a sermon preached before the king; *Conjectures on Original Composition . . .* (1759), addressed to Samuel Richardson; and *Resignation . . .* (1762), a poem.

YOUNG, MAHONRI MACKINTOSH (1877–), American sculptor, painter and etcher, was born at Salt Lake City, Utah, on Aug. 9, 1877. He studied with J. T. Harwood, Salt Lake City, at the Art Students' League, New York city, and in Paris. His works are characterized by simplicity, dignity and breadth of conception, united with exquisite workmanship. He is known chiefly through his statuettes, figures of labourers and cowboys, which exhibit close observation of nature and virile form. Among his best known works are "Man with Pick" in the Metropolitan Museum of Art; the Hopi and Apache groups in the Museum of Natural History, New York city; "A Labourer" and "The Rigger" in the free public library, Newark, N.J.; the "Sea-Gull" monument in Salt Lake City; "Rolling His Own" and "Monument to the Dead" (with Bertram Goodhue), in Paris.

YOUNG, OWEN D. (1874–), American lawyer and business man, was born at Van Hornesville, N.Y., on Oct. 27, 1874. He was educated at St. Lawrence university, N.Y. (A.B., 1894), and Boston university law school (LL.B., 1896). He commenced the practice of law in Boston (1896), being associated with and later a partner of Charles H. Tyler until 1912, when he retired in order to become general counsel for the General Electric company. In 1913 he was elected vice-president in charge of policy and in 1922 was elected chairman of the board of directors. He organized and became chairman of the board of the Radio Corporation of America. He was also a director of the Federal Reserve Bank of New York, General Motors corporation, the International General Electric company, and chairman of the American section of the international chamber of commerce.

Young was a member of President Wilson's second industrial conference, chairman of the committee on business cycles and unemployment appointed by President Harding, and chairman of the American group, international court of arbitration of trade disputes of the international chamber of commerce. In Dec. 1923, he accepted the invitation of the reparations commission to act as a member of the first committee of experts charged with the enquiry into the balancing of the German budget and the stabilizing of the German currency. Their ensuing report was accepted by the commission. Again by invitation Young became chairman of the second committee of experts which met in Paris in January 1929, to draw up a plan for the permanent settlement

of the reparations problem. This committee drafted the Young Plan (New Plan) which fixed the debt limit and term of years for payments, and established the Bank for International Settlements. The Young Plan went into effect May 17, 1930. During 1940–41 Young served as chairman of the advisory board for transportation study of the National Resources Planning board. (*See* also REPARATIONS.)

YOUNG, THOMAS (1773–1829), English man of science, belonged to a Quaker family of Milverton, Somerset, where he was born on June 13, 1773. At the age of fourteen he was acquainted with Latin, Greek, French, Italian, Hebrew, Arabic and Persian. He studied medicine in London, Edinburgh and Göttingen. In 1797 he entered Emmanuel College, Cambridge, and in 1799 he established himself as a physician in London. Appointed in 1801 professor of physics at the Royal Institution, in two years he delivered ninety-one lectures, which contain a remarkable number of anticipations of later theories. He resigned in 1803. In the previous year he was appointed foreign secretary of the Royal Society of which he had been elected a fellow in 1794. In 1816 he was secretary of a commission charged with ascertaining the length of the seconds pendulum, and in 1818 he became secretary to the Board of Longitude and superintendent of the National Almanac. He died in London on May 10, 1829.

Young is best known for his work in physical optics, as the author of a series of researches which did much to establish the undulatory theory of light, and as the discoverer of the principle of interference of light. (*See* LIGHT and INTERFEROMETER.) He gave the word "energy" its present scientific significance and gave his name to Young's modulus. In 1793 he explained the mode in which the eye accommodates itself to vision at different distances; in 1801 he described the defect known as astigmatism; and in his lectures he put forward the hypothesis, afterwards developed by H. von Helmholtz, that colour perception depends on the presence in the retina of three kinds of nerve fibres which respond respectively to red, green and violet light. In physiology he made an important contribution to haemadynamics in the Croonian lecture for 1808 on the "Functions of the Heart and Arteries." In another field of research, he was one of the first successful workers at the decipherment of Egyptian hieroglyphic inscriptions. Some of his conclusions appeared in the famous article on Egypt which he wrote in 1818 for the *Encyclopædia Britannica*.

His works were collected, with a *Life* by G. Peacock, in 1855.

YOUNGHUSBAND, SIR FRANCIS (EDWARD) (1863–1942), British soldier, explorer and author, was born at Murree, India, on May 31, 1863, and educated at Clifton and Sandhurst. He entered the army in 1882, and rose to the rank of lieutenant colonel in 1908. In 1886 he crossed the heart of central Asia, by crossing the Muztagh, the great mountain barrier between China and Kashmir. In 1890 he was transferred to the Indian political department, and in 1902 accompanied the British mission to Tibet, sent out to counteract the Russian influence on the dalai lama. The mission was ended by the treaty of Sept. 7, 1904, and Younghusband was made K.C.I.E. in the same year. His work during this period resulted in an extension of the Indian system of triangulation which finally determined the geographical position of Lhasa. He also proved that the Muztagh is the true water-divide west of the Tibetan plateau. Sir Francis returned to England in 1905 and was appointed Bede lecturer at Cambridge, but in 1906 he went to Kashmir as resident, remaining there until 1909. He travelled widely in India, Manchuria, China, Turkistan and South Africa. He was made K.C.S.I. in 1917. Sir Francis died July 31, 1942.

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YOUNG MEN'S CHRISTIAN ASSOCIATION, an organization for social and religious work among young men, founded in England in 1844 by George Williams (1821–1905). It grew out of meetings for prayer and Bible-reading which Williams held among his fellow-workers in a dry-goods business in the City of London. Similar associations had been founded earlier in Scotland. The distinctive feature of the movement was the combined interest in social and in religious welfare. It spread rapidly; branches were soon formed in France and Holland, and overseas in the United States, Canada, India and Australia. The first world conference was held in Paris in 1855.

The Y.M.C.A. expanded until, at the end of 1942, it was active in 56 countries, autonomously organized under the world committee at Geneva. There were more than 10,000 associations, employing almost 6,000 executive officers. The membership, according to the latest figures available in 1942, was 1,869,963, of whom 657,241 were boys. In the United States the Y.M.C.A. is usually regarded as a leading community institution, supported by citizens of all opinions. The value of its U.S. property and funds in 1942 was $259,740,300.

During World War II the Y.M.C.A.'s of most of the British empire and China were engaged in direct service among the fighting forces, but in the United States the association united with five other agencies under the United Service organizations in performing such service. Throughout the British empire, in China and in many neutral countries, the Y.M.C.A. in 1942 was conducting religious, educational and recreational programs among four to six million prisoners of war.

YOUNGSTOWN, a city of north-eastern Ohio, U.S.A., on the Mahoning river, about equally distant (65 m.) from Cleveland and Pittsburgh; the county seat of Mahoning county. It has a municipal airport; is served by the Baltimore and Ohio, the Erie, the New York Central, the Pennsylvania, the Pittsburgh and Lake Erie and the Lake Erie and Eastern railways, two industrial belt lines, inter-urban trolleys, motor-bus and truck lines; and is on the route of the proposed barge canal from Lake Erie to the Ohio river. Pop. (1920) 132,258 (26% foreign-born white); 1940 federal census 167,720.

The city occupies 34·5 sq.m., lying on both sides of the river, at an altitude of 858 ft. at the public square. It is on the watershed between Lake Erie and the Ohio river, and is surrounded by rolling hills. The adjacent country is a fine agricultural region, rich in mineral resources. Youngstown is the centre of the third largest iron and steel district of the country, producing $\frac{1}{6}$ of all the pig iron and $\frac{1}{8}$ of all the steel made in the United States, and using annually more than 8,500,000 tons of iron ore from the Lake Superior mines. Coal comes in over short hauls, and the limestone needed is quarried in the vicinity. The output of the city's industries is valued at more than $425,000,000 annually.

The public square (given in 1802 by the founder of the city) is still the centre of municipal life. Facing it, or near by, are several of the older churches, several banks, stores and office buildings, the Stambaugh memorial auditorium, the Reuben Mc Millan free library (named after the first superintendent of schools), and the beautiful Butler Art institute, of Georgia marble. The parks of the city cover 2,513 ac. The character of the chief occupations is reflected in the preponderance of men in the population (115 males to 100 females in 1920), the very small proportion of women employed (18·5% of all ten years of age and over) and the very small proportion of children 10 to 14 years of age working for wages (2·5% in 1920). The city's assessed valuation for 1940 was $267,000,000. Bank debits for 1940 aggregated $645,643,517.22.

Youngstown was named in honour of John Young (1763–1825) of New Hampshire, who in 1796 bought a tract of land in the Western Reserve, on which the city now stands, from the Connecticut Land Company. The first settlement was made in 1796 by William Hillman. A township government was organized in 1802, the town was incorporated in 1848 and in 1867 it was chartered as a city. In 1876 the county seat was moved from Canfield to Youngstown; in 1879, after litigation, the legality of the change was confirmed. Iron was mined in the vicinity in 1803 by Daniel Eaton, who in 1804 built the first blast furnace north of the Ohio and west of Pennsylvania and in 1826

the first one within the present limits of Youngstown. As late as 1860 the population of the city was only 2,759. By 1880 it had grown to 15,435 and by 1900 to 44,885. The 20th century has been the period of rapid development. Between 1900 and 1920 the population increased threefold, and the area was enlarged in about the same ratio.

YOUNG WOMENS CHRISTIAN ASSOCIATION, an organization founded in 1855 by two ladies simultaneously. In the south of England Miss Emma Robarts started a prayer union with a purely spiritual aim, and in London Lady Kinnaird commenced the practical work of opening homes and institutes for young women in business. In 1887 the two branches united in the Young Womens Christian association, which seeks to promote the all-round welfare of young women by means of residential and holiday homes, club and rest rooms, classes and lectures, and other useful departments. The association has spread all over the world, and the total membership is over half a million.

See article "Young Women's Christian Association," by Emily Kinnaird, in Hastings' *Encyclopaedia of Religion and Ethics,* vol. xii.

YPRES, JOHN DENTON PINKSTONE FRENCH, 1ST EARL OF (1852–1925), British soldier, was born at Ripple, Kent, on Sept. 28, 1852. The son of a naval officer, he entered the royal navy, in which he served as cadet and midshipman from 1866 to 1870. Joining the militia he passed from this into the army in 1874 and was gazetted to the 19th Hussars. He married Eleanora, daughter of R. W. Selby Lowndes in 1880. He served in the Nile expedition in 1884–5, and commanded his regiment from 1889 to 1893. After two years on the war office staff he commanded a cavalry brigade (1897–9), and on the mobilisation of the expeditionary force for S. Africa in 1899 he was chosen to command the Cavalry Division and was promoted major-general. Pending the assembly of this he served in Natal where he commanded the troops on the field at Elandslaagte and took part in the early combats near Ladysmith, but he proceeded to Cape Colony just before the place was invested. After a few weeks in charge of the force at Colesburg, he led the cavalry during Lord Roberts' advance from Cape Colony, relieved Kimberley, cut off the retreat of Cronje's army, and occupied Bloemfontein. During the subsequent advance into the Transvaal he was in command of the left wing, and at a later stage of the victorious campaign he played a prominent part in the move from Pretoria to Komati Poort. For these services he was given the K.C.B. During most of the second phase of the struggle he was in command of the forces operating against the enemy in Cape Colony, and he was on the conclusion of hostilities promoted lieutenant-general and was given the K.C.M.G.

He commanded at Aldershot from 1902 to 1907, in which year he was promoted general, and he then became inspector-general of the Forces for five years. He was appointed chief of the Imperial General Staff in 1912 and was promoted field-marshal in 1913. In April 1914 he vacated the post of C.I.G.S., owing to military troubles in Ireland in connection with Ulster, but four months later he was chosen to take charge of the Expeditionary Force on the outbreak of the World War, and he commanded the British Army on the Western Front from the outset of the struggle until the end of 1915. The terribly costly and somewhat fruitless advances of this year, culminating in Loos, provoked criticism at the time, and controversy has raged over French's share in them since. He certainly failed signally to harmonise with Kitchener at the War office. He resigned in December of that year, Sir D. Haig taking his place, and he returned to England, to be raised to the peerage as Viscount French of Ypres and High Lake. He then became commander-in-chief in the United Kingdom, and he held that appointment until May 1918, when he was selected to be lord lieutenant of Ireland. This position he occupied under most trying conditions until early in 1921. On resigning he was rewarded with an earldom. He died on May 22, 1925, at Deal Castle, Kent. At the end of the war, Lord French published his personal narrative under the title, *"1914."*

YPRES (Flemish *Yperen*), a town of Belgium in West Flanders, of which it was formerly considered the capital. Pop. (1939) 16,134. It is situated 35 mi. S. of Ostend and 12 mi. W. of Courtrai, on the Yperlée, a small river flowing into the Yser, both of which have been canalized. In the 14th century it ranked with Bruges and Ghent. Its fine Halles or cloth market, with a façade of over 150 yd., was begun in 1201, completed in 1304, and reduced to ruins in World War I. The cathedral of St. Martin dated from the 13th century, with a tower of the 15th century and was also ruined in 1914–18. Jansen, bishop of Ypres and the founder of the Jansenist school, is buried in the cathedral. For four war years (1914–18) the town was the centre of a salient of the British armies and was reduced to ruins, but was later largely rebuilt. The Menin Gate was built as a memorial to missing British soldiers. There are 40 cemeteries within two miles of Ypres.

YPRES, THE BATTLE OF, 1914, is the name given to the heavy but indecisive fighting near Ypres at the close of the "race to the sea" (Oct. 19 to Nov. 22, 1914). It is commonly spoken of as the First Battle of Ypres.

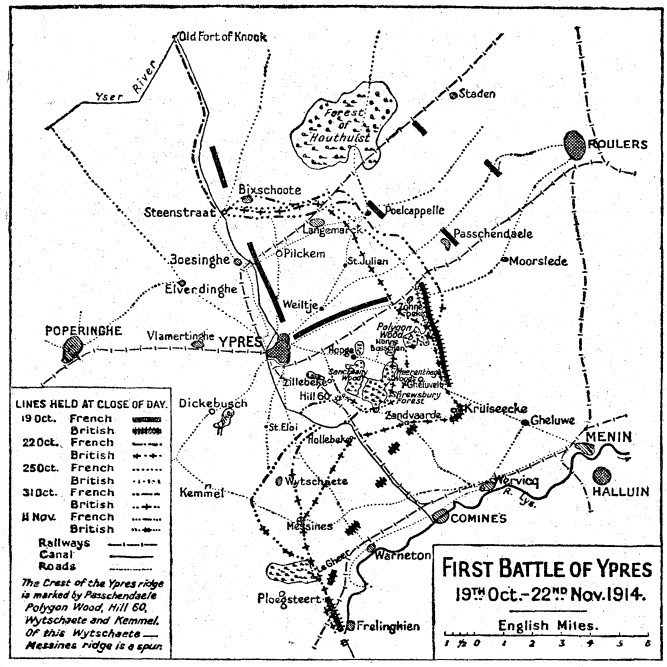
Genesis of the Battle.—When in Oct. 1914 the British Expeditionary Force under F.M. Sir John French left the Aisne front to be transferred to Flanders, its various corps, as they arrived in succession on the left of the Allied line, at once came into contact with the enemy, for each of the two belligerent forces was simultaneously extending its front northwards. Thus the II. Corps (Smith-Dorrien) on Oct. 10 began the "battle of La Bassée," and the III. Corps (Pulteney) and the Cavalry Corps (the 1st and 2nd Cavalry Divisions under Allenby), on Oct. 12–13, the battles of "Armentières" and "Messines." On Oct. 14–15 the IV. Corps (Rawlinson), the Belgian army and a French Marine brigade, falling back from Antwerp, and de Mitry's cavalry corps and two French Territorial divisions, coming up from the west between Ypres and the Belgians, completed the Allied line to the sea. Of this line, the British held the portion from the La Bassée canal to Langemarck, north of Ypres.

The co-ordination of the Allied operations in Flanders was placed by Gen. Joffre in the hands of Gen. Foch, and the general plan now adopted was for the British, supported by the French and Belgians, to advance from the neighbourhood of Ypres, break through the enemy's front, cut off any Germans between the gaps thus made and the sea, and then turn southward to roll up the German line.

The Opening of the Battle.—On Oct. 19, on the arrival behind Ypres of the I. Corps (Haig), Sir J. French sent forward Rawlinson's corps (consisting only of the 7th Division and the 3rd Cavalry Division) towards Menin, and directed Pulteney's and Allenby's corps to move down the Lys on both banks in the same direction. But on the day previous, the 18th, the enemy, with a general plan similar to that of the Allies, had also begun an advance, with a new IV. Army under Duke Albert of Württemberg, on a front from the Ypres-Gheluvelt (Menin) road to the sea. This army consisted of the new XXII., XXIII., XXVI. and XXVII. Reserve Corps composed of young volunteers with 25% of old soldiers and the III. Reserve Corps of three divisions which had besieged Antwerp. Thus, as the German VI. Army, under Crown Prince Rupprecht of Bavaria, south of the IV. Army, also attacked, battle was engaged on the 19th on the whole front from La Bassée to the sea. In the sector between the river Lys and the sea, the German XIX. Corps attacked the left wing of Wilson's division (4th) of Pulteney's corps; four German cavalry corps advanced against Allenby's two cavalry divisions; whilst of the 11 divisions of the German IV. Army, four were sent against Capper's division (7th) and Byng's cavalry division of Rawlinson's corps, two and one-half against the French north of Ypres, and four and one-half against the Belgians.

On Oct. 21, just as Haig's corps, which had been put in on the left of Rawlinson's, was making good progress towards Langemarck, the French on its left fell back before the enemy to the Ypres canal. Haig, with his flank thus exposed to the attack of the XXIII. Reserve Corps, whilst engaged with the XXVI. on his front, had to use his reserve to cover his left, and his advance, thus deprived of any fresh impetus, came to an end. Elsewhere, the British were opposed to at least double their numbers: Capper's division to the XXVII. Reserve Corps, the three British

cavalry divisions to eight German, and Wilson's division to the XIX. Corps. Nevertheless, they managed to hold their line unbroken on the 21st and 22nd. When on Oct. 23 the French IX. Corps (Gen. Dubois) reached Ypres and took over the Zonnebeke–Langemarck sector from Lomax's 1st Division of Haig's corps, a further slight advance was made; but the enemy was in superior numbers and had too much heavy artillery for any decisive success to be obtained. On the 24th Duke Albrecht equally abandoned any hope of a break-through until he could be reinforced; but desultory fighting continued, and on the 26th Capper's division lost the Kruiseecke salient, south-east of Gheluvelt. Meantime, the Belgians had been hard put to it and on Oct. 27 let in the sea at Nieuport to form an inundation in front of their line along the Yser.



The Second German Offensive.—On the same day, the 27th, Gen. von Falkenhayn, the chief of the German general staff, issued instructions for a new attack with increased forces. Six fresh divisions, brought from quiet parts of the line, to form under Gen. von Fabeck, the right of the VI. Army, were on the 30th to take the place of the four cavalry corps and attack Ypres from the south-east for the purpose of breaking through on the front Messines—Gheluvelt, which was held by two of the three cavalry divisions, now all united under Allenby's command, and Capper's division. At the same time, all the German troops north of the La Bassée canal were ordered to make a general attack. The addition of six divisions to the Ypres front gave, excluding cavalry, the Germans 15½ to the French and British six and one-half; but their artillery was even more overwhelming, for Fabeck, apart from what the other German commanders before Ypres possessed, was allotted over 250 heavy and super-heavy guns and howitzers, to which the Allies could only oppose 50, and of these more than half were of old and obsolete patterns.

There was some preliminary fighting on the 29th, when the British lost a little ground near Menin road. On this date, the eve of the second German offensive at Ypres, the line was held from the Lys to Zonnebeke by part of Wilson's division, the cavalry corps and the 7th, 1st and 2nd Divisions, all three since the 27th under Haig, who henceforward commanded in front of Ypres. Thence Dubois's IX. Corps and de Mitry's cavalry corps carried it on to the canal. The greater part of the Allied front maintained its ground on the 30th, but, under the heavy pressure of the six fresh German divisions, Allenby's cavalry divisions and Capper's division were forced back to the Messines-Wytschaete ridge, losing Zandvoorde and Hollebeke. Further danger in this sector was averted by Gen. Dubois, at Haig's request, sending his own reserve of four battalions and three batteries to the assistance of the British cavalry, and Gen. Haig himself despatching first two battalions and later three more, under Maj.-gen. E. Bulfin.

Gheluvelt, Oct. 31.—Matters, however, became more serious on the 31st, when, after a heavy bombardment, a convergent attack of five German divisions and three brigades on Haig's three divisions broke the line on a two battalion front at Gheluvelt, despite the desperate resistance of the 1st Battalion of the Queen's, which was annihilated. Elsewhere the front held, but at Messines part of the village was lost, and immediately south of the Menin road the line was pushed back. The situation was critical, and just at this time the staffs of Lomax's and Monro's divisions of Haig's corps were nearly all killed or disabled by a shell that struck Hooge Chateau.

A counter-attack ordered by Brig.-gen. H. Landon (3rd Brigade) drove back the Germans who had advanced from Gheluvelt along the Menin road; the village itself was recovered owing to the stout defence of the 1st South Wales Borderers north of the break, who held on to the park and chateau to the north of the village until a determined counter-attack of the 2nd Worcestershires initiated by Brig.-gen. C. Fitzclarence (1st Brigade) recaptured it; whilst south of the road a third counter-attack by the 2nd Royal Sussex, 1st Northamptonshire, and 2nd Gordon Highlanders, under the orders of Maj.-gen. E. Bulfin, regained all the ground that had been lost there, and more. At night, however, a retirement was made to a selected line east of Gheluvelt.

French Reinforcements.—On Nov. 1 the Germans continued to attack, and Messines was lost by Allenby's cavalry corps, but the French XVI. Corps (32nd, 39th and 43rd Divisions under Gen. Grossetti) arriving to relieve the cavalry, greatly strengthened the defence. Wytschaete and the rest of the ridge, however, were lost by the French next day. The Allied line was now held by the British and French alternately: from the Lys to opposite Messines by the British; thence as far as the Ypres-Comines railway by the French; thence along the front of Shrewsbury forest and Polygon wood to Zonnebeke by Haig's three divisions; and thence to the canal, by the French again; and this remained the distribution until the end of the battle. During Nov 3, 4 and 5 the German attacks somewhat died down; a composite division of Smith-Dorrien's II. Corps (under Maj.-gen. F. W. D. Wing) and the French 11th Division reinforced the Allies. But this assistance was counter-balanced by three out of five German divisions on the Belgian front being brought down against Ypres.

The Final German Effort.—The German supreme command now decided to attack the haunches of the Allied salient round Ypres from the north-east and south-east. Four more divisions, including a composite one of the Guard Corps, and the 4th (Pomeranian), one of the best in the whole army, were despatched to the sector with more heavy artillery. On the 4th, Crown Prince Rupprecht was given a definite order to break through south-east of Ypres, and whilst this offensive was in preparation to continue attacks all along the line, and the Duke of Württemberg was ordered to move against the north-east part of Ypres. During the 6th, 7th, 8th and 9th the Germans managed to make a little progress at several points; they gained Le Gheer on the edge of Ploegsteert wood, and Zwarteleen near Hill 60, barely 2m. from Ypres; but elsewhere they were repulsed with heavy loss, and Grossetti's corps recovered ground lost between Wytschaete and St. Eloi. On the 10th, after a long and desperate defence, Dixmude (13m. north of Ypres) was lost by the Belgians, and a very heavy attack was delivered against the French on the north-east and north of Ypres which gained a small amount of ground.

The Prussian Guard Attack on Nov. 11.—On Nov. 11 at 6:30 A.M., on a dark and misty morning, the German artillery opened a terrific fire, increasing in intensity as 9 A.M. approached, at which hour the German infantry, under cover of the mist, advanced to the assault on the Lys-Polygon wood front. The British were weary with three weeks' continuous fighting without reliefs, the French nearly as tired. But, in spite of the German numerical superiority—23 divisions to 9½, with cavalry in about the same proportion—the Allied line resisted the enemy's repeated assaults except at two places—just north of the Menin canal,

where a detachment of Dubois's IX. Corps was driven back, and just north of the Menin road. South of and across this road, where the German 4th Division and Winckler's Guard Division attacked, a front of about 2m., stood Wing's composite division of Smith-Dorrien's II. Corps, its battalions so weak that it was about the strength of a brigade, the 2nd K. O. Scottish Borderers on the right, then the 2nd R. Irish Rifles, 1st Gordon Highlanders, 1st Cheshire, 2nd Bedfordshire, 1st Lincolnshire, 1st Northumberland Fusiliers, 4th Royal Fusiliers, and 2nd Duke of Wellington's. North of the road was Fitzclarence's brigade of the 1st Division (the 1st Scots Guards, 2nd Cameron Highlanders and 1st Black Watch), 800 men in all, with the 1st King's of Monro's division in Polygon wood beyond them. By the mere weight of the advance of the German 2nd Guards Brigade (six battalions of the 1st and 3rd Foot Guards Regiments), the front and support lines of Fitzclarence's three Scots battalions were overwhelmed. The attack passed over them, but fire from the 1st King's in Polygon wood, from three strong points (small defended posts with all-round defence) which formed Fitzclarence's third line of defence, and from various battalion headquarters in farms put in a state of defence, then held the Germans up and took heavy toll of them. About 400 or 500, however, pressed on into the Nonne Bosschen (wood), only to be met by the point-blank fire of Haig's field artillery in action beyond it; and the rifle-fire of some artillery men and engineers, including cooks and grooms, hastily collected. The final discomfiture of the German Guards was completed by a counter-attack of the 2nd Oxfordshire and Buckinghamshire through the Nonne Bosschen.

The Close of the Battle.—On the next day, Nov. 12, the weather began to break and become wintry; nevertheless, on this and the following days the Germans made several further attacks against the French in the Wytschaete area and against Wing's division south of the Menin road. These did not alter the situation, and the fighting then died down, and both sides set about completing their defences. With the end of the First Battle of Ypres, on the 22nd, open warfare ceased, and the operations of siege warfare, so-called trench warfare, begun on the Aisne in September, prevailed along the whole western front.

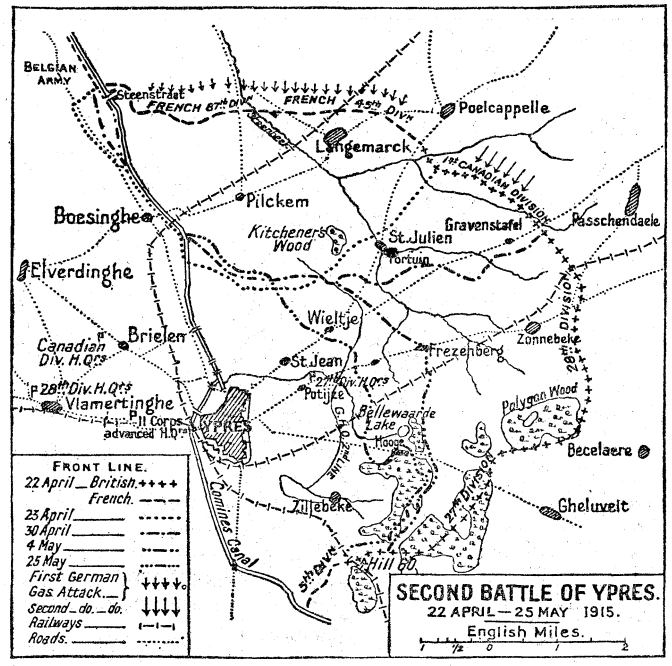
Opposed to more than double its own numbers, the British Expeditionary Force had held its own by sheer good shooting and superior training, and the skilful use by Gen. Sir Douglas Haig of his very small reserve. But such heavy losses had been incurred in the five weeks' battle and in the fighting at La Bassée and Armentières, which went on during the same period, that of the original British Expeditionary Force of fully trained officers and men very few remained, and for the future the empire was dependent on three divisions from overseas garrisons, on Territorial and New Army divisions, and dominion troops.

BIBLIOGRAPHY.—"Military Operations, France and Belgium, 1914," *History of the Great War*, vol. ii. (1925), where there is a bibl.; Gen. Dubois, *Deux Ans de Commandement sur le front de France* (1920); *Die Schlacht an der Yser und bei Ypern* (1917), issued by the German General Staff. (J. E. E.)

YPRES, THE BATTLES OF, 1915, commonly called the second battle of Ypres, comprise the period of severe fighting that took place in front of Ypres beginning on April 22 with the first gas attack and continuing to May 25, 1915. It resulted in heavy casualties and considerable loss of ground round the town of Ypres, the base of the Allied salient, measured along the Ypres canal, being reduced from 8m. to 5½m., and its maximum depth from 6m. to 2½ miles.

Phases of the Battle.—For the purposes of general description, the battle is best divided into five phases (*see* sketch map): (1) the first German attack on April 22 against the French, resulting in the loss of the Pilckem area; (2) the second attack on April 24 against the Canadian Division, resulting in the loss of the St. Julien-Gravenstafel area; (3) the fruitless British counter-attacks; (4) the British withdrawal to the Frezenberg line, abandoning the Zonnebeke area; and (5) the renewed German attacks (Frezenberg-Bellewaarde), resulting in further loss by the British of a narrow belt of ground.

The Situation Before the Battle.—During the winter of 1914–15 the German Supreme Command had decided to carry out an offensive against Russia in 1915, and to stand on the defensive in the western theatre, leaving only sufficient troops there to hold the line. No general attack at Ypres was contemplated. It was, however, desired to try a new weapon, gas, thoroughly in the field, and the Ypres front was selected for the purpose on the advice of the German meteorological experts. Duke Albrecht of Württemberg commanding the IV. Army, which held



the sector from the Comines-Ypres canal to the coast, proposed to turn the use of gas to local advantage, to improve his position. If he could obliterate the Ypres salient and drive the Allies beyond the canal, he would deprive them of a bridgehead which gave them facilities for attack. The duke's forces consisted of the XV. Corps, the four new Reserve Corps, XXVII., XXVI., XXIII. and XXII., and two *Ersatz* and two *Landwehr* brigades which had fought at the first battle of Ypres. The Marine Division guarded the Belgian coast.

The Allied line from the Comines canal northward was held by part of the 5th Division (Morland), as far as Hill 60; the 27th Division (Snow); the 28th Division (Bulfin); and the 1st Canadian Division (Alderson). The last three formed the II. Corps (Plumer) of the II. Army (Smith-Dorrien). The 27th and 28th Divisions had been formed of troops from Indian and overseas garrisons, but, having suffered heavily from the winter conditions in Flanders, contained in April a considerable proportion of partially trained reinforcements. The Canadian Division had reached England in Oct. 1914, and had embarked for France in Feb. 1915. After being in the line at Neuve Chapelle, it had, between April 15 and 17, relieved French troops covering Ypres. The front defences taken over by the II. Corps were poor, but there was a well-developed back line known as "the G.H.Q. Line." The left of the Canadians extended as far as the Ypres—St. Julien—Poelcappelle road, beyond which were two French divisions under Gen. Putz: the 45th Division, which had arrived on April 16, containing nine newly raised Zouave battalions and three battalions of African natives, these latter being in the line; and the 87th Territorial Division, a division of elderly reservists.

The First Gas Attack.—On April 22, after an afternoon of comparative quiet, suddenly at 5 P.M. a yellowish cloud—now known to have proceeded from chlorine gas released from cylinders in the trenches—was seen to form on the German front opposite the African troops and French Territorials. It blew slowly towards them, whilst the German artillery opened with every kind of gun, firing on the French troops with shrapnel and bombarding all the villages in the salient and the town of Ypres with high-explosive shell. The French infantry in the line fled beyond the canal, leaving their artillery to be captured, abandon-

ing a large area of ground and entirely exposing the British left flank (*see* sketch map). Fortunately for the Allies, the enemy had begun his attack so late in the afternoon that in the dusk he did not discover his immense success. Content with having secured Pilckem ridge and establishing outposts beyond it, about 7.30 P.M., according to plan, as it is asserted, but more probably in consequence of the stout defence put up by various small Canadian detachments, the Germans ceased any attempt to push into the gap, except at Steenstraat.

Gen. Plumer and his divisional commanders hurried what available troops they had to cover the gap, and when Gen. Putz in the course of the evening informed Gen. Smith-Dorrien that he meant to counter-attack at 4.30 A.M., and requested that the British should assist, arrangements were made to co-operate. But no movement of the French took place, nor were they in the succeeding days able to make any serious effort to recover the ground they had lost on the eastern bank of the canal.

Several counter-attacks were made by the British on April 23 to regain the ground lost by the French. They were carried out by the Canadians, the 13th Infantry Brigade, and Geddes's detachment—a temporary formation composed of six battalions of the 27th and 28th Divisions—without avail. The forces were too small, and there was not sufficient artillery or ammunition to support them. The Germans did no more than repel the counter-attacks on the 23rd, but from the 24th onward proceeded to follow two objectives: first to roll up the flank of the British line, aiming to get behind the troops still in position; secondly, to increase their gains across the canal near Steenstraat and separate the Belgians from the French and British. By the division of their forces, they failed to achieve either purpose.

The Second Gas Attack.—On April 24, at 4 A.M., the enemy released gas against the front of the 2nd and 3rd Canadian Brigades. In spite of having only extemporized means of protection (handkerchiefs, linen bandoliers, etc., dipped in water), they held fast for a time, but the enemy, after breaking in at one place, enlarged his gains, and the 3rd Canadian Brigade was gradually forced back, involving in the retirement through St. Julien the troops on the new left flank that had been built up. Gen. Snow, the only divisional general who had his headquarters east of the canal, at Potijze, took charge of the defence, and such reserves as could be hurried up were eventually placed by Gen. Plumer under his command, as communication across the canal between the headquarters of the other commanders and their troops was constantly interrupted. Although the Germans were driven out of St. Julien by a counter-attack of two battalions of the York and Durham Infantry Brigade of the Northumbrian (Territorial) Division, another large piece of the salient was lost, and after further German attacks on the 25th, Gravenstavel was abandoned, and the British line ran from the original left of the 28th Division past St. Julien, almost due west to the canal.

The British Counter-Attacks.—Counter-attack after counter-attack was now made by fresh troops hurried up to Ypres, the 11th Infantry Brigade (4th Division), the Lahore Division and the Northumberland Infantry Brigade (Northumbrian Division) with assistance on the left from the French. All were without success; they found the enemy well entrenched, and their only result was heavy casualties. In the operations of April 26, when some of the French 45th Division co-operated on the left of the Lahore Division, the Germans opened a few gas cylinders in defence, and broke the attack; whilst on the 27th gas shelling alarmed the African natives and caused them a second time to retreat in panic.

The position of the British troops in the narrow salient, projecting 6m. in front of Ypres and only some 3m. across was obviously untenable, as it was surrounded on three sides by the enemy and subject to constant bombardment. Gen. Smith-Dorrien proposed to withdraw to a line nearer Ypres. In consequence, however, of Gen. Foch's protests and promises that the French would regain the ground they had lost, and of the political desirability of not abandoning any more Belgian territory if it could be avoided, Sir John French agreed to leave his troops in their exposed position for some days longer. Gen. Joffre, having in preparation his great offensive which was to begin on May 9, near Arras, was not disposed to allow Gen. Foch to employ any more troops near Ypres; and the French attacks languished.

The Withdrawal from the Apex of the Salient.—When on May 1 the French infantry in a projected attack failed to leave their trenches, all hope of their recovering ground came to an end, and Sir John French directed Gen. Plumer, who by his orders was now in special charge of the operations near Ypres, to begin the retirement to the Frezenberg line, abandoning a zone some 2m. deep. This retirement was carried out with complete success by the infantry brigades of the 27th, 28th and 4th (which had replaced the Canadian) Divisions in the line on the nights of May 1–2, 2–3, and 3–4. The French now held the 1½m. of the left of the new semicircle round Ypres.

The Renewed German Attacks.—All hope of obtaining victory by gas attacks having disappeared, as the Allies were prepared for them, the Germans now tried by sheer weight of artillery to drive the British off their new position. After finally getting possession of Hill 60 on May 5–6, they made carefully prepared attacks on May 8 and on May 24. In spite of splendid defence and desperate British counter-attacks, in which the 4th, 27th, 28th, and Northumbrian Divisions and the Cavalry Corps troops were engaged, the enemy, dominating the situation with heavy artillery, gained a small amount of ground. Meanwhile, on the night of May 15–16, he had been compelled by the French to abandon his position on the western bank of the canal. On May 25, after the II. Corps had established itself on a strong line, the Germans brought the battle to a close.

The total British losses in the Ypres and Hill 60 fighting were 2,150 officers and 57,125 other ranks, the total killed being 10,519. The German losses on the Allied front were returned at 860 officers and 34,073 other ranks.

See "Military Operations, France and Belgium, 1915," *History of the Great War based on Official Documents,* vol. i., with a bibliography (1927); Palat, *Grande Guerre sur le front Occidental,* vol. ix. (1922); M. Schwarte, *Der deutsche Landkrieg,* vol. ii. (1923). The French and German official accounts are not yet available, but official information furnished in advance is included in the British account. (J. E. E.)

YPRES, BATTLES OF 1917. Almost continuous fighting took place in the Ypres-Yser region during many weeks in the summer and autumn of 1917, but the operations as a whole may be said to have consisted of two distinct phases. First came the brilliantly successful combat, lasting a few hours, which has come to be known as the battle of Messines. Then, after a lull, there came to be launched immediately north of the scene of the Messines victory a series of attacks at short intervals which lasted four months. This was not a battle, but rather a campaign, with the fighting more defined than the purpose—of the nature familiar in the military annals of Flanders and the Low Countries generally. Like its German forerunners of 1914 and 1915, it achieved little except loss—in which, again, it repeated the earlier history of this theatre of war. So fruitless in its results, so depressing in its direction was this 1917 offensive, that "Passchendaele" has come to be, like Walcheren a century before, a name of ill-omen and a synonym for military barrenness.

An offensive in this sector had formed part of Haig's original contribution to the Allied plan for 1917. Its actual inauguration had been postponed by the unfortunate turn of events elsewhere. When the ill-success of the opening offensive in the spring at Arras (*q.v.*) and in Champagne (*q.v.*) was followed by the threatened collapse of the French army as a fighting force, Haig's "first-aid" treatment was to allow the British offensive at Arras by the III. Army to continue for some weeks longer, with the general object of keeping the Germans occupied, and with the local object of reaching a good defensive line. When successive thrusts, against an enemy now fully warned and strengthened, failed to reach this line, Haig decided to transfer the main weight of this effort northward to Flanders, as he had originally intended. His loyalty to his Allies and his acute sense of the common interest, inspired him to press on with an offensive policy.

It is right to emphasise that in May Haig's opinion of the policy to pursue was reinforced by the Prime Minister, Lloyd George, who, having committed himself to the Nivelle gamble for victory.

was equally ardent to continue the offensive. It is true, however, that on cooler reflection he subsequently tried in vain to check the policy which he had countenanced.

British Objectives.—The aim was the occupation of the whole of the belt of high ground which extends from a point about three miles north of Armentières, to near Dixmude. It rises some 100 to 150 ft. above the great Flanders plain, and reaches a height of over 200 ft. at some points. In the spring of 1917 its southern portion enclosed to a great extent the Ypres salient, although the Allies' trenches gave them possession of the lower slopes of their side of the high ground. Farther to the north the enemy held the whole of the high ground. The general plan of operations was to begin at the southern end and to work thence northwards. The capture of the high ground was to be followed by an advance in the coast district. But the axis of the attack diverged from, instead of converging on, the German main communications, so that an advance could not vitally endanger the security of the enemy's position in France.

But, worse still, the Ypres offensive was doomed before it began—by its own destruction of the intricate drainage system in this part of Flanders. The High Command had persevered for over two years with the method of a prolonged preparatory bombardment, believing that quantity of shells was the key to success. The offensive at Ypres, which was finally submerged in the swamps of Passchendaele in October, threw into stronger relief than ever before the fact that such a bombardment blocked the advance for which it was intended to pave the way—because it made the ground impassable.

THE BATTLE OF MESSINES

The preliminary move is known as the Battle of Messines, and its purpose was to gain the high ground about Messines and Wytschaete as a flank bastion for the subsequent advance from Ypres. For while in German possession it gave the enemy complete observation of the British trenches and forward battery positions, enabled them to command the British communications up to the Ypres salient, and to take in enfilade, or even in reverse, the trench positions therein. General Plumer and his II. Army, who had been acting as wardens of the Ypres front for two years, had been selected to carry out this operation, while the V. Army under General Gough had been transferred from the Somme to hold the line north of the II. Army. Preparations for the undertaking had begun nearly a year before although their real development dated from the winter. Thus when Haig asked Plumer, on May 7, when he would be ready to deliver the attack Plumer was able to say, "a month from to-day," and to keep his promise.

Messines was to be a strict siege operation, the capture of a fortified salient at the minimum cost of lives by the maximum substitution of mind (care in preparation) and material for manpower. Mines, artillery, gas and tanks all contributed. But a contrary wind curtailed most of the scheme of gas projection, and the effect of the mines and artillery was so overwhelming that the tanks were hardly needed. On the centre corps front alone, of about three miles, a total of 718 guns and howitzers, 192 trench mortars, and 198 machine-guns was concentrated.

For the defence of this salient the Germans depended on two separate trench systems coinciding in trace with its arc, the more advanced one pushed down the forward slope of the high ground while the rear one followed its crest; they had also constructed two chord positions, stretching along the base of the salient on the reverse slope. The troops of the II. Army detailed for the enterprise were, from right to left, the II. Anzac Corps, with the Australian 4th Division in support, the IX. Corps with the 11th Division in support, and the X. Corps with the 24th Division in support. There were thus nine divisions in front line and three in support. The fact that the attack would converge against a salient increased its chances, but it complicated the staff, troop, and artillery organization of the attack. For the sectors of each attacking corps were of varying depths, and contracted more and more in width up to the final objective which was the chord of the arc forming the salient. As, however, it was a siege operation, without any attempt at exploitation or a break-through, it was easier to avoid the congestion which had occurred at Arras (*q.v.*). The problem was further simplified by the plan of allotting sectors so that five of the divisions had sectors of equal breadth from front to rear, while the four which filled the interstices had smaller tasks. Further, when the main ridge was captured, fresh troops were to "leap-frog" through to gain the final Oosttaverne line across the base of the salient. The first bombardment and "wire-cutting" began on May 21, were developed on May 28 and culminated in a seven days' intense bombardment, mingled with practice barrages to test the arrangements. The loss of surprise did not matter at Messines as it was a purely "limited" attack.

At 3.10 A.M. on June 7 the nineteen mines—one only had previously been blown by the enemy—were exploded, wrecking large portions of the Germans' front trenches. Simultaneously the barrage fell. When the débris and shock of the mines subsided, the infantry advanced and within a few minutes the whole of the enemy's front line system was overrun, almost without opposition. Resistance stiffened as the penetration was deepened, but the training of the infantry and the efficiency of the barrage enabled continuous progress to be made, and within three hours the whole crest of the ridge was secured.

The New Zealand Division had cleared the intricate fortifications of Messines itself—here the pace of the barrage was regulated to 100 yards in fifteen minutes instead of the general pace of 100 yards in three minutes. The garrisons of Wytschaete and the White Chateau held out for a time, but the first village was captured after a fierce struggle by troops of the 36th (Ulster) and 16th (Irish) Divisions in a combined effort—a feat of symbolical significance. Perhaps the most difficult sector was that of the 47th (London) Division, which had not only to overcome the highly fortified position of the White Chateau but had the Ypres-Comines canal as an oblique interruption across its line of advance. The Londoners, however, overcame both and by 10 A.M. the objective of the first phase was reached along the whole attacking line. While it was being consolidated, over forty batteries were moved forward to support the next pounce.

At 3.10 P.M. the reserve divisions and tanks "leap-frogged" through and within an hour almost the whole of the final objective was captured. Some 7,000 prisoners had been taken, apart from dead and wounded. The success had been so complete that only feeble counter-attacks were attempted that day. When the expected general counter-attack was launched on the whole front on the morrow, it failed everywhere against defences that had been rapidly and firmly organized, and in the recoil yielded the British still more ground.

THE MAIN OFFENSIVE

A long pause now occurred while preparations for carrying out the rest of Haig's programme were being completed. Although Plumer's victory of June 7 had put an end to the enemy overlooking Ypres from the south, the Germans still, in a measure, dominated the place from the east, from the north-east and from the north. Thus the preparations could not be concealed and the Germans knew that they were being made. The plan at the outset was that, while the II. Army stood fast, the V. Army under Gough on its left with the French I. Army still further to the left, should attack the enemy front from near Hooge to north of Steenstraat on the Yser canal.

Nearly two months passed before the preparations for the main advance were completed. This gave the Germans, amply warned, time to make counter-preparations of characteristic thoroughness and ingenuity. Having learnt by experience that a continuous system of trenches did not offer a satisfactory form of defence unless there was abundant underground cover, and realizing that the waterlogged soil of Flanders handicapped the creation of subterranean galleries, they had established a system of numerous disconnected trenches and strong points, arranged in depth rather than in breadth, together with numbers of concrete blockhouses armed with machine-guns. As their front line near Ypres had been in existence since 1915, they trusted to the old system to meet the first shock of attack, and it was rather in the

later offensive operations that the Allies found themselves confronted with these new defensive devices. A further new asset was the introduction of mustard gas which the Germans used to cause serious interference with the attackers' artillery.

On July 22 the bombardment opened, by 2,300 guns, to continue for ten days, until on July 31 the infantry advanced on a fifteen-mile front to the accompaniment of torrential rain. On the left substantial progress was made, Bixschoote, St. Julien, and the Pilckem Ridge being gained, and the line of the Steenbeke reached. But in the more vital sector round the Menin road the attack was repulsed.

The second blow, on Aug. 16, was a diminished replica of the first in its results. The left wing was again advanced across the shallow depression formed by the little valley of the Steenbeke and past the ruins of what had been Langemarck. But on the right, where alone an advance might have a strategic effect, a heavy price was paid for nought, and even the tally of prisoners shrank to a mere two thousand. Nor did men feel that the enemy's skilful resistance and the mud were the sole explanation of their fruitless sacrifice. Severe complaints against the direction and staff work were general, and their justness seemed to receive recognition when Haig extended the II. Army's front northward to include the Menin road sector, and thereby entrusted to Plumer the direction of the main advance towards the ridge east of Ypres.

It was a thankless task at the best, for the experience of war attested the futility of pressing on in places where failure had already become established, and it seemed heavy odds that the laurels earned by Messines must become submerged in the swamps beyond Ypres. Yet, in the outcome, the reputation of Plumer and the II. Army staff, headed by Harington, was enhanced—less because of what was achieved in scale than because so much more was achieved than could reasonably have been expected.

Bad weather and the need for preparation delayed the resumption of the offensive until Sept. 20, but that morning the II. Army attack, on a four-mile front, achieved success in the area of previous failure—on either side of the Menin Road. Fractions of six divisions, the 19th, 39th, 41st, 23rd, 1st and 2nd Australian advanced at 5.40 A.M.; by 6.15 A.M. the first objective was gained almost unopposed, and, with the exception of one or two strong points, the third and last objective was gained soon after midday, and the counter-attacks were repulsed by fire. A fresh spring on Sept. 26, and another on Oct. 4—the last a larger one on a six-mile front, by troops of the 37th, 5th, 21st, and 7th Divisions, the 1st, 2nd, and 3rd Australian Divisions, and the New Zealand Division—gained possession of the main ridge east of Ypres, with Gheluvelt, Polygon Wood, and Broodseinde, despite torrents of rain, which made the battlefield a worse morass than ever. On each occasion the majority of the counter-attacks had broken down under the British fire, a result which owed much to the good observation work of the Royal Flying Corps and the quick response of the artillery. Some 10,000 prisoners were swallowed in the three bites, and this frightened the enemy into modifying his elastic tactics and strengthening his forward troops—to their increased loss.

As a result of the operations begun on June 7 the crest of the long belt of high ground overlooking the Flanders plain had now, after four months of intermittent fighting, been secured from Messines northwards to within a few hundred yards of the Ypres-Roulers railway. And yet, regarding this Flanders offensive as a whole, the work was in reality only begun. The Houthulst forest, with the long line of high ground forming the quadrant of a circle beyond it, was still in the enemy's hands. Until the ridge had been secured to the vicinity of Staden it would be premature to embark upon the second part of the general scheme of operations—an attack on the German positions along the coast between Nieuport and Ostend, for which the IV. Army under General Rawlinson had been assembled on the extreme left.

Unhappily, the Higher Command decided to continue the pointless offensive during the few remaining weeks before the winter, and thereby used up reserves which might have saved the belated experiment of Cambrai (*q.v.*) from bankruptcy. Having wasted the summer and strength in the mud, where tanks foundered and infantry floundered, they turned in November to dry ground—where a decisive success went begging for lack of reserves.

At Ypres minor attacks on Oct. 9 and 12 advanced the line a trifle, and then, after an interval, a combined attack by the V. Army and the French was tried, with small result, on Oct. 22. On Oct. 26 the II. Army, in torrents of rain, as usual, made a fresh effort, which was less successful than before, owing to the exhaustion caused by pushing forward over a morass and to the fact that the mud not only got into and jammed rifles and machine-guns but nullified the effect of the shell-bursts. The trials of the attackers were augmented by the enemy's increasing use of mustard gas, and by his renewed adoption of his tactics of holding the bulk of his troops well back for counter-attack. Thus when, on Nov. 4, a sudden advance by the 1st Division and 2nd Canadian Division gained the empty satisfaction of occupying the site of Passchendaele village, the curtain was at last rung down on the pitiful tragedy of "Third Ypres." It was the long-overdue close of a campaign which had brought the British armies to the verge of exhaustion, one in which had been enacted the most doleful scenes in their history, and for which the only justification evoked the reply that, in order to absorb the enemy's attention and forces the Higher Command had chosen the spot most difficult for the defender and least vital for the attacker.

(B. H. L. H.)

YPSILANTI or HYPSILANTI, the name of a family of Phanariot Greeks claiming descent from the Comneni. ALEXANDER YPSILANTI (1725–1805) was dragoman of the Porte, and from 1774 to 1782 hospodar of Wallachia. He was again appointed hospodar just before the outbreak of the war with Austria and Russia in 1790. He allowed himself to be taken prisoner by the Austrians, and was interned at Brünn till 1792. Returning to Constantinople, he fell under the suspicion of the sultan and was executed in 1805. His son CONSTANTINE (d. 1816), who had joined in a conspiracy to liberate Greece and, on its discovery, fled to Vienna, had been pardoned by the sultan and in 1799 appointed by him hospodar of Moldavia. Deposed in 1805, he escaped to St. Petersburg, and in 1806, at the head of some 20,000 Russians, returned to Bucharest, where he set to work on a fresh attempt to liberate Greece. His plans were ruined by the peace of Tilsit; he retired to Russia, and died at Kiev. He left five sons, of whom two played a conspicuous part in the Greek war of independence.

ALEXANDER YPSILANTI (1792–1828), eldest son of Constantine Ypsilanti, accompanied his father in 1805 to St. Petersburg, and in 1809 received a commission in the Imperial Guard. He fought with distinction in 1812 and 1813, losing an arm at the battle of Dresden. He was one of Alexander's adjutants at the congress of Vienna. In 1820, on the refusal of Capo d'Istria to accept the post of president of the Greek *Hetairia Philike,* Ypsilanti was elected, and in 1821 he placed himself at the head of the insurrection against the Turks in the Danubian principalities. With other Greek officers in the Russian service he crossed the Pruth on March 6, announcing that he had the support of a "great power." There followed a series of humiliating defeats, culminating in that of Dragashan on June 19. Eventually he crossed the frontier into Austria in the hope of finding an asylum. He was immediately thrown into prison, where he remained for seven years. He died at Vienna on Jan. 31, 1828.

DEMETRIOS YPSILANTI (1793–1832), second son of Prince Constantine, fought as a Russian officer in the campaign of 1814, and in the spring of 1821 went to Morea, where the war of Greek independence had just broken out. In January 1822 he was elected president of the legislative assembly; but retired early in 1823. In 1828 he was appointed by Capo d'Istria commander of the troops in East Hellas. He succeeded, on Sept. 25, 1829, in forcing the Turkish commander Aslan Bey to capitulate at the Pass of Petra, which ended the active operations of the war. He died at Vienna on Jan. 3, 1832.

See the works cited in the bibliography of the article GREEK INDEPENDENCE, WAR OF, especially the *Δοκίμιονἱστορικὸν* of J. Philemon.

YPSILANTI (ĭp-sĭ-lăn'tĭ), a city of Washtenaw county, Michigan, U.S.A., on the Huron river, 713 ft. above sea-level,

30 mi. W. by S. of Detroit. It is on federal highway 112 and state highway 17 and is served by the New York Central railway and numerous truck and bus lines. The population was 7,413 in 1920 (83% native white) and was 12,121 in 1940 by the federal census. It is the seat of Michigan State Normal college (1849) and Cleary college (1883) with combined enrolment of 2,300. The city's assessed valuation for 1940 was $10,349,550 and the output of its 21 diversified manufacturing plants was valued at $4,140,000. Ypsilanti was laid out in 1823 and named after the Greek patriot. It was incorporated in 1832 and chartered as a city in 1858.

YPURINAN, a small group of tribes of South American Indians, forming an independent linguistic stock. The Ypurinas (Hypurinas) live in western Brazil, on the upper Purus and Acre rivers. They are forest rather than river Indians.

See W. Chandless, "Notes on the Tapajos, Purus and Aquiry" (*J. Roy. Geog. Soc.* vol. xxxvi., xxxix.); J. B. Steere, "Narrative of a visit to Indian Tribes of the Purus River, Brazil" (*U.S. Nat. Museum, Rep.* 1901).

YSAŸE, EUGÈNE (1858–1931), Belgian violinist, was born at Liége in 1858, where he studied with his father and under R. Massart, at the Conservatoire, until he was fifteen; he had some lessons from Wieniawski, and later from Vieuxtemps. In 1879 Ysaÿe played in Germany, and next year acted as leader of Bilse's orchestra in Berlin; he appeared in Paris in 1883, and for the first time in London at a Philharmonic concert in 1889. He was violin professor at the Brussels Conservatoire from 1886 to 1898, and instituted the celebrated orchestral concerts of which he was manager and conductor. Ysaÿe first appeared as conductor before a London audience in 1900, and in 1907 conducted *Fidelio* at Covent Garden. The sonata concerts in which he played with Raoul Pugno (b. 1852), the French pianist, became very popular in Paris and Brussels, and were notable features of several London concert seasons. As a violinist he ranks with the finest masters of the instrument, with extraordinary temperamental power as an interpreter. During the war he went to America, and for some time conducted the Cincinnati orchestra. He has received many orders and decorations, including the Legion of Honour. His compositions include *Poème élégiaque* for violin and orchestra and other pieces for violin, violoncello, etc. Ysaÿe died May 12, 1931. His brother THÉOPHILE YSAŸE (1865–1918), pianist and composer, was born at Verviers in 1865. He studied at Liége and in Berlin, and finally in Paris under César Franck.

YSER, a small coastal river, 78 km. long, of which 50 km. are in Belgian territory. It is famous as marking the point, in the World War (1914–18), at which the German advance towards Calais and the English coast was checked. On Oct. 10, 1914, the Belgian army, after being forced to evacuate Antwerp and Ghent, retreated on the Yser; on the 16th the battle of the Yser began, and the Allied troops fought desperately for 15 days. Eventually, assisted by the floods which, beginning on Oct. 29, reached Dixmude by Nov. 2, the allies succeeded in establishing themselves in an impregnable position on the left bank of the Yser.

YSER, BATTLE OF THE. On Oct. 10, 1914, the Belgian field army encamped on the west bank of the Ghent-Terneuzen canal (*see* ANTWERP, SIEGE OF). The British Naval Division, which had embarked at St. Gilles-Waes, regained Dunkirk except two battalions, which were cut off, and passed into Holland; the French Fusilier Marine Brigade, half of the British 7th Division and the 4th Belgian Brigade were holding Ghent and had repulsed an attack on that city by the 1st Res. Ersatz Brigade. Information had been received that a Bavarian cavalry division had advanced towards Deynze exploring between the Schelde and the Lys; that a column of 20,000 men had passed through Courtrai and Menin and that the German IV. Cavalry Corps was holding the region Tourcoing-Ypres-Poperinghe. The only way for the Belgian army to baffle the threat of envelopment on a large scale was an immediate march to the coast. It was decided to transport all the forces without delay to the region of Ostend-Thourout-Dixmude-Furnes, the infantry by rail, the artillery and transport by road, under the protection of all the cavalry and Rawlinson's Corps.

Plans of Opposing Commanders.—The "race to the sea" had in the meantime caused the Western Front to extend to La Bassée. The British army had been withdrawn from the region of the Aisne and was beginning to detrain west of Lille. A few French divisions, taken from other sectors, were given the same destination. It seemed to Gen. Joffre that the moment had come for bringing about the much-desired envelopment of the German right wing by a concentric offensive against Lille. The British army, the Belgian army and some French reinforcements would constitute, it was believed, under the high command of Gen. Foch, an *ensemble* capable of securing a decisive victory. Unfortunately, the assembling of the Allied troops by means of the Paris-Calais and Paris-Hazebrouck railways would take time. On the other hand, it was necessary to take in account that the Beseler Army Group would not fail to follow the Belgians.

The mission of the Belgian army was once again that of gaining time. The king, anxious to keep his left wing resting on the sea, and to preserve at all costs a fragment of national territory from invasion, thought best to entrench the army on the river Yser and the Ypres canal.

Events soon proved the wisdom of this decision. The British II. and III. and Cavalry Corps were stopped at the Lys by the German IV., VII. and XIII. Corps; Rawlinson's Corps found Menin in the hands of the XIX. Corps. Beseler's troops now entered Bruges and Ostend. It was known that numerous detrainments were taking place west of Brussels and that a new German IV. Army had installed its headquarters at Ghent. In fact Falkenhayn, the new chief of the German general staff, had anticipated the Allies' projects and like them, considered the moment for a decisive victory to have arrived.

With four new army corps, composed mainly of volunteers, the XXII., XXIII., XXVI. and XXVII. Res. Corps, Beseler's group and the artillery park from the siege of Antwerp, Prince Albert of Württemberg was charged to proceed to the Yser with his right resting on the sea, in order to attack in flank and in rear the Allied left, whose front the VI. Army was engaging between Arras and Armentières. Falkenhayn considered that: "The conquest of the coast was the sole means of frustrating the war of blockade which England contemplated and of retaliating through our destroyers, submarines, aeroplanes and Zepplins. . . . If we succeeded in driving the enemy out of the Yser valley and pursuing him at the point of the sword, there was no doubt that, having replenished our ranks and our stores, we should be in a condition to overthrow the western front."

Thus the Belgian army, which had only just moved into position in the general Allied line, found itself in focus for a new battle. It occupied a front of 40 km., from the sea to Boesinghe, with $4\frac{1}{2}$ divisions and $1\frac{1}{2}$ divisions in reserve behind the centre. The cavalry division was operating with de Mitry's French Cavalry Corps, east of the forest of Houthulst. On the army's right a French territorial division extended as far as Ypres and Rawlinson's Corps had entrenched itself along the line Passchendaele-Gheluvelt.

Opening of the Battle.—The battle commenced on the 18th with an attack by Beseler's corps (4th Ersatz and 5th and 6th Reserve Divisions) between the sea and Keyem. The Belgian outposts were only driven back after desperate fighting and the enemy did not even reach the Yser. On the morning of the 19th Ronarch's Marine Brigade and the 5th Division debouched from Dixmude on the flank of the III. Res. Corps. Beerst and Vladsloo were retaken; but the intervention of the XXII. Corps, coming from Thourout, and the XXIII. coming from Cortemarck, foiled the counter-attack. By the 20th the fighting had become general all the way from the sea to Gheluvelt between the Duke of Württemberg's $5\frac{1}{2}$ divisions on the one hand and the Belgian army, de Mitry's Cavalry Corps and Rawlinson's Corps on the other. After 48 hours of obstinate fighting the Belgian positions remained practically unchanged.

The attack of the 4th Ersatz Division on Nieuport had failed, partly on account of the flanking fire from Admiral Hood's flotilla; while that of the XXII. Corps against the bridgehead at Dixmude had been checked by Meiser's Brigade. But in the night

of the 21st–22nd the 6th Reserve Division made a surprise crossing of the Yser in the Tervaete salient and threw over 2½ battalions to the west bank. Concentrated artillery fire prevented the division from making any progress on the 22nd, but a gallant counter-attack, in which four battalions of grenadiers and carabineers faced death with superb indifference, broke down completely under their machine-gun fire, owing to the exposed nature of the ground. The following night the Germans passed a second regiment into the bend without, however, extending their ground.

On the 24th, the whole of the III. Reserve Corps and half of the 44th Reserve Division, covered by a bombardment from 10 heavy howitzer batteries and 150 field guns, broke through the front at St. Georges-Tervaete, only to find the Belgians deployed behind the Nieuport-Dixmude railway embankment, together with the French 42nd Division which had arrived in the meantime.

Finding themselves checked in this direction, the Germans renewed their attack on Dixmude. After a four hours' bombardment (in which 21 and 42 cm. howitzers were employed amongst others) which turned the town into a mass of burning ruins, the 43rd Reserve Division delivered its assault at midnight, driving its guns through the middle of—and even in advance of—its infantry. In spite of a threefold attempt it was completely repulsed by the 12th Belgian Regiment, assisted by some French companies of marines. A new attack on the night of the 25th–26th met with the same fate.

Opening of the Nieuport Sluices.—The battle had been in progress for eight days. Over a total of 48,000 rifles the losses amounted to 15,000 in all ranks. Many guns had been put out of action, by excessive use of rapid fire; the munitions were nearly exhausted, the men at the end of their tether. Neither the British nor the French, both hard pressed at Bixscoote, Langemarck and Zonnebeke, were able to send reinforcements. Having no reserves, the Belgian commander decided to call in the sea to his assistance.

On the 26th and 27th all the pioneers were set to stop up the 22 culverts of the Nieuport-Dixmude railway embankment so as to prevent the liberating tide from invading the Belgian positions. On the 27th at dawn a first attempt by the sluice of the Furnes canal, at high tide, failed to yield an effective result. Fresh attempts on the 28th and 29th proved that the inflow of water from this canal was too slight and too slow. Actually, another sluice, that of the Noordvaart, promised a larger delivery but as it lay in No Man's Land its utilization appeared hazardous. Fortunately, the Germans—also being weary—remained relatively quiet during that time. On the 29th, however, their artillery blazed forth again, and it seemed that a new attack was imminent. The Belgian command, acting on information from a waterman named Geeraert, determined on an audacious *coup*. During the night a party of pioneers opened the Noordvaart sluice under the noses of the enemy. Driven by a strong gale the sea water rushed through in a flood. At dawn on the 30th, the three divisions of Beseler's corps attacked along the line of the railway, taking possession finally of Ramscapelle and Pervyse; but the drains were now overflowing; the flooded meadows soon made it impossible for the Germans to advance or even to stay; no alternative was left to them but a hasty retreat. The battle of the Yser was won and the left flank of the Allies definitely saved. Checked along the coast line, the Germans moved the weight of their attack farther inland and made their desperate assault on Ypres. The Belgian army, in scrupulous observance of the spirit of the obligations of neutrality, had, from Aug. 4 to Oct. 31, 1914, gloriously defended its honour, paying the price with its blood and also with the loss of practically the whole of its territory. (*See* also YPRES, THE BATTLE OF, 1914.)

See Tasnier and Van Overstraeten, *L'armée belge dans la guerre Mondiale* (1926). *See* also WORLD WAR I: *Bibliography*.

(R. VAN O.; X.)

YSTAD, a seaport of Sweden on the S. Baltic coast, in the district (*län*) of Malmöhus, 39 mi. E.S.E. of Malmö by rail. Pop. (1943) 11,537. Two of its churches date from the 13th century. Its artificial harbour, which admits vessels drawing 19 ft., is freer from ice in winter than any other Swedish Baltic port.

YTTERBIUM, a rare metallic element (symbol Yb, atomic number 70, atomic weight 173·5), of the rare-earth group, was first separated by Marignac in 1878. In 1907 G. Urbain split paleoytterbium into neoytterbium and lutecium. Von Welsbach also, independently, separated Marignac's ytterbium into its two component elements. The new ytterbium he named aldebaranium. The name ytterbium is reserved by most chemists for that portion of the mixture exhibiting the main characteristics of Marignac's element. Ytterbium is almost identical with lutecium in its properties. It possesses a very characteristic spectrum and has a higher magnetic susceptibility than lutecium. (*See* RARE EARTHS.)

(C. J.)

YTTRIUM, a metallic element (symbol Y, atomic number 39, atomic weight 89·0), belonging to the rare-earth group, was discovered by Gadolin in 1794 and further purified by Mosander in 1843. Only a few workers have prepared absolutely pure yttrium compounds. The common impurities are small amounts of holmium and erbium. The purity of yttrium compounds can best be determined by measuring the magnetic susceptibility, which for the oxide should be $-0{\cdot}12\times10^{-6}$. Traces of erbium and holmium cause the magnetic susceptibility to become strongly positive. Yttrium is one of the commoner rare earths found in the minerals gadolinite, xenotime, euxenite, etc. It may be separated from all others except erbium by the fractional crystallization of the bromates. The erbium may then be removed by boiling the nitrate solution with sodium nitrite, when the yttrium is the last to be precipitated. Yttrium oxide, Y_2O_3, is pure white and is rapidly attacked by most acids giving colourless solutions which show no absorption spectrum. The spark spectrum is very characteristic and strong. The pure metal has never been prepared. (*See* RARE EARTHS.)

(C. J.)

YUAN SHIH-K'AI (1859–1916), Chinese statesman, was born at Hsiang Cheng, a member of a family belonging to the smaller landed gentry of the province of Honan. His first important post was in Korea, where, as Imperial Resident and the trusted lieutenant of the Viceroy Li Hung-chang, he strove by adroit diplomacy to preserve China's shadowy suzerainty over the Hermit Kingdom and to check the steadily increasing ascendancy of Japan. After the Chino-Japanese war (1894–95) he held office as judicial commissioner, with military functions, under the viceroy Li, in Chihli, where he brought the troops to a remarkable standard of efficiency.

In Aug. 1898, the emperor Kuang Hsü, hoping to secure Yuan's services in support of his scheme to seize and imprison the empress dowager, summoned him to a special audience at the Summer Palace. The subsequent *coup d'état* by the empress dowager, which removed the emperor from the throne and replaced him under severe tutelage, owed its success to Yuan's betrayal of the emperor's confidence and to his active support of the conservative Manchu party. To the end of his unhappy career, the emperor never forgave Yuan's treachery, and on his death-bed (Nov. 1908) bade his brother, Prince Chun, see to it that he should not go unpunished.

Yuan received from the empress dowager the governorship of Shantung as reward for his services. In the summer of 1900, on the outbreak of the Boxer rising, he maintained order and protected foreigners throughout his jurisdiction. He had no sympathy with the empress dowager's anti-foreign policy. After the signature of the peace protocol (Peking 1901), as the aged Li Hung-chang desired to be relieved of further duty, Yuan was appointed to act in his place as viceroy of Chihli. At Li's death (Dec. 1901) the appointment was made substantive. Yuan now held the highest office in the gift of the Throne; at the same time he was made a Junior Guardian of the heir apparent. A month later the Yellow Jacket was conferred upon him, together with the appointments of consulting minister to the Government council and director general of the northern railway. In the following year he became a minister of the army reorganization council. During the five years of his viceroyalty, he raised and equipped six divisions of troops, greatly superior in every way to those of the Peking field force or the best provincial levies. But his rapid rise to place and power aroused much jealousy, and, in 1907, a cabal

against him, led by his old rival, the ex-Boxer Tatar general Tieh Liang, persuaded the empress dowager to transfer him from the Tientsin viceroyalty to the capital. He was made grand councillor and president of the Board of Foreign Affairs, which post he held until the death of the dowager and the emperor in Nov. 1908.

For a month after the death of the "Old Buddha," rumours were rife in the north concerning the regent's, Prince Chun's, vindictive intentions with regard to Yuan. But he merely deprived Yuan of office (Jan. 2, 1909) and ordered him into retirement at his native place in Honan. But on the outbreak of the revolution the regent, by an edict of Nov. 14, 1911, appointed him viceroy of Hunan and Hupeh, with a mandate to proceed south with his foreign-drilled troops and put an end to the insurrection. Yuan clearly foresaw and declared that if the monarchy were overthrown, the result would be chaos, "amidst which all interests would suffer and for several decades there would be no peace." Thus his avowed policy was to preserve a limited monarchy, pledged to systematic and practical reforms. Had he been loyally served by his representative, Tang Shao-yi, in the negotiations with the revolutionary leaders at Shanghai, above all, had he received the support which he was entitled to expect in the shape of a foreign loan, he might have won. As it was, he continued to fight on, practically singlehanded, against the forces of disruption, until Feb. 1912 when the terrified Manchu court decided to abdicate. Within two days of the issue of the abdication edict (Feb. 12), the southern revolutionaries, on the initiative of Sun Yat-Sen, exemplified the "unbroken continuity of immemorial tradition" in China by inviting him to stand for the presidency of the republic.

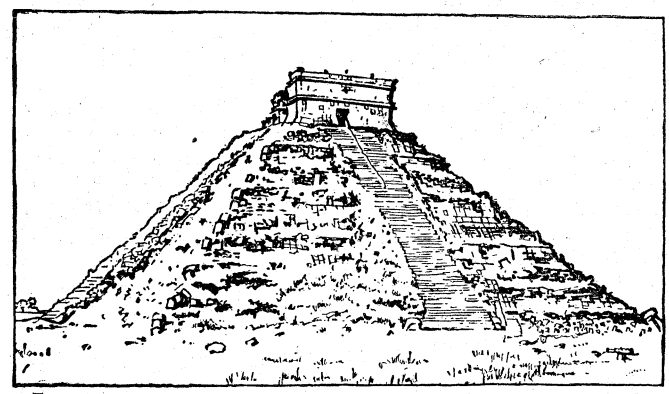
Yuan made a virtue of necessity, and on March 12 took the oath of office as president. Nevertheless, he continued to uphold the principles which he had publicly proclaimed in justification of his defense of the monarchy, and to insist upon maintenance of the continuity of the classical tradition of government and the preservation of the Confucian system. He was willing for a time to pay lip service to the republican formulas, but his actions proved clearly that he had no sympathy with Canton.

In the summer of 1913, a "war to punish Yuan" was started in the south by Sun Yat-Sen, Huang Hsing and other malcontents, but Yuan, having by this time secured a foreign loan and the moral support of the Powers, had no difficulty in retaining the venal "loyalty" of the chief military commanders in the provinces; the Cantonese insurrection came, therefore, to a swift and inglorious end. But Yuan dissolved and proscribed the Kuomintang, and with it made an end of its farce of parliamentary government and representative institutions.

The movement for the restoration of the throne organized by Yuan's adherents, began to take shape in the autumn of 1915. The leaders of the movement failed especially to perceive the danger created by Japan's 21 demands (May 1915), and to realize that the active opposition of the Japanese government would in all probability be fatal to Yuan's ambitions. In October the state council referred the question of the monarchy to the provinces. The result (a foregone conclusion) was a practically unanimous vote in favour of Yuan's accession. Meanwhile, however, the Japanese minister at Peking, supported by his British and Russian colleagues, had made friendly representations to the Chinese foreign office, deprecating the restoration of the monarchical system at this juncture. But on Dec. 12 the monarchy was proclaimed and the enthronement ceremony fixed for Feb. 9, 1916. A week after this announcement, an insurrection, led by one of Yuan's own nominees, broke out in Yunnan. The movement spread rapidly, one province after another declaring its independence. On Jan. 22 Yuan announced the postponement and the establishment of the monarchy. Toward the end of April he consented, while retaining the presidency, to surrender all civil authority to the cabinet, under the premiership of Tuan Chi-jui. He died on June 6, 1916. With him passed the last of the great viceroys of the old regime.

YUCATAN, a peninsula of Central America, which includes in its area of 55,400 sq.mi. the states of Campeche and Yucatan and the territory of Quintana Roo in Mexico, plus small parts of British Honduras and Guatemala. The natural boundary of the peninsula on the south is formed in part by the ridges extending across northern Guatemala, the line terminating in the east at the lower part of Chetumal bay, and in the west at Laguna de Terminos. From this base the land extends north and slightly east between the Gulf of Mexico and the Caribbean sea in nearly rectangular form for about 280 mi., with a mean breadth of about 200 mi., and a coast line of 700 miles.

Physical Features.—The coast on the north and west is low, sandy and semibarren. The outer shore line on the north for nearly 200 mi. consists of a narrow strip of low sand dunes, within



"THE CASTLE" AT CHICHEN ITZA, CAPITAL OF THE ANCIENT MAYA CIVILIZATION, SHOWING A CEREMONIAL TEMPLE ON TOP OF THE GREAT MOUND

which is a broad channel terminating to the east in a large lagoon. There are a number of openings through the outer bank and several small towns or ports have been built upon it. The eastern coast consists of bluffs, indented with bays and bordered by several islands, the larger ones being Cozumel (where Cortés first landed), Cancum, Mujeres and Contoy. There is more vegetation on this coast, and the bays of Chetumal, Espiritu Santo, Ascencion and San Miguel (on Cozumel island) afford good protection for shipping. It is, however, sparsely settled and has little commerce except in henequén, and in chicle, the basis for chewing gum.

The peninsula is almost wholly composed of a bed of coralline and porous limestone rocks, forming a low tableland, which rises gradually toward the south until it is merged in the great Central American plateau. It is covered with a layer of thin, dry soil, through the slow weathering of the coral rocks.

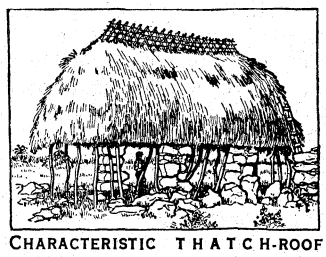
LOADING SISAL AT PROGRESO, YUCATAN, FOR SHIPMENT TO AN AMERICAN CORDAGE FACTORY

The climate of Yucatan is hot and dry and the absence of high mountainous ridges to intercept the moisture-bearing clouds from the Atlantic gives it a limited rainfall. The temperature ranges from 75° to 98° F. in the shade, but the heat is modified by cool sea winds which prevail day and night throughout the greater part of the year. The atmosphere is also purified by the fierce *temporales,* or "northers," which occasionally sweep down over the Gulf and across this open region. The dry season lasts from October to May, the hottest months appear to be in March and April, when the heat is increased by the burning of the corn and henequén fields.

All the northern districts, as well as the greater part of the Sierra Alta, are destitute of large trees; but the coastlands on both sides toward Tabasco and British Honduras enjoy a sufficient rainfall to support forests containing the mahogany tree, several valuable cabinet woods, vanilla, logwood and other dyewoods. Logwood forests fringe all the lagoons and many parts of the seaboard, which are flooded during the rainy season. The chief cultivated plants are maize, the sugar cane, tobacco, cotton, coffee and

especially henequén, which produces the so-called "sisal hemp."

History.—The modern history of Yucatan begins with the expedition of Francisco Hernandez de Cordova, a Spanish adventurer settled in Cuba, who discovered the east coast of Yucatan in Feb. 1517, when on a slave-hunting expedition. He followed the coast round to Campeche, but was unable to penetrate the interior. In 1518 Juan de Grijalva followed the same coast, but added nothing to the information sought by the governor of Cuba. In 1519 a third expedition, under Hernando Cortés, the conqueror of Mexico, came into collision with the natives of the island of Cozumel. In 1525 the inland part of the peninsula was traversed by Cortés during an expedition to Honduras. The conquest of the peninsula was undertaken in 1527 by Francisco de Montejo, who encountered a more vigorous opposition than Cortés had on the high plateau of Anáhuac. In 1549 Montejo had succeeded in establishing Spanish rule over barely one-half of the peninsula, and it was never extended further. The Spaniards found here the remains of a high aboriginal civilization which had already entered upon decline. There were deserted cities falling into ruins, and others, like Chichen-itza, Uxmal and Tuloom, which were still inhabited by remnants of their former Maya populations. (For details of the Maya civilization *see* CENTRAL AMERICA: *Archaeology* and *Ethnology;* also CHRONOLOGY: *Maya and Mexican.*



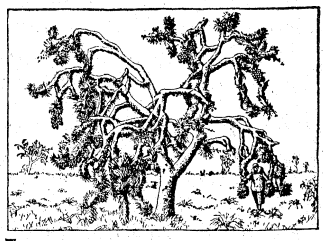
CHARACTERISTIC THATCH-ROOF DWELLING OF THE POORER CLASS IN YUCATAN

Since the Spanish conquest, the Mayas have clung to the semi-barren, open plains of the peninsula, and have more than once revolted. They seceded in 1839 and maintained their independence until 1843. In 1847 another revolt followed, and the Indians were practically independent throughout the greater part of the peninsula until near the beginning of the Diaz administration. In 1910 there was another revolt with some initial successes, such as the capture of Valladolid, but then the Indians withdrew to the unknown fastnesses of Quintana Roo.

The Mexican State of Yucatan occupies the northern part of the Yucatan peninsula, and is bounded east and south by the territory of Quintana Roo, and south and west by the State of Campeche. Its population in 1940 was 418,210 or a density of 28.2 per square mile. Area, 14,864 sq.mi. The capital is Merida.

Quintana Roo was separated from the State of Yucatan in 1902 and received a territorial government under the immediate supervision of the national executive, but its few remaining Indian tribes (pop. in 1940, 18,752 or 0.9 per sq.mi.) are practically independent. Area, 19,435 sq.mi.

YUCCA, a genus of the family Liliaceae (*q.v.*), containing about 30 species. The plants occur in greatest frequency in Mexico and the south-west United States, extending also into Central America, and occurring in such numbers in some places as to form straggling forests. They have a woody or fibrous stem, sometimes short, and in other cases attaining a height of 30 ft. to 40 ft., and branching at the top into a series of forks. The leaves are crowded in tufts at the ends of the stem or branches, and are generally stiff and sword-shaped, with a sharp point, sometimes flaccid and in other cases fibrous at the edges. The numerous flowers are usually white, bell-shaped and pendulous, and are borne in much-branched terminal panicles. The three-celled ovary is surmounted by a short thick style, dividing above into three stigmas, and ripens into a succulent berry in some of the species, and into a dry three-valved capsule in others. The flowers are fertilized entirely through the agency of certain moths. (*See* POLLINATION and YUCCA-MOTH.)



THE JOSHUA-TREE (YUCCA BREVIFOLIA), A TREE YUCCA OF THE SOUTHWESTERN DESERTS OF THE UNITED STATES, SOMETIMES 35 FT. HIGH

A coarse fibre is obtained by the Mexicans from the stem and foliage, which they utilize for cordage, and in the south-east United States the leaves of some species, under the name "bear-grass," are used for seating chairs, etc. The fruits of some species are cooked as food, and the roots of others contain a saponaceous matter used in place of soap.

Some 15 species of Yucca are native to the United States; of these nine attain the stature of small trees. Among the best known are the Spanishdagger (*Y. aloifolia*), the moundlily (*Y. gloriosa*) and the bear-grass or Adamsneedle (*Y. filamentosa*), of the south Atlantic and Gulf coast, all of which are planted for ornament. Among the most conspicuous are the Joshuatree (*Y. brevifolia*), sometimes 35 ft. high, and the Mohave yucca (*Y. schidigera*), 8 ft. to 15 ft. high. An almost stemless species (*Y. Whipplei*), called mission bells and Quixote-plant, which rears a stout flower-stalk, 12 ft. to 15 ft. high, bearing an immense cluster, 3 ft. to 6 ft. long, of fragrant, creamy-white, drooping bell-shaped flowers, is a strikingly handsome plant of the southern California chaparral (*q.v.*). The western Spanish-bayonet or Datil yucca (*Y. baccata*), found from New Mexico to California, bears a dark purple edible fruit.

YUCCA-MOTH, the name given to a genus of moths, *Tegeticula,* the various species of which are each adapted to a separate species of the yucca (*q.v.*). The moth emerges at the time of opening of the yucca flowers, which frequently remain open only for a single night. The female moth rolls together a ball of pollen, flies to another flower, lays four or five eggs in the pistil and inserts the pollen mass in the opening thus formed. Each larva, on hatching from the egg, requires about 20 seeds of the yucca plant as food. As the plant produces some 200 ovules, this leaves about 100 seeds over to perpetuate the plant. The yucca can be fertilized by no other insect. The larva of the yucca-moth can only live on its own species of yucca.

YUCHI, an Indian tribe, formerly on the Savannah river in Georgia and South Carolina to the number of 3,000–4,000, constituting a separate linguistic stock. They gradually joined the Creek confederacy and about 500, mixed with white and Negro blood, survive in the Creek area in Oklahoma. Their culture was marked by traits of Muskogi type.

See F. G. Speck, *Anthr. Publ. Mus. Univ. Penn.,* i. (1909).

YUDENICH, NIKOLAI NIKOLAEVICH (1862–1933), Russian soldier, was born July 18, 1862. He entered the army in 1879, and from 1887 to 1902 served on the general staff. In 1902 he became a regimental commander, in 1905 a general, an assistant chief of staff in 1907 and a chief of staff in 1913. At the beginning of the World War he commanded the II. Turkistan Corps, and was soon placed in command of all the military forces in the Caucasus, a post which he held till the arrival of the Grand Duke Nicholas in 1915. In March 1917 he resumed command, but further advance was rendered impossible by the increasing disorganisation of the Russian army. In 1919 Yudenich led anti-Bolshevik forces in an attempt against Petrograd (Leningrad). This venture was a failure, and Yudenich retired.

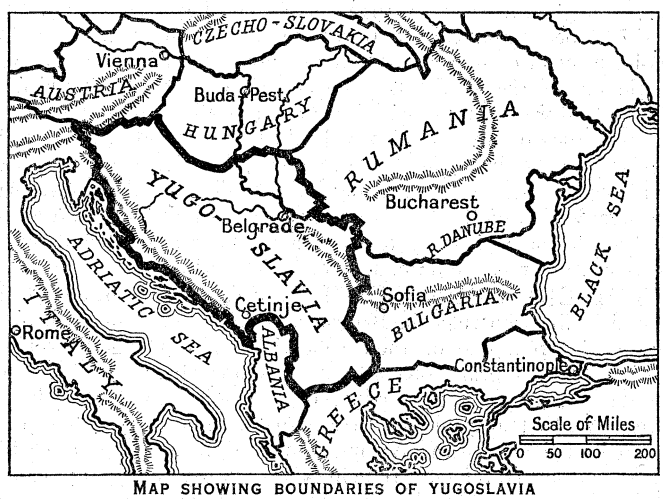
YUE-CHI or **YUEH-CHIH,** the Chinese name of a central Asiatic tribe who ruled in Bactria and India, are also known as Kushans (from one of their subdivisions) and Indo-Scythians (*q.v.*). They appear to have been a nomad tribe, inhabiting part of the present Chinese province of Kan-suh, and to have been driven W. by Hiung-nu (*q.v.*) tribes of the same stock. They conquered a tribe called the Wusun, who lived in the basin of the Ili river, and settled for some time in their territory (*c.* 175–140 B.C.). They then attacked another tribe known as Sakas (*q.v.*) and drove them to Persia and India. For about twenty years it would seem that the Yue-Chi were settled in the country between the rivers Chu and Syr-Darya, but here they were attacked again by the Hiung-nu, their old enemies, with whom was the son of the defeated Wusun chieftain. The Yue-Chi then occupied Bactria (*q.v.*), and little is heard of them for a hundred years. During this period they became a united people, having previously been a confederacy of five tribes, the principal of which, the Kushans (or Kwei-Shwang), supplied the new national name.

The chronology of this invasion and of the history of the

Kushans in India is uncertain; available evidence seems to show that a king called Kozulokadphises, Kujulakasa or Kieu-tsieu-k'io (? A.D. 45–85) united the five tribes, conquered the Kabul valley and annihilated the remnants of Greek dominion. He was succeeded, possibly after an interval, by Ooemokadphises (Himakapisa or Yen-kao-tsin-tai), who completed the annexation of N. India. Then followed Kanishka (*?c.* A.D. 123–53), who is celebrated throughout eastern Asia as a patron of the Buddhist church and convener of the third Buddhist council. He is also said to have conquered Kashgar, Yarkand and Khotan. His successors were Huvishka and then Vasudeva, who may have died *c.* A.D. 225. After Vasudeva's reign the power of the Kushans gradually decayed, and they were driven back into the valley of the Indus and N.E. Afghanistan. Here, according to Chinese authorities, their royal family was supplanted by a dynasty called Ki-to-lo (Kidara), who were also of Yue-Chi stock, but belonged to one of the tribes who had remained in Bactria when the Kushans marched to India. The subsequent migration of the Kitolo S. of the Hindu Kush was due to the movements of the Jwen-Jwen, who advanced W. from the Chinese frontier. Under this dynasty a state known as the Little Kushan kingdom flourished in Gandhâra (E. Afghanistan) about A.D. 430, but was broken up by the attacks of the Hûnas.

See Vincent Smith, *Early History of India* (1908); Hoernle and Stark, *History of India* (1905); Rapson, *Indian Coins* (1898); Gardner, *Coins of Greek and Scythian Kings in India* (1886); Franke, *Beiträge aus Chinesischen Quellen zur Kenntnis der Türkvölker und Skythen* (1904), and numerous articles by Cunningham, Fleet, A. Stein, Vincent Smith, Sylvain Levi, E. H. Parker and others in the *Journal of the Royal Asiatic Society, Asiatic Quarterly,* etc.

YUGOSLAVIA, a convenient name for the Serb, Croat, and Slovene state (*Kraljevina Srba, Hrvata, i Slovenaca*), which originated at the end of 1918 by the union of parts of the former Austro-Hungarian empire with Serbia and, at a slightly later date, with Montenegro. The declared basis of the union was ethnic, the desire being to group together all the South Slavs (Yugoslavs), though the actual frontiers represent a series of compromises. The inhabitants are mainly South Slav, but the new kingdom is, nevertheless, one of the most heterogeneous of the post-war states of Europe. Serbs constitute over one-third of the total population, and outnumber any other single element. But the Serbia of 1918 was not a unit, its frontiers having undergone notable changes since the outbreak of the Balkan wars. The Catholic Croats of Croatia-Slavonia and Dalmatia, the next largest group, number



MAP SHOWING BOUNDARIES OF YUGOSLAVIA

over three millions, but surpass the Serbs of Serbia both in culture and economic development. Serbia—or, more accurately, the Serbs of Belgrade, the only large town in the old kingdom—is however quite definitely the dominant partner.

The predominance of the Serbs of Belgrade is due both to political and geographical causes. Among the former we have to note that Belgrade, the capital of the old Serbian state as it is of the new Yugoslav one, possessed all the advantages of the presence of an organized national administration. No other part of the new state—apart from the small kingdom of Montenegro—had had any experience of complete self-government. Even when associated with numerical preponderance and military strength this might not have ensured concentration of power at Belgrade, had it not been for the outstanding position of the town at the convergence of great highways.

Divisions.—Yugoslavia has an area of 95,558 sq.mi., with a population in 1931 of 13,934,038, and an estimated population on Jan. 1, 1940, of 15,703,000. It is made up of the following 7 areas: (1) the Serbia of the treaty of Bucharest (1913) with some minor modifications; (2) the Montenegro of 1912; (3) Bosnia and Hercegovina; (4) Dalmatia, without the town of Zara and the islands of Lagosta and Pelagosa; (5) Croatia-Slavonia, without Fiume but with some minor additions; (6) Slovenia; (7) the Voyvodina or Duchy.

Of these the first two were independent South Slav states, Serbia having had its area nearly doubled and its population increased by one-half as the result of the Balkan wars. In both the Cyrillic alphabet is used, and the majority of the people belong to the Eastern or Orthodox church. But the new territories in the south, obtained by Serbia as the result of the Balkan wars, contain a considerable Muslim element, both in Old Serbia and in Macedonia. Bosnia and Hercegovina, nominally Turkish till the Austro-Hungarian annexation in 1908, had been administered by the Austro-Hungarian government since 1878. There is a large Muslim element in the population, Bosnia being the most northerly Muslim outpost in Europe.

Dalmatia was a purely Austrian province, with a mainly Catholic population. Italian influence was, however, strong in the coastal towns, particularly in Zara, which has been assigned to Italy. The Catholic Slavs of Dalmatia use the Latin alphabet and thus technically rank as Croats. Croatia-Slavonia (capital Zagreb) was formerly attached to Hungary, its port, Fiume, forming the chief Hungarian sea-outlet. To the Croatia-Slavonia which is included in Yugoslavia were added the commune of Kastav, on the peninsula of Istria to the west of Fiume, the island of Krk (Veglia), and a small area (Medjimurje) between the Mur and the Drava, with a Croat population. The port of Fiume, after long negotiation, went to Italy. Slovenia, the land of the Slovenes, is a name which has been given to a part of pre-war Austria inhabited by Slovenes and now attached to Yugoslavia: there has, however, never been a Slovene state since the early Middle Ages, and Slovenia is made up of fragments of former Austrian provinces. Thus it includes southern Styria, with the town of Maribor (Marburg), the greater part of Carniola, with the town of Ljubljana (Laibach), and a few communes only of Carinthia. To these has been added a small area (Prekmurje) north of the river Mur, formerly attached to Hungary but containing a Slovene population. The Slovenes are predominantly Catholics and highly westernized. Finally, the Voyvodina is similarly composed of scraps of territory, brought together because of the composition of the population and without any physical unity of its own. It includes the southern and often swampy part of the Hungarian plain, and both from the ethnic and the religious standpoint the population is exceedingly mixed. The Slav majority is due primarily to the flight of Balkan Serbs before the advancing Turk, for such low-lying lands were as a rule avoided by the early Slav settlers, who preferred wooded and hilly country. The considerable German and Magyar groups mostly owe their origin to a deliberate process of colonization, the Germans particularly having done much to drain and make habitable the swampy lands. The Rumanian element is due to migration from the hilly country to the east, especially during the 18th century. Many of the Slavs, particularly towards the east, belong to the Orthodox Church, while Catholics are in a majority to the west. There is also a Protestant element (German and Magyar).

The lands included are a part of the Baranja, the Mesopotamian area in the angle between the Danube and the Drava, the remainder of the Baranja being still attached to Hungary; the greater part of the Bačka, the area between the Danube and the Lower Tisa, the smaller part remaining Hungarian; the western part of the Banat, or area east of the Lower Tisa, the eastern part

being attached to Greater Rumania. The Voyvodina in this sense includes the town of many names now officially called Subotica (Ger. *Theresiopel,* Magyar *Szbadka*), a market town and a considerable centre of communication for the plain. Subotica (100,058) is the third largest town of the new kingdom.

Regional Division.—It has to be noted that while the lands briefly described above are those which were united together to form Yugoslavia, they ceased to exist as units. By a decree promulgated by the ministerial council in 1922, Yugoslavia was divided into 33 *oblasti* or regions, on a basis which has been stated to show "strong religious and political party influences"; which may be interpreted as meaning that they were intended to ensure Serb predominance. It is noteworthy that the old administrative or political river frontiers were sometimes preserved in the regions; as for example with the Drina (where it separated Bosnia and Serbia) and the Sava (where it separated Bosnia and Slavonia), and there they isolated from each other groups of different religious and political sympathies. But the old political frontier of the Danube was disregarded to allow the oblast of Belgrade to extend into the eastern part of the Bačka which had a considerable Orthodox element as well as many Catholics, and also into a part of the Banat where there was a similar mingling of creeds. The remainder of the Banat was included in a region (Podunavska or Danube) which also extended across the Danube. Here the solidly Orthodox element in that part of the oblast which lay in Serbia more than counter-balanced the Catholics which were intermixed with the Orthodox in the formerly Hungarian region on the left bank of the Danube.

Population.—The 1931 census showed that 10 million of the 13,934,038 inhabitants of Yugoslavia spoke Serbo-Croat, and over 1 million the Slovene language. Thus Serbs, Croats and Slovenes constitute together about 85% of the total population. The largest minority group is the German-speaking one, numbering over half a million. Most of the Germans inhabit the Voyvodina where they form about 23% of the population of that heterogeneous territory. There they live in compact agricultural colonies as well as forming a considerable part of the town population. The remainder live for the most part in Croatia-Slavonia and in Slovenia. In the latter area they are mainly urban. The Magyar-speaking element is only slightly less than the German-speaking one, and the Magyars constitute nearly the same percentage of the population in the Voyvodina as do the Germans. There they occur particularly in the neighbourhood of the river Tisa, often in compact groups. Elsewhere they occur chiefly in Croatia-Slavonia. The third considerable minority element is formed by the Albanian-speaking peoples. These are not much inferior to the Hungarians in numbers, and their proximity to the independent kingdom of Albania in Old Serbia and Serbian Macedonia gives a possibility of irredentist propaganda. Albanians are practically limited to this part of Yugoslavia. There are also about ¼ million Rumanian-speaking people, of whom the majority live in the Timok region of Serbia, or more accurately, between the river Timok, the Danube and Upper Mlava. Rather more than ¼ million people are registered as speaking Slav languages other than Serbo-Croat or Slovene. These include a certain number of Czechoslovaks in the Voyvodina and Croatia-Slavonia.

The density of pop. (1921) is highest in the Voyvodina (181 per sq. m.), a fact which reflects the productivity of this fertile agricultural region, well fitted for the growth of cereals. In Slovenia (169) and Croatia-Slavonia (162) the density is not greatly inferior. Here the causes are not only the presence of productive lands but the considerable degree of development of the economic resources, associated with marked urbanization. While Serbia has but one large town, and outside of that town has a population mainly of peasants, occupations in Croatia and Slovenia are diverse, mining and manufacturing having made a good deal of progress. Serbia as a whole has a density (111 per sq. mile) lower than that of Dalmatia (126), but the figure is reduced by the fact that the lands added in 1913 are undeveloped and thinly-peopled. In Bosnia and Hercegovina and particularly in barren Montenegro the density is low. For the whole kingdom the density is (1931) 145·8 per square mile.

Frontiers.—Yugoslavia is of trapezoidal shape, the long axis having a N.W.-S.E. direction. The south-eastward extension is narrowed by Albania, which separates Old Serbia and Serbian Macedonia from the Adriatic. The national seaboard extends from the river Fiumara, on which stands the Italian port of Fiume, to the river Bojana, which forms the frontier with Albania. Owing to the numerous islands and peninsulas, the latter with long bordering channels, the coast has a total length of nearly 1,000 miles.

Of the four sides of the trapezium the northern one abuts, from west to east, on Austria, Hungary and Rumania. Strategically it is the weakest of all the frontiers, but this means that there is easy communication with the adjacent states and with Central Europe in general. The Hungarian section (353 m.) of this frontier is the longest, and is traversed by the most important lines of rail. The Austrian frontier (160 m.) is short but is again traversed by important railway lines. The Rumanian section (337 m.) falls into two parts, the old Danube frontier with Serbia and the new one in the Banat.

To the east Yugoslavia marches with Bulgaria, and this frontier (283 m.) is strategically the strongest of all. Strategic changes have been made in the old Serbo-Bulgarian frontier in four places. In the north, in the Timok region, a slight rectification had for its object the affording of greater protection to the railway which follows the Timok valley from Knjaževac and Zaječar to Negotin and thus to the Danube below the obstacle of the Iron Gate. Formerly this railway was close to the frontier. The other changes have been made in the region of Caribrod, where the Niš-Sofia railway line crosses the frontier; to the east of Vranje; and in the Strumica region.

To the south the frontier with Greece (152 m.) remains that agreed upon between Greece and Serbia in 1913. The Albanian part (277 m.) of the western frontier is similarly in essentials that laid down by the Conference of Ambassadors at London in 1913.

The north-western frontier with Italy (132 m.) has only been settled with a considerable degree of difficulty, particularly in the Fiume region, where only the small port of Baros with the delta region remains to Yugoslavia. The frontier is not drawn on a linguistic basis, large numbers of Croats and Slovenes being included within the borders of enlarged Italy.

Within these boundaries Yugoslavia has an extreme range in latitude of from 41°–47° N., and in longitude of from about 14°–23° E.

Communications.—A section of the main European highway passes through Belgrade, branching at Niš for Constantinople and Salonika respectively. Thus the new state had not to improvise a national system from the cut fragments of routes which converged on centres outside the national territories, for a main trunk line was already present.

In the northern area Yugoslavia obtained in the first place that part of the Belgrade-Budapest route which runs via Novi Sad to Subotica. This section was already linked to an important east-west trunk line, with many branches, which follows broadly the Sava valley. Thus Zagreb (185,581) the second city of the kingdom, lying in the Sava valley, had direct connection with Belgrade (238,775), as had also Ljubljana farther west. Zagreb was also connected, if by a somewhat difficult route, to the Hungarian port of Fiume, and directly to Budapest. Ljubljana (59,767) had similarly railway connections both to Fiume and to Trieste and directly to Vienna through Maribor.

Further, southern Hungary had an excellent system of waterways, and just as Belgrade was linked to the Hungarian railway net because of its position, so also that position makes it the centre of the waterways. Navigation is possible on the R. Sava to Sišak, south-east of Zagreb; on the Danube; on the Tisa; and on the Drava as far as Barcs on the left or Hungarian bank of the river. In addition the Voyvodina contains a number of canals, constructed to function both as means of irrigation and as waterways. Again, the navigable Sava receives a number of powerful tributaries from forested Bosnia, well fitted for floating timber.

Conditions are different in Bosnia where Austrian policy in railway construction was determined by political motives. It was not to Austria's interest to facilitate communication between

Turkish lands and Bosnia, and there is not even now any railway through what used to be the *sanjak* of Novipazar. From Skoplje in Serbian Macedonia a railway runs towards Novipazar, but this line ends "in the air" at Mitrovica. Again, since the Bosnians, whether Muslims or not, are Slavs, it was contrary to Austria's interest to permit of any direct connection being made between Serbia and Bosnia. A possible route does, however, occur between the Morava valley and Sarajevo (78,173). The Morava has a large left-bank tributary, the Western or Serbian Morava, which flows in a generally west-to-east direction, and opens up a line of communication into western Serbia. A Serbian railway was built from the Belgrade-Niš route along this valley line, which ended blindly at Užice, near the Serbian-Bosnian frontier. Within Bosnia feeders of the River Drina made it easy to construct a line from Sarajevo of similar direction. This line, however, stopped at Višegrad, a short distance from the frontier. By filling up the Užice-Višegrad gap Yugoslavia was able to connect Sarajevo to the main Belgrade-Niš line. Further, there is a connection from Paraćin on that line to Zaječar in the Timok valley, already mentioned. Since the Zaječar line runs down to the Danube near Negotin there is thus a transverse connection from Sarajevo to the navigable section of the Danube below the Iron Gate and thus to the Black sea.

Sarajevo was linked to Austria by a line through the Bosnia valley which joined the Sava valley trunk-line at the town of Brod. The Austrians also connected Sarajevo with the Dalmatian coast by a narrow-gauge line, which has a rack-and-pinion section and is quite unsuited for heavy traffic. It was largely a tourist line, Austria having done much to develop the Dalmatian coast as a tourist resort.

During the Austrian period Dalmatia may be said broadly to have had no railways of any account apart from this line. The multitude of small ports made coastal traffic easy, and the population is chiefly centred in the towns on the fertile parts of the shore—for the coast is not uniformly productive. Dalmatia was not effectively linked with the interior, and without such links there was no hope of finding outlets on the national seaboard. The problem has not yet been solved, despite a certain amount of railway construction. During the post-war period when feeling ran high between Italy and Yugoslavia all sorts of obstacles were put in the way of Italian coastal steamer services, and since Yugoslavia found it impossible to organize an effective national service, trade and the revival of tourist traffic were seriously hampered. Such facts are of importance because they give reasons for the intensity of the political feeling between Serbs and Croats, and the danger of a policy so centralized at Belgrade as to be out of touch with local needs. Railway construction in Dalmatia has led to the two ports of Sebenico (Šibenik) and Spalato (Split) being connected via Knin and Gospic to Ogulin on the main route between Zagreb and Fiume. A branch line from Knin goes by a very indirect route via Prijedor to the main Sava valley line. Even if it were possible to build a number of railway lines between Dalmatian ports and the interior, the long and expensive haul would complicate their use. Further, the ports are not equipped for dealing with heavy traffic. It would appear, therefore, as though Yugoslav maritime trade must continue to use foreign ports, especially Salonika, where there is a Free Zone, and Fiume.

NATURAL REGIONS

Three great types of land-forms are represented in Yugoslavia: — (1) the western mountain belt which is a continuation of the Alpine folding; (2) the Danubian plains, or Pannonian basin of Austrian geographers, with their southern hilly rim; (3) the much disturbed belt of country, with alternating hills and small plains, separating the western mountains from the crust-block of old rocks which forms the core of the Balkan peninsula; this is best called the Morava-Varder depression, from the great valley which traverses it from north to south. Speaking broadly, we may say that (1) includes the Slovene lands, the western and south-western part of Croatia-Slavonia, Dalmatia, a large part of Bosnia, Hercegovina and Montenegro. The extreme eastern edge of the Slovene lands, the eastern part of Croatia-Slavonia, the northern part of Bosnia and Serbia, with the whole of Voyvodina, fall into (2), while a large part of Serbia is included under (3).

Of these three types, however, the mountain belt in particular is too complex to be regarded as a unit. In the first place the mountains of the north-west show some striking contrasts to the Dinaric Alps which margin the west coast of the Balkan Peninsula proper. The former are made up of the Julian Alps (Terglav, 9,400 ft.), the Karawanken, the Steiner Alps (Grintovec, 8,395 ft.) and some smaller ranges, all with a general west to east direction. This means that the intervening valleys open towards the Danubian plains. North of the Karawanken lies the valley of the Upper Drava, of which, however, only a comparatively small part lies in Yugoslavia. The river may be said to emerge from the mountain to the plain section at the town of Maribor. Between the Karawanken and the Julian Alps lies the roughly parallel Upper Sava valley, of which a larger part falls within the state. Here the considerable (25 m. by 6 m.) basin in which lies the town of Ljubljana may be said to mark the end of the mountain section.

Farther south the mountain belt differs greatly in character. The fold-lines take on a south-easterly direction, parallel to the coast-line, and three distinct zones can be recognized. The coastal ranges have been largely submerged beneath the sea to form the chain of islands and the characteristic peninsulas. Here, particularly in the islands and occasionally in narrow strips on the mainland, there are areas with a considerable depth of fertile soil, enjoying a Mediterranean type of climate, despite the blasts of the bora, or cold northerly wind. Water occurs in the form of springs, often of great force, with, on the mainland, rivers which sometimes mingle their waters with the sea within a mile or two, or even a few hundred yards, of their sources in the limestones, but occasionally reach a considerable length. This coastal belt, with its characteristic products, form a distinct natural region, and is separated by steep limestone cliffs or hills from the barren karst behind. The karst area of massive limestones extends from Carniola, south of the Ljubljana basin, through western Croatia, the interior of Dalmatia, a part of western Bosnia, the greater part of Hercegovina and western Montenegro to the Albanian frontier. It includes ridges such as the Great and Little Kapela and the Velebit, the Uskok Mts. west of Zagreb and other hilly areas, with intervening basins and depressions of varying sizes, much of the surface being below 2,000 ft. above sea-level.

Farther inland, however, especially to the south, in Bosnia, the extreme east of Hercegovina and eastern Montenegro, the elevation increases notably, outstanding heights being Durmitor (8,234 ft.) in north-west Montenegro and Majlić (7,840 ft.) on the frontier between Montenegro and Hercegovina. This elevated area is the Planina region of the Slavs, planina being the precise equivalent of alp (mountain pasture) in the Alps proper. In the Planinas or high mountain region then, upland pastures and forests re-appear.

The Five Natural Regions.—We may therefore recognize five natural regions in Yugoslavia, falling into three groups. Of these (1) the Pannonian basin in the wide sense is by far the most important economically, and with it may be associated (2) the Slovene Alps, which are linked to it by the Drava and Sava valleys. (3) The Morava-Vardar depression forms a unit by itself. In the west, despite the difficulties of communication (4) the coastal belt may be associated with (5) the Dinaric karst and mountain belt.

1. **The Pannonian Basin.**—This obtains its name from the old Roman province of Pannonia, the name being applied by geologists to a great depression between the Alps on the west and the Transylvanian Mts. on the east which was flooded by water during the Tertiary period. The water was finally drained off by the Danube as it cut its way through the encircling mountain rim by the gorge which forms the Iron Gate. Northwards the plain left by the ebbing of the waters extends beyond the limits of Yugoslavia; southwards, beyond the plain which fringes the Sava-Danube, it gives place to an undulating platform which seems to represent the shore of the old lake. This hill country forms part of northern Bosnia and northern Serbia, extending in the latter country southwards to the hills west of Niš, notably the Jastrebac and Kopaonik ranges.

That part of this productive Tertiary hill country which extends

eastwards from the Kolubara to the Morava and is bounded to the south by the valley of the Western Morava, forms the Šumadija of the Serbs and constituted the heart of modern Serbia. Originally thickly forested—Šumadija means forest—the woods have been largely cleared except on the island-like mountains of older rock, such as Rudnik, which rise from the general surface. In Bosnia, however, much of the original woodland remains.

The whole region, including plains, river valleys, hill country and isolated mountains and uplands, constitutes economically the most important part of the state, and has a considerable variety of resources. In Serbia the characteristic occupation is mixed farming carried on by peasants on small holdings. The cereals include maize, wheat, barley and oats. A great variety of vegetables is grown for local use, and there are numerous orchards, the characteristic plum being accompanied by all the usual temperate fruit-trees. Local advantages of climate and soil account for certain special crops, such as tobacco (especially near Užice in the valley of the Western Morava); the vine for table grapes or wine in the more sheltered areas, especially near Smederevo in the Morava valley and in the lower Timok valley; sugar beet in the Morava valley; flax, especially in the Drina and Kolubara valleys; mulberry for silkworm-rearing in the Morava valley, and so on. Of stock animals the pig is particularly important but cattle and horses are reared, with many sheep on the uplands.

In the Voyvodina conditions are broadly similar, but cereal production, especially of wheat, is more important, and the farming is of a more advanced type. There is a correspondingly greater development of the industries using local raw material, such as flour-milling, sugar-extraction, brewing and distilling, rope-making from local hemp, the making of linen and silk goods, etc., and as a consequence towns are more numerous and larger. The greater variety of the surface in Croatia-Slavonia, again, brings certain modifications. Orchards are numerous, and to the plums, vines, apples, pears, etc., of Serbia are added walnuts and chestnuts. Stock-rearing is extensively practised, and the fact that there are large forested areas results in a great development of industries based on wood and wood products.

The part of Bosnia included within the region may be said to resemble a more backward Serbia. Maize is the most important cereal, and since there has been less clearing for agriculture here extensive and valuable forests remain. As in Serbia the plum is by far the most important fruit-tree.

2. **The Slovene Alps.**—The essential features of this region have been described. From the economic standpoint it has to be noted that, on account of the limited amount of arable land, there is not only no surplus of cereals, such as is found in (1), but an actual deficiency, so that additional supplies have to be obtained especially from Slavonia, Bačka and the Banat. On the other hand the well-organized dairying industry permits of a considerable export of dairy products. Ljubljana and Maribor are not only centres of this trade but also of a number of minor industries similarly dependent on the extensive rearing of live stock, such as meat-packing, the making of margarine, soap, candles and so forth. Further, the valleys and the margins of the basins yield fruit, including walnuts and chestnuts, the vine, especially in the Drava valley where Maribor carries on a considerable trade in wine of good quality, as well as small fruits.

Forests are not only extensive but include both conifers and such hardwoods as beech, oak, chestnut, etc., and industries dealing with timber are important. Since water-power is abundant and coal also occurs, while the forests are widely distributed, many of the industries are of old standing and of the small, scattered type rather than commercialized undertakings. The products, notably furniture, show the influence of localized skill and tradition and had a ready sale in the old Austria-Hungary. Minerals, in addition to coal, are of some importance, though many of the industries based upon them have suffered from the drawing of the new frontiers.

3. **The Morava-Vardar Depression.**—This not very appropriate name may be given to the region which extends from the southern margin of the Šumadija to the Greek frontier. It is traversed by a series of basins strung along the Morava and Vardar systems, and affording a continuous route from north to south. Structurally the region is remarkably complex, for it represents the zone of weakness where the fold-mountains of the west and north-east abut upon the central crust-block of the peninsula. Instead of the continuous and extensive depression which gave rise to the Pannonian basin to the north, earth movements were limited and localised, producing numerous small basins, originally flooded by water but now largely drained by river action. These basins are floored by soft deposits and are in consequence fertile, containing arable land. With them alternate great mountain masses, such as the Kopaonik, Golja, Crna Gora, Šar and others. The Crna Gora marks the limit between Old Serbia or Raška to the north and Serbian Macedonia (*see* MACEDONIA) to the south.

Among the more important rivers may be noted the Nišava, a right-bank tributary of the Morava which allows of the passage of the railway from Niš to Sofia and Constantinople. The Toplica, a left-bank tributary of the Morava, drains a very fertile valley. The long stream of the Ibar has a small headstream, the Sitnica, which drains a part of the productive Kosovo polje, or plain of the blackbirds, with the town of Priština. The Ibar itself passes through a wide valley containing the towns of Mitrovica and Raška and enters the western Morava. In a side valley to the west lies the town of Novipazar, which is extremely "Turkish" in appearance and has a large Muslim element.

As regards resources the arable plains and basins produce a considerable variety of crops, becoming more and more southern in type as the Greek frontier is approached. The mountains and uplands allow for a notable development of the live stock industry, the area in earlier days having furnished a considerable part of the meat supplies of Constantinople, to which the sheep could be driven by successive stages. Finally the mineral resources are considerable, especially round Skoplje, Veles and Kumanovo. Coal, copper, silver-lead, chrome ore, iron and antimony all occur.

Among the products of the live stock industry is wool of good quality, particularly from the sheep reared on the eastern uplands. This forms the basis of the celebrated carpet industry of Pirot, in the upper Nišava valley, the carpets being noted for their excellent colours and designs. Round Lake Dojran the camel is present.

The crops of Old Serbia are generally similar to those of the Šumadija, but in Macedonia they are more varied. Thus the Bregalnica valley near Kočane is famous for its rice fields and near Štip for opium poppy yielding a high percentage of opium, exported from Salonika. In the Strumica valley farther south cotton, rice, sesame, tobacco, with much fruit and a variety of other crops, all occur. Gevgeli, the frontier station on the Skoplje-Salonika line, is famous for its silk production and silk factories.

4. **The Coastal Belt.**—The general geographical interest of this region far exceeds its economic one. Even the name is somewhat deceptive, for parts of the coast are as barren and arid as the karst lands of the interior. Characteristic Dalmatian landscapes are best seen in such areas as the Riviera of the Seven Castles, which stretches from Spalato to Trau (Trogir), forming a narrow, fertile strip about 10 m. in length, watered by short, spring-fed streams and backed and sheltered by bare and waterless limestone hills; or round Ragusa, one of the most perfect examples of the Mediterranean city-state in miniature. The olive grows round Spalato, but olive oil is imported from Italy.

The coastal belt is for the most part unsuited to cereals, which are grown in the poljen of the interior. But the marshy area round the mouth of the river Narenta forms an exception to the general statement. Wine is made and exported largely to France to be mingled with locally-produced kinds. Special products of some interest are the liqueur maraschino, distilled from cherries at Spalato and Sebenico (Šibenik); insect powder made from locally-grown and wild pyrethrum, and a variety of substances obtained from the aromatic plants of the maquis. Among the last rosemary (especially from the islands of Lesina [Hvar] and Lissa [Vis]), sage and noble laurel may be named. Apart from the shrubs, wood is rare.

Minerals are not very important, but large beds of cement-stones occur near Spalato and form the basis of a considerable industry using the water-power of the short river Jader, which

gushes out of the limestone near by. The water power of the river Kerka near Sebenico and of the river Cetina near Almissa (Omiš) is also used for such industries as the making of calcium carbide and cyanamide. These industries were mainly established with Italian capital. Fishing is of some importance, especially on the islands, where Lissa has a canning industry. The catch includes tunny, sardines, mackerel and crabs and lobsters.

5. **The Dinaric Karst and Mountain Region.**—If the coast of Dalmatia is apt to be estimated too highly, precisely the reverse is true of this region which is less unproductive than it appears at first sight. From the human standpoint the contrasts are very striking, for if Ragusa and Spalato are western and Latin, with many evidences of a great past, towns like Sarajevo, Mostar, Trebinje and Cetinje are thoroughly eastern in appearance, and the rural population is in many ways highly primitive and backward. The area owes its Slav population to the Turkish advance, to the same cause, that is to say, as that which led ultimately to the decay of the coastal towns. The Slavs of the interior fled, at various times, before the advancing Turk, and were constrained to occupy and use poor land.

Montenegro is particularly well fitted for livestock rearing because of the appearance of schists in the mountain belt which lies east of the Zeta valley. There is a better and more permanent water supply and a richer growth of grass there.

Cereals, especially maize, with wheat and barley, tobacco and wine are produced in the depressions of the mountain region.

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(M. I. N.)

HISTORY

The Adriatic Dispute at Paris.—At the Paris Conference there was from the first a deadlock in the Adriatic dispute. (*See* SERBIA.) Clemenceau and Lloyd George found themselves between two irreconcilable standpoints—between Sonnino, who claimed the literal fulfilment of their treaty pledges, with the addition of the port of Fiume, and Wilson, who refused all cognizance of the secret treaties and regarded them as abrogated by the Allies when they accepted his successive Notes as the basis of the Armistice. The three Western Powers were in the impossible position of judges in a dispute to which one was a party, while two were accessories. On Feb. 11, 1919, the Yugoslavs offered to submit the whole dispute to the arbitration of President Wilson, and on April 16 to leave the settlement of frontiers to a plebiscite.

But these proposals were rejected by the Italians, who even withdrew for a time from Paris; and Wilson's public manifesto on the Adriatic question (April 23) so far from improving matters, actually stiffened Italian resistance. The problem was left unsolved during the final stages of the negotiations on the German treaty, and was still being postponed when, on Sept. 12, D'Annunzio and his Arditi, with official Italian connivance, seized Fiume and proceeded to create a *fait accompli.* On Dec. 9, 1919, the Supreme Council made a definite proposal to Italy on the basis of a slight modification of the so-called "Wilson Line," Fiume as a buffer State, a special régime in Zara, Valona in full sovereignty and an Italian mandate in Albania.

Late in April the Yugoslavs consented to direct negotiations with Italy, but the Nitti cabinet fell before any decision could be reached, and it was not till Nov. 12, 1920, that the Treaty of Rapallo was signed. By it Italy acquired a frontier considerably farther east than the Wilson line, the watershed of the Julian Alps as far as Snježnik (Monte Nevoso), almost all Istria with Abbazia and Volosca, and a narrow strip of shore connecting it with Fiume, which was to become an independent unit under the League of Nations, while the Croat suburb of Sušak was to remain in Yugoslavia and the Baroš Port was added as an outlet for Yugoslav trade. Zara became a free city under Italian sovereignty, but as a tiny island isthmus without hinterland or islands. Italy renounced all claim to Dalmatia, and of all the islands retained only Lussin and Cherso. Special linguistic and other privileges were assured to the tiny Italian minority in the Dalmatian towns, but no corresponding charter was granted to the 400,000 to 500,000 Slovenes and Croats annexed to Italy. One practical result of the treaty was that Italy tacitly abandoned the cause of King Nicholas and accepted as inevitable Montenegro's incorporation in Yugoslavia. Unhappily Italy allowed the treaty to remain a dead letter as regards Fiume, which was firmly held by D'Annunzio's irregulars, to the utter ruin of its trade and prosperity. The final liquidation of the Adriatic dispute was postponed till Jan. 27, 1924, when Mussolini and Pašić (Pashitch) concluded the so-called "Pact of Rome" guaranteeing the Peace Treaties of St. Germain, Trianon and Neuilly and promising neutrality if either should be attacked by a third party. A supplementary agreement recognized Italy's annexation of Fiume, but left to Yugoslavia the Baroš Harbour and also a free commercial zone in Fiume itself, with proper railway access.

The New Frontiers.—In five other directions also the regulation of the new frontiers was a slow and difficult process.

1. The frontier between Yugoslavia and Rumania rests on a decision of the Peace Conference, published on June 13, 1919. Rejecting equally the frontier fixed by the secret treaty of 1916, under the terms of which Rumania entered the war, and the line up to which the Serbs had been allowed to occupy after the Armistice, the Allies divided the Banat on a mainly ethnographic basis. At the last moment they drove two awkward salients into Rumanian territory, in order to include Vršac and Bela Crkva in Yugoslavia, thereby blocking the railway outlet of Timişoara and Arad towards the Danube at Bazias.

2. The regulation of the Austro-Yugoslav frontier was decided according to a plebiscite supervized by an inter-Allied Commission at Klagenfurt. After a keen contest between rival Slovene and Pan-German propagandists, voting took place in Oct. 1920 and resulted in a majority of 12,747 for Austria in Zone A (the more southerly section in dispute), whereupon Zone B also was automatically assigned to Austria.

3. By the Treaty of Neuilly (Nov. 27, 1919), Bulgaria was forced to cede to Yugoslavia (*a*) the Strumnica salient, which threatened the Vardar railway from the east, (*b*) the district of Kočana and the Bregalnica and (*c*) the town and district of Tsaribrod, which places Sofia strategically at the mercy of her neighbour.

4. The Albanian frontier remained in suspense till 1921, when the Supreme Council sanctioned the line laid down by the Council of Ambassadors in the winter of 1913, thus putting an end to the disreputable design favoured in some quarters of an Italo-Yugoslav "deal" on the lines of "Scutari for Fiume."

5. The frontier with Hungary was the last to be regulated. By the Treaty of Trianon the Banat (save a small Magyar triangle opposite the city of Szeged) was divided between Rumania and Yugoslavia, while the latter received the whole Bačka (except Baja and district), part of the Baranya (forming the angle between Drave and Danube) and the Medjumurje (between Drave and Mur). Thus, in order to secure the town of Subotica (Szabadka) with its large Bunjevac (or Catholic Serb) population, she was allowed to annex not less than 250,000 Magyars.

Internal Politics.—So long as these vital frontier disputes were outstanding, the Government hesitated to hold new elections, and the new united parliament rested on a highly irregular basis, the Serbian mandates having actually expired in June 1914, and the delegates from most of the new provinces owing their positions to membership in the numerous revolutionary committees which sprang up in Oct. 1918. The chaotic party conditions slowly crystallized into a keen struggle between the Radicals, who still possessed the best party machine and stood for a narrowly Serbian as opposed to a Yugoslav programme, and the new Democratic party, which absorbed most of the Opposition groups in Serbia, the old Serbo-Croat coalition of Croatia and the Slovene Liberals. In Aug. 1919 Protić was replaced by Davidović, the Democratic

leader, but at the elections to the Constituent Assembly (November 1920) no party secured an absolute majority. Pašić again became premier in January 1921, and was able to steer through parliament a new Constitution on extreme centralist lines. This caused immediate ill-feeling, and drastic measures "for the defence of the state," including the annulment of the mandates of the 53 Communist Deputies.

Having broken openly with the Democrats, Pašić formed a purely Radical cabinet. Davidović replaced him in 1924, but soon after Pašić resumed power, supported by Pribičević. Radić, meanwhile, had been making political visits to Western Europe, Vienna and Moscow. In 1925 he suddenly recognised the constitution, dynasty and army, and entered the Government, but withdrew his support the next year. After a long deadlock, a Government coalition was formed in 1927 between the Radicals, Democrats, Slovenes, Clericals and Muslims. Radić and Pribičević united to organise among the Prečani (former subjects of Austria-Hungary) a campaign against centralist inefficiency and corruption. This was waged with increasing violence until on June 20, 1928, a Montenegrin Radical Deputy named Puniša Račić fired in the Skupština on the Croat Deputies, mortally wounding Stephen Radić and killing his nephew and a colleague outright. The Croats withdrew to Zagreb. Efforts to find a new Parliamentary modus proved unavailing.

The coup d'état of January 1929.—On January 6, 1929, King Alexander suspended the Constitution and established a personal dictatorship with the declared objects of improving administration, eliminating corruption and inefficiency and bringing about national unity. When those objects had been achieved, constitutional life—it was expressly promised—should be restored. The King's first premier was General Živković, commander of the Royal Guard, and the cabinet included both Serbs and Croats.

Considerable administrative and financial reforms were at first introduced. The King's most important measures were, however, those promulgated on October 3, 1929. The official name of the State was changed from the Serb-Croat-Slovene kingdom to Yugoslavia; and the historic subdivisions vanished altogether, the country being re-partitioned into 9 "Banovinas," called after their main rivers, and generally arranged (except in the case of the Drave Banovina, which corresponded to the old Slovenia) so as to strengthen the centralist elements. The Governors of the Banovinas were appointed by the Crown.

These steps were highly unpopular in Serbia itself, but the more obvious discontent was in Croatia, where it was fanned by the numerous arrests and political trials, including that of M. Maček, Radić's successor. Many Croat leaders—extremists and some moderates—fled abroad. Other political leaders from all parties were interned. The dictatorial regime continued throughout 1930. On September 3, 1931, a new Constitution was promulgated, but existing repressive measures remained in force, voting was open and no parties or other associations resting on a basis of religion, race or district were allowed. The opposition urged their adherents to boycott the elections, which returned a parliament mostly composed of Serbs, nearly all men quite unknown to the public. In fact, although General Živković retired from the premiership on April 4, 1932, the civilian ministers who succeeded him (Dr. Marinković, M. Srskić and M. Uzunović) were all representatives of the King's strongly personal and centralist policy, the "Yugoslav" tendency of which was still incomprehensible to most of the public. The widespread discontent was fostered by great economic difficulties, due mainly to the world crisis and to the fall in prices of agricultural produce; and by rumours of corruption in Government circles.

Foreign Policy.—In foreign affairs the King remained faithful to the policy of the Little Entente, strengthened by the signature in 1933 of its new Organisation Pact. Certain differences of policy were, however, to be noted in Yugoslavia's very friendly attitude towards Germany, which caused it to be widely believed that she would not oppose the Anschluss of Austria to Germany, preferring German influence in Austria to Italian. For the rest, Yugoslav foreign policy was pacific, and the King himself made notable and very successful endeavours after 1930 to improve relations with Bulgaria. He was unable to secure Bulgaria's participation on the Balkan Pact, signed in February, 1934, under which Rumania, Yugoslavia, Greece and Turkey mutually guaranteed each other's Balkan frontiers; but he brought about a genuine rapprochement with Bulgaria, whose capital he courageously visited in 1934. Relations with Italy and Hungary remained strained.

The Assassination of the King.—On October 9, 1934, King Alexander visited France, and on arriving at Marseilles, was assassinated by a Macedonian émigré. The assassins had had some connections in Italy and particularly Hungary, and relations with those two countries became increasingly difficult. A worse conflict was averted by the mediation of the League of Nations. The effect was greatly to strengthen the feeling of national unity. King Alexander's heir was his son, Peter II.; but the regency was entrusted to a Council of Three, consisting of Alexander's cousin, Prince Paul, and two Croats, Dr. Stanković and Dr. Perović. It was hoped that the centralist regime would now be relaxed, but although a few concessions were made, M. Uzunović kept in the main to the old centralising policy. His successor M. Yevtić, began with some concessions to the Croats, but the elections held in May 1935, although the opposition was allowed to contest them, proved a disappointment to those who expected a real change of methods. A new cabinet under M. Stoyadinović made certain further concessions; but the situation remained unsatisfactory.

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THE STRUGGLE FOR YUGOSLAVIA

The Royal Dictatorship.—The royal coup d'état of Jan. 6, 1929, by which the constitution had been suspended and parliament dissolved, had pursued one aim: to overcome the difficulties inherent in the fact that Yugoslavia was a heterogeneous state made up of three main elements of population, the Serbs, the Croats and the Slovenes, who though closely related by descent and language were different in their national temperament and in their historical traditions. King Alexander despaired of the effort to work out by patient parliamentary means a modus vivendi which would establish an ever more intimate relationship between the different constituent groups of the triune kingdom of the Serbs, Croats and Slovenes. Instead of that, he wished to force the amalgamation of the three elements in a united and unitarian Yugoslav kingdom, regarding himself as the great unifier of the southern Slavs. The new division of the kingdom into nine banovinas, named after rivers and following entirely geographic lines, was to obliterate the historical lines of division. Their names were: Dravska, Savska, Vrbaska, Primorska, Drinska, Zetska, Dunavska, Moravska and Vardarska. But King Alexander's experiment could be carried on only against the dissatisfaction of large parts of the population. The Serbs, by temperament and tradition a deeply democratic people, politically highly conscious and vocal, a nation of small independent sturdy peasants, protested against the dictatorial methods involved in the coup d'état. The Croats, by their history a much more peaceful and tractable people but sharing in the democratic attitude peculiar to the awakened Balkan peasantry, resented the dictatorial form of the regime and, even more, the attempt to divest them of their character as a separate nationality with its own deeply ingrained cultural traditions, and were afraid that the new regime would perpetuate the predominance of Belgrade instead of creating a more flexible federal constitution for which they had hoped.

The years of the dictatorship were, therefore, years of tension and trouble. King Alexander, in his plans for the new national state, looked to the fascist dictatorships for some idea as to how to strengthen national unity. Among others he accepted the idea of creating official youth organizations to inspire the young people with the spirit of national unity and loyalty to his regime. The famous athletic organization, the Sokol, or "falcon," which had been established among the Yugoslavs after the Czech example, on a voluntary basis of democratic patriotism, was to be incorporated officially into the new state. Like all other parties, the Croat Peasant party led by Dr. Vladimir Maček had been dissolved, but terrorist actions in Croatia led to the persecution and trial for sedition of Dr. Maček and some of his collaborators. He and most of his codefendants were acquitted. The internal tension was heightened by a threat of war with Italy, by corresponding military preparations and by the growing economic crisis which reached Yugoslavia in 1930 and made itself severely felt in all agrarian countries of southeastern Europe.

It was not only Croatian discontent which caused concern; it was also the discontent of the Macedonians in those parts of Serbia which had been annexed after the Balkan War in 1913. The revolutionary Macedonian organization kept alive the unrest in the provinces bordering on Bulgaria. The Yugoslav government tried hard to improve relations with Bulgaria. Bulgarians are southern Slavs like the Serbs

and the Croats, an agrarian democratic people, and there is much feeling of kinship among them. There have been repeated efforts for a union of all southern Slavs, but the rivalry between the Bulgarian and the Yugoslav royal houses made such a union impossible, though undoubtedly it would have been in the common interest and welcomed by the population. But in the years following 1930 serious attempts were made to arrive at a reconciliation between the two branches of the southern Slavs who in the last decades had been estranged by several wars between them and by their mutually exclusive claims to Macedonia with its inextricably mixed population groups.

On Sept. 3, 1931, King Alexander proclaimed a new constitution, which formally put an end to the existing dictatorship. But this constitution retained all the decisive powers in the hands of the king, strengthened the tendency toward centralization, and thus was far from satisfactory to the democratic and autonomist aspirations of the different parts of the population. It was accused of being a mere screen for the continuation of the royal dictatorship. The new constitution recognized the rights of the three official languages of the kingdom, Serb, Croat and Slovene, guaranteed the individual liberties and freedom of religion and of the press, but it did not allow the formation of any parties on ethnic or regional bases, and so made the formation of the Croat Peasant party and similar parties impossible. The electoral law of Sept. 12 made certain the victory of the government candidates, who represented the National Yugoslav party, a unitarian group somewhat aspiring to become the only Yugoslav party, like the Fascist party in Italy. But the deep democratic traditions and the proud sense of independence of the Serbs never allowed the transformation of the regime into anything approaching a fascist dictatorship. Demands for the restoration of a true democratic and representative government did not cease but gained in momentum, and were coupled with demands for the establishment of a federal state in which the different ethnic and regional groups would enjoy a large autonomy. This discontent led on April 4, 1932, to the resignation of the cabinet of Gen. Živković, who as the king's man had headed the Yugoslav cabinet after the coup d'état of 1929. He was followed by a number of civilians, who, however, continued to be straw men for the king's will. None of them lasted for more than a few months; first Dr. Voyislav Marinković, then Dr. Milan Srškić tried to include in their cabinets as many representatives of the Croats and of the Slovenes as possible, but that in no way reconciled the Croats. On May 30, 1932, bombs were thrown at the king's palace and at other points in Belgrade, and Croat nationalists carried on guerrilla warfare against Serbian authorities. Communist agitation and financial difficulties caused by the poor crops and the decline in foreign trade complicated the situation. On Nov. 14 an executive committee of a coalition formed of Serbian democratic opposition and Croatian Peasant leaders issued a manifesto demanding a return to democracy.

The new parliament elected under the new constitution did not meet with any favourable response. According to the constitution the parliament consists of two houses. The members of the senate were elected for six years, half of them to be re-elected every three years, and a corresponding number to be nominated by the king. Only citizens over 40 years of age can become senators. The chamber of deputies or Skupština was elected by public and verbal elections, in which every male citizen of over 21 years could participate. The lack of secrecy and the verbal character of the vote, however, gave the authorities complete control over the election results. Deputies were elected for a period of four years, one for every 50,000 inhabitants. At the elections held on Nov. 8, 1931, all deputies elected organized themselves into one party adhering to the government policies.

Meanwhile, with the accession of Hitler to power in Germany, the situation of the Little Entente, to which Yugoslavia belonged together with Czechoslovakia and Rumania, had become more critical. Incidents in Dalmatia had again aroused the spectre of a conflict with Italy; a proposed customs union between Italy and Albania had increased Yugoslavia's fears. There were even rumours current that the three "revisionist" powers, Italy, Germany and Hungary, might unite to divide Yugoslavia, Rumania and Czechoslovakia among themselves. Italian influence was very strong in Hungary and Bulgaria, and all that was felt as a threat to Yugoslavia who tried to rely partly upon her understanding with the Little Entente and with the newly formed Balkan Entente, comprising Turkey, Greece, Rumania and Yugoslavia —but partly also upon a rapprochement with Germany against which apparently Yugoslavia felt no aversion. Some Yugoslav circles were of the opinion that the German domination of Austria might be more advantageous to Yugoslavia's security than Italy's preponderant influence there.

To counteract the economic crisis, a number of new trade agreements were concluded in 1933, and an effort was made to implement the political co-operation of the Little Entente by economic co-operation. In spite of the growing seriousness of the international situation, the internal tension between Croats and the government showed no relaxation, though Croat and Serb leaders collaborated in their demands for the restoration of democracy.

The Tragedy of Marseilles.—In the internationally tense situation the French foreign minister, Louis Barthou, one of the most agile of French statesmen, tried to re-establish closer ties between France and her eastern allies, and especially to arrange for an understanding between Yugoslavia and Italy. On Oct. 9, 1934, King Alexander landed in Marseilles, where he was greeted by M. Barthou. On their way through the streets of the French port they were both assassinated. It was proved that the assassination had been inaugurated by a Croat revolutionary organization under Dr. Ante Pavelić, the head of the terrorist Ustashi, and his fellow worker Sladko Kvaternik. A French court sentenced them to death in absentia for the murders. Both were living in Italy, where apparently they were on the best of terms with the fascist government. The Ustashi movement also had a training farm at Janka Puszta in Hungary near the Yugoslav border, where the terrorists were trained and educated in fascist principles. The Yugoslav government charged that the Hungarian government had been aware of this activity and had supported it.

The eleven-year-old son of King Alexander, Peter II, became king under the regency of his uncle Prince Paul, as chief regent, with Dr. Radenko Stanković, a Slovene, and Dr. Ivo Perović, a Croat, as members of the regency council. All three had been appointed by the late king in his last will.

The death of the king introduced a more conciliatory spirit into the administration, but the new cabinet under Bogoljub Yevtić was in no way ready to accept the demands of the opposition. New elections in May 1935, did not change the composition of the parliament. The Croats refused to collaborate. In 1936 Milan Stojadinović became prime minister. He tried to alleviate the economic crisis by diversification of agriculture and industrialization of the country. The basis for a heavy industry was not lacking, as sufficient ore was found in the country. But the most important event under the new cabinet consisted in the attempt to reorient Yugoslavia's foreign policy. Mr. Stojadinović was favourably inclined toward the fascist dictatorships. Thus the ties binding the countries of the Little Entente were loosened, and especially cordial relations were established with National Socialist Germany.

Toward a Serb-Croat Understanding.—On Sept. 15, 1937, Dr. Maček met with the leaders of the Serb Radical party, the Serb Democratic party and the Serb Agrarian party at Zagreb, the Croatian capital. His own party, which represented the overwhelming majority of the Croat people, and the three Serb parties, which could speak for the overwhelming majority of the Serb people, reached complete agreement and demanded the abolition of the semidictatorial constitution, free elections to a constituent assembly which would elaborate the new constitution and finally the formation of a coalition ministry containing representatives of all major parties. Thus the foundation was laid for a Serb-Croat understanding. But the government of Stojadinović did not wish to reintroduce democracy, the more so because it knew that the Serbs and the Croats were for complete and close co-operation with the democratic peoples, while Mr. Stojadinović followed more and more openly a policy of close collaboration with the Rome-Berlin Axis. As a result of this policy he in no way opposed Germany's annexation of Austria, though this act brought the German army to the borders of Yugoslavia. He trusted Mr. Hitler, who solemnly pledged the inviolability of Yugoslavia's frontiers. Nor did the Yugoslav government help its nominal ally Czechoslovakia when Germany threatened that country. The sympathies of the Yugoslav population were outspokenly and enthusiastically for Czechoslovakia, but the government did not heed popular opinion and pursued unflinchingly its pro-National Socialist policy, which also helped to establish the economic domination of Germany in Yugoslavia.

The year 1937 saw also much agitation of the Orthodox church against a proposed concordat of the government with the Roman Catholic church. The patriarch of the Orthodox church died during the controversy.

The year 1938 was marked by continued co-operation between the Croats and the Serbs. Dr. Maček visited Belgrade on Aug. 14. Both peoples were united in their demands for democracy and in their opposition to a profascist foreign policy. Meanwhile Prime Minister Stojadinović visited Italy and Germany and was everywhere most warmly received. His policy led also to a rapprochement with Hungary and Bulgaria. On Dec. 11, 1938, new elections were held, in which all opposition parties, Serbian and Croation, joined in a common front against the government. The government succeeded in receiving a slight majority of votes. The only outright fascist party, the Zbor, received only 30,310 votes, or less than 1% of the votes cast. The great triumph of the opposition at the polls indicated the instability of the regime. In spite of all the pressure exercised by the government and in spite of the method of open and oral ballots, the government succeeded in getting—according to its own official figures which were subject to doubt—only 1,643,783 votes as against 1,364,524 for the opposition.

As a result, Stojadinović resigned on Feb. 4, 1939. He was followed by Dragisha Cvetković. Minister of foreign affairs in the cabinet was Aleksander Cincar-Marković; minister of war was Gen. Milutin Nedić. The new government mitigated the pro-Axis course in foreign policy in agreement with public opinion, though the sympathies of the foreign minister were known to be profascist. But a serious attempt was made to solve the Croat-Serb problem. After long negotiations, agreement was reached on Aug. 25, 1939. Two of the banovinas, Savska, and Primorska, were united into a single administrative unit called Banovina Croatia, comprising about one-fifth of the total area of the state and having a population of 4,500,000 or about a third of the country. Croatia was to enjoy a large autonomy and to

have its own Diet at Zagreb. Mr. Subasitch was appointed ban of autonomous Croatia. These measures were regarded as only the first step toward the complete reconstruction of Yugoslavia, the autonomous constitution of further units and the reintroduction of parliamentary democracy based upon free elections as the centre of the government. The outbreak of European war in the fall of 1939 postponed the realization of these plans.

Yugoslavia and the War.—With the outbreak of World War II, the Yugoslav government proclaimed its neutrality. As the year 1940 developed, the government, despite the outspoken sympathies of the large majority of the people, showed a pronounced tendency toward rapprochement with Germany. Efforts to establish closer co-operation and an antifascist bloc among the Balkan countries through the medium of the Balkan entente proved futile. Each of the nations was split into pro and antifascist cliques; this divisory spirit among the Balkan governments worked to the advantage of the axis. Furthermore, within Yugoslavia itself, the ill feeling existing between the Croats, who sought more representation in the government, and the reigning Serbs complicated that country's position.

Meanwhile, the government rulers moved closer toward the axis and on Feb. 26, 1941, Yugoslavia signed a friendship pact with Hungary. This step of the Yugoslav administration toward tighter bonds with the axis was facilitated by Hitler's bloodless and successful occupation of Rumania. The adherence of Hungary, Rumania and Bulgaria to the axis pact left Yugoslavia little choice. The alternative was to resist Germany in co-operation, if possible, with Greece and Turkey. However, the government was predisposed toward the axis and in the early months of 1941, the prime minister, Dragisha Cvetkovitch, and the foreign minister, Alexander Cincar-Markovitch, visited Hitler in Berlin. While they seemed politically inclined toward the fascist orbit, they had legitimate reason to fear that the Yugoslav people might revolt against an alliance with Germany and Italy. Thus Cvetkovitch and Cincar-Markovitch dallied in their negotiations with Hitler until March 22, 1941, when, yielding finally to a German ultimatum, they decided to join up with Hitler and Mussolini. On March 25, Cvetkovitch and Cincar-Markovitch affixed their signatures in Vienna to the axis pact.

This proved to be a fatal mistake of the Cvetkovitch government. Two days later, the people and elements of the army who had objected to this surrender to fascist pressure overthrew the government. Gen. Dusan Simovitch, Yugoslav chief of aviation became prime minister and King Peter II assumed the government amid unprecedented scenes of public rejoicing by the Serb people, who saw their liberty saved and in a lesser degree by the Croats. Under Gen. Simovitch, Dr. Vladimir Maček continued as vice-premier. Prince Regent Paul fled to Greece and Cvetkovitch and Cincar-Markovitch were arrested.

The Yugoslav decision to make a fight rather than submit to the axis came too late. The country already was hemmed in by German troops and as the preceding government was inclined to appeasement, it had not prepared the army and its mobilization sufficiently. Thus, when the wehrmacht struck from several directions on April 6, 1941, it defeated the courageous Yugoslav army in two weeks.

Promptly thereafter the axis powers partitioned Yugoslavia. Croatia was brought under the "protection" of the Italian crown. Italy also annexed important parts of the Dalmatian coast and divided Slovenia with Germany. For their assistance, Bulgaria and Hungary also received shares of Yugoslavia.

After the collapse of his armies, King Peter II fled to London where he set up a government-in-exile. At home, Yugoslav guerrilla armies emerged; within Serbia, Gen. Draja Mikhailovitch organized the Chetniks who, at one time, claimed a membership of 250,000. A rival group, the partisans, was headed by Marshal Josip Broz (Brozovitch), a Croat communist, more widely known as Tito. Mikhailovitch's army consisted chiefly of Serb factions loyal to King Peter. Tito's forces were more representative in character and welcomed volunteers from men of all races, parties and classes.

After 1942, Tito's forces vastly overshadowed the Chetnik movement in size and importance and the British, who had been supporting Mikhailovitch switched their support to the partisans.

Then, on Dec. 4, 1943, Tito's Yugoslav Committee of National Liberation announced that it had set up a provisional government in opposition to the existing *émigré* regime in London. Tito's assumption of power was opposed by the Chetniks and clashes between the two forces were frequent. As a result of the émigré government's failure to disavow Mikhailovitch, Tito deprived the London regime of all rights and openly accused Mikhailovitch, who had been named war minister in the royal government, of organizing civil strife.

At first King Peter refused to recognize the Tito government; later, he endorsed the formation of a new cabinet for the London regime by Dr. Ivan Subasitch (July 7, 1944), who was empowered to confer with Tito and to work out a solution of the dispute. Tito and Subasitch agreed on formation of a regency for rule of Yugoslavia. This agreement was reluctantly recognized by King Peter on Jan. 29, 1945.

As World War II drew to its end, Tito's partisans in Yugoslavia and Allied forces in northern Italy engaged in a race for occupation of the Venezia Giulia department of Italy. In May 1945, a Yugoslav partisan force entered Trieste but was prevented from assuming complete control of the port by the almost simultaneous arrival of British and U.S. troops.

Tito's efforts to win control of Trieste and surrounding areas resulted in sharp and acrimonious exchanges with the U.S. and British. But on June 20, a compromise agreement was reached whereby a joint occupation of the disputed Italo-Yugoslav border area by U.S., British and Yugoslav troops was provided until final disposition of the territory at the peace conference.

The Republic.—On Aug. 7, 1945, Marshal Tito appealed to the national congress meeting in Belgrade to support a republican form of government and he denounced the monarchical regime. Tito's views were upheld in the national elections for a constituent assembly, Nov. 11, when about 6,500,000 Yugoslavs voted their approval of his policies while 700,000 cast ballots against him. The rightist opposition refused to participate in the elections on grounds that they were neither free nor democratic. Tito, however, declared (Nov. 16) that the results of the vote proved conclusively that the people of Yugoslavia rejected any "return to the old state of affairs." On Nov. 29, a republic was proclaimed by the constituent assembly meeting in Belgrade and the monarchy was abolished. On hearing the news, King Peter in London asserted that the decision was unfairly reached, alleging that Tito had forbidden the people to express their own wishes on the issue of retaining the monarchy.

The new constitution was adopted by the constituent assembly (Jan. 31, 1946) and Tito was asked to form a new government. In its post-war foreign policy, the Tito government was decidedly pro-Russian and anti-British. Tito made renewed demands for Istria and that part of Slovenia containing Trieste.

The Russians were disposed to support Tito's claims while the British rejected them. Tito also suspected that the Allied armies in northern Italy might be used for a possible thrust into Yugoslavia. The Allies on the other hand feared that Tito's communism would spread into Italy if their forces did not bar the way. These conflicting views were mirrored in the Allied-Yugoslav dispute on the presence of Yugoslav royalist and anti-Russian Polish forces in Italy and in the Allied occupation zones of Germany. On Feb. 16, the Tito government, through the medium of the Russian delegate to the United Nations, charged that the Polish forces in Italy had been moving closer toward the Yugoslav border and were a "possible future threat to peace." This accusation was categorically denied two days later by Ernest Bevin, the British foreign secretary.

The U.S. state department announced April 18, 1946, that it would recognize the new republic, although with some reservations as to Tito's domestic policies.

In the spring of 1946, Draja Mikhailovitch, who had been captured by Yugoslav forces (March 13), was on the way to becoming an international *cause célèbre*. The Tito government's announcement that Mikhailovitch would be tried on charges of collaboration with the axis provoked an outcry from anti-Tito elements in the U.S. and Britain who expressed doubt that the Chetnik leader would receive a fair hearing.

A U.S. state department request that some U.S. airmen who had been rescued during the war by the Chetniks be permitted to testify for Mikhailovitch was rejected by the Yugoslav government (April 5, 1946). The trial took place between June 10 and July 15, 1946, when Mikhailovitch was declared guilty of treason and collaboration with the axis and sentenced to death. He was shot on July 17. (*See* also WORLD WAR II.) (H. Ko.; X.)

DEFENSE

The first shots in World War I were fired by Austrian guns bombarding Belgrade on July 29, 1914. After a gallant resistance the Serbian army was overpowered by its northern adversaries in October 1915, and forced into a disastrous retreat across Albania as the result of a sudden blow struck from the right rear by the old adversary Bulgaria. After being reconstituted in Greek territory (Corfu) the Serbian troops joined the Allied army at Salonika, and those troops formed the nucleus of the Yugoslavian army of 1939. In October 1918, when the resistance of the central powers was on the point of collapse and the Bulgarians had already thrown up the sponge, the Serbian army numbered 63,050 combatants, with a ration strength of 110,550. It was organized in six infantry divisions and one of cavalry, with 289 field guns. Its battle casualties had exceeded 331,000, a figure which included 45,000 killed and over 133,000 wounded in action. Such was the war record of the Serbian troops in what was later the army of Yugoslavia.

The Army of 1939: Recruitment and Service.—The territory of the Serbs, Croats and Slovenes was divided into 5 army areas, each of these containing three or four divisional areas subdivided into military districts. Military service was obligatory for all physically fit citizens between the ages of 21 and 40 with the active army and subsequently with the reserve up to the age of 50. With the sanction of the cabinet, the war minister could also call up youths of ages from 18 to 20 and all men under 55 years. Service with the colours was for 18 months from the year in which the 21st birthday falls.

Yugoslavia was divided into areas for 16 infantry and 3 cavalry divisions. The infantry divisions included also artillery, while the cavalry divisions included horse artillery. On the whole there were in 1939, 53 infantry regiments, 10 cavalry regiments and 33 artillery regiments. In addition there were independent heavy artillery formations and pioneer and engineering regiments. The budget for the year 1939–40 comprised a sum of 2,928,166,000 dinars for army and navy.

In Yugoslavia the ministry of war controls the army, the air force and the navy.

The Yugoslav air force in 1939 counted 8 regiments with 48 squadrons and 2 hydroplane regiments with 7 squadrons. The small navy, destined exclusively for coastal defence, comprised 1 cruiser, 1 flotilla leader, 3 destroyers, 6 torpedo boats, 8 motor torpedo boats, 4 submarines and 35 different auxiliary units. (X.)

ECONOMIC AND FINANCIAL POSITION

Agriculture and Livestock.—Agriculture occupies about 80% of the total population of Yugoslavia. The different provinces vary greatly in climate, soil, configuration and methods of cultivation. The coastal districts and the high Karst land immediately behind them are mountainous and often barren, and present great difficulties of communication. The most fertile districts are the Voivodina (Banat and Bačka), Slavonia and northern Serbia (especially the Mačva, Morava and Timok districts) and portions of Croatia, Slovenia and Bosnia. The principal crops are maize and wheat (40% of both being produced in the Voivodina), sugar beet, hemp and hops (also in the north), opium (in Macedonia) and tobacco (chiefly in Macedonia and Hercegovina). Other important crops are beans, potatoes, flax, clover and lucerne.

Areas Sown and Productions in 1938

Crop	Acreage	Tons
Wheat	5,262,393	3,029,037
Barley	1,026,235	421,259
Rye	627,178	227,102
Oats	894,051	326,526
Maize	6,801,742	4,755,873
Vines	540,264	4,672,157*

*Hectolitres

Admirable wines are produced in Dalmatia and Hercegovina in Syrmia (of the Hungarian type) and along the Danube in Serbia (Smederevo). The fruit industry is important, notably in the Sumadija district of Serbia and in the east of Bosnia. In an average year some 750,000 tons of fresh plums are produced, and 40,000 to 50,000 tons of dried plums and pulp are exported. There were eight sugar factories, two state-owned, the rest in the hands of foreign banks and companies.

In 1938 there were in Yugoslavia 1,264,470 horses, 142,323 mules and asses, 4,267,339 cattle, 10,137,357 sheep, 3,450,884 pigs and 1,890,386 goats. The forests cover 7,500,000 hectares of land, of which all save 2,000,000 is old forest. Timber is a main article of export, Italy, Egypt and the Levant being the best customers. The most important state forests are in Bosnia, beech, fir and oak being the commonest trees. The Slavonian oak (known abroad as "Austrian oak") is valuable and of high quality. In Serbia 60% of the forests are beech. At Teslić there is a wood-distilling factory, which is the largest in Europe, and produces methylated spirit, alcohol, formaldehyde and acetone.

Mining and Mineral Resources.—The mineral resources of Yugoslavia have for the most part lain idle since Roman and mediaeval times, but offer very great possibilities. Iron ore of good quality occurs in enormous quantity and near the surface at Ljubija, in Bosnia, where it is mined by the state mining authorities and sold for exportation. Another iron mine worked by the state exists at Vareš, in Bosnia, and is worked in conjunction with a coal mine and iron-smelting establishment and the ironworks at Zenica. The metallurgical works here are on a primitive scale, their production being pig iron and small castings. The ironworks at Jesenice (Slovenia), which have a capacity of 70,000 tons per annum, produce bar iron, iron and steel sheets, steel rails up to 22 kilograms per metre (as used on the Bosnian narrow-gauge railways), rolled iron, drawn iron and wire nails. Bar iron is manufactured at Store, near Celje, in Slovenia; steel and steel springs at Guštanj, on the Maribor-Klagenfurt railway, and highly silicated foundry iron is produced at Sopusko in Slovenia. Large deposits of brown coal and lignite occur in many parts of Yugoslavia, but there is no coking coal. Copper is produced at Bor and Majdanpek in Serbia.

In 1938 the output of iron ore was 606,884 metric tons, of copper ore 762,066 metric tons and of lead-zinc ore 882,892 metric tons. Of chrome ore 58,470 metric tons were produced, and of brown coal and lignite 5,737,193 metric tons.

Principal exports in 1939, valued in thousands of dinars

	1938	1939
Eggs	157,455	160,313
Wheat	208,811	375,101
Cattle	74,865	107,659
Maize	480,873	99,082
Swine	376,954	484,161
Fresh meat	236,589	282,521
Timber	676,275	853,102
Copper ore	406,062	441,428

Foreign Trade.—The total exports in 1939 amounted to 5,521,187,370 dinars—the principal items being shown in the table in the first column. The chief countries of destination are shown in the table below.

Chief countries of destination

Country	Value in thousands of dinars	
	1938	1939
Germany	1,813,864	1,762,003
Great Britain	485,133	366,698
Czechoslovakia	398,361	769,203
Belgium	336,843	348,304
Italy	324,297	583,516
United States	255,860	280,736
Hungary	215,377	289,246
Greece	130,250	135,382
Netherlands	108,788	103,388
Switzerland	83,741	167,529

Imports during 1939 amounted to 4,757,381,947 dinars, the most important items being cotton and cotton goods (690,740,000 dinars), iron and iron goods (576,461,000 dinars), wool and woollen goods (415,169,000 dinars) and machinery (388,303,000 dinars). Germany took first place on the list of countries supplying Yugoslavia's imports.

Revenue and Expenditure.—For the year 1939–40, the expenditure was estimated at 12,942,000,000 dinars, and the revenue at the same figure. The principal sources of revenue were (in millions of dinars): direct taxes, 3,025; indirect taxes, 2,304; state enterprises, 4,253; monopolies, 2,215; and various, 44.

The Yugoslav dinar was originally equal to a franc. On May 8, 1931, a stabilization loan was concluded in Paris to help in the legal stabilization of the dinar. As a result the dinar was stabilized at a value of 26.5 mg. of gold, or 11 dinars corresponding to 1 gold franc, 100 dinars to $1.76 in gold.

Public Debts.—On July 1, 1939, the public external debt of Yugoslavia comprised the most various items, partly prewar debts, going as far back as 1888, war debts to the British government, to the United States and to the French government, and finally postwar debts. The internal debt amounted on April 1, 1939, to 8,613,000,000 dinars. (H. Ko.)

YUKON, the largest river in Alaska, and the fifth largest in North America. With its longest tributaries not in Alaska, the Lewes and the Teslin (or Hootalinqua), its length is about 2,300 mi., in the form of a great arc, beginning in the Yukon district of British Columbia, near the Pacific ocean, and ending at the Bering sea coast. Its catchment area is about 330,000 sq.mi., more than one-half of which lies in Canada. The Lewes river rises in Lake Bennet, or, more accurately speaking, Lake Lindeman, on the northern slope of the coast range just over the Dyea pass up from Lynn canal (at the head of Chatham strait). It flows north through a chain of lakes with connecting streams until it is joined by the Hootalinqua about 30 mi. below the last of these lakes (Lebarge). Its confluence with the Pelly river, at Selkirk, Yukon district, about 120 mi. due east of the Alaskan-Canadian boundary, forms the headwaters of the Yukon proper. Flowing thence north-west, the Yukon turns abruptly to the south-west near Ft. Yukon, Alaska, on the Arctic Circle, and continues nearly at right angles to its former course to a point south of the head of Norton sound, where it turns again and flows in a north-west direction, emptying into the sound from its south shore.

The Yukon valley comprises four sub-provinces, or physiographic divisions, called the "Upper Yukon," "Yukon flats," "Rampart region" and "Lower Yukon." The "Upper Yukon" valley is about 450 mi. long and from 1 to 3 mi. broad, and is flanked by walls rising to the plateau level from 1,500 to 3,000 ft. above the stream. In this part of its course the Yukon receives from the south the Selwyn river (about 40 mi. below the junction of the Lewes and Pelly rivers); from the west the White river (about 60 mi. below the Selwyn); from the north the Stewart river (about 10 mi. below the White), one of the largest tributaries of the Yukon; from the east the Klondike river (near 64° N. lat.); from the west Forty-mile creek (about 40 mi. above the Alaskan-Canadian boundary line), and many other smaller streams. The "Yukon flats" flank the river for about 200 mi. and are from 40 to 100 mi. wide. Here the stream varies in width from 10 to nearly 20 mi., and involves a confused network of constantly changing channels. Here, too, the river makes its great bend to the south-west, and its channels are constantly changing. The "flats" are monotonous areas of sand bars and low islands, thickly wooded with spruce. The principal tributaries here are the Porcupine river (an important affluent, which enters the main stream at the great bend about 3 mi. N. of the Arctic Circle); the Chandlar river, also confluent at the great bend, from the north, and, near the west edge of the flats, the Dall river, also

from the north. The "Rampart region" begins near 66° N. lat., where the "flats" end abruptly, and includes about 110 m. of the valley, from 1 to 3 m. wide, and extending to the mouth of the Tanana. No large tributaries are received in this part of the river. At the west edge of the Ramparts the Yukon receives the Tanana river, its largest tributary lying wholly within Alaska. The Tanana valley is about 450 m. long, nearly parallel to the Yukon from about due west of its head waters to the great bend, and drains about 25,000 square miles. Its sources lie in the glaciers on the north slopes of the coast, or St. Elias range, and it receives many tributaries. The Lower Yukon includes that portion between the ramparts and the sea, a stretch of about 800 m. At the mouth of the Tanana (which enters the main stream from the south) the gorge opens into a lowland from 15 to 20 m. wide. Along the north-west boundary of the valley are low mountains whose base the Yukon skirts, and it continues to press upon its north bank until the delta is reached. The valley is never less than 2 or 3 m., and the river has many channels and numerous islands; it has walls nearly to the head of the delta, though about 100 m. above the delta the south wall merges into the lowland coastal plain; the relief is about 1,000 feet. The Yukon delta begins near 63° N. lat. Here the main stream branches into several channels which follow north or north-west courses to Norton sound. The northernmost of these channels is the Aphoon pass, and the most southerly is Kwikpak pass; their outlets are about 75 m. apart on the coast, and from 40 to 50 m. from the head of the delta. Between them is a labyrinth of waterways, most of the intervening land being not more than 10 ft. above low tide.

The Yukon river is unique among rivers, in that it rises within 15 m. of tidal waters in the Dyea inlet on the Pacific coast, whence it flows in a north-westerly direction nearly 1,000 m., just crossing the Arctic Circle, where it turns south-west through the middle of Alaska, and then flows more than 1,200 m. until it reaches the ocean within sight of which it rose; for we may properly call Bering sea a part of the Pacific ocean. This grand stream is also surprising in the length of navigation way it gives in proportion to its length, for less than 15 m. N. from where its tiniest streamlets trickle from the crest of Dyea pass lies Lake Bennet, whose head is the true beginning of steamboat navigation on this noble stream. From the starting-point of those same streamlets one can look down on other streamlets beginning their steep descent of the Dyea pass to the waters of the Lynn canal. The nearest harbour for ocean-going vessels is a poor one at St. Michael's island, about 60 m. north-east of the delta; here freight and passengers are transferred to flat-bottomed river steamers. These enter the delta and the river by the Aphoon pass, which is about 4 ft. deep at mean low water, the current varying from 1½ to 4 m. an hour. The Lewes is navigable as far as White Horse rapids, which with Miles cañon obstruct the river for a few miles. Above them the stream is again navigable to its source, about 100 m. beyond. The White pass and Yukon railway from Skagway to White Horse (111 m.) overcomes these obstructions, however, for traffic and travel. The Stewart river, seldom less than 150 yd. wide, is navigable by light-draught steamers to Frazer falls, a distance of nearly 200 miles. The Tanana is navigable for about 225 m. to the mouth of the Chena, and above the mouth of the Chena it again becomes navigable for more than 250 m., including its principal upper tributary, the Nebesna. The Koyukuk, the second largest tributary, entering the Yukon about 600 m. up from its mouth, is navigable for 570 m. (Camden). Altogether the Yukon proper with its principal tributaries embraces more than 3,500 m. of navigable waters. The system is open to navigation from May until September.

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YUKON TERRITORY, the most westerly of the northern territories of Canada, bounded south by British Columbia, west by Alaska, north by the Arctic ocean and east by the watershed of Mackenzie river. It has an area of 205,346 sq.mi. (excluding water). The territory is chiefly drained by the Yukon river and its tributaries, though at the southeast corner the headwaters of the Liard river, flowing into the Mackenzie, occupy a part of its area. The margins of the territory are mountainous, including part of the St. Elias range with the highest mountains in Canada at the southwest corner, Mount Logan (19,850 ft.) and Mount St. Elias (18,008 ft.), and the north extension of the Rocky mountains along the south and northeast sides; here, however, not very lofty. The interior of the territory is high toward the southeast and sinks toward the northwest and may be described as a much dissected peneplain with low mountains to the south. The most important feature of the hydrography is the Yukon (*q.v.*) and the rivers which flow into it. The Klondike gold mines are reached by river boats coming down 460 mi. from White Horse, the terminus of the White Pass railway, 111 mi. long, from Skagway on an inlet of the Pacific. The Trans-Canada Airlines have branch services to the Yukon from Edmonton. The Alaska-Canada highway of 1942 connects railhead at Dawson Creek, B.C., with the Yukon and Alaska.

Before the discovery of gold on the Forty Mile and other rivers flowing into the Yukon the region was inhabited only by a few Indians, but the sensational finds of rich placers in the Klondike (*q.v.*) in 1896 brought in a vigorous population centred in the mines and at Dawson, which was made the capital of the newly constituted Yukon territory. With the decline of the gold-mining industry, the population decreased from 27,219 in 1901 to 4,157 in 1921, with 4,914 (males 3,153) in 1941. The Yukon is administered by an appointed (dominion) commissioner and a Territorial Council of three, elected for three years from the Dawson, White Horse and Mayo districts. Law and order are enforced by members of the Royal Canadian Mounted Police. The Yukon is represented in the dominion parliament by one member in the house of commons. Placer gold, originally the principal output, is now quite subordinate to lode mining. Gold output, 1941, 70,939 fine oz. The Yukon has also been a steady producer of silver and in 1940 yielded 2,259,343 fine oz., mostly from Keno and Galena Hills, in the Mayo district. A concentrator has been installed at Keno Hill. The wide distribution of the ores of gold, copper, silver and lead indicate enormous mining possibilities. Coal, of which there are large reserves, is being mined. Large game and fur-bearing animals abound.

Though so near the Pacific the Yukon territory has a rigorous continental climate with very cold winters seven months long, and delightful sunny summers. Owing to the lofty mountains to the west the amount of rain and snow is rather small, and the line of perpetual snow is more than 4,000 ft. above sea-level, so that glaciers are found only on the higher mountains; but the moss-covered ground is often perpetually frozen to a depth of 100 or 200 ft. Vegetation is luxuriant along the river valleys, where fine forests of spruce and poplar are found, and the hardier grains and vegetables are cultivated with success.

YUMA, a city near the south-western corner of Arizona, U.S.A., on the Colorado river, at the mouth of the Gila river; it is the county seat of Yuma county. It is on Federal highway 80; has a municipal airport; and is served by the Southern Pacific and the Yuma Valley railways. Pop. (1940) 5,325.

YUMAN, a speech stock of American Indians, named from the Yuma tribe, living about the lower Colorado river and occupying a distinctly desert habitat. The groups that belong are the Havasupai, Walapai and Yavapai of the mountains of western Arizona; the Mohave (*q.v.*), Yuma, Kamia and Cocopa (*q.v.*) in the Colorado river bottomlands; the Maricopa (*q.v.*), Halchidhoma, Kohuana, Halyikwamai, once on the river but driven out and the remnants, except the Maricopa, lost to tribal identity; the Diegueño to the rear of San Diego in California; and the Akwa'ala, Yukiliwa, Cochimi and other groups known under varying local names in Mexican California. Of these tribes, the most advanced were those on the Colorado, who have changed little since their discovery by Alarcon in 1540. They have always been warlike and turbulent, but chiefly among one another. They are agricultural, marking the north-western frontier in the continent of the native practice of maize farming. They make pottery but no basketry. They are divided into totemic patrilineal clans

YUNCAN, a group of tribes of South American Indians, forming an independent linguistic stock. The Yuncas (known also as Chimus and Muchic) occupied originally the arid coastal region of northern Peru comprised within the valleys of Trujillo, Chicama, Jequetepeque, Lambayeque and Morope; later, by conquest, they extended the area controlled north as far as Tumbez and southward to Chancay. In the 15th century they were conquered, after stubborn resistance, by the Incas and their territory included within the Inca empire. Their most important centre was the great city of Chan Chan (Gran Chimu), which was situated near the present Trujillo.

The Yuncas were a city-dwelling, agricultural people with highly developed agriculture, growing manioc, maize and sweet potatoes. While the houses of the poorer people were doubtless of reeds and matting or thatch, the better dwellings and all the important structures were built of sun-dried brick. The temples were stepped pyramids, raised on high platforms, and containing burial chambers within. Some of the palaces were decorated with elaborately executed stucco relief patterns in geometric style derived from textiles, and reminiscent of the stone mosaics of Mitla in Mexico. The Yuncas were wide traders along the coast, using reed and log balsas or rafts, and constructed regular harbour works at their ports. They were expert textile makers and raised cotton for the purpose; were very skilful workers in gold, of which great amounts have been excavated by treasure-hunters; and were also makers of very fine pottery, of which three sequent styles may be distinguished. They would appear to have had a rather elaborate social and governmental organization, with kings or chiefs of considerable power. In their religion they venerated the moon more than the sun (in contrast to their Inca conquerors), and also held sea deities in high esteem.

See M. C. Balboa, *Histoire du Perou;* A. de la Calancha, *Cronica moralizada,* etc. (Barcelona, 1638); E. W. Middendorff, *Das Muchik oder die Chimu-Sprache* (Leipzig, 1892); M. Uhle, "Die Ruinen von Moche," *J. Soc. Americanistes de Paris,* (ms.) vol. x., pp. 95–119; A. L. Kroeber, "The Uhle Collection from Moche," *Univ. of California, Pub. Amer. Arch. Ethnol.,* vol. xxi., pt. 5.

YUNNAN (*South of the Clouds*), a southwest province of China, bounded north by Szechwan and Sikang, east by Kweichow and Kwangsi, south by Annam and Burma, and west by Burma and Assam; area 155,861 sq.mi. The population was 10,853,359 in 1939, but increased due to wartime migration from Japanese-occupied China. The inhabitants include many races beside Chinese, such as Shans, Lolos and Miaotze. The Mosos, in northwest Yunnan, once formed an independent kingdom which extended into East Tibet. Some of the inhabitants are staunch Moslems. The west and northwest have high mountain ranges and deep gorges of the Kinsha-kiang (upper Yangtze-kiang), the Mekong and the Salween; the ridges have peaks over 16,000 ft. high, the slopes are often heavily forested. The Burma road, built in 1939, leads from Kunming via Paoshan and Lungling to Lashio with a branch road via Tengyueh to Bhamo. The southeast includes the upper basin of the Songkoi or Red river, and of the Pata-ho (upper Si-kiang); the former becomes navigable near Man-hao, just before it leaves Yunnan for Tonkin. This region has rich valleys and open, undulating country. The northeast, near the Yangtze-kiang's right bank, is not very high, though higher than Kweichow, over the border, but it is deeply dissected and sparsely peopled. There are a few lakes, especially near the capital, Kunming. The mean monthly temperature of Kunming varies from 47° F. in December to 69° F. in July, the warm season being April to August and the rainy season March to August, with the maximum in June (13.34 in.). The total annual fall is 37 to 38 in. Yunnan under its native governor, Lung Yün, had been practically autonomous. But war conditions after 1937 reintegrated the province with the national government. The province became an important communications link between Chungking, Chengtu, Kweiyang and Burma. Following an Anglo-Chinese agreement in 1941, finally delimiting the Sino-Burmese border, railway construction was begun for a Kunming-Lashio railway as the railway to Japanese-controlled Indo-China had been torn up. The fall of Lashio to the Japanese in 1942 closed the Burma road. The Japanese continued their advance into Yunnan province as far as the Salween river occupying Tengyueh and Lungling. In 1944 a Chinese counteroffensive aimed at clearing the province and reopening the Burma road in connection with the Sino-American upper-Burma offensive. The war greatly stimulated the industrial and agricultural development of the province. The mineral resources in tin, coal, iron, tungsten, antimony, copper and gold were being developed, and private factories in metallurgy, machinery, electrical equipment, textiles, rubber, cement and other productions were established. In food and textiles progress has been made toward provincial self-sufficiency. Yunnan, long independent, was subdued by Kublai Khan, but was not finally incorporated in the empire until the 17th century. It was the principal centre of the great Mohammedan rebellion, which lasted 16 years and was suppressed in 1872.

See H. R. Davies, *Yunnan, the Link between India and the Yangtze* (Cambridge, 1909); A. Little, *Across Yunnan* (London, 1910); Rev. J. M'Carthy, "The Province of Yunnan," in *The Chinese Empire* (London, 1907); L. Richard, *Comprehensive Geography of the Chinese Empire* (Shanghai, 1908).

YUN-NAN-FU (KUNMING), the capital of Yunnan province, China, about 500 mi. by rail N.N.W. of Haiphong, Tonkin. It is centrally placed at a focus of ways within the province. The plain near by is fertile and well populated. The city has a strong Mohammedan colony and suffered during the Mohammedan rising in 1855. The opening of the French railway from Tonkin in 1910 brought a development with French interests. However, Kunming, pop. about 50,000, remained a provincial city with inefficient electric light and telephone systems. The population and importance greatly increased (pop. to over 150,000) during 1940–41 with the completion of the Burma road with Kunming as terminus. The railroad to Japanese-controlled Indo-China was torn up and French influence ended. Kunming became a centre of tin, steel, copper, cement, rubber, textile and other industries and the communications and cultural centre of the southwest.

YURIEV: *see* TARTU.

YUROK, a tribe on the lower Klamath river, asserted but also disputed to be of Algonkin speech lineage, is perhaps the nuclear group of the N.W. California Indian culture, principal others being the Hoḳan Karok upstream, the Athabascan Hupa (*q.v.*) of Trinity, the Chilula of Redwood, the Tolowa of Smith river; and the Algonkin (?) Wiyot of Humboldt bay. The Yurok once numbered about 2,400 in more than 50 villages; 500 remain.

YURUCAREAN, a small group of tribes of South American Indians, constituting an independent linguistic stock. The Yurucares live in Bolivia on the eastern slopes of the Andes and the lowlands along the Chaparé, Isiboro and Securé rivers, tributaries of the Mamoré. They are a tall, well-built folk, slightly lighter in colour than the Quechua of the highlands, who gave them the name by which they are known, signifying "white men." Their dress consisted of a poncho-like garment, without sleeves, of bast, decorated with geometric patterns, printed by means of large wooden dies. The Yurucares are sedentary agriculturalists and hunters, living in open thatched shelters.

See A. D'Orbigny, *L'Homme Americain* (Paris, 1839); L. E. Miller, The "Yurucare Indians of Eastern Bolivia" (*Geog. Review,* 1917, pp. 450–464).

YUSAFZAI, a large group of Pathan tribes, originally immigrants from the neighbourhood of Kandahar, which includes those of the Black Mountain, the Bunerwals, the Swatis, the people of Dir and the Panjkora valley, and also the inhabitants of the Yusafzai plain in Peshawar district of the North-West Frontier Province of India. Three sections of the tribe, the Hassanzais, Akazais and Chagarzais, inhabit the W. slopes of the Black Mountain, and the Yusafzai country extends to the Utman Khel territory.

YVERDON (1,437 ft.), a town in the canton of Vaud, Switzerland, and on the south-western corner of Lake Neuchatel, at the mouth of the Thièle. It is situated on the site of the small Roman town of Eburodunum. Population (1941) 10,856, French-speaking and mostly Protestant. At the beginning of the 19th century its castle was the home of Pestalozzi's school. It has an historical museum and several industries. It is a well-known spa with warm and sulphurous springs.

YVES, SAINT, OF BRITTANY (1253–1303), was born in 1253 at Kermartin, near Tréguier, Brittany. His father was Héloury, seigneur of Kermartin, and his mother Azou de Quenquis. In 1267 he went to Paris to study law, and ten years later to Orléans to study canon law. On returning to Brittany he was appointed ecclesiastical judge under the archdeacon of Rennes. In 1285 he was ordained priest and appointed first to the parish of Trédrez, and afterwards to Louannec, where he died on May 19, 1303. He was buried in the cathedral of Tréguier, and was canonized by Clement VI. in 1347. As a lawyer and judge he was famed for his rectitude and wisdom and for his zeal in defending the cause of widows and orphans. His feast is celebrated on May 19. He is the patron saint of lawyers for he was "advocatus et non latro, res miranda populo" (a lawyer and not a thief, a marvel to the people).

YVETOT, a town of north France, in the department of Seine-Inférieure, 24 mi. N.W. of Rouen on the railway to Le Havre. Pop. (1936) 6,565. Cotton goods and hats are made; also trade in agricultural products. The lords of Yvetot bore the title of king from the 15th till the middle of the 16th century, their petty monarchy being popularized in one of Béranger's songs. In 1592 Henry IV here defeated the troops of the League.

Z THIS letter together with Y was adapted by the Romans from the Greek alphabet after the conquest of Greece for use in Greek words borrowed or transliterated. It was the seventh letter of the Greek alphabet and had the form or . It was not taken over by the Latins from the Chalcidic alphabet with the rest of the letters as the sound it represented did not occur in Latin. Its place in the alphabet was filled by the letter G adapted from C to represent the voiced velar stop. The letter corresponded to Semitic (*zain*).

The minuscule letter has generally retained the form of the majuscule, though in certain hands the form has developed.

The sound represented by the letter in Greek is not precisely known. It was, at least in certain cases, a double sound and probably varied in separate dialects as well as in different words between *z, ž, zd, dz,* or *dž.* In Latin it was probably the voiced fricative corresponding to *s* and this value it has retained till modern times. (B. F. C. A.)

ZABERN: *see* SAVERNE.

ZABRZE: *see* HINDENBURG.

ZACATECAS, a state of Mexico. Its area is 28,117 sq.mi.; pop. (1940) 565,437. It belongs wholly to the great central plateau of Mexico, with an average elevation of about 7,700 ft. The state is somewhat mountainous, traversed in the west by lateral ranges of the Sierra Madre Occidental, and by numerous isolated ranges in other parts—Mazapil, Norillos, Guadalupe and others. There are no large rivers, only the small headstreams of the Aguanaval in the north, and of the Guazamota, Bolanos and Juchipila in the west, the last three being tributaries of the Rio Grande de Santiago. As the rainfall is light this lack of streams suitable for irrigation is a drawback to agriculture. The climate is dry and generally healthful, warm in the valleys and temperate in the mountains. The agricultural products are cereals, sugar and maguey; the first depends on the rainfall which often fails altogether, the second on irrigation in the lower valleys, and the third doing best in a dry climate on a calcareous soil with water not far beneath the surface. A natural product is *guayule,* a shrub from which rubber is extracted and which attracted considerable attention in the U.S. after the outbreak of war in the Pacific in 1941 cut off the normal sources of rubber supply. Mining for silver, gold, mercury, copper, iron, zinc, lead, bismuth, antimony and salt is carried on. The state's mineral wealth was discovered soon after the conquest, and some of its mines are among the most famous of Mexico, dating from 1546. Zacatecas is traversed by the Mexican National railway. Manufactures are limited chiefly to the reduction of mineral ores; extraction of rubber from *guayule,* making of sugar, rum, mescal, pulque, woollen and cotton fabrics; and some minor industries of the capital. The capital is Zacatecas. Other principal towns are: Sombrerete, pop. (1940) 5,628, an important silver-mining town 70 mi. northwest of the capital (elevation 8,430 ft.); Villa Garcia, pop. (1940) 1,922; Concepción del Oro, 4,847; Tlaltenango, 4,627; and the silver-and-copper-mining centre at Fresnillo, 24,614.

ZACATECAS, a city of Mexico, capital of the state of Zacatecas, 442 mi. by the Mexican National railway northwest of Mexico City. Pop. (1940) 21,846. It is built in a deep, narrow ravine, 8,050 ft. above sea level, with narrow, crooked streets climbing the steep hillsides, and white, flat-roofed houses of four and five stories overtopping each other. The city is well drained and has a fine aqueduct for its water supply. The cathedral is an elaborately carved red-stone structure with unfinished towers and richly decorated interior. Overlooking the city from an elevation of 500 ft. is the Bufa Hill, which is crowned by a chapel and is a popular pilgrimage resort.

Zacatecas was founded in 1546 and was built over a rich vein of silver discovered by Juan de Tolosa in the same year. This and other mines in the vicinity attracted a large population, and it soon became one of the chief mining centres of Mexico. It was made a city in 1585 by Philip II.

ZACCONI, LUDOVICO, Italian musical theorist, was born about the middle of the 16th century at Pesaro, the years of his birth and death being unknown. He made his home in Venice, where he became an Augustine monk and was appointed *maestro di cappella* at the church of his Order. After a short time spent in the service of Wilhelm, duke of Bavaria in 1592, and a longer period in Vienna with the archduke Charles, he returned in 1619 to Venice. Zacconi's fame is based on a single monumental work, the *Prattica di musica utile et necessaria si al compositore . . . si anco al cantore* (2 pts., Venice, 1596 and 1619). It is one of three standard theoretical works of the Polyphonic period, the others being the *Dodecachordon* of Glaureanus and the *Musicae activae Micrologus* of Ornithoparcus; Zacconi's work, being the latest of the three, treats of the methods of the ripest period of the Polyphonic school.

Complete copies of the *Prattica di Musica* are in the British museum and the Royal College of Music, London. *See* the article by W. S. Rockstro in Grove's *Dictionary of Music;* also F. Batielli, *Un musicista pesarese nel seccolo* xvi (1905) and *Notizie su la vita e le opere di L. Zacconi* (1912); H. Kretzschmar, *Ludovico Zacconi's Leben auf Grund seiner Autobiographie* (1910).

ZACHARIAE VON LINGENTHAL, KARL SALOMO (1769–1843), German jurist, was born on Sept. 14, 1769, at Meissen in Saxony, the son of a lawyer, and was educated there and at Leipzig university. He was professor of law at Wittenberg (1798), and at Heidelberg from 1807 till his death on March 27, 1843. In 1820 he was member for his university in the new parliament of Baden, and in 1825, after the revision of the constitution, for the district of Heidelberg. Throughout his parliamentary career he was a strong Conservative, and it was the growth of liberalism that induced him to retire in 1829, and devote himself entirely to juridical work. The German universities still had their old jurisdiction in legal questions of international importance, and Zachariae had referred to him such points as the claim of Sir Augustus d'Este to the dukedom of Sussex, and the dispute about debts due to the elector of Hesse-Cassel, confiscated by Napoleon. He was ennobled in 1842.

His writings deal with almost every branch of jurisprudence, and relate to Roman, Canon, German, French and English law. The first book of much consequence which he published was *Die Einheit des Staats und der Kirche mit Rücksicht auf die Deutsche Reichsverfassung* (1797), a work on the relations of church and state, with special reference to the constitution of the empire. In 1805 appeared *Versuch einer allgemeinen Hermeneutik des Rechts;* and in 1806 *Die Wissenschaft der Gesetzgebung,* an attempt to find a new theoretical basis for society in place of the opportunist politics which had led to the French Revolution. This basis he seemed to discover in something resembling Bentham's utilitarianism. Zachariae's last work of importance was *Vierzig Bücher vom Staate* (1839–42), to which his admirers point as his enduring monument. It has been compared with Montesquieu's *L'Ésprit des lois,* and covers no small part of the field of Buckle's first volume of the *History of Civilization.*

For an account of Zachariae and his works, *see* Robert von Mohl, *Geschichte u. Literatur der Staatswissenschaften* (1855–58), and Charles Brocher, *K. S. Zachariae, sa vie et ses oeuvres* (1870); also his biography in *Allgem. Deutsche Biographie* (vol. 44) by Wilhelm Fischer, and Holtzendorff, *Rechts-Lexicon, Zachariae von Lingenthal.*

His son, KARL EDUARD ZACHARIAE (1812–1894), also an eminent jurist, was born on Dec. 24, 1812, and studied at Leipzig, Berlin and Heidelberg. Having made Roman and Byzantine law his special study, he visited Paris in 1832 to examine Byzantine mss., went in 1834 to St. Petersburg (Leningrad) and Copenhagen for the same purpose, and in 1835 worked in the libraries

of Brussels, London, Oxford, Dublin, Edinburgh and Cambridge. In 1837 he went in search of materials, to Italy and the East, visiting Athens, Constantinople and the monasteries of Mount Athos. Having a taste for a country life, and none for teaching, he gave up his position as extraordinary professor at Heidelberg, and in 1845 bought an estate in the Prussian province of Saxony. He died on June 3, 1894.

For a list of Zachariae's works, see *Allgem. Deutsche Biogr.*

ZACHARIAS, ST., pope from 741 to 752, was a Greek by birth, and appears to have been on intimate terms with Gregory III., whom he succeeded (November 741). Contemporary history dwells chiefly on his great personal influence with the Lombard king Luitprand, and with his successor Rachis; it was largely through his tact in dealing with these princes in a variety of emergencies that the exarchate of Ravenna was rescued from becoming part of the Lombard kingdom. A correspondence, between Zacharias and St. Boniface, the apostle of Germany, is still extant, and shows how great was the influence of this pope on events then passing in France and Germany; he encouraged the deposition of Childeric, and it was with his sanction that Boniface crowned Pippin as king of the Franks at Soissons in 752. Zacharias is stated to have remonstrated with the emperor Constantine Copronymus on the part he had taken in the iconoclastic controversy. He died on March 14, 752, and was succeeded by Stephen II.

The letters and decrees of Zacharias are published in Migne, *Patrolog. lat.* lxxxix. p. 917–960.

ZAGAZIG (Zaḳāzīḳ), a town of Lower Egypt, capital of the province of Sharkia. Pop. (1937) 59,793. It is built on a branch of the Fresh Water or Ismailia canal, and on the Al-Mo'izz canal (the ancient Tanitic channel of the Nile), and is 47 m. by rail N.N.E. of Cairo. Situated on the Delta in the midst of a fertile district, Zagazig is a great centre of the cotton and grain trade of Egypt. It has large cotton factories and the offices of numerous European merchants. About a mile south of the town are the ruins of Bubastis (*q.v.*).

ZAGHAWA: *see* NUBA.

ZAGHLUL, SAAD (1860–1927), Egyptian patriot, came of fellahin stock in the district of Ibian, Gharbia Province. He was educated at the village school and at the university of El Azhar, in Cairo. In 1880, he became editor of the *Official Journal.* Later he was nominated a Moawin under the Ministry of the Interior and eventually became Chief of the Contentieux for the province of Giza. Involved in the Arabi revolt, he was one of the many notables detained on the occupation of Egypt by British troops in 1882. In 1884 he began to practise at the bar, and in 1893 became a judge in the native court of appeal. He became Minister of Education in 1906, and in 1910 Minister of Justice. At the Ministry of Justice he made a charge of corruption against the Khedive Abbas Hilmi, and was asked (1912) by Lord Kitchener to resign. Zaghlul's evidence was insufficient, but he was thought to have been fundamentally justified, and his fierce opposition to British domination was undisguised from that time onwards. He then became vice-president of the Legislative Assembly.

On the signing of the Armistice (Nov. 1918) Zaghlul, who had for long been considered the principal spokesman of the Nationalist party, appealed to the Residency in Cairo for the recognition of Egyptian independence, basing his demand on President Wilson's self-determination policy and the British proclamation defining the status of the other countries liberated from Turkish rule by the World War. His proposal that he, with other representative Nationalists, should visit London to press their views was refused by the Government, and his attitude was so hostile that he and three others were arrested on March 8, 1919 and deported to Malta. This was the signal for a murderous outbreak in Egypt and serious disturbances (*see* EGYPT: *History*). Zaghlul and his friends were later released by Lord Allenby, and a special mission under Viscount Milner was sent to Egypt in Nov. 1919 to report on the situation.

Zaghlul returned to Egypt early in 1921, where he represented the extreme Nationalist party in opposition to the more moderate ministry under the presidency of Adly Pasha. At the end of the year, when trouble again broke out in Egypt, Zaghlul was arrested once more and deported, first to Aden and then to the Seychelles. In Sept. 1922 he was transferred to Gibraltar, whence he was released on April 4, 1923, on the grounds of ill-health. After the promulgation of the new constitution, martial law was abolished and Zaghlul was free to return to Egypt. He was enthusiastically received, and in the elections of Jan. 1924 his supporters gained an overwhelming majority. Yehia Ibrahim Pasha resigned and Zaghlul formed a ministry. Conversations to secure a settlement between England and Egypt took place in London (Sept. 25—Oct. 3) between Zaghlul and Ramsay Macdonald; Zaghlul refused to modify his intransigent attitude, and no agreement was reached. On Nov. 19, 1924 Sir Lee Stack, the Sirdar, was assassinated and Zaghlul was forced to resign. Nevertheless he became president of the new Chamber of Deputies. From that time the history of Zaghlul Pasha is the history of Egypt (*q.v.*).

Zaghlul died at Cairo on Aug. 23, 1927. His health had long been failing, but he was to the end the life and soul of Egyptian nationalism.

ZAGHOUAN, a small town of Tunisia, French North Africa, 35 mi. S. of Tunis by rail, 275 ft. above sea-level. Pop. (1936) 4,100. It occupies the site of an ancient town (perhaps Onellana) of which nothing remains but a monumental entrance gate. Below the rocky mass known as the Djebel Zaghouan (over 4,000 ft.) are the openings which were used for the Roman aqueduct of Carthage; they were directed into an oval basin, behind which was a hemicycle 100 ft. wide; in the centre of the curve stood the temple of the protecting nymph or divinity.

ZAGREB, the capital of Croatia-Slavonia, Yugoslavia (German, *Agram*), lies on the Sava, with a background of mountains and surrounded by vineyards and country houses. Pop. (1931) 185,581. In 1910 it was only 79,083, but the influx of officials and business men after the formation of the state of Yugoslavia more than outweighed the exodus of Magyars and Germans. Zagreb is the second city of Yugoslavia and its commercial and financial centre, with many important trade associations. It was also the headquarters of one of the five army provinces. The older part of the town, with narrow, winding streets, contains the 15th century Gothic cathedral and the bishop's palace, while the newer part, with wide streets, open squares, a park and botanical gardens, contains the business and industrial quarters. Here too are the palace of justice, the South Slavonic academy, the university, a synagogue, and a Protestant church. Roman Catholic schools and churches are numerous, and there is also a School of Music. Tobacco, leather, linen, carpets, war material, hats and caps, boots, paper, chemicals, varnish and oil-colours are made.

Modern excavations have shown that a settlement existed at Zagreb in Roman times, and though the Croats probably built a town there in the 7th century, the first written record of the city occurs in 1093 when King Ladislaus of Hungary made it the see of a bishop. The older part of Zagreb, known as the Kaptol, contains the bishop's palace and the 15th century Gothic cathedral surrounded by the towers of the 11th century fortress. In 1242 a walled town, now called the Upper Town, arose on a neighbouring hill, and was raised to the rank of a royal free town by King Bela of Hungary.

For centuries a bitter feud raged between the Kaptol and the Upper Town, until these rivals were forced to join hands against the Turks.

Zagreb, already the political centre of Croatia-Slavonia, was selected as the capital in 1867. It suffered severely from earthquakes in 1880 and 1901. It became the home of an aristocracy and a seat of culture on a level with more famous European centres.

It was also the centre of the Yugoslav movement before 1918, and in that year a national assembly met there and proclaimed Croatia's adhesion to the kingdom of the Serbs, Croats and Slovenes. Soon, however, serious differences arose between Croat national aspirations for autonomy and Serb tendencies toward centralization. Zagreb became the seat of the Croat autonomists. When in April 1941, after the partition of Yugoslavia, an independent Croatia was created, Zagreb became its capital.

ZAHAROFF, SIR BASIL (1849–1936), financier and politician, was born in Mughla, Anatolia, of Greek parents, on October 6, 1849. Little is known of his early years except that he was educated in London and Paris. In fact a veil of mystery enshrouded most of his life. He was reputed to be one of the world's richest men, his fortune being built up from munition plants, shipbuilding, oil and other enterprises. He exerted a strong if indirect influence during World War I and at the Paris conference, being a close friend and political adviser of Lloyd George, Venizelos, Clemenceau and Briand. During this period he extended very considerable financial aid to the British and French governments, and later was honoured by these countries for his war services. He is said to have given Greece $2,500,000 a year during the Balkan War, and half that sum during World War I. To the American Near East Relief fund for refugee relief projects in Greece he contributed several thousand pounds and he gave 1,000,000 francs to France for the "save the franc fund." He established chairs of aviation at the universities of Paris, Petrograd, and London and endowed the Marshal Foch professorship of French literature at Oxford university and the Field-Marshal Haig chair of English literature at Paris university. He died Nov. 27, 1936.

ZAHN, ERNST (1867–), Swiss novelist and poet, was born at Zürich on Jan. 24, 1867. Long associated with his father in the management of the railway restaurant at Göschenen, at the entrance to the St. Gotthard tunnel, he became in turn councillor, judge and president of the diet of Canton Uri; but he has latterly devoted himself wholly to literature. His first book was *Kämpfe* (Zurich, 1893), a romance; his most popular novel is *Lukas Hochstrassers Haus* (Stuttgart and Leipzig, 1907). Other notable volumes are: *Blancheflur* (Stuttgart, 1924), *Frau Sixta* (Stuttgart, 1926), and two collections of short stories, *Helden des Alltags* (Stuttgart, 1906) and *Das Licht* (Stuttgart, 1912). *Herrgottsfäden* (Stuttgart, 1901), dealing with the St. Gotthard tunnel, has been translated into English under the title of *Golden Threads* (1908).

See a study by H. Spiero, *Ernst Zahn* (Stuttgart, 1927).

ZAILA or **ZEILA,** a town in British Somaliland, on the African coast of the Gulf of Aden, 124 mi. S.W. of Aden. Pop. (1933) about 5,000 Somali, Arabs, Indians, Greeks, Jews and a few British. The town has the sea on three sides; landward the country is unbroken desert for some 50 miles.

Zaila owed its importance to its proximity to Harar, the great entrepôt for the trade of southern Abyssinia. Its trade received, however, a severe check on the opening (1902) of the railway to Dire Dawa, near Harar, from the French port of Jibuti, which is 35 mi. N.W. of Zaila. Some trade with Harar survived, and about 10% of the imports and 15% of the exports of British Somaliland pass through Zaila. Zaila was captured by Italians Aug. 5, 1940, but was retaken in March 1941.

ZAÏMIS, ALEXANDER (1855–1936), Greek statesman, was born in Athens Oct. 28, 1855, and came of a family of politicians. Entering public life rather from duty than ambition, Zaïmis became the "utility man" of Greek politics; thus he was first appointed prime minister in Oct. 1897, to clear up the aftermath of the disastrous Graeco-Turkish War. Resigning in 1899, after having accomplished that task, he again became premier after the "Gospel Riots" had caused the fall of Theotokes in Nov. 1901, but succumbed to the majority which supported his uncle, Deliyannes, in 1902. In Sept. 1906 he was appointed high commissioner of the Powers in Crete, a post which he held until 1911. In 1913 he was appointed governor of the National Bank. He became premier for the third time in Oct. 1915, but returned to the Bank after a month's office, emerging, however, to resume the premiership in June 1916. He became for the fifth time premier in 1917, and announced to King Constantine the decision of the three Protecting Powers that he must abdicate. He then retired again to the National Bank, but was removed on the restoration of King Constantine. After the king's second abdication, Sept. 1922, Zaïmis refused a sixth premiership, and was talked of as a possible president. On Dec. 4, 1926, he became premier of an Oecumenical Government of three republican ex-premiers and the two Royalist leaders, and remained at the head of the two coalition cabinets, which succeeded it in Aug. 1927 and Feb. 1928. From 1929 to 1935 he was president of the Greek Republic. (W. M.)

ZAIMUKHT, the name of a small Pathan tribe who inhabit the hills between the Miranzai and Kurram valleys.

ZAIRE, a Portuguese variant of a Bantu word (*nzari*) meaning river, a name by which the river Congo was formerly known. In the 16th and 17th centuries the powerful native kingdom of Congo possessed both banks of the lower river, and the name of the country was in time given to the river also. Until, however, the last quarter of the 19th century "Zaire" was frequently used to designate the stream. It is so called by Camoens in the *Lusiads.* (*See* CONGO, river.)

ZAISAN ("Noble"). (1) A lake of Asiatic Russia, situated in a valley between the Altai range on the north-east and the Tarbagatai on the south, at an altitude of 1,355 feet. Its area is 707 sq.m., and its surface is dotted with islands; it is 60 to 65 m. long and 10 to 20 m. wide and receives the drainage of ten rivers, including the Black Irtysh and the Kendyrlyk; the White Irtysh forms the north-western outlet of the lake. Roach, perch, carp, trout, *nyelma* and sterlet abound during the fishing season, May to August. The lake has a depth of 50 ft. and is navigable for steamers; and barges ascend the Black Irtysh into Mongolia.

(2) A town in the Kazakstan A.S.S.R., in 47° 32′ N., 84° 56′ E., situated on a route into Mongolia, at an altitude of 2,200 feet. It lies south-east of Lake Zaisan and south of the Black Irtysh. Population 8,130. Its tanning and leather industry is important and it is a centre for trade between Kazakstan and Mongolia. Topolni Mis, on Lake Zaisan, acts as a port for it.

ZAKOPANE, a town of Poland in the province of Cracow, situated amid superb scenery in the heart of the Tatra mountains; a great health resort both in summer and winter; the most frequented holiday resort of Polish tourists and rock climbers. It has important thermal springs. The town lies 1,000 metres above sea-level and has an alpine climate. Pop. (1931) 17,703. Zakopane was occupied by Germany in Sept. 1939.

ZALEUCUS, of Locri Epizephyrii in Magna Graecia (*fl. c.* 660 B.C.), Greek lawgiver, is said to have been the author of the first written code of laws amongst the Greeks. The story has some familiar features. The Locrians were distressed at their own lawlessness; they commissioned Zaleucus a slave, to draw up a code, and he did so under divine inspiration. The code was a severe one of the Draconic type which remained unchanged for centuries. The story ends with the episode (*cf.* Charondas) of the lawgiver committing suicide on discovering that he had inadvertently broken one of his own laws.

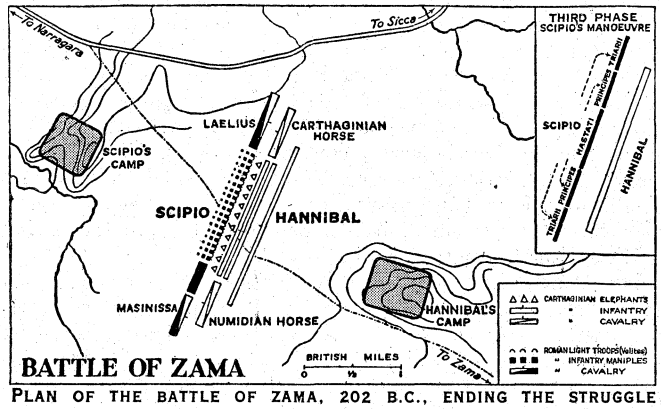
See Bentley, *Dissertation on the Epistles of Phalaris;* F. D. Gerlach, *Zaleukos, Charondas, Pythagoras* (1858); G. Busolt, *Griechische Geschichte* (1885–1904).

ZALMOXIS or ZAMOLXIS, a semi-mythical social and religious reformer, regarded as the only true god by the Thracian Getae. According to Herodotus (iv. 94), the Getae, who believed in the immortality of the soul, looked upon death merely as going to Zalmoxis. It is probable that Zalmoxis is Sabazius, the Thracian Dionysus or Zeus; Mnaseas of Patrae identified him with Cronus. In Plato (*Charmides,* 158 B) he is mentioned with Abaris as skilled in the arts of incantation. No satisfactory etymology of the name has been suggested.

ZAMA, BATTLE OF, 202 B.C. One of the most decisive battles in military history in its military result, Zama ranks above any, save perhaps Waterloo, for its decisive effect on the course of world history. For the defeat of Hannibal, the first and only true defeat in his career, left Carthage naked, and her surrender put an end to the long struggle between Rome and Carthage (*see* PUNIC WARS) for the mastery of the Mediterranean World.

The prologue to Zama had been the invasion of Africa by Scipio (*q.v.*), almost in defiance of the Roman senate which wished him instead to attack Hannibal, who still stood unconquerable in Southern Italy. In Africa Scipio's brilliant series of victories over less formidable generals had forced Carthage to sue for peace before Hannibal could answer the summons of recall. But while the peace negotiations were being conducted in Rome, Hannibal landed at Leptis, whereupon the Carthaginians broke the

truce, and Scipio's military position was gravely compromised—isolated on hostile soil and with part of his force detached to assist his ally Masinissa in securing his new kingdom of Numidia. Instead of awaiting Hannibal near Carthage, Scipio cut himself off from his base and marched on a divergent path into the interior. Security lies often in calculated audacity, and an analysis of the military problems makes it highly probable that his march inland



PLAN OF THE BATTLE OF ZAMA, 202 B.C., ENDING THE STRUGGLE BETWEEN ROME AND CARTHAGE FOR MASTERY OF THE MEDITERRANEAN WORLD

up the Bagradas valley was aimed, by its menace to the rich interior on which Carthage depended for supplies, to force Hannibal to push west to meet him instead of north to Carthage. By this clever move he threatened the economic base of Carthage and protected his own, also luring Hannibal away from his military base—Carthage. A complementary purpose was that this line of movement brought him progressively nearer to Numidia, shortening the distance which Masinissa would have to traverse with his expected reinforcement of strength.

It had the intended effect, for the Carthaginians sent urgent appeals to Hannibal to advance towards Scipio and bring him to battle, and within a few days he marched west, and arrived by forced marches at Zama. He then sent out scouts to discover the Roman camp and its dispositions for defence—it lay some miles farther west. Almost coincidently Masinissa arrived with 6,000 horse and 4,000 foot, and Scipio then broke up his camp and moved to a fresh site near the town of Narragara, his position being well chosen tactically, and having water "within a javelin's throw." Hannibal also moved his camp forward to meet him.

A parley between the two commanders led to no result, and both thereupon prepared to decide the issue by arms. The dispositions made by the rival leaders have several features of note. Scipio placed his heavy Roman foot—he had probably two legions—in the centre; Laelius with the Italian cavalry on the left wing; and on the right wing Masinissa with the whole of the Numidians, horse and foot. The heavy infantry were drawn up in the normal three lines: first, the *hastati;* then the *principes;* and finally, the *triarii.* But instead of adopting the usual chequer formation, with the maniples of the second line opposite to and covering the intervals between the maniples of the first line, he ranged the maniples forming the rear lines directly behind the respective maniples of the first line—thus forming wide lanes between each two cohorts.

The Carthaginian had eighty elephants, more than in any previous battle, and in order to terrify the enemy he placed them in front of his line. Supporting them, in the first line, were the Ligurian and Gallic mercenaries, intermixed with Balearic and Moorish light troops. In the second line were the Carthaginian and African levies, their combined strength probably exceeding that of the first line. Finally, Hannibal's own troops from Italy formed the third line, held back more than 200 yards distant from the others, in order evidently to keep it as an intact reserve. On the wings Hannibal disposed his cavalry, the Numidian allies on the left and the Carthaginian horse on the right. His total force was probably in excess of 50,000, perhaps 55,000. The Roman strength is less certain, but if we assume that each of Scipio's two legions was duplicated by an equal body of Italian allies, and add Masinissa's 10,000, the complete strength would be about 36,000.

The battle opened, after preliminary skirmishing, with Hannibal's order to the drivers of the elephants to charge the Roman line. Scipio promptly countered by a blast of trumpets along the whole line. The strident clamour so startled and terrified the elephants that many of them at once turned back on their own troops. This was especially the case on the left wing, where they threw the Numidians, Hannibal's best cavalry wing, into disorder just as they were advancing to the attack. Masinissa seized this golden opportunity to launch a counter-stroke, which inevitably overthrew the disorganized opponents. With Masinissa in hot pursuit, they were driven from the field, and so left the Carthaginian left wing exposed. The remainder of the elephants wrought much havoc among Scipio's *velites,* caught by their charge in front of the Roman line. But the foresight that had provided the "lanes" and laid down the method of withdrawal was justified by its results. For the elephants took the line of least resistance, penetrating into the lanes rather than facing the firm-knit ranks of the heavy infantry maniples. Once in these lanes the *velites* who had retired into the lateral passages, between the lines, bombarded them with darts from both sides. Their reception was far too warm for them to linger when the door of escape was held wide open. While some of the elephants rushed right through, harmlessly, and out to the open in rear of the Roman army, others were driven back out of the lanes, and fled towards the Carthaginian right wing. "It was at this moment that Laelius, availing himself of the disturbance created by the elephants, charged the Carthaginian cavalry, and forced them to headlong flight. He pressed the pursuit closely, as likewise did Masinissa." Both Hannibal's flanks were thus stripped bare.

In the meantime the infantry of both armies had slowly advanced on each other, except that Hannibal kept his third line back. At first the Gauls and Ligurians had the balance of advantage, through their personal skill in skirmishing and more rapid movement. But the Roman line remained unbroken, and the weight of their compact formation pushed the enemy back despite losses. Another factor told, for while the leading Romans were encouraged by the shouts from the rear lines, coming on to back them up, Hannibal's second line—the Carthaginians—failed to support the Gauls, but hung back in order to keep their ranks firm. Forced steadily back, and feeling they had been left in the lurch by their own side, the Gauls turned about and fled. When they tried to seek shelter in the second line they were repulsed by the Carthaginians, who deemed it essential to avoid any disarray which might enable the Romans to penetrate their line. In a short time the relics of the first line had dispersed completely, or disappeared round the flanks of the second line. The latter, however, showed their fighting quality by thrusting back the Roman first line—the *hastati.* In this they were helped by a human obstacle, the ground encumbered with corpses and slippery with blood, which disordered the ranks of the attacking Romans. Even the *principes* had begun to waver when they saw the first line driven back so decisively, but their officers rallied them, and led them forward in the nick of time to restore the situation. This reinforcement was decisive. Hemmed in, because the Roman formation produced a longer frontage and so overlapped their line, the Carthaginians were steadily cut to pieces. The survivors fled back on the relatively distant third line, but Hannibal continued his policy of refusing to allow the fugitives to mix with and disturb an ordered line.

The curtain now rose on what was practically a fresh battle. The Romans "had penetrated to their real antagonists, men equal to them in the nature of their arms, in their experience of war, in the fame of their achievements. . . ." Livy's tribute is borne out by the fierceness and the long uncertain issue of the subsequent conflict, which refutes the suggestion that Hannibal's "Old Guard" was but a shadow of its former power—in the days of Trasimenus and Cannae. The Romans had the moral advantage of having routed two successive lines, as well as the cavalry and elephants, but they had now to face a compact and fresh body of probably 24,000 veterans, under the direct inspiration of Hannibal. And no man in history has shown a more dynamic personality in infusing his own determination in his troops. The Romans, too, had at last

a numerical advantage, not large, however—the forces were "nearly equal in numbers" according to Polybius—and in reality still less than it appeared. For while all Hannibal's third line were fresh, on Scipio's side only the *triarii* had not been engaged, and these represented but half the strength of the *hastati* or *principes*. Further, the *velites* had been so badly mauled that they had to be relegated to the reserve, and the cavalry were off the field, engaged in the pursuit. Thus it is improbable that Scipio had at his disposal for this final blow more than 18,000 or 20,000 infantry, less the casualties these had already suffered.

His next step is characteristic of the man—of his cool calculation even in the heart of a battle crisis. He sounded the recall to his leading troops, and then, in face of an enemy at hardly more than a bow-shot distance, he not only reorganized his troops but reconstructed his dispositions. His problem was this: against the first two enemy lines the Roman formation, shallower than the Carthaginian phalanx and with intervals, had occupied a wider frontage, and so enabled him to overlap theirs. Now, against a body double the strength, his frontage was no longer, and perhaps less, than Hannibal's. His appreciation evidently took in this factor, and with it two others. First, that in order to concentrate his missile shock power for the final effort it would be wise to make his line as solid as possible and this could be done because there was no longer need for or advantage in retaining intervals between the maniples. Second, that as his cavalry would be returning any moment there was no advantage in keeping the orthodox formation in depth and using the *principes* and *triarii* as a direct support and reinforcement to his front line. The blow should be as concentrated as possible in time and as wide as possible in striking force rather than a series of efforts. He, therefore, made his *hastati* close up to form a compact centre without intervals. Similarly he closed each half of his *principes* and *triarii* outwards, and moved them forward to extend the flank on either wing. He now once more overlapped the hostile front. The rôle of Scipio's infantry in the final phase was to fix Hannibal's force ready for the decisive manoeuvre to be delivered by the cavalry. For this rôle violence and wideness of onslaught was more important than sustenance. Scipio made his redistribution deliberately and unhurriedly—the longer he could delay the final tussle, the more time he gained for the return of his cavalry. It is not unlikely that Masinissa and Laelius pressed the pursuit rather too far, and so caused an unnecessary strain on the Roman infantry and on Scipio's plan. For Polybius tells us that when the rival infantries met, "the contest was for long doubtful, the men falling where they stood out of determination, until Masinissa and Laelius arrived providentially at the proper moment." Their charge, in the enemy's rear, clinched the decision, and though most of Hannibal's men fought grimly to the end, they were cut down in their ranks. Of those who took to flight few escaped.

The completeness of the victory left no room for a strategic pursuit, but Scipio did not linger in developing the moral exploitation of his victory. An immediate move on Carthage achieved its object, a bloodless capitulation.

ZAMBEZI, the fourth in size of the rivers of Africa, and the largest of those flowing eastwards to the Indian ocean. Its length (taking all curves into consideration) is about 2,200 m. The area of its basin, according to Dr. Bludau, is 513,500 sq.m., or rather less than half that of the Nile. The main channel is clearly marked from beginning to end. The river takes its rise in 11° 21′ 3″ S., 24° 22′ E. The source lies in British territory in a depression of an undulating country 5,000 ft. above the sea, covered with bracken and open forest. The water, like that of all the rivers of the neighbourhood, issues from a black marshy bog. Eastward of the source the water-parting between the Congo and Zambezi basins is a well-marked belt of high ground, falling abruptly north and south, and running nearly east and west between 11° and 12° S.

The Upper River.—The infant Zambezi, after pursuing a south-westerly course for about 150 m., turns more directly south and, receives on either side numerous small tributaries. A few miles above Kakengi (in 12° 24′ S.), the Zambezi, narrow, picturesque and tortuous, suddenly widens from 100 to 350 yd. Below Kakengi are a number of rapids ending (13° 7′ S.) in the Suapuma cataracts. At this point the river flows tumultuously through a rocky fissure.

The first of its large tributaries to enter the Zambezi is the Kabompo, a left-hand affluent. It joins the main stream in 14° 26′ S. A little lower down (in 14° 18′ S.) the Zambezi receives from the west the waters of a much larger stream than the Kabompo, namely, the Lungwebungu. The land, from 5,000 ft. at the source, falls gradually to 3,600 ft. at Kakengi—a distance of 220 m. From this point until the Victoria Falls are reached—500 m.—the level of the Zambezi basin is very uniform, the fall being in this distance 600 ft. only. Twenty miles below the confluence of the Lungwebungu the country becomes flat, and in the rainy seasons is largely covered by floods. From the east the Zambezi continues to receive numerous small streams, but on the west is without tributaries for 150 m., when the great river formerly misnamed the Chobe, but known to the natives as Kwando or Linyante, joins it (in 17° 47′ S.).

The Middle Zambezi.—The Victoria Falls are reached some 60 m. below the Kwando confluence. The surrounding country is formed of horizontal flows of basic lavas, which are traversed by two well marked sets of joints. Along these the river, following an extremely angular course, has eroded a great cañon, about 400 ft. deep and in many places, with vertical sides. (*See* Victoria Falls.) Into the cañon the river plunges over a vertical wall of rock. The narrow gorge can be traced more or less continuously along its course for about 40 miles. The middle course of the river may be said to extend for 800 m. below the Victoria Falls to the Kebrabasa Rapids, where the Zambezi crosses the great East African escarpment, and enters the coastal belt.

The Lower River.—The lower Zambezi—400 m. from Kebrabasa Rapids to the sea—presents no obstacles to navigation save the shallowness of the stream in many places in the dry season. This shallowness arises from the different character of the river basin. Instead of, as in the case of the middle Zambezi, flowing mainly through hilly country with well-defined banks, the river traverses a broad valley and spreads out over a large area. Only at one point, the Lupata Gorge, 200 m. from its mouth, is the river confined between high hills. Here it is scarcely 200 yd. wide. Elsewhere it is from 3 to 5 m. wide, flowing gently in many streams. The river-bed is sandy, the banks are low and reed-fringed. At places, however, and especially in the rainy season, the streams unite into one broad swift-flowing river. About 100 m. from the sea the Zambezi receives the drainage of Lake Nyasa through the river Shiré. On approaching the ocean, which it reaches in 18° 50′ S. the Zambezi splits up into a number of branches and forms a wide delta. Each of the four principal mouths—Milambe, Kongone, Luabo and Timbwe—is obstructed by a sand-bar.

Mileage of Navigable Water.—As a highway into the interior of the continent the Zambezi, like all other large African rivers, in greater or less degree, suffers on account of the bar at its mouth, the shallowness of its stream, and the rapids and cataracts which interrupt its course. Nevertheless its importance to commerce is great, as the following recapitulation of its navigable stretches will show: (1) From the sea to the Kebrabasa Rapids, 400 m. (2) From Chikoá (above Kebrabasa) to within 140 m. of the Victoria Falls, 700 m. (3) From the rapids above the Victoria Falls to the Katima Molilo Rapids, 100 m. (4) Above the Gonye Falls to the Supuma cataract, 300 m. (5) Above the Supuma cataract, 120 m. Thus for 1,620 m. of its course the Zambezi is navigable for steamers with a draught up to 28 in.

Several of the Zambezi affluents are also navigable for many miles. The Lungwebungu, which enters the upper river, is navigable for a long distance, thus supplying communication with the extreme north-west corner of the Zambezi basin. Parts at least of the Luena, Kafukwe, Loangwa and the Kwando tributaries are also capable of being navigated. The Shiré is also navigable for a considerable distance. The sum of such navigable reaches within the Zambezi basin as exceed 100 m. is nearly 4,000 m.

Exploration of the River.—The Zambezi region was known to the mediaeval geographers as the empire of Monomotapa and

the course of the river, as well as the position of Lakes Ngami and Nyasa, were filled in with a rude approximation to accuracy in the earlier maps. These were probably constructed from Arab information. The first European to visit the upper Zambezi was David Livingstone in his exploration from Bechuanaland between 1851 and 1853. Two or three years later he descended the Zambezi to its mouth and in the course of this journey discovered the Victoria Falls. During 1858–60, accompanied by Dr. (afterwards Sir) John Kirk, Livingstone ascended the river by the Kongone mouth as far as the Falls, besides tracing the course of its tributary, the Shiré, and discovering Lake Nyasa. For the next 35 years practically no additions were made to our knowledge of the river system. In 1889 the entrance of vessels from the sea was much facilitated by the discovery by D. J. Rankin of the Chinde channel north of the main mouths of the river. Major A. St. Hill Gibbons and his assistants, during two expeditions, in 1895–96 and 1898–1900, ably continued the work of exploration begun by Livingstone in the upper basin and central course of the river. Of non-British travellers Major Serpa Pinto examined some of the western tributaries of the river and made measurements of the Victoria Falls (1878).

See David and Charles Livingstone, *Narrative of an Expedition to the Zambesi and its Tributaries* (1865); A. de Serpa Pinto, *How I Crossed Africa* (1881); D. J. Rankin in *Proc. R.G.S.* (March 1890); A. Sharpe, *ibid.* (December, 1890); H. S. Bivar, "Curso medio do Zambeze," *B.S.G. Lisboa,* vol. xxiv. (1906); G. W. Lamplugh in *Geo. Jnl.,* vol. xxxi. (1908); F. Coillard, *On the Threshold of Central Africa* (London, 1897), and A. St. H. Gibbons, *Africa from South to North through Marotseland* (2 vols., London, 1904). (F. R. C.)

ZAMBOANGA, a municipality (with administrative centre and 60 *barrios* or districts) and capital of Zamboanga province, and an important port of entry, of Mindanao, Philippine Islands, situated at the south extremity of the Zamboanga peninsula on Basilian strait. Pop. (1939) 131,455, of whom 69,066 were males and 204 were white. A native settlement had long existed on the site when the Spanish town was founded in 1635. It soon became a centre for Spanish activity in their long contest with the Moros. Its climate is said to be cooler than that of Manila. The surrounding forests contain valuable timber, and the agricultural products include palay (rice), copra, abacá (Manila hemp), sugar, tobacco and sweet potatoes. There was a flourishing trade until the Japanese invasion of Dec. 1941, as the shipping facilities were good and exports of copra and abacá were extensive. There is a meteorological station, a modern water system and an electric lighting plant. Of the inhabitants aged 6-19 inclusive, 26.8% were reported in 1939 as attending school, and 40.2% of the population 10 years old and over was reported as literate. (C. S. L.)

ZAMIA, a genus of cycads which comprise about 30 species of small fern-like plants, native to tropical and sub-tropical America. They have a turnip-like, mostly underground stem surmounted by a crown of leaves, 1 ft. to 2 ft. long, surrounding large fruiting cones. The crushed stems yield starch used for food, after washing to extract an alkaloid. Two species, *Z. floridana* and *Z. pumila,* known as coontie or comfort-root, occur in southern Florida.

ZAMINDAR or **ZEMINDAR,** an Indian landholder (from Persian *zamin*-"land"). In official usage the term is applied to any person, whether owner of a large estate or cultivating member of a village community, who is recognized as possessing some property in the soil, as opposed to the ryot (*q.v.*), who is regarded as having only a right of occupancy, subject in both cases to payment of the land revenue assessed on his holding.

ZAMINDAWAR, a district of Afghanistan, situated on the right bank of the Helmund river to the north-west of Kandahar, bordering the road which leads from Kandahar to Herat via Farah. Zamindawar is a district of hills, and of wide, well populated and fertile valleys watered by important affluents of the Helmund. The principal town is Musa Kala, which stands on the banks of a river of the same name, about 60 mi. N. of Girishk. The whole of this region is a well-known hotbed of fanaticism, the headquarters of the Achakzais, the most aggressive of all Durani tribes.

ZAMORA, an inland province of Spain, one of the three into which the former province of León was divided in 1833; bounded W. by Portugal and Orense, N. by León, E. by Valladolid, S. by Salamanca. Pop. (1940) 298,722; area 4,082 sq.mi. Zamora is traversed from east to west by the river Duero or Douro (*q.v.*); the Tormes also skirts the southwestern boundary for some 25 miles. Except in the northwest, where it is entered by two outlying ridges of the Cantabrian mountains, the Sierra de la Culebra and Sierra de Peña Negra, the surface is a level or slightly undulating plateau; its lowest point is 1,070 ft. Its plains, especially the valley of the Esla, yield much grain and pulse; wine and flax are also produced; and on the higher grounds many merino sheep and goats are reared. Three railway lines, from the north, south and east, traverse the province and meet at the city of Zamora. Other towns include Benavente (7,713) and Toro (7,881). Spanish nationalists occupied Zamora in 1936.

ZAMORA, an episcopal city, and the capital of the Spanish province of Zamora; on the right bank of the river Duero (Douro), and at the junction of railways from Salamanca, Medina del Campo and Astorga. Pop. (1940) 29,036 (mun., 32,388). In the early period of the Christian re-conquest Zamora was a place of considerable strategic importance. Ferdinand I of Castile and Leon in 1061 gave it to his daughter Doña Urraca. After his death in 1065 his son Sancho II disputed possession with Urraca and laid siege to the city, but without success, although the famous Cid Ruy Diaz de Bivar was among his warriors. Zamora became subject to Alphonso VI in 1073. Zamora occupies a rocky height overlooking the Duero, a little below its confluence with the Valderaduey. The river is crossed by a fine 14th-century bridge of sixteen pointed arches. The citadel of Zamora dates from the 8th century. The small but beautiful Romanesque cathedral, one of four 12th-century churches, was completed about 1175.

ZAMOYSKI, JAN (1541–1605), Polish statesman, was the son of Stanislaw, Castellan of Chelm, and Anna Herburtowna, a noble Polish lady. After completing his education at Paris, Strasbourg and at Padua, where as rector of the academy he composed his celebrated work *De senatu romano* (Venice, 1563), he returned home in 1565, one of the most consummate scholars and jurists in Europe, and at once entered politics. He played a leading part, after the the death of Sigismund II., in remodelling the Polish constitution and procuring the election of Henry of Valois. After the flight of that prince Zamoyski seems to have aimed at the throne himself, but quickly changed his mind and supported Stephen Báthory, whose election he prepared and whose foremost counsellor he became. Appointed chancellor on May 1, 1576, immediately after the coronation, as *wielki hetman,* commander-in-chief, in 1580, Zamoyski strenuously supported Stephen during his long struggle with Ivan the Terrible. He also enabled the king in 1585 to bring the traitorous Samuel Zborowski to the scaffold. On the death of Stephen, the Zborowski recovered their influence and did their utmost to keep Zamoyski in the background. At the election diet of July 9, 1587, however, Zamoyski triumphed over his rivals, and rejecting an offer from the Habsburgs of the title of prince, with the Golden Fleece and 20,000 ducats, procured the election of Sigismund of Sweden, son of Catherine Jagiellonica (Aug. 19). The opposite party immediately elected the Austrian Archduke Maximilian, but Zamoyski routed and captured the archduke at Byczyna (Jan. 24, 1588).

From the first there was a certain coldness between the new king and the chancellor, Sigismund desiring an alliance with the Habsburgs, which Zamoyski feared. Friction became acute when Sigismund appointed an opponent of Zamoyski vice-chancellor, and made other ministerial changes which limited his authority; though ultimately, with the aid of his partisans and the adoption of such desperate expedients as the summoning of a confederation to annul the royal decrees in 1592, Zamoyski recovered his full authority. In 1595 Zamoyski, in his capacity of commander-in-chief, at the head of 8,000 veterans dethroned the anti-Polish hospodar of Moldavia and installed in his stead a Catholic convert, George Mohila. On his return he successfully sustained in his camp at Cecora a siege by the Tatar khan. Five years later (Oct. 20, 1600) he won his greatest victory at Tirgoviste, over Michael the Brave, hospodar of Walachia and Moldavia. But

beyond securing the Polish frontier Zamoyski would never go. He refused to wage war with Turkey even under the most favourable circumstances, nor could he be drawn into the Holy League against the Ottomans in 1600, making conditions for Poland's co-operation which her allies could not possibly accept. Statesman though he was, Zamoyski cannot, with all his genius and valour, be called a true patriot. Sigismund was undoubtedly right when he attempted to reform the Polish constitution in 1605 by strengthening the royal power and deciding all measures in future by a majority of the diet. These reforms Zamoyski strenuously opposed. The last speech he delivered was in favour of the anarchic principle of free election. He died suddenly at Zamosc, June 3, 1605.

See *Vincent Laureo, 1574–78, et ses dépêches inédites* (Ital.) (Warsaw, 1877); Augustin Theiner, *Vetera monumenta Poloniae et Lituaniae* vol. ii. (Rome, 1862); Adam Tytus Dzialynski, *Collectanea vitam resque gestas J. Zamoyocii illustrantia* (Posen, 1881).

ZANESVILLE, a city of south-eastern Ohio, U.S.A., the county seat of Muskingum county; on the Muskingum river at the mouth of the Licking, 55 mi. E. of Columbus. It is on Federal highways 40 and 22; and is served by the Baltimore and Ohio, the New York Central, the Pennsylvania, the Wheeling and Lake Erie and motorbus and truck lines and river packets to Parkersburg and Pittsburgh. Pop. (1920) 29,569; (1930) 36,440; (1940) it was 37,500. The city lies on both sides of both rivers, at an altitude of 700 feet. A "Y" bridge (the only one of the type in the United States) crosses the Muskingum, its two arms running on either side of the Licking. The present concrete structure (erected 1901) replaced a covered wooden bridge of the same plan which had stood for 68 years. Zanesville is one of the principal centres in the country for the manufacture of clay products, notably encaustic and mosaic tile, art pottery and stoneware. Other important manufactures are cement, glass containers, bottles, steel products, cast-iron radiation and electric transformers. In 1935 the product of 44 factories was valued at $17,038,390. There were a few pioneers on the site of the city of Zanesville when "Zane's Trace" was cut through from Wheeling (under an act of Congress of 1796) by Ebenezer and Jonathan Zane and Ebenezer's son-in-law, John McIntire, who received for this service three sections of land. Jonathan Zane and McIntire chose their sections at the point where the new road (now the national highway) crossed the Muskingum river. The town was planned in 1800, incorporated in 1814 and in 1850 was chartered as a city. It was made the county seat when Muskingum county was created in 1804, and from Dec. 1810, until May 1812, it was the capital of the State. Zanesville was an important station on the old national road. The population was 9,229 in 1860.

ZANGWILL, ISRAEL (1864–1926), Jewish man of letters, was born in London on Feb. 14, 1864. His early childhood was spent in Plymouth and at Bristol, where he received his first schooling. He was in his ninth year when his parents settled in Spitalfields, and he entered the Jews' Free School, where eventually ne became a teacher, working at the same time for his university degree. He had written a clever fantastic tale entitled *The Premier and the Painter* with Louis Cowen, when he gave up teaching for journalism. He founded and edited *Ariel, The London Puck,* and did much miscellaneous work on the London press. He made his literary reputation with a novel, *The Children of the Ghetto* (1892), which was followed by *Ghetto Tragedies* (1893); *The Master* (1895); *Dreamers of the Ghetto* (1898); *The Mantle of Elijah* (1901); and other tales and novels of great interest dealing with Jewish life. *Children of the Ghetto* was produced as a play in New York with success in 1899, and has since been extensively played both in English and Yiddish. He was greater as a playwright than as a novelist, and did admirable work both in light comedy and in serious plays. *Merely Mary Ann* (Duke of York's, 1904) and *Too Much Money* (1917) represent his lighter gift; *The Melting Pot* (1908), *The War God* (1911) and *The Next Religion* (1914), banned by the censor, all deal with serious social problems. Zangwill was an outstanding personality in the Jewish world. He was at one time president of the Jewish Territorial Organization for the Settlement of Jews within the British Empire, and later an advocate of the Zionist movement. He died on Aug. 1, 1926.

ZANTE (anc. *Zacynthus*), southernmost of the Ionian Islands, west of Greece, 25 mi. long, about 12 broad, and 64 mi. round, with an area of 277 sq.mi., and a population in 1928 (last census before World War II) of 40,492. Zante lies 8 mi. S. of Cephalonia, forming with it, Leucas and Ithaca a crescent-shaped group, the crest of a submerged limestone ridge facing the Gulf of Patras. Zante is of somewhat irregular oval shape, indented by a deep inlet at its south end. A wide fertile central plain is skirted on the west by bare limestone hills 1,000 to 1,200 ft. high, which fall gently landwards, but with steep sea cliffs culminating northwards in Mount Skopos (ancient *Elatos,* 1,600 ft.). On the east the plain is also limited by a low ridge. These hills are still densely clothed to the summit with olives, figs, myrtles, laurels, oranges, aloes, vines and other sub-tropical plants. The central plain is an almost continuous stretch of gardens and vineyards, with a few cornfields and pastures. The peculiar dwarf vine, the "currant" (from Corinth) of commerce, is the staple export of Zante, as of the neighbouring mainland: it grows to 3 ft., begins to yield in seven years and lasts a century. Earthquakes are frequent and at times disastrous. During recent times the most destructive were those of 1811, 1820, 1840 and 1893. Other volcanic indications are the oil springs on the coast, and in the bed of the sea near Cape Skinari on the north, and especially the bituminous wells in a swamp near the coast village of Chieri, mentioned by Herodotus (iv. 195). These still yield pitch.

Zante, capital and seaport, on the east side, with a population of 11,609, occupies the site of ancient Zacynthus, said to have been founded, like the neighbouring citadel of Psophis, by Zacynthus, son of Dardanus, a legendary Arcadian chief.

Traditionally Zacynthus belonged to Ulysses, king of Ithaca, and was peopled by settlers from Achaea or Arcadia. It figures occasionally in history as a base for belligerents. Thus during the Peloponnesian War and again in 374 B.C. the Athenians used it; in 357 it was the headquarters of Dion on his expedition against Syracuse; in 217 it was seized by Philip V of Macedon. The Romans captured it in 211, but restored it temporarily to Philip; in 191, to keep it out of the hands of Greek powers, they annexed it themselves. In 86 it was raided by Mithradates' admiral Archelaus. Under the Roman Empire, Zante was included in the province of Epirus. In the 11th century it passed to the Norman kings of Sicily; after the Fourth Crusade it belonged at various times to the despots of Epirus, the emperors of Constantinople, and the Orsini counts of Cephalonia. After remaining from 1357 to 1482 in the hands of the Tocco family it became a Venetian possession. In 1797 it was ceded to France, and after a short occupation by the Russians was brought under British protection; in 1864 it was ceded with the other Ionian islands to Greece. In 1941, during World War II, it was occupied by Italy.

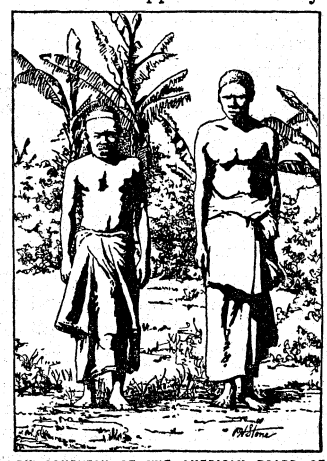
The long Venetian occupation is reflected in the appearance, character, and to some extent even the language and religion of the Zantiots. Nearly all the aristocracy claim Venetian descent; most of the upper classes are bilingual, speaking both Greek and Italian; and a considerable section of the population are Roman Catholics. Even the bulk of the people, although mainly of Greek stock, form in their social usages a connecting link between the Hellenes and the western nations.

See B. Schmidt, *Die Insel Zakynthos* (Freiburg, 1899).

ZANZIBAR, a sultanate and British protectorate of East Africa. The sultanate, formerly of much larger extent (see *History*) is now reduced to the islands of Zanzibar and Pemba, some adjacent islets and the nominal sovereignty of a strip of coastland—10 mi. deep—forming the protectorate of Kenya (*see* KENYA COLONY). The collective area of the sultanate (Zanzibar and Pemba) is 1,020 sq.mi. The island of Zanzibar, in 6° S. latitude, is separated from the mainland by a channel 22½ mi. across at its narrowest part. The largest coralline island on the African coast, it is 50 mi. long by 24 mi. broad (maximum measurements), and has an area of 640 sq.mi.

Topography.—Pemba (*q.v.*), lying 25 mi. to the northeast, and the more distant Mafia (to the south), which is part of Tangan-

yika Territory, form with Zanzibar an independent geological system, resting on a foundation of coralline reefs, and constituting a sort of outer coast-line, which almost everywhere presents a rocky barrier to the Indian ocean. All three are disposed parallel to the mainland, from which they are separated by shallow waters, mostly under 30 fathoms, strewn with numerous reefs dangerous to navigation, especially in the Mafia channel opposite the Rufiji delta. Some 6 mi. off the N.W. coast of Zanzibar and forming part of the coral reef is the small, densely wooded island of Tumbatu. Zanzibar island, called Unguja in Kiswahili, is not exclusively of coralline formation, several heights of reddish ferruginous clay rising in gentle slopes 400 to 450 ft. in the centre, and to double that height in the north. The forests which formerly covered the island have largely disappeared; the western part has been cleared for cultivation, and the eastern half is mostly covered with low scrub.



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SWAHILI NATIVES OF ZANZIBAR

The great heat and excessive moisture of the atmosphere render the climate trying to Europeans. The year is divided into two seasons, according to the direction of the monsoons. The northeast monsoon sets in about the end of November, the southwest monsoon in April. The "hot season" corresponds with the northeast monsoon, when the minimum readings of the thermometer often exceed 84° F. In June to September the minimum readings drop to 76°, the mean annual temperature being about 80.5°. Rain falls in every month of the year. December, April and May are the rainiest months, August to October the driest. The average annual rainfall (45 years' observations) is 61.47 in. (In 1859 as much as 170 in. were registered.)

Inhabitants.—On the east side of Zanzibar island the inhabitants, a Bantu-speaking race of low development, probably represent the aboriginal stock. They are known as Wahadimu and are noted as good fishermen, cattle raisers and skilled artisans. In the west, and especially in the capital (for which, *see* below), the population is of an extremely heterogeneous character, including full-blood and half-caste Arabs, Hindus, Goanese, Parsis, Persians, Baluchs, Swahili of every shade, and representatives of tribes from many parts of East Africa. The Arabs number about 11,500; the Indians and other Asiatics 13,000; and Europeans less than 300. Pop. of the sultanate (1931 census) 235,428 (Zanzibar 137,741 and Pemba 97,687); 1941 est. 250,000 (Zanzibar 150,000, Pemba 100,000). Besides the port of Zanzibar there are no large towns. Chwaka is a health resort facing the Indian ocean.

HISTORY

From the earliest times of which there is any record the African seaboard from the Red sea to an unknown distance southwards was subject to Arabian influence and dominion. Egyptians, Chinese and Malays also appear to have visited the coast. At a later period the coast towns were founded or conquered by Persian and Arab Mohammedans who, for the most part, fled to East Africa between the 8th and 11th centuries on account of the religious differences of the times, the refugees being schismatics. Various small states thus grew up along the coast, Mombasa seeming to be the most important. These states are sometimes spoken of as the Zenj empire, though they were never, probably, united under one ruler. Kilwa (*q.v.*) was regarded as the capital of the "empire." The seaboard itself took the name of *Zanquebar* (corrupted to Zanzibar by the Indian traders), the Bilad ez-Zenj, or "Land of the Zenj" of the Arabs, a term which corresponds to the Hindu-bar, or "land of the Hindu," formerly applied to the west coast of India. By Ibn Batuta, who visited the coast in 1328, and other Arab writers the Zenj people are referred to in a general way as Mohammedan Negroes; and they are no doubt still represented by the Swahili or "coast people," in whose veins is a large admixture of Asiatic blood. The Zenj "empire" began to decline soon after the appearance of the Portuguese in East African waters at the close of the 15th century. To them fell in rapid succession the great cities of Kilwa with its 300 mosques (1505), Mombasa the "Magnificent" (1505), and soon after Malindi and Mukdishu the "Immense" (Ibn Batuta). The Portuguese rule was troubled by many revolts, and towards the end of the 16th century the chief cities were ravaged by the Turks, who came by sea, and by the Zimbas, a fierce Negro tribe, who came overland from south of the Zambezi. On the ruins of the Portuguese power in the 17th century was built up that of the Imams of Muscat. Over their African dominions the Imams placed *valis* or viceroys, who in time became independent of their overlord. In Mombasa power passed into the hands of the Mazrui family. The island of Zanzibar, conquered by the Portuguese in 1503–08, was occupied by the Arabs in 1730, and in 1832 the town of Zanzibar, then a place of no note, was made the capital of his dominions by the Sayyid Said of Muscat, who reconquered all the towns formerly owing allegiance to the Imams, Mombasa being taken by treachery in 1837. On the death of Said in 1856 his dominions were divided between his two sons, the African section falling to Majid, who was succeeded in 1870 by his younger brother Bargash ibn Said, commonly known as sultan of Zanzibar. At that time besides the islands of Zanzibar, Pemba and Mafia, the sultan's dominions extended along the East African coast from Cape Delgado northwards to and including some of the Somali ports, with an undefined extension inland. Bargash, however, lived to witness the dismemberment of his dominions by Great Britain, Germany and Italy (*see* AFRICA) and in March 1888 left to his successor, Sayyid Khalifa, a mere fragment of the territories over which he had once ruled. The mainland territories were divided, Italy acquiring the northern part, Great Britain the central part (now the Kenya protectorate) and Germany the southern part (now Tanganyika Territory) as well as Mafia island. The division was first by lease; subsequently Germany and Italy purchased the sovereign rights in their respective areas. The Sayyids Majid and Bargash acted largely under the influence of Sir John Kirk (*q.v.*) who from 1866 to 1887 was consular representative of Great Britain at Zanzibar. Had an offer by Bargash been accepted the whole of his mainland dominions would have been leased to a British company in 1877. By Sir John's efforts a treaty for the suppression of the slave trade in the sultanate was concluded in 1873.

British Protectorate.—On Nov. 4, 1890, what was left of the sultanate was proclaimed a British protectorate, in conformity with conventions by which Great Britain on her part ceded Heligoland to Germany and renounced all claims to Madagascar in favour of France. On the death of the then sultan, Sayyid Hamoud bin Thwain, in Aug. 1896, his cousin, Sayyid Khalid, proclaimed himself sultan, and seized the palace. The British government disapproved, and to compel Khalid's submission the palace was bombarded by warships. Khalid fled to the German consulate, whence he was removed to German East Africa, and Hamoud bin Mohammed, brother of Hamoud bin Thwain, was installed sultan by the British representative (Aug. 27, 1896). The government was reconstituted under British auspices in Oct. 1891, when Sir Lloyd Mathews was appointed prime minister, a title afterwards changed to first minister. In 1897 after a long agitation the legal status of slavery was abolished, compensation being given to the slave owners, mostly Arabs, who had used slave labour for the clove plantations. In 1913 the control of the protectorate was transferred to the colonial office. At first the British agent and consul general in Zanzibar also administered the East Africa protectorate (Kenya colony). This arrangement ceased in 1904; the colonial office (in 1913) made the governor of the East Africa protectorate high commissioner for Zanzibar, local affairs being entrusted to a British resident, who took over the functions of first minister. With abolition of the office of high commissioner in 1925 the British resident became directly responsible to the colonial office. An advisory council was then created, only to be replaced in 1926 by a nominated legislative council.

Although the administration was controlled by the British resident the sultan continued to exercise much authority. Sayyid Khalifa bin Harud (born 1879), who became sultan in 1911, was a great-nephew of Bargash. He worked in full agreement with the British and as the leading Moslem prince in East Africa his moderating influence did much to steady Moslem opinion in that part of Africa during World War I. The most dramatic incident of the war, for Zanzibar, was the sinking of the ancient British cruiser "Pegasus" by the German cruiser "Königsberg" on Sept. 20, 1914, the "Pegasus" being at the time at anchor in Zanzibar roadstead, undergoing repairs. During World War I, in 1917, the Sayyid Khalid, who had lived in German East Africa since his attempt to seize the throne, surrendered to the British. He was deported to St. Helena, but in 1921 was allowed to live in Mombasa, where he died in 1927.

Administration.—The government is administered by the British resident. Questions of importance are referred to an executive council (of four officials *ex officio* and three officials appointed by the sultan), over which the sultan presides. The legislative council consists of four officials *ex officio* (including the resident, who is president) and five official and six unofficial members, both the latter appointed by the sultan. Legislation consists of the decrees of the sultan and certain British statutes of general application; the sultan's decrees, when countersigned by the resident, are binding upon all persons. The Mohammedan law, which in civil matters is the fundamental law of the sultanate, controls in some measure personal relationship and land tenure among the Islamic population. There is a British court for British and foreign subjects and for all cases where one of the parties is a non-native.

Economic Conditions.—The modern development of Zanzibar dates from the occupation of the islands by the Muscat Arabs about 1830. In addition to the cultivation of cloves (made compulsory under the Sayyid Said), Zanzibar had a large transit trade in ivory, slaves, cotton goods and rice. Many merchants from India settled in Zanzibar—and apart from the traffic carried on by dhows with Arabia—trade fell largely into their hands. In 1873 the highly profitable slave trade was declared illegal, though illicitly it was carried on for the next 25 years. The Arab-owned clove and other *shambas* (plantations) were worked by domestic slave labour, but the legal status of slavery was abolished in 1897 and slavery in the sultanate finally ceased in 1907. Many Arabs failed to adapt themselves to the new conditions and their shambas passed into the hands of natives. In course of time nearly half of the adult male population was either clove plantation owners or peasant proprietors. The protectorate produces more than 80% of the world's supply of cloves, the exports of which, in 1940, amounted to 217,836 cwt.; at that period some 48,000 ac. were under clove cultivation. Coco-nuts are the second most important economic crop, and limited quantities of tobacco and citrus fruits are also exported. Manufacture of agricultural products is confined to the distillation of oil from clove buds and stems and the expression of edible oil from copra and from imported groundnuts and sesame seeds. The principal imports are rice and grain, and cotton piece goods. In 1940 the exports of the sultanate were valued at £1,158,474, and the imports at £875,697. The East African Currency board shilling (of 100 cents) became the standard coin in 1936, when the rupee of British India ceased to be legal tender. Indian and South African banks have branches in Zanzibar.

Communication.—The port of Zanzibar is well served by British and other European shipping companies, as well as by those of India, Japan and the United States; vessels of the Zanzibar government maintain a service to Pemba and to Dar-es-Salaam. Cable communication is provided by Cable and Wireless, Ltd. Prior to World War II there was a bi-weekly aeroplane service from Zanzibar to Dar-es-Salaam, Tanga, Mombasa and Nairobi, connecting with the London-to-Cape Town service. There are no railways in the island, but nearly 250 mi. of roads suitable for motor traffic.

Education.—The education of Arabs and Africans devolves almost entirely on the government, for Islamic influence is supreme. Elementary education is free, and compulsory for subjects of the sultan. In 1940 there were, for boys, 15 elementary rural schools, a rural boarding school, two urban central schools and a secondary school; for girls (provision for whose education began in 1928), there were two elementary schools and an urban school. The three missions operating in the sultanate (the Universities' Mission to Central Africa, the Society of the Holy Ghost, and the Friends' Industrial) restrict their educational activities to mainland adults and children resident in Zanzibar.

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ZANZIBAR, an East African seaport, capital of the island and sultanate of the same name, in 6° 9′ S., 39° 15′ E. Pop. (1931 census) 45,276; 1941 est. about 65,000. The town is situated on the western side of the island 26 mi. N.E. of the mainland port of Bagamoyo. Zanzibar is built on a triangular-shaped peninsula, about 1½ mi. long, which runs from east to west, forming a safe and spacious roadstead, with a minimum depth of water exceeding five fathoms. In addition to this anchorage, there is a concrete wharf 800 ft. long, capable of berthing ships alongside up to 400 ft.; the wharf is fitted with five electrically operated cranes, and transit sheds are provided for exports and imports. Viewed from the sea, the town—which has a thoroughly oriental aspect—presents a pleasant prospect. Certain sections of the narrow bazaar street are surfaced with precast concrete slabs, and there are 9 mi. of waterproofed roads other than bazaar streets. Characteristic of the streets are the carved and massive wooden doors, whose blackness contrasts with the white stone of the houses, and the bright red of the acacias in the garden enclosures. The bazaar is a great centre of attraction. The Anglican cathedral (built 1873–79), a semi-Gothic coral building, occupies the site of the old slave market, which was closed in 1873. The Roman Catholic cathedral is a fine building in the Renaissance style.

The motley population of Zanzibar—the chief elements are Arab, Indian and Negro—is indicative of the commercial importance of the city. Its geographical position made it the key of East Africa from Cape Guardafui to Delagoa Bay. "When you play on the flute at Zanzibar" (says an Arab proverb) "all Africa as far as the lakes dances." The Americans were the first among white merchants to realize the possibilities of the port, and a United States consulate was established as early as 1836. The name Merikani, applied to cotton goods and blankets on the east coast, is a testimony to the enterprise of the American trader. The city was the headquarters of the Arabs who ravaged East Africa for slaves and ivory during the major part of the 19th century, and was described by Henry Drummond in *Tropical Africa* (1888) as a "cesspool of wickedness oriental in its appearance, Mohammedan in its religion, Arabian in its morals." Nevertheless, Zanzibar in those days was the focus of all exploring and missionary work for the interior.

ZAPARAN, a group of tribes of South American Indians forming an independent linguistic stock. The Zaparos live in the region of the Peruvian-Ecuadorian border, on the Curary and Napo rivers and the lower Aguarico. They are a tall, robust people, rather light in skin colour, with prominent noses and are said sometimes to have blue eyes. The men wear a tree-bast poncho-like garment, ornamented with painted designs. The women wear only a small fringed apron. Their houses are merely thatched shelters with no sides. Their weapons are bows, spears and blowguns, poison being used on the darts for the latter and for their arrows. They depend mainly on hunting and fishing for food, although growing some sweet potatoes and bananas.

See A. Simpson, "Notes on the Zaparos," *Journ. Anthrop. Inst. Gr. Brit. and Ire.*, vol. vii, pp. 502–510; G. Osculati, *Esplorazione delle Regioni Equatoriali, etc.* (Milano, 1854); Reinburg, "Folklore amazonien," *J. Soc. Americanistes de Paris* (n.s.) vol. xiii, pp. 11–17.

ZAPOROZHE (formerly Alexandrovsk), a town of the Ukrainian S.S.R., in 47° 51′ N., 35° 10′ E., on the left bank of the

Dnieper river. Pop. (1939) 289,188. Its name means "beyond the rapids," and it is situated south of the falls on which the Dnepropetrovsk hydraulic station was constructed. There is a motor factory and five factories produce agricultural machinery; the town is also a railway junction. Zaporozhe is opposite to Khortitsa Island, a former camp of the Zaporozhian Cossacks and kurgans (tumuli) are numerous in the district.

Zaporozhe was captured by the Germans in 1941 and was retaken by soviet troops in 1943.

ZAPOTEC, a south Mexican nationality, the most important of a group comprising also Mixtec and half a dozen other peoples, all speaking tonal languages, and occupying a territory roughly coterminous with the state of Oaxaca. The population in this area of the so-called Zapotecan family, of which the Zapotec proper held the south-eastern part, is still overwhelmingly Indian in blood and largely native in speech. The ancient Zapotec were an important people, who probably served as intermediaries of culture between the Maya and the Nahua, but also developed traits of their own. They excelled in finely modeled figure jars of pottery. Their calendar appears to have been that of the Maya and Aztec; their glyphs have not been read. Two important groups of ruins in Zapotec territory lie at Monte Alban and at Mitla. The former, which appear to be the earlier, comprise terraces and pyramids on a hill, and inscribed stelae and tablets. Mitla has long stone buildings, sunken or on low platforms, with stone columns, veneers of stone cut into geometric patterns, and pictographic frescoes. The population speaking Zapotec numbered 231,000 in 1895; that speaking idioms of Zapotec family, about 450,000.

ZARA, a town on the east coast of the Adriatic, formerly the capital of Dalmatia but now attached to Italy, and included in Venezia Giulia. Italian territory includes an adjacent belt with a total area of 42 sq.mi., and a population of 20,055, of whom 12,838 lived within the town in 1936. Zara in this sense forms a small enclave on the coast of the Yugoslav *oblast* of Split. The town is placed on the north-west end of a small, low-lying peninsula separated by the Canale di Zara from the islands of Ugliano and Pasman. It is about 73 m. N.W. of Split and about 92 m. N. of E. from Ancona, with which it is connected by steamer. The space between the peninsula on which the town stands and the adjacent mainland forms a natural, deep-water harbour, the entrance to which was in Venetian times blocked by a chain. Surrounded on three sides by the sea the town was rendered still more secure, after its capture by the Venetians in 1409, by the digging of a deep ditch on the fourth side, so as to convert the tip of the peninsula into an island. When the fortifications were reconstructed by Sanmicheli in the 16th century, a gate, the Porta di Terraferma, was erected to guard the single entrance across the ditch on the landward side.

At the end of the 10th century Zara passed for the first time under Venice. For four centuries it was bandied about from Venice to Hungary and back again. Finally, in 1409 it was sold by the King of Hungary to the Republic and remained Venetian till the Republic ceased to exist. It was then ceded to Austria, passed temporarily into French possession, forming part of the short-lived Illyrian kingdom, till in 1814 the French were driven out and it remained Austrian till the end of World War I. Its transference to Italy, when the rest of Dalmatia became Yugoslav, was justified by the large Italian element in the population and the continuity of Latin culture and speech.

Of the churches one of the oldest is the secularized S. Donato, probably dating from the early 9th century, and recalling S. Vitale at Ravenna. The cathedral dates from the 13th century and its treasury contains some good examples of Dalmatian silver work.

See T. G. Jackson, *Dalmatia, the Quarnero and Istria* (1887) and G. Dainelli, *La Dalmazia* (with atlas, 1918).

ZARHON, a mountain in Morocco, altitude 3,600 feet, 9½ m. N. of Meknes; it is covered with olive-trees and vines, and has numerous villages; it is one of the most picturesque and smiling regions of Morocco. On the flanks of the Zarhon is the town Mulai Idrīs Zarhoon, so called after Mulai Idrīs I., the founder of the Moorish empire, who was buried there in A.D. 791. The whole town is considered as a sanctuary. Not far from Mulai Idrīs are the ruins of the Roman town of Volubilis (Oulili). *See* L. Chatelain, *Les fouilles de Volubilis* (Casablanca, 1915).

ZARIA, a province occupying a central position in the Northern Provinces of the British protectorate of Nigeria. It has an area of 23,695 sq.m. and a population (1926) of 1,031,567. The province was enlarged in 1926 by the transference to it of the Katsina emirate from Kano province (*see* KATSINA). The province, of which a great portion consists of open rolling plains, is watered by the Kaduna affluent of the Niger and its many tributaries, and is generally healthy. There is an area of high land (2,000 ft. and over) in the centre of the province which in the south consists of parksland—"orchard brush." In the north the country is more open and becomes semi-desert where the Katsina emirate adjoins the French Niger colony. The chief towns are Zaria, the capital of the emirate, 87 m. S.W. of Kano, and Kaduna, the capital of the Northern Provinces. Both Zaria and Kaduna are in direct railway communication with Kano, Lagos and Port Harcourt, the Western and Eastern railways of Nigeria having their junction at Kaduna. There is also a railway from Zaria to the Bauchi tin-fields, and another railway goes N.W. from Zaria towards Sokoto. There are over 1,000 m. of motor roads in the province. Cotton is very extensively grown.

The ancient state of Zaria, also called Zeg-Zeg by the geographers and historians of the middle ages, was one of the original seven Hausa states. It suffered all the fluctuations of Hausa history, and in the 13th and early 14th centuries seems to have been the dominating state of Hausaland. At later periods it submitted in turn to Kano, Songhoi and Bornu. At the end of the 18th century it was an independent state under its own Mohammedan rulers, but, like the rest of northern Hausaland, it was conquered in the opening years of the 19th century by the Fula. It remained a Fulani emirate up to the period of the British occupation of Nigeria. The emir of Zaria professed friendliness to the British, and in March 1902 the province was taken under British administrative control. It was found that, notwithstanding his friendly professions, the emir of Zaria was intriguing with Kano and Sokoto, then openly hostile to Great Britain, while he continued to raid for slaves and to perpetrate acts of brutal tyranny and oppression. He was deposed in the autumn of 1902, and after the Sokoto-Kano campaign of 1903, which assured the supremacy of Great Britain in the protectorate, another emir, Dan Sidi, was appointed to Zaria.

ZARLINO, GIOSEFFO (1517–1590), Italian musical theorist, surnamed from his birthplace ZARLINUS CLODIENSIS, was born at Chioggia, Venetia, in 1517 (not 1540, as Burney and Hawkins say). Studying in his youth for the Church, he was admitted to the minor orders in 1539 and ordained deacon in 1541 at Venice; but he soon devoted himself entirely to the study of music under the guidance of Adrian Willaert, then choirmaster at St. Mark's. Willaert, dying in 1562, was succeeded by Cipriano di Rore, on whose removal to Parma in 1565 Zarlino was elected choirmaster. Though now remembered chiefly as the earliest advocate of a system of equal temperament for fretted and keyed instruments and for his invaluable contributions to the theory of music, he was both a practical musician and a composer. His printed works consisted of a volume entitled *Modulationes Sex Vocum* (Venice, 1566) and a few motets and madrigals scattered through the collections of Scotto and other contemporary publishers, but he also produced and superintended the public performance of some important pieces in the service of the republic. The only example we possess of his compositions on a grand scale is a ms. mass for four voices, in the library of the Philharmonic Lyceum at Bologna. He died at Venice on Feb. 14, or, according to some Feb. 4, 1590.

Zarlino's first theoretical work was the *Istitutioni Armoniche* (Venice, 1558; reprinted 1562 and 1573). This was followed by the *Dimostrationi Armoniche* (Venice, 1571; reprinted 1573) and by the *Sopplimenti Musicali* (Venice, 1588). Finally, in a complete edition of his works published shortly before his death Zarlino reprinted these three treatises, accompanied by a *Tract on Patience,* a *Discourse on the True date of the Crucifixion of Our Lord,* an essay on *The Origin of the Capuchins,* and the *Resolu-*

tion of Some Doubts Concerning the Correction of the Julian Calendar (Venice, 1589).

The *Istitutioni* and *Dimostrationi Armoniche* deal, like most other theoretical works of the period, with the whole science of music as it was understood in the 16th century. The earlier chapters, treating chiefly of the arithmetical foundations of the science, differ but little in their line of argument from the principles laid down by Pietro Aron, Zacconi, and other early writers of the Boeotian school; but in bk. ii. of the *Istitutioni* Zarlino boldly attacks the false system of tonality to which the proportions of the Pythagorean tetrachord, if strictly carried out in practice, must inevitably lead.

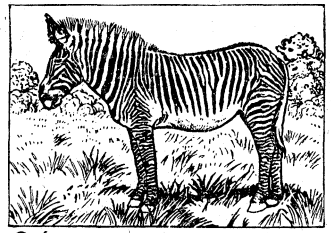
Again, Zarlino was in advance of his age in his classification of the ecclesiastical modes. These scales were not wholly abolished in favour of our modern tonality in the 17th century. Eight of them, it is true, fell into disuse; but the mediaeval Ionian and Hypo-ionian modes are absolutely identical with the modern natural scale of C; and the Aeolian and Hypo-aeolian modes differ from our minor scale, not in constitution, but in treatment only. Mediaeval composers, however, regarded the Ionian mode as the least perfect of the series and placed it last in order. Zarlino thought differently and made it the first mode, changing all the others to accord with it. His numerical table, therefore, differs from all others made before or since, prophetically assigning the place of honour to the one ancient scale now recognized as the foundation of the modern tonal system.

These innovations were violently opposed by the apostles of the monodic school. Vincenzo Galilei led the attack in a tract entitled *Discorso Intorno alle Opere di Messer Gioseffe Zarlino,* and followed it up in his famous *Dialogo,* defending the Pythagorean system in very unmeasured language. It was in answer to these strictures that Zarlino published his *Sopplementi.*

ZAUSCHNERIA, a genus of North American plants of the evening-primrose family (Onagraceae), comprising several species native to California and adjacent Mexico. They are low, slightly shrubby perennials, with small narrow or ovate leaves and large scarlet, fuchsia-like flowers. *Z. californica,* known as California fuchsia and Mexican balsamea and found on mountain slopes, is planted in flower gardens.

ZEALAND (Dan. *Sjaelland*), the largest island of the kingdom of Denmark 2,709 sq.mi. in area, lying between Fyn (11 mi. distant) on the west, and southern Sweden (only 3 mi. distant at the sound) on the east. The surface is undulating, but little above sea-level, and the outline very irregular. On the island are the old cathedral city of Roskilde, the Danish capital, Copenhagen, and the historic port of Helsingfors (Helsinki). Pop. (1940) 1,406,232. (*See* DENMARK.)

ZEBRA, the name for the African striped members of the horse tribe. The true or mountain zebra (*Equus zebra*) maintains a precarious foothold in the mountainous region of Cape Colony and also inhabits Angola. It stands about 4ft. at the shoulder, with fairly long ears, a tail scantily clothed with hair, and a short mane. The ground colour is white and the stripes, absent only on the abdomen and inside of the thighs, are black. The lower part of the face is brown. The stripes on the haunch do not reach the median dorsal stripe and there are a number of transverse short stripes on each side of the midline. These are absent in Burchell's zebra (*E. burchelli*), which has broader stripes, often with shadow stripes between them. The typical race is extinct, but other races of this species are common from the Transvaal to Uganda. The ground colour is pale buff, the stripes, which in the southern race do not extend to the lower limbs, dark brown or black. The East African race (*E.b. boemi*) has the lower parts striped and shadow stripes are usually lacking. The closely related quagga (*q.v.*) is extinct. Grévy's zebra (*E. grevyi*) of Somaliland, northern Kenya and parts of Ethiopia, is distinguished by its long head, large ears and numerous narrow stripes. Zebras occur in large herds and are preyed upon chiefly by lions. They have been crossed with the domestic horse but the resultant hybrid is not as valuable as the horse, mule and ass. Fossil horses, with teeth closely resembling those of zebras, have been found in the Pleistocene of North America. (*See* HORSE; EQUIDAE.) (J. E. HL.)



GRÉVY'S ZEBRA (EQUUS GREVYI) DISTINGUISHED BY ITS NUMEROUS STRIPES AND ASSLIKE EARS

ZEBU (*Bos indicus*), an Indian species of ox, characterized by light colour and a hump. The sacred bulls of India belong to this species, which is used for draught work, and supplies milk. In many places it is crossed with domestic cattle. (*See* CATTLE.)

ZEBULON, a tribe of Israel, named after the sixth son borne by Leah to Jacob (Genesis xxx. 20). The fertile territory occupied by the tribe lay roughly north-east of the plain of Jezreel, but the boundaries between it and the neighbouring territories of Naphtali, Asher and Issachar are ill-defined. The somewhat obscure text of Genesis xlix. 13 seems to imply that at one time Zebulon extended to the sea-coast and marched with Phoenician territory. The tribe appears to have furnished valiant warriors, and receives special mention in the Song of Deborah for its martial exploits (Judges v. 14, 18).

ZECHARIAH, the eleventh in order of the "minor prophets" of the Old Testament. He was associated with Haggai (*q.v.*) in stimulating the re-building of the temple at Jerusalem, begun in 520 (Ezra iv. 24) and completed in 516 (Ezra vi. 15). A previous attempt made by returned exiles in 537 (Ezra i. 1 *seq.,* iii. 1 *sqq.*) seems to have been checked by local opposition and not renewed owing to economic pressure. In 520, however, the political disturbances of the Persian empire (of which the Jewish community in Palestine was a negligible part) were interpreted by these two prophets as a sign that the Messianic expectations were now to be realized, and that the "Day of Yahweh" was at hand. Haggai gave the first impulse to the new attempt; two months later, Zechariah joined him in encouraging the faint-hearted. His prophecies, exactly dated in 520 (i. 1, 7) and 518 (vii. 1), are to be found in the first eight chapters of the book now bearing his name. Their central feature is a series of "night-visions" (i. 8, iv. 1), intended to show Yahweh's immediate and effective intervention on behalf of His people. They are arranged with literary art in connected sequence, beginning with the vision of horsemen who report that the expected Messianic crisis has not yet come (i. 11, *cf.* Hagg. ii. 21 *seq.*), and culminating in the vision of Yahweh's war-chariots despatched to execute His vengeance upon the heathen, especially on Babylonia (vi. 8). The six intervening visions (all the eight are ascribed to a single night) reveal in succession four horns, representing the heathen powers of the four quarters of the earth, cast down by four craftsmen (i. 18–21), a man with a measuring line, whose narrow ideas of the future city are replaced by the conception of a city without walls because of its great extent, to which Yahweh's protection will be a wall of fire (ii. 1–5), the formal acquittal and restoration of Joshua the high-priest, representing the community (iii. 1 *seq.*), the seven-branched lampstand, representing Yahweh's watchful eyes, with two olive-trees, representing Joshua and Zerubbabel (iv. 1–14, but see the commentaries), the flying roll which brings its ubiquitous curse on evil-doers (thieves and false-swearers), and so cleanses the land of moral evil (v. 1–4), the woman carried off in an ephah, representing the removal of guilt (v. 5–11). These visions are now prefaced by a call to repentance and the promise of forgiveness (i. 2–6), in which Zechariah's appeal to "the former prophets" (like the detail of an interpreting angel in the visions themselves) reminds us that the great prophetic period (8th–6th centuries) lies in the past, and that the conception of revelation itself has lost something of its original simplicity and spontaneity.

The "night-visions" are followed, two years later (vii. 1), by a divine oracle which directs that the fasts kept throughout the exile should now become festivals (viii. 18 *seq.*). The enquiry which led to the oracle (vii. 3) is made the occasion of warning against the externality of fasting, of appeal for true conduct, and of an idyllic picture of the happiness of the coming Mes-

sianic age (note especially viii. 4, 5). In this happy future the prophet expected that Zerubbabel would be the Messiah, and the bringing of an offering of gold and silver from Jews in Babylon led Zechariah to crown him symbolically in the name of Yahweh (vi. 9–15; *see* the commentaries for the original text). The darkness that falls on Jewish history with the completion of the second temple suggests that these words and deeds may have thrust Zerubbabel into a dangerous political prominence, leading to his removal by the Persian authorities, and the eclipse of Messianic expectations.

The remainder of the present book of Zechariah (ix.–xiv.) is of an altogether different character, and is now generally admitted to belong to a period later than the Persian (as indeed the direct reference to Greece in ix. 13 implies). This portion of the book is divided by the titles in ix. 1, xii. 1. ("The burden of the word of Yahweh"), into two distinct collections, each of which it seems necessary to divide again, so that we have four groups of prophecies, distinguished by their subject-matter. The first (ix.–xi. 3) deals with the recovery of Palestine by Yahweh's victories over Syria, Phoenicia and Philistia (ix. 1–8), the coming of the Messianic king to the restored and victorious Israel (ix. 9–17), the overthrow of the (foreign) "shepherds" or rulers, and the gathering of exiled Israelites (x. 1–12), closing with a figurative dirge over the fall of these "shepherds" (xi. 1–3). The second group (xi. 4–17, with the misplaced xiii. 7–9) describes the rejection of the prophet, representing a worthy shepherd, and the accursed doom of a worthless one, a purified third of the people alone remaining. The third (xii., xiii. 1–6) pictures an attack of the nations upon Jerusalem, in which Judah is first a foe and then a victorious friend to the mother city; this is followed by elaborate mourning for an unnamed martyr (xii. 10, R. V. mg.), and the cleansing of Jerusalem from idolatry and *prophecy*. The fourth division (xiv.) describes the delivery of Jerusalem from the heathen, that it may become the metropolis of religion for all the world. The last two of these divisions are of a markedly eschatological character, and even the first two could be so regarded (so Sellin). These writings are perhaps the most obscure of the Old Testament, chiefly because we have no sufficient clue to the historical allusions, such as the cutting off of three shepherds in one month (xi. 8), the pierced martyr (xii. 10) and the antagonism of Judah and Jerusalem (xii. 2, xiv. 14). By some scholars these chapters have been brought down as late as the Maccabean age, the events of which are supposed to explain these and other allusions. But the fact is that we are almost wholly ignorant of Jewish history during the earlier part of the Greek period (from 331 B.C.), to which these writings might equally well belong.

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ZEDEKIAH, son of Josiah, and the last king of Judah (2 Kings xxiv, 17 *sqq.*; 2 Chron. xxxvi, 10 *seq.*). He was appointed king by Nebuchadrezzar after the capture of Jerusalem (597 B.C.) and held his position under an oath of allegiance. After three years he began an intrigue with Moab, Edom, Ammon, Tyre and Sidon, and it is possible that he was summoned to Babylon to explain his conduct. Nevertheless, relations were maintained with Egypt and steps were taken to revolt. The Babylonian army laid siege to Jerusalem in 588 B.C., and a vain attempt was made by Pharaoh Hophra to cause a diversion. After six months a breach was made in the city, Zedekiah was captured and taken to Nebuchadrezzar at Riblah. His sons were killed, and he was blinded and carried to Babylon in chains where his predecessor, Jehoiachin was already a captive.

ZEEBRUGGE, ATTACK ON: *see* BELGIAN COAST OPERATIONS.

ZEEHAN, a town of Montagu county, Tasmania, 225 mi. N.W. of Hobart, on the Little Henty river. It is a railway centre and focus of the silver-lead mining of the neighbourhood. It is about halfway along the railway between the copper mines at Mount Lyell and the tin mines of Mount Bischoff. In 1938 Tasmania produced silver-lead worth £268,000, mostly from Zeehan. Pop. for locality (1933), 1,002.

ZEELAND, the most southerly North sea maritime province of the Netherlands, consists mainly of six deltaic islands between the Grevelingen (the southern sea-exit of the Waal-Maas) and De Hont or Western Schelde sea-channel, together with a strip of the Flanders mainland lying south of De Hont. Belgium borders it on the south; the Dutch provinces of North Brabant, east, and South Holland, north, are its other neighbours. It is 609 sq.mi. in area, and of the other ten Dutch provinces only Utrecht is smaller. Very little of its entire surface is above sea-level. Formed of the accumulated alluvium from the great rivers and with little natural protection against the encroaching waves, its life has been marked by inundation catastrophes and by the long, slow winning back of territory in the lee of successive ranks of many miles of artificial dikes. (*See* HOLLAND: *Dikes.*)

Above a gateway of the old mint of the counts of Holland in Middelburg a sculptured lion of Zeeland rises through stone waves and his "Luctor et emergo" is one of the most apposite of the provincial mottoes. Its pop. (est. 1938) 254,565, is, with the exception of Drente, the lowest of any province in Holland. However, its fertile soil favours the cultivation of cereals, wheat, rye and barley and of root crops. Its famous black and white cattle and dairy produce are important exports.

The constituent islands are Walcheren to the south-west with North Beveland and South Beveland in close proximity to the east. North of the fairly wide waterway Ooster Schelde, which at the eastern end has the significant name of Verdronken (Drowned) Land, are Schouwen-en-Duiveland (westward), and the smaller Tholen and still smaller St. Philipsland. All the islands preserve archaic customs and costumes. Walcheren, though not the largest island, is the most densely populated and nearest to England with which Flushing (Vlissingen), its largest town, has regular passenger and mail boat services *via* Harwich and Queenborough. Flushing (pop. 21,716) is not only a sea and canal port, but also a gay resort. It is the railhead for the line which in 1866 first crossed the great railway dam between Walcheren and South Beveland and now runs to Roosendaal (North Brabant) the great railway junction for Belgium, Germany and north Holland. The ship canal from Flushing divides Walcheren into two unequal parts and passes Middelburg en route for Veere, while steam trams connect Flushing and Middelburg with Domburg. Domburg is a small seaside resort built over and round a much older settlement with civic rights dating back to the 13th century; in addition, numerous Roman antiquities found locally suggest a still earlier origin. South-west of Domburg is the famous Westkapelle dike. Middelburg, the capital of the province, is but little smaller than Flushing. It is and has long been the real focus of Dutch life in Zeeland and has many interesting buildings.

The small industries of Walcheren include ship-building, distilling, brewing and spinning, but it deservedly ranks as the flower garden of Zeeland; in latter days it is cultivating a great variety of products from hemp to the opium poppy and its orchards are important. South Beveland and its small neighbour North Beveland are even more important for fruit which, in their case, is largely exported as jam. South Beveland has suffered much from inundations, particularly in the south-west; here, during the 16th century, the island of Borsselen was submerged but has been gradually recovered. North Beveland, destitute of ship canal or railway has no large settlements; it is intensively cultivated and shares with Schouwen and South Beveland an important oyster-breeding industry, Yerseke on the north-east coast of South Beveland being particularly famed. Goes (pop. [1940] 9,669) is the largest town of North Beveland, Schouwen contains the greatest amount of elevated land in Zeeland and the well-wooded tract along the western seaboard introduces a less usual scenic feature. The former natural seaway between Schouwen and Duiveland has been closed by the damming of the Dykwater but a canal still follows its line. On this is the old port of Zierikzee which has probably retained more of its mediaeval features than any other Zeeland town.

In the north of Schouwen is Brouwershaven, established as a port by the brewers and wine merchants of Middelburg. Here the English supporters (under Jacquelin of Bavaria) were defeated by the troops of Philip of Burgundy. St. Philipsland is rather inaccessible and has little of interest; Tholen, only little easier of approach, has on its east coast a small ancient circular town of the same name, noted for oysters and onions. In the still smaller village of St. Maartensdyk little remains of its once mighty 14th-century castle—the home of the Borsseles—but the village church contains a tomb of Floris van Borssele. Stavenisse on the west coast is modern and ugly. The strip of Zeeland-Flanders gives the Dutch command of both banks of the Lower Schelde. Here the busiest town is Terneuzen at the sea-end of the canal (1825–27), running due south to Ghent; south-east of it lies Axel, formerly fortified but now noted only for the peculiar costumes of its peasant women. Zeeland played an important role in the battle of Holland in May 1940, as it was able to hold out for about 10 days longer than the other provinces in the battle against the German invaders. Most of its capital, Middelburg, was destroyed by enemy bombing. (W. E. WH.; X.)

ZEEMAN, PIETER (1865–1943), Dutch physicist, was born at Zonnemaire, Zeeland, on May 25, 1865. He studied at Leyden, where he was successively assistant in physics (1890–94), *Privat-dozent* (1894–97) and lecturer (1897–1900). In 1900 he was appointed professor of physics at Amsterdam, and in 1908 director of the Physical institute in that city. Zeeman's best known work in physics is the so-called Zeeman effect (*q.v.*), the splitting up of spectral lines in a magnetic field, which he discovered in 1896. The theoretical explanation was first given by Hendrik Antoon Lorentz soon after the effect was observed. The phenomenon has been used by astronomers for the detection of magnetic effects at the surface of the sun. Later Zeeman worked on the propagation of light in moving media. He made observations in water, quartz and flint; the bodies were given an oscillatory motion and instantaneous photographic methods were applied, the exposure being made when the velocity was at a maximum. The results of these observations are collected in *Archives Néerlandaises des Sciences Exactes* (vol. x, 1927). Zeeman was a member of many learned societies and was the recipient of many awards, including the Nobel prize, which he won jointly with Lorentz in 1902. He was the author of several books on magneto-optics, which were translated into English and German. He died in Amsterdam, Oct. 9, 1943.

ZEEMAN EFFECT, named after its discoverer, is the term used to describe the phenomena produced in spectroscopy (*q.v.*) by a magnetic field. When a substance, which emits a line spectrum, is placed in a strong magnetic field, every line is split up into several components each of which has a characteristic change of frequency and characteristic polarization and intensity. Magnetism produces many curious effects in matter (change of electrical resistance, "Hall" effect, etc.), but the Zeeman effect has an importance immensely greater than the rest because it has proved to be one of the most powerful means of discovering the nature of the forces in the atom. The first indication of a connection between light and magnetism was due to Faraday, who discovered the magnetic gyration of light in 1845; *i.e.*, when plane polarized light goes through transparent matter in a magnetic field the plane of polarization is rotated. With extraordinary insight he conjectured that there ought to be a corresponding effect in the emission of light, and almost the last experiment of his life was to seek for it. He failed to detect it since the technique both of spectroscopes and of magnetic fields was insufficiently developed, but modern theory entirely bears out the correctness of his conjecture. In 1896 Zeeman made a similar attempt and was successful. When a source of light, such as a metallic arc, was placed between the poles of a powerful electromagnet, the lines of its spectrum were split into components, some displaced to the red and some to the blue, and each of these was polarized in a characteristic way.

The experimental study of the Zeeman effect calls for little comment. Even in the strongest magnetic fields available (say 30,000 gauss) the extreme components into which a line is split are never more than about 1 Å. U. apart, and there may well be a dozen or so components between them, so that it is not only necessary to have a powerful magnet, but also a spectroscope of high resolving power. The consequent difficulties are very great, but are not peculiar to the Zeeman effect. The polarizations of the various components are shown by the ordinary methods used for polarized light, and their intensities by means of an opaque wedge according to the usual photometric practice, and only one point calls for comment. Light passing through a diffraction grating has its intensity differently affected according as it is polarized along or across the lines of the grating, and this might entirely vitiate the comparison of the intensities of lines polarized in these two ways. The difficulty is avoided by the use of a quartz plate, which rotates the planes of polarization so that both types are at 45° to the lines of the grating. It was only after this was done that it was found possible to obtain correct values for the intensities, with important consequences for the general theory of spectra.

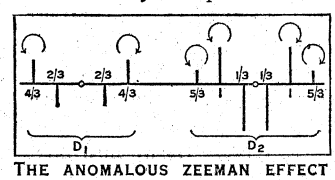
The Normal Zeeman Effect.—Almost immediately after Zeeman had made his discovery, Lorentz showed how it would fit into the classical electric theory. His explanation has been superseded in the light of later knowledge, but it still furnishes a convenient description of the simpler features of the effect. It explains what is called the "normal effect," though, as so often happens with scientific nomenclature, it turns out that the normal effect is of rather rare occurrence and is not in fact the most primitive type. Lorentz supposed that the atom contains an electron which describes free vibrations about a centre. The restraining force is proportional to the distance from the centre and is the same for all directions, so that the free period is independent of the orbit of the electron. Such an electron will emit light of its own frequency and with polarization completely determined by its orbit. When there is no external magnetic field the orbits of the various atoms in the source are orientated at random, and their average effects give unpolarized light.

When an electron is placed in a magnetic field, it experiences a force at right-angles to the direction of the field and also at right-angles to its line of motion, and this force is to be superposed on the other forces acting on the electron. The effect is most conveniently described by Larmor's theorem which asserts that the field is equivalent to a rotation. This means that the actual motion of the electron in the field is the same as the apparent motion it would have without the field, but now as seen by an observer who is himself rotating at a suitable speed about an axis in the direction of the magnetic force. The angular velocity of the Larmor rotation is $eH/2mc$, where H is the strength of the field, e and m the charge and mass of the electron and c the velocity of light. Compared to ordinary standards this is a very high speed even for quite weak fields (for the earth's magnetic field is about a million rotations a second), but it is much smaller than the speed with which it is to be compared, the electron's motion in the atom.

The equivalence of magnetism and rotation is true whatever other forces may act on the electron. In our case the effect can best be seen by considering three special types of orbits; the general motion is merely a superposition of these. The first is a motion along the line of the magnetic field, and this is evidently unaffected by the rotation. The others are circular motions, both in a plane perpendicular to the field, but in opposite directions. The Larmor rotation must be added to one of these, and subtracted from the other. If the original frequency was ν there will now be three frequencies, ν and $\nu \pm eH/4\pi mc$, and we conclude that the magnetic field will split one line into three. Moreover each of the three will have a characteristic polarization, associated with the corresponding motion of the electron. These polarizations vary according to the position of the observer, and are most easily described by saying that the light-vector (electric force) behaves like the perspective view that the observer has of the motion of the emitting electron. Thus the light of frequency ν corresponds to the electron vibrating along the line of the field. Viewed from anywhere it appears to describe a straight line, and so the associated light is plane-polarized. From the poles (in the

direction of the magnetic field) the electron will appear motionless, and so no light is emitted in this direction. At the equator the apparent motion is a maximum and the light is polarized with vector in the same direction as the field; for this reason the component is called *parallel*. Next consider one of the circular motions; on the same principle it emits circularly polarized light towards the poles, and plane-polarized light towards the equator where the electron's motion is seen edgewise. From the direction of its polarization at the equator this component is called *perpendicular*. One of the first tasks of Zeeman was to examine the light in the polar direction, for, by finding whether the bluer component gives right- or left-handed circularly polarized light, it is possible to fix the sign of the Larmor rotation, and so to determine the sign of the electron's charge *e*. Once this is done it is most convenient to observe the effect from the equator, since in that direction all three components are plane-polarized, and this is much more convenient for investigation.

The Anomalous Zeeman Effect.—The experiments on some spectral lines (in particular on the chief cadmium lines which are used as fundamental standards of wave-length) entirely bore out Lorentz's theory and gave a measure of e/mc, which in magnitude and sign was in agreement with the value determined for free electrons. This result, however, proved to be quite exceptional; nearly all lines were found to give much more complicated splitting and this in many different ways, which are collectively referred to as the *anomalous Zeeman effect*. There are usually many more than the three lines of Lorentz's theory, and often none in the positions predicted by it; but the scale of the pattern is still proportional to the magnetic force and the polarizations still fall into the three classes described, the central ones being *parallel* and the outer *perpendicular* of the two types. Moreover the displacement always bears a simple numerical ratio to that given by the simple theory. The general rules are very complicated and we may be content to describe a single example, the yellow lines, D_1 and D_2, of sodium. These two lines break up into 4 and 6 components respectively, in the manner shown in figure. This is the simplest case of the anomalous effect, and theory now shows it to be the most primitive effect of all, much more so than the normal Lorentz triplet.



THE ANOMALOUS ZEEMAN EFFECT FOR THE D LINES OF SODIUM

The anomalous Zeeman effect is connected with another important phenomenon, called the Paschen-Back effect after its discoverers. As the magnetic field is increased, the components get further apart, and for a strong enough field those of D_1 and D_2 ought to overlap one another. This does not occur, but a complicated rearrangement takes place; some lines weaken in intensity and disappear, others melt together and finally, when the magnetic field is very strong indeed, a totally new pattern is observed in the form of a *single* Lorentz triplet. A trace of the original two lines remains, in that each component has a fine structure and is not a simple line. The actual transition to the Paschen-Back effect cannot be observed for the D-lines, because it would need quite unattainable strengths of field, but it is safely inferred from the behaviour of other lines of the same type which are originally much closer together. Though we have only described one particular example, it is universally true that in very strong fields every *multiplet* of a spectrum is replaced by a single Lorentz pattern.

The disentangling of the very complicated patterns was made possible by the quantum theory of spectra, according to which there is a spectrum of *levels* underlying the spectrum of lines. Every line is given in frequency by the difference in "height" between two levels, and the levels have much simpler characteristics than the lines. The analysis was worked out with the help of quasi-dynamical models, and its result was to express the displacement, polarization and intensity of every line algebraically in terms of the *quantum numbers* which describe the two associated levels. From this analysis it emerged that in the atom there are two kinds of system, one exhibits the Larmor rotation, while the other shows a rotation just twice as great. By the interaction of the two systems it is possible to explain both the anomalous Zeeman effect and the Paschen-Back effect. For some time the existence of this doubled rotation was mysterious, but it was finally traced to the electron itself; the electron in addition to its electric charge is a magnet and rotates in the magnetic field with twice the Larmor speed. Even this is not the last word, for it has been shown that it is only possible to make a picture of electrical phenomena which rigorously reconciles the quantum theory with the theory of relativity by endowing the electron with magnetism in just the way required for the Zeeman effect. Einstein's conception of relativity was developed to explain a totally different category of phenomena, and it is one of the most remarkable syntheses in the history of physics that it should be possible to make it responsible for the intricacies of the Zeeman effect.

We have described the most interesting aspect of the Zeeman effect, and need only touch on a few others. There is the *inverse Zeeman effect* where light is absorbed by matter in a magnetic field; this follows exactly the same rules as the direct effect. Faraday's magnetic gyration (*see* LIGHT) is another aspect of the same thing. The theory of the effect is still very incomplete for band spectra, and indeed for some classes of line spectra. In conclusion we may refer to a more practical use to which the Zeeman effect has been put: by its means it is known that there are very powerful magnetic fields in sun-spots, and also that the sun as a whole has a magnetic field like the earth. *See* also SPECTROSCOPY; OPTICS; LIGHT; QUANTUM MECHANICS.

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(C. G. D.)

ZEITZ, a town in the extreme south of the Prussian province of Saxony, Germany, on the Weisse (White) Elster, 28 mi. by rail S.S.W. of Leipzig on the line to Gera, and with branches to Altenburg and Weissenfels. Pop. (1939) 36,131. Zeitz is an ancient place of Slavonic origin. From 968 till 1028 it was the seat of a bishopric, afterwards removed to Naumburg, and styled Naumburg-Zeitz. In 1564 the last Roman Catholic bishop died, and his dominions were thenceforward administered by princes of Saxony. From 1653 till 1718 Zeitz was the capital of the dukes of Saxe-Zeitz. It thereafter remained in the possession of the electors of Saxony until 1815, when it passed to Prussia.

ZELLER, EDUARD (1814–1908), German philosopher, was born at Kleinbottwar in Württemberg on Jan. 22, 1814, and educated at the University of Tübingen and under the influence of Hegel. In 1840 he was *Privatdozent* of theology at Tübingen, in 1847 professor of theology at Bern, in 1849 professor of theology at Marburg, migrating soon afterwards to the faculty of philosophy as the result of disputes with the Clerical party. He became professor of philosophy at Heidelberg in 1862, removed to Berlin in 1872, and retired in 1895. His great work is his *Philosophie der Griechen* (1844–52). He was one of the founders of the *Theologische Jahrbücher,* a periodical which acquired great importance as the exponent of the historical method of David Strauss and Christian Baur. Like most of his contemporaries he began with Hegelianism, but later he saw the necessity of going back to Kant in the sense of demanding a critical reconsideration of the epistemological problems which Kant had made but a partially successful attempt to solve. None the less his merits as an original thinker are far outshone by his splendid services to the history of philosophy, in spite of the fact that his view of Greek thought is somewhat warped by Hegelian formalism. He died on March 19, 1908. Among his other works are: *Platonische Studien* (1839); *Gesch. d. christlich. Kirche* (1898); *Gesch. d. deutsch Philos. seit Leibniz* (1873, 1875); *Staat und Kirche* (1873); *Über Bedeutung und Aufgabe d. Erkenntniss-Theorie* (1862); *Über teleolog. und mechan. Naturerklärung* (1876); *Philosoph. Aufsätze* (1887).

The *Philosophie der Griechen* was translated into English (2 vols., 1881) under the editorship of S. F. Alleyne. The *Philosophie* appeared in an abbreviated form as *Grundriss d. Gesch. d. Griech. Philos.* (1883; 5th ed. 1898); Eng. trans. by Alleyne and Evelyn Abbott (1866), under the title, *Outlines of the Hist. of Gk. Philosophy.*

ZEMARCHUS (*fl.* 568), Byzantine general and traveller. The Turks, by their conquest of Sogdiana in the middle of the 6th century, gained control of the silk trade which then passed through Central Asia into Persia. But the Persian king, Chosroes Nushirvan refused to allow the old commerce to continue, and the Turks in 568 sent an embassy to Constantinople to form an alliance with the Byzantines and "transfer the sale of silk to them." The offer was accepted by Justin II., and in Aug. 568, Zemarchus the Cilician, "General of the cities of the East," left Byzantium for Sogdiana. The embassy was under the guidance of Maniakh, "chief of the people of Sogdiana," who had himself come to Byzantium to negotiate the "Roman alliance." On reaching the Sogdian territories the travellers were offered iron for sale, and solemnly exorcised; Zemarchus was made to "pass through the fire" (*i.e.*, between two fires), and strange ceremonies were performed over the baggage of the expedition. The envoys then proceeded to the camp of Dizabul (or rather of Dizabul's successor, he having just died) "in a hollow encompassed by the Golden Mountain," apparently in some locality of the Altai. They found the khan surrounded by astonishing barbaric pomp—gilded thrones, golden peacocks, gold and silver plate and silver animals, hangings and clothing of figured silk. They accompanied him some way on his march against Persia, passing through Talas or Turkistan in the Syr Darya valley.

Near the river Oēkh (Syr Darya?) he was sent back to Constantinople with a Turkish embassy and with envoys from various tribes subject to the Turks. Halting by the "vast, wide lagoon" (of the Aral sea?), Zemarchus sent off an express messenger, one George, to announce his return to the emperor. George hurried on by the shortest route, "desert and waterless," apparently the steppes north of the Black sea; while his superior, moving more slowly, marched 12 days by the sandy shores of "the lagoon"; crossed the Emba, Ural, Volga and Kuban (where 4,000 Persians vainly lay in ambush to stop him); and passing round the western end of the Caucasus, arrived safely at Trebizond and Constantinople. For several years this Turkish alliance subsisted, while close intercourse was maintained between Central Asia and Byzantium; but from 579 the friendship rapidly began to cool. All this travel does not seem to have corrected the misapprehension that the Caspian was a gulf of the Arctic ocean.

See Menander Protector, Περὶ Πρεσβέων Ῥωμαίων πρὸς Ἔθνη (*De Legationibus Romanorum ad Gentes*), pp. 295–302, 380–385, 397–404, Bonn edition (xix.), 1828 (=pp. 806–811, 883–887, 899–907, in Migne, *Patrolog. Graec.*, vol. cxiii., Paris, 1864); H. Yule, *Cathay*, clx.–clxvi. (Hakluyt Society, 1866); L. Cahun, *Introduction à l'histoire de l'Asie*, pp. 108–118 (1896); C. R. Beazley, *Dawn of Modern Geography*, i. 186–189 (1897). (C. R. B.)

ZEMGALS, GUSTAV (1871–1939), president of the republic of Latvia (1927–30), was born in Courland on Aug. 12, 1871. Educated in Riga, he studied law at the University of Moscow. Up to the time of his election as president of the republic he was a well known lawyer and notarius publicus in Riga, and took an active part in the Co-operative movement. He was vice-president of the Latvian National Council in 1918, and this council was recognized by the Western European Powers as being the legitimate representative body of the Latvian nation. It was he who proclaimed the independence of Latvia on Nov. 18, 1918, in the absence of Monsieur Tschakste, the president of the Latvian National Council.

He was elected president of the republic of Latvia for three years on April 8, 1927, in succession to the late J. Tschakste, the first president of the republic of Latvia. President Zemgals was elected by a great majority, receiving about 80 votes out of a possible 100 in the Latvian parliament. He held office until April 8, 1930, when he was succeeded by Albert Kviesis. He enjoyed remarkable popularity among all classes of the population, as he was keenly interested in the life and the progress of the people of the country. He was a member of the Constituent Assembly of Latvia and had a seat in the first parliament (Saeima). He was lord mayor of Riga and was minister of war from 1921–23. He died Jan. 7, 1939.

ZEMUN, a town of Croatia-Slavonia, Yugoslavia (German *Semlin*), on the Danube opposite Belgrade. Pop. (1931) 28,083, the majority being Serbs. Zemun is the seat of an Orthodox bishop; but most of the inhabitants are Roman Catholics. Zemun has an important transit trade in grain, fruit, livestock and timber. On a hill overlooking the Danube are the ruins of the castle of Hunyadi Janos, who died here in 1456. Until 1881 the town belonged to the military frontier of Austria-Hungary. In April 1941, the town passed under German occupation.

ZENÁGA, a Berber tribe of southern Morocco who gave their name to Senegal, once their tribal home. With other tribes under Yusef bin Tashfin, they crossed the Sahara and gave the Almoravide dynasty to Morocco and Spain. The Zeirid dynasty which supplanted the Fatimites in the Maghrib and founded the city of Algiers was also of Zenága origin. The Zenága dialect of Berber is spoken in southern Morocco and on the banks of the lower Senegal, largely by the negro population.

ZENATA or ZANATÀ, a Berber tribe of Morocco in the district of central Atlas. Their tribal home seems to have been south of Oran in Algeria, and they early claimed an Arab origin, though the Arabs called them descendants of Goliath, *i.e.*, Philistines or Phoenicians (Ibn Khaldun, vol. iii. p. 184 and vol. iv. p. 597). They were formerly a large and powerful confederation, and took a prominent part in the history of the Berber race. The Beni-Marin and Wattasi dynasties of Zenata origin, reigned in Morocco from 1213 to 1548.

ZEND-AVESTA, the original document of the religion of Zoroaster (*q.v.*), still used by the Parsees as their bible and prayer-book. The name "Zend-Avesta" has been current in Europe since the time of Anquetil Duperron (*c.* 1771), but the Parsees themselves call it simply *Avesta, Zend* (*i.e.*, "interpretation") being specially employed to denote the translation and exposition of a great part of the Avesta which exists in Pahlavi. The origin and meaning of the word "Avesta" (or in its older form, *Avistāk*) are alike obscure; it cannot be traced further back than the Sassanian period. The term is now applied both to the collection of writings and also to the language in which they are composed. The Avesta is a work of but moderate compass (comparable, say, to the *Iliad* and *Odyssey* taken together), but no single manuscript gives it in entirety.

Contents.—As we now have it, the Avesta consists of the following parts:—

1. The *Yasna,* the principal liturgical book of the Parsees, in 72 chapters (*hāiti, hā*), contains the texts read by the priests at the solemn yasna (Izeshne) ceremony, the general sacrifice in honour of *all* the deities. The arrangement of the chapters is purely liturgical, although their matter in part has nothing to do with the liturgical action. It falls into three sections of about equal length:—(*a*) The introduction (chap. 1–27) consists mainly of invocations. Yet it includes some interesting texts, *e.g.*, the *Haoma* (*Hom*) Yasht (9, 11) and the ancient confession of faith (12), which is of value as a document for the history of civilization. (*b*) The Gāthās (chap. 28–54) contain the discourses, exhortations and revelations of the prophet, written in a metrical style and archaic language. The Gāthās proper, arranged according to the metres in which they are written, fall into five subdivisions (28–34, 43–46, 47–50, 51, 53). Between chap. 34 and chap. 43 is inserted the so-called Seven-Chapter Yasna (*haptanghāiti*), a number of small prose pieces not far behind the Gāthās in antiquity. (*c*) The so-called Later Yasna (*Aparō Yasnō*) (chap. 5–72) consists mainly of invocations. Special mention ought to be made of the *Sraosha* (*Srōsh*) Yasht (57), the prayer to fire (62), and the great liturgy for the sacrifice to divinities of the water (63–69).

2. The *Vispered,* a minor liturgical work in 24 chapters (*karde*), is alike in form and substance completely dependent on the Yasna, to which it is a liturgical appendix. The name *Vispered,* meaning "all the chiefs" (*vispē ratavō*), has reference to the spiritual heads of the religion of Ormuzd, invocations to whom form the contents of the first chapter of the book.

3. The *Vendidad* the priestly code of the Parsees, contains in 22 chapters (*fargard*) a kind of dualistic account of the creation (chap. 1), the legend of Yima and the golden age (chap. 2), and in the bulk of the remaining chapters the precepts of religion with

regard to the cultivation of the earth, the care of useful animals, the protection of the sacred elements, such as earth, fire and water, the keeping of a man's body from defilement, together with the requisite measures of precaution, elaborate ceremonies of purification, atonements, ecclesiastical expiations and so forth. Yet in spite of an exaggerated casuistry the whole of Zoroastrian legislation is subordinate to one great point of view: the war—preached without intermission—against Satan and his noxious creatures, from which the whole book derives its name; for "Vendīdād" is a modern corruption for *vī-daēvō-dātem*—"the anti-demonic Law." The three concluding chapters are devoted to sacerdotal medicine.

4. The *Yashts, i.e.,* "songs of praise," except those inserted in the Yasna, form a collection by themselves. They contain invocations of *separate* Izads, or angels, number 21 in all, and are of widely divergent extent and antiquity. The great Yashts—some nine or ten—are impressed with a higher stamp, and represent the religious poetry of the ancient Iranians. They resemble the Rig-Veda hymns, and are a rich source of mythology and legendary history. Side by side with full, vividly coloured descriptions of the Zoroastrian deities, they frequently interweave, as episodes, stories from the old heroic fables. The most important of all, the 19th Yasht, gives a consecutive account of the Iranian heroic saga in great broad lines, together with a prophetic presentment of the end of this world.

5. The *Khordah Avesta, i.e.,* the Little Avesta, comprises a collection of shorter prayers designed for all believers—the laity included—and adapted for the various occurrences of ordinary life.

There are also a considerable number of fragments from lost books, *e.g.,* the *Nīrangistān,* as well as quotations, glosses and glossaries.

The Larger Avesta and the Twenty-one Nasks.—In its present form, however, the Avesta is only a fragmentary remnant of the old priestly literature of Zoroastrianism. Native tradition, carrying us back to the Sassanian period, tells of a larger Avesta in 21 books called *nasks* or *nosks,* as to the names of which we have several more or less detailed accounts, particularly in the Pahlavi Dīnkard (9th century A.D.) and in the Rivāyats. From the same sources we learn that this *larger* Avesta was only a part of a yet more extensive *original* Avesta, which is said to have existed before Alexander. But even of the remains of the Avesta, as these lay before the author of the 9th century, only a small residue has survived to our time. Of all the nasks one only, the 19th, has come down on us intact—the Vendidad.

It would be rash summarily to dismiss this old tradition of the 21 nasks as pure invention. The number 21, being a sacred number, points, indeed, to an artificial arrangement of the material. In the enumeration of the nasks we miss the names of the books we know, like the Yasna and the Yashts. But we must assume that these were included in such or such a nask, as the Yashts in the 17th or *Bakān* Yasht; or, it may be that other books, especially the Yasna, are a compilation extracted for liturgical purposes from various nasks. Further, the author of the Dīnkard appears to have had before him the text of the nasks, or at all events of a large part of them: for he expressly states that the 11th nask was entirely lost, so that he is unable to give the slightest account of its contents. And, besides, in other directions there are numerous indications that such books once really existed. The numerous other fragments, the quotations in the Pahlavi translation, the many references in the *Bundahish* to passages of this Avesta not now known to us, all presuppose the existence in the Sassanian period of a much more extensive Avesta literature than the mere prayer-book now in our hands. The existence of a larger Avesta, even as late as the 9th century A.D., is far from being a mere myth, and we may well believe the Parsees themselves, when they affirm that their sacred literature has passed through successive stages of decay, the last of which is represented by the present Avesta.

Origin and History.—While all that Herodotus (i. 132) has to say is that the Magi sang "the theogony" at their sacrifices, Pausanias is able to add (v. 27. 6) that they read from a book. Hermippus, in the 3rd century B.C., is said by Pliny to have explained the doctrine which Zoroaster had composed in 20 times 100,000 verses. According to the Arab historian, Ṭabari, these were written on 12,000 cow-hides, a statement confirmed by Mas'ūdī, who further says that the book consisted of 21 parts, and that Zartusht, who invented "the writing of religion," wrote it in Old Persian. These assertions sufficiently establish the existence and great bulk of the sacred writings. Parsee tradition adds a number of interesting statements as to their history. According to the Dīnkard, there were two copies, of which one was burned, while the second came into the hands of the Greeks. One of the Rivāyats relates how after the villainy of Alexander, several high-priests collected all the fragments that could be found. As to this re-collection and redaction of the Avesta the Dīnkard gives various details. One of the Arsacid kings, Vologeses (I. or III.?), ordered the scattered remnants of the Avesta to be carefully preserved and recorded, and under several of the Sassanian kings in the 3rd and 4th centuries the new redaction was completed.

The Avesta, as we now have it, belongs to the Sassanian period, but it cannot be said to be of Sassanian origin. From the remnants and heterogeneous fragments at their disposal, the diasceuast or diasceuasts composed a new canon from the materials of the old. In point of detail, it is now impossible to draw a sharp distinction between that which they found surviving and that which they themselves added or revised. It may reasonably be supposed, not only that they constructed the external framework of many chapters, and also made some additions of their own, but also that they fabricated anew many formulae and imitative passages on the model of the materials at their disposal. All the grammatically correct texts, together with those portions of the Avesta which have intrinsic worth, the Gāthās and greater Yashts, especially the metrical passages, are indubitably authentic and taken *ad verbum* from the original Avesta. Opinions differ greatly as to the precise age of the original texts. According to some, they are pre-Achaemenian; according to Darmesteter's former opinion, they were written in Media under the Achaemenian dynasty; according to some, their source must be sought in the east, according to others, in the west of Iran. But it is more correct to say that the Avesta was worked at from the time of Zoroaster down to the Sassanian period. Its oldest portions, the Gāthās, proceed from the prophet himself. This conclusion is inevitable for every one to whom Zoroaster is an historical personality. The rest of the Avesta, in spite of the opposite opinion of orthodox Parsees, does not even claim to come from Zoroaster. As the Gāthās now constitute the kernel of the most sacred prayer-book, viz., the Yasna, they were the nucleus of a religious literature.

The Avesta now in our hands is but a small portion of the book as restored and edited under the Sassanians. The larger part perished under the Mohammedan rule and under the more barbarous tyranny of the Tatars, when through conversion and extermination the Zoroastrians became a mere remnant. The understanding of the older Avesta texts began to die away at an early period. The need for a translation and interpretation became evident; and under the Later Sassanians the majority of the books, if not the whole of them, were rendered into the current Pahlavi. For the interpretation of the older texts the Pahlavi is of great value where they are concerned with the fixed, formal statutes of the church. But when they pass beyond this narrow sphere, as particularly in the Gāthās, it becomes defective and unreliable. The Parsee priest, Neryosangh, subsequently translated a portion of the Pahlavi version into Sanskrit.

The manuscripts of the Avesta are, comparatively speaking, of recent date. The oldest is the Pahlavi Vispered in Copenhagen, dated 1258. Next come the four manuscripts of the Herbad Mihirāpān Kaī Khusro at Cambay (1323 and 1324), two Vendidads with Pahlavi in London and Copenhagen, and two Yasnas with Pahlavi in Copenhagen and Oxford. The earliest mss. are the best, though careful 17th and 18th century transcripts come from Kirman and Yazd in Persia.

The first European scholar to direct attention to the Avesta was Hyde of Oxford, in his *Historia Religionis Veterum Persarum eorumque Magorum* (1700), which, however, failed to awake any

lasting interest in the sacred writings of the Parsees. The merit of achieving this belongs to the enthusiastic orientalist Anquetil-Duperron, the fruit of whose prolonged stay in India (1755–61) and his acquaintance with the Parsee priests was a translation (certainly very defective) of the Zend-Avesta. The foundation of a scientific exegesis was laid by Burnouf. The interpretation of the Avesta is one of the most difficult problems of oriental philology. Up to the present no kind of agreement has been reached by conflicting schools, even upon some of the most important points. Opinion is divided also as to the significance of the Avesta in the literature of the world. Upon the whole, the Avesta is a monotonous book. The Yasna and many Yashts in great part consist of formulae of prayer which are as poor in contents as they are rich in verbiage. The book of laws (*Vendidad*) is characterized by an arid didactic tone; only here and there the legislator clothes his dicta in the guise of graceful dialogues and tales, or of poetic descriptions and similitudes; and then the book of laws is transformed into a didactic poem. Nor can we deny to the Yashts, in their depiction of the Zoroastrian angels and their presentment of the old sagas, a certain poetic feeling, at times, and a pleasant diction. The Gāthās are quite unique in their kind. As a whole, the Avesta, for profundity of thought and beauty, stands on a lower level than the Old Testament. But as a religious book—the most important document of the Zoroastrian faith, and the sole literary monument of ancient Iran—the Avesta occupies a prominent position in the literature of the world. At the present day its significance is decidedly underrated. (For works on the theology of the Avesta *see* ZOROASTER.)

EDITIONS.—*Zend-Avesta,* ed. by N. L. Westergaard (Copenhagen, 1852–54), complete; F. Spiegel, *Avesta* (Vienna, 1853–58), only Vendidad, Vispered and Yasna, but with the Pahlavi translation; K. Geldner (Stuttgart, 1886–96). Translations.—Anquetil-Duperron, *Zend-Avesta, Ouvrage de Zoroastre* (Paris, 1771); Fr. Spiegel (Leipzig, 1852–63); both completely antiquated. *Avesta* traduit par C. de Harlez, ed. 2 (Paris, 1881); *The Zend-Avesta, Part I, Vendidad, Part II, Sīrōzahs, Yashts and Nyāyish,* tr. by J. Darmesteter, *Part III, Yasna, Vispered,* etc. by L. H. Mills (Oxford 1880–87), in the *Sacred Books of the East; Le Zend-Avesta,* traduction nouvelle par J. Darmesteter (Paris, 1892–93) (*Annales du Musée Guimet*).

BIBLIOGRAPHY.—Anquetil-Duperron (*see* above); Haug, *Essays on the Sacred Language, etc., of the Parsis,* especially in the new edition by E. W. West (London, 1884); De Harlez, *Introduction to the Avesta* (Bombay, 1921); Max Duncker, *Geschichte des Altertums,* vol. iv; Eduard Meyer, *Geschichte des Altertums,* vol. i (Stuttgart, 1884; 4th ed. 1921, does not yet include Persia); J. Darmesteter, in the *Introduction* to his translation (*see* above); K. Geldner, *Avesta-Literatur* in the *Grundriss der iranischen Philologie,* by Geiger and Kuhn (Strasbourg, 1896), vol. ii, 1 f.; E. W. West, *Contents of the Nasks,* S. B. E. 37 (Oxford, 1892). (K. G.; E. J. T.)

ZEND LANGUAGE: *see* IRANIAN LANGUAGES AND PERSIAN.

ZENGER, JOHN PETER (1697–1746), U.S. printer, was born in Germany and went to the U.S. in 1710. From 1711–19 he served an apprenticeship with the printer William Bradford. In 1720 he settled in Chestertown, Md., remaining there for two years. For a short time he worked in partnership with Bradford, but in 1726 established himself in his own printing business. On Nov. 5, 1733, he published the first issue of the *New York Weekly Journal,* a newspaper which was founded solely as a political organ by a group of New York citizens who opposed the policies of the colonial governor, William Cosby. For a year the paper contained in almost every issue scathing attacks on the governor until, in Nov. 1734, unable any longer to endure them in silence, Cosby issued a proclamation condemning the "divers scandalous, virulent, false and seditious reflections" which the *Journal* had published and offering a reward for the apprehension of their author. On Nov. 17, 1734, Zenger was arrested for libel and until the following August remained in prison, continuing to edit the *Journal* from his cell. His case finally came to trial on Aug. 4, 1735, his defense being handled by the noted lawyer Andrew Hamilton. Hamilton began by offering to prove the truth of the statements which had appeared in Zenger's paper but, in accordance with English law, the judge, a supporter of the administration, refused to allow this procedure, instead instructing the jury simply to decide whether the statements in question had actually been printed and to leave the decision as to whether they were libelous to the court. Hamilton, however, urged the jury to consider itself competent to make that decision itself and stated Zenger's cause so eloquently that the jury returned a verdict of not guilty. Zenger subsequently served as public printer in both New York and New Jersey. His account of the trial was published in 1736 in the *Journal* and was widely circulated both in the U.S. and in England. He died July 28, 1746. Zenger's case established the first important victory for freedom of the press in the colonies. With juries given the right to decide not only whether statements said to be libelous had been published but also whether they actually were libelous, the press was freed from censorship by a biased judiciary, and although this principle was not for many years established as a legal precedent, it was for the first time recognized as valid in the Zenger case.

ZENITH TELESCOPE, a form of telescope specially devised for the accurate determination of the latitude of a station. It is used both in geodetic surveys and also at fixed stations for measuring the variation of latitude. The usual form of instrument consists of a telescope which can be clamped at any angle to a vertical axis and rotated about the vertical. Two stars of known declination δ_1 and δ_2 are chosen which transit within a few minutes of one another, the one north and the other south of the zenith at nearly equal zenith distances. If ϕ is the latitude the respective zenith distances are $\delta_1-\phi$ north and $\phi-\delta_2$ south, so that the small difference between them is $\delta_1+\delta_2-2\phi$. Settings of a micrometer wire are made on each star in turn, the telescope being of course rotated from the north to the south direction between the two observations: the small distance that the wire has to be moved measures the quantity $\delta_1+\delta_2-2\phi$ and hence determines ϕ. This method, known as the Talcott method, depends on securing accurate rotation about the vertical; usually delicate spirit levels attached to the telescope are used to determine the correction for imperfect fulfilment of this condition. In a floating zenith telescope devised by B. Cookson and now employed for latitude variation at Greenwich observatory, rotation about the true vertical is obtained by floating the whole instrument in mercury. The observations are made photographically; the trails of the pair of stars are shown close together on the plate, and the distance between them (equivalent to $\delta_1+\delta_2-2\phi$) is measured with a suitable micrometer.

ZENO, East Roman emperor from 474 to 491, was an Isaurian of noble birth. Of his early life nothing is known; after his marriage to Ariadne, daughter of Leo I, in 468 he became patrician and commander of the imperial guard and of the armies in the east. In 474 Leo I died after appointing as his successor Leo, the son of Zeno and Ariadne; Zeno, however, succeeded in getting himself crowned also, and on the death of his son in the same year became sole emperor. In the following year, in consequence of a revolt fomented by Verina in favour of her brother Basiliscus, he was compelled to take refuge in Isauria. The growing misgovernment of Basiliscus ultimately enabled Zeno to re-enter Constantinople unopposed (476); his rival was banished to Phrygia, where he soon afterwards died. The remainder of Zeno's reign was disturbed by numerous other less formidable revolts. Since 472 the aggressions of the two Ostrogoth leaders Theodoric had been a constant source of danger. In 487 he induced Theodoric, son of Theodemir, to invade Italy and establish his new kingdom. In ecclesiastical history the name of Zeno is associated with the *Henoticon* or instrument of union, promulgated by him and signed by all the eastern bishops, with the design of terminating the Monophysite controversy.

See J. B. Bury, *The Later Roman Empire* (1889), i, pp. 250–274; E. W. Brooks in the *English Historical Review* (1893), pp. 209–238; W. Barth, *Der Kaiser Zeno* (Basel, 1894).

ZENOBIA (Gr. Ζηνοβία), queen of Palmyra, one of the heroines of antiquity. Her native name was Septimia Bathzabbai. This remarkable woman was well fitted to be the consort of Odainatti (*see* ODAENATHUS) in his proud position as Dux Orientis; during his lifetime she actively seconded his policy, and after his death in A.D. 266–267 she determined to surpass his position and make Palmyra mistress of the Roman empire in the east. Wahab-allath or Athenodōrus (as the name was Graecized), her son by Odainath, being still a boy, she took the reins of gov-

ernment into her own hands. Under her general-in-chief Zabdā, the Palmyrenes occupied Egypt in A.D. 270 under the pretext of restoring it to Rome; and Wahab-allath governed Egypt in the reign of Claudius as joint ruler. In Asia Minor Palmyrene garrisons were established as far west as Ancyra in Galatia and Chalcedon opposite Byzantium. When Aurelian became emperor in 270 he quickly realized that the policy of the Palmyrene queen was endangering the unity of the empire and instantly took measures; Egypt was recovered for the empire by Probus (270), and the emperor himself prepared a great expedition into Asia Minor and Syria. Towards the end of 271 he marched through Asia Minor and, overthrowing the Palmyrene garrisons in Chalcedon, Ancyra and Tyana, he reached Antioch, where the main Palmyrene army under Zabdā and Zabbai, with Zenobia herself, attempted unsuccessfully to oppose his way. The queen was defeated at Emesa (now Homs) and fell back upon Palmyra, where Aurelian followed her and laid siege to the city. The queen and her son fled to seek help from the Persian king, but were captured on the bank of the Euphrates, and the Palmyrenes, losing heart, capitulated (A.D. 272). Zenobia probably closed her days at Tibur, where she lived with her sons the life of a Roman matron. A few months after her fall Palmyra revolted again; Aurelian unexpectedly returned and destroyed the city.

Among the traditions relating to Zenobia may be mentioned that of her discussions with the Archbishop Paul of Samosata on matters of religion. It is probable that she treated the Jews in Palmyra with favour; she is referred to in the Talmud as protecting Jewish rabbis (Talm. Jer. *Ter.* viii, 46 b).

The well-known account of Zenobia by Gibbon (*Decline and Fall,* i, pp. 302–312 Bury's edition) is based upon the imperial biographers (*Historia Augusta*) and cannot be regarded as strictly historical in detail. *See* A. P. Caussin de Perceval, *Essai sur l'hist. des Arabes,* ii, 28 f., 197 f. (3 vols., 1847–48); Tabari, i, 757 f. *See* further PALMYRA.

(G. A. C.; X.)

ZENOBIUS, a Greek sophist, who taught rhetoric at Rome during the reign of Hadrian (A.D. 117–138). He was the author of a collection of proverbs in three books, still extant in an abridged form, compiled, according to Suïdas, from Didymus of Alexandria and Lucillus of Tarrha. Zenobius is also said to have been the author of a Greek translation of Sallust and of a birthday poem (γενεθλιακόν) on Hadrian.

Editions by T. Gaisford (1836) and E. L. Leutsch-F. W. Schneidewin (1839), and in B. E. Miller, *Mélanges de littérature grecque* (1868); *see* also W. Christ, *Griechische Literaturgeschichte* (1898).

ZENODOTUS, Greek grammarian and critic, pupil of Philetas (*q.v.*) of Cos, was a native of Ephesus. He lived during the reigns of the first two Ptolemies, and was at the height of his reputation about 280 B.C. He was the first superintendent of the library at Alexandria and the first critical editor (διορθώτης) of Homer. Having collated the different mss. in the library, he expunged or obelized doubtful verses, transposed or altered lines, and introduced new readings. He divided the Homeric poems into books (with capitals for the *Iliad,* and small letters for the *Odyssey*), and possibly was the author of the calculation of the days of the *Iliad* in the Tabula Iliaca. He is further called an epic poet by Suïdas. There appear to have been at least two other grammarians of the same name: (1) Zenodotus of Alexandria, surnamed ὁ ἐν ἄστει; (2) Zenodotus of Mallus, the disciple of Crates, who like his master attacked Aristarchus.

See F. A. Wolf, *Prolegomena ad Homerum,* s. 43 (1859 ed.); H. Düntzer, *De Zenodoti studiis Homericis* (1848); A. Römer, *Über die Homerrecension des Zenodotus* (Munich, 1885); F. Susemihl, *Geschichte der griechischen Literatur in der Alexandrinerzeit,* i, p. 330, ii, p. 14; J. E. Sandys, *Hist. of Class. Schol.* (1906).

ZENO OF ELEA, son of Teleutagoras, born probably towards the beginning of the 5th century B.C. The pupil and the friend of Parmenides, he sought to recommend his master's doctrine of the existence of the One by controverting the popular belief in the existence of the Many. In virtue of this method of indirect argumentation he is regarded as the inventor of "dialectic," that is to say, disputation having for its end not victory but the discovery of truth. In Plato's *Parmenides,* Socrates, "then very young," discusses with Parmenides and Zeno, "a man of about forty," but it may be doubted whether such a meeting was chronologically possible. Plato's account of Zeno's teaching (*Parmenides,* 128 *seq.*), however, is presumably accurate. In reply to those who thought that Parmenides's theory of the existence of the One involved inconsistencies, Zeno tried to show that the assumption of the existence of a plurality of things in time and space, carried with it more serious inconsistencies. In early youth he collected his arguments in a book, which, according to Plato, was put into circulation without his knowledge.

Of the paradoxes used by Zeno to discredit the belief in plurality and motion, eight survive in the writings of Aristotle and Simplicius. They are commonly stated as follows: (1) If the Existent is Many, it must be at once infinitely small and infinitely great—infinitely small, because its parts must be indivisible and therefore without magnitude; infinitely great, because, that any part having magnitude may be separate from any other part, the intervention of a third part having magnitude is necessary, and that this third part may be separate from the other two the intervention of other parts having magnitude is necessary, and so on *ad infinitum.* (2) In like manner the Many must be numerically both finite and infinite—numerically finite, because there are as many things as there are, neither more nor less; numerically infinite, because, that any two things may be separate, the intervention of a third thing is necessary, and so on *ad infinitum.* (3) If all that is is in space, space itself must be in space, and so on *ad infinitum.* (4) If a bushel of corn turned out upon the floor makes a noise, each grain and each part of each grain must make a noise likewise; but, in fact, it is not so. (5) Before a body in motion can reach a given point, it much first traverse the half of the distance; before it can traverse the half of the distance, it must first traverse the quarter; and so on *ad infinitum.* Hence, that a body may pass from one point to another, it must traverse an infinite number of divisions. But an infinite distance (which the paradox does not distinguish from a finite distance infinitely divided) cannot be traversed in a finite time. Consequently, the goal can never be reached. (6) If the tortoise has the start of Achilles, Achilles can never come up with the tortoise; for, while Achilles traverses the distance from his starting point to the starting point of the tortoise, the tortoise advances a certain distance, and while Achilles traverses this distance, the tortoise makes a further advance, and so on *ad infinitum.* Consequently, Achilles may run *ad infinitum* without overtaking the tortoise. (This paradox is virtually identical with [5], the only difference being that whereas in [5] there is one body, in [6] there are two bodies, moving towards a limit. The "infinity" of the premise is an infinity of subdivisions of a distance which is finite; the "infinity" of the conclusion is an infinity of distance.) (7) So long as anything is in one and the same space, it is at rest. Hence an arrow is at rest at every moment of its flight, and therefore also during the whole of its flight. (8) Two bodies moving with equal speed traverse equal spaces in equal time. But, when two bodies move with equal speed in opposite directions, the one passes the other in half the time in which it passes it when at rest. These paradoxes are probably properly regarded as dilemmas advanced in refutation of specific doctrines attributed to the Pythagoreans.

Important as these paradoxes of plurality and motion were in stimulating speculation about space and time, their direct influence upon Greek thought was less considerable than that of another paradox—strangely neglected by historians of philosophy—the paradox of predication. Plato says (*Parmenides,* 127 D) that "the first hypothesis of the first argument" of Zeno's book above mentioned ran as follows: "If existences are many, they must be both like and unlike (unlike, inasmuch as they are not one and the same, and like, inasmuch as they agree in not being one and the same [Proclus, *On the Parmenides,* ii, 143]). But this is impossible; for unlike things cannot be like, nor like things unlike. Therefore existences are not many."

When in the second decade of the 4th century the pursuit of truth was resumed, it was plain that Zeno's paradox of predication must be disposed of before the discussion of the problems of knowledge and the problem of being could be resumed. Accordingly, in bk. 7 of the *Republic,* Plato directs the attention

of studious youth primarily, if not exclusively, to the concurrence of inconsistent attributes; and in the *Phaedo*, 102 B–103 A, taking as an instance the tallness and the shortness simultaneously discoverable in Simmias, he offers his own theory of the immanent idea as the solution of the paradox. Simmias, he says, has in him the ideas of tall and short. Again, when it presently appeared that the theory of the immanent idea was inconsistent with itself, and moreover inapplicable to explain predication except where the subject was a sensible thing, so that reconstruction became necessary, the Zenonian difficulty continued to receive Plato's attention. Thus, in the *Parmenides*, with the paradox of likeness and unlikeness for his text, he inquires how far the current theories of being (his own included) are capable of providing, not only for knowledge, but also for predication, and in the concluding sentence he suggests that, as likeness and unlikeness, greatness and smallness, etc., are relations, the initial paradox is no longer paradoxical; while in the *Sophist*, Zeno's doctrine having been shown to be fatal to reason, thought, speech and utterance, the mutual *κοινωνία* of *εἴδη* which are not *αὐτὰ καθ' αὐτά* is elaborately demonstrated.

In all probability Zeno did not observe that in his controversial defence of Eleaticism he was interpreting Parmenides's teaching anew. While Parmenides had recognized, together with the One, which is, and is the object of knowledge, a Many, which is not, and therefore is not known, but nevertheless becomes, and is the object of opinion, Zeno plainly affirmed that plurality, becoming and opinion are one and all inconceivable. In a word, Parmenides's tenet "The Ent is, the Non-ent is not," was with Zeno a declaration of the Non-ent's absolute nullity. Thus, just as Empedocles developed Parmenides's theory of the Many to the neglect of his theory of the One, so Zeno developed the theory of the One to the neglect of the theory of the Many. With the severance of its two members Eleaticism proper, the Eleaticism of Parmenides, ceased to exist.

BIBLIOGRAPHY.—F. W. A. Mullach, *Fragmenta Philosophorum Graecorum* (Paris, 1860); E. Zeller, *Die Philosophie der Griechen* (Leipzig, 1876); P. Tannery, *Pour l'histoire de la science hellène* (1887); H. von Armin, *Stoicorum veterum fragmenta* (vol. i., 1905); H. Diels, *Die Fragmente der Vorsokratiker* (1906–07); J. Burnet, *Early Greek Philosophy* (1920). On the mathematical questions raised by certain of Zeno's paradoxes, *see* G. Noël in the *Revue de Métaphysique et de Morale* (vol. i., 1893); B. Russell, *Principles of Mathematics* (1903) and F. Cajou, *Hist. of Zeno's Arguments against Motion* (1915).

ZEOLITES, a family of minerals consisting of hydrated silicates of alumina with alkalis or alkaline earths or both. The water they contain is readily lost, and before the blowpipe it is expelled with intumescence; hence the name zeolite, from the Greek *ζεῖν* (to boil) and *λίθος* (a stone). In some other characters, as well as in their origin and mode of occurrence, they have points in common. Several species have been distinguished, of which the following are the more important:—

Heulandite Group	Heulandite	$H_4CaAl_2(SiO_3)_6+3H_2O$.
	Brewsterite	$H_4(Sr, Ba, Ca)Al_2(SiO_3)_6+3H_2O$.
	Epistilbite	$H_4CaAl_2(SiO_3)_6+3H_2O$.
Stilbite Group	Wellsite	$(Ba, Ca, K_2)Al_2Si_3O_{10}+3H_2O$.
	Phillipsite	$(K_2, Ca)Al_2(SiO_3)_4+4H_2O$.
	Harmotome	$H_2(K_2, Ba)Al_2(SiO_3)_5+5H_2O$.
	Stilbite	$CaAl_2(SiO_3)_6+6H_2O$.
	Gismondite	$CaAl_2(SiO_3)_4+4H_2O$.
	Laumontite	$H_4CaAl_2Si_4O_{14}+2H_2O$.
Chabazite Group	Chabazite	$(Ca, Na_2)Al_2(SiO_4)_2+4H_2O$, etc.
	Gmelinite	$(Na_2, Ca)Al_2(SiO_3)_4+6H_2O$.
	Levynite	$CaAl_2Si_3O_{10}+5H_2O$.
	Analcite	$NaAl(SiO_3)_2+H_2O$.
Natrolite Group	Natrolite	$Na_2Al_2Si_3O_{10}+2H_2O$.
	Mesolite	$(Ca, Na_2)Al_2Si_3O_{10}+2H_2O$.
	Scolecite	$CaAl_2Si_3O_{10}+3H_2O$.
	Edingtonite	$BaAl_2Si_3O_{10}+3H_2O$.
	Thomsonite	$(Na_2, Ca)Al_2(SiO_4)_2+2\frac{1}{2}H_2O$.

Some of the chemical formulae given above are only approximate, since in some species the composition varies between certain limits and can be best expressed by the isomorphous mixing of different molecules. They are all readily decomposed by hydrochloric acid, usually with the separation of gelatinous silica. By the action of various reagents several substitution products have been prepared artificially: thus, crystallized products, in which the alkalis or alkaline earths are replaced by ammonium or silver, etc., have been obtained.

The zeolites are often beautifully crystallized, and belong to several crystal-systems. The crystals usually show evidences of twinning, and when examined in polarized light they frequently exhibit optical anomalies and a complex structure. The hardness (3·5–5·5) and specific gravity (2·0–2·4) are comparatively low, and so are the indices of refraction and the double refraction.

The water of zeolites presents many points of interest. Laumontite loses water on exposure to air, and the crystals soon crumble to powder unless they are kept in a moist atmosphere. All the zeolites lose a portion of their "water of crystallization" in dry air (over sulphuric acid), and a considerable portion at a temperature of 100° C, increasing in amount to 200° or 300°; the actual amount lost depending not only on the temperature, but also on the tension of aqueous vapour in the surrounding atmosphere. In some species the remaining water is expelled only at a red heat, and is therefore to be regarded as "water of constitution." With the progressive loss of water there is a progressive change in the optical characters of the crystals. When a partially dehydrated and opaque crystal is exposed to moist air the water is reabsorbed, the crystal becoming again transparent and regaining its original optical characters. Not only may water be reabsorbed, but such substances as ammonia, hydrogen sulphide and alcohol may be absorbed in definite amounts and with an evolution of heat. The water of zeolites may therefore be partly driven off and reabsorbed or replaced by other substances without destroying the crystalline structure of the material, and it would thus seem to differ from the water of crystallization of most other hydrated salts.

Zeolites are minerals of secondary origin and in most cases have resulted by the decomposition of the felspars of basic igneous rocks: in fact their chemical composition is somewhat analogous to that of the felspars with the addition of water. Nepheline and sodalite are often altered to zeolites. They usually occur as crystals lining the amygdaloidal and other cavities of basalt, melaphyre, etc. Usually two or more species are associated together, and often with agate, calcite and some other minerals. Less frequently they occur in cavities in granite and gneiss, and in metalliferous veins (*e.g.*, harmotome); while only exceptionally are they primary constituents (*e.g.*, analcite) of igneous rocks. Several species have been observed in the Roman masonry at the hot springs of Bourbonne-les-Bains: and phillipsite has been dredged from the deep sea. (L. J. S.)

ZEPHANIAH, the ninth of the minor prophets in the Bible. His ancestry is traced to his great-grandfather Hezekiah, who may, in spite of 2 Kings xx. 18, xxi. 1, be the well-known king of Judah (*c.* 720–690). This would agree fairly with the title (i. 1) which makes the prophet a contemporary of King Josiah (*c.* 637), and this in turn appears to agree (*a*) with the internal conditions (i. 4–6, *cf.* 2 Kings xxiii. 4, 5, 12) which, it is held, are evidently earlier than Josiah's reforms (621); (*b*) with the denunciation of the royal household, but not of the (young) king himself (i. 8, iii. 3); (*c*) with the apparent allusion in ch. i. to the invasion of the Scythians (perhaps *c.* 626), and (*d*) with the anticipated downfall of Assyria and Nineveh (ii. 13, 612 B.C.).

Although one single leading motive runs through the book of Zephaniah there are abrupt transitions which do not depend on modern subjective considerations of logical or smooth thought, but are material and organic changes representing different groups of ideas. The instruments of Yahweh's anger (ch. i.) are not so real or prominent on the political horizon as, for example, in Isaiah, Jeremiah or Habakkuk. The Scythian inroad and its results for Judah and Philistia are less important when it is observed that the doom upon Philistia, the vengeance upon Moab and Ammon, and the promises for Judah (ch. ii.), belong to a large group of prophecies against certain historic enemies (Edom included) who are denounced for their contempt, hostility and intrusion. The prophecies are in large measure associated tradition-

ally with the fall of Jerusalem, and to some such calamity, and not to the inroad of the Scythians, the references to the "remnant" and the "captivity" refer. The anticipation of future events is of course conceivable in itself; but the promises (in ch. ii.) *presuppose* events other and later than those with which the Scythians were connected. On the other hand, a prophecy relating to Scythians may have been re-shaped to apply to later conditions, and on this view it is explicable why the indefinite political convulsions should be adjusted to the exile and why the gloom should be relieved by the promise of a territory extending from the Mediterranean to the Syrian desert (ii. 7, 9). After a period of punishment (*cf.* book of Lamentations) Yahweh's jealousy *against* the semi-heathen Judah has become a jealousy *for* his people, and we appear to move in the thought of Haggai and Zechariah, where the remnant are comforted by Yahweh's return and the dispersed exiles are to be brought back (*cf.* Zech. i. 14–17, viii. 2–17). But in ch. iii. other ideas are manifest. Israel's enemies have been destroyed, her own God Yahweh has proved *his* loyalty and has fulfilled *his* promises, but the city remains polluted (*vv.* 1–7, *cf.* Isa. lviii. *seq.;* Malachi). Once more doom is threatened, and once more we pass over into a later stage where Yahweh has vindicated *his* supremacy and Zion is glorified. Instead of the realities of history we have the apocalyptical feature of the gathering of the nations (*v.* 8); the thought may be illustrated from Zech. xii. 1.–xiii. 6, where Jerusalem is attacked, purged and delivered, and from Zech. xiv. where the city is actually captured and half the people are removed into captivity (*cf.* Zeph. iii. 11 purging, 15 removal of the enemy, 18–20 return of the captivity). The goal is the vindication of Israel and of Israel's God, and the establishment of universal monotheism (ii. 11, iii. 9 *seq.*). The foe which threatened Judah has become the chastiser of Ethiopia and Assyria (ii.) and the prelude to the golden age (iii., *cf.* Ezek. xxxviii. *seq.*).

If Jer. iv. 5–vi. 30 originally referred to the Scythians, it has been revised to refer to the Chaldeans; also in Ezek. xxxviii. *seq.* a northern foe becomes associated with the great world-judgment. Also, in Isaiah and Zechariah, notably, older and later *groups* of prophecies are preserved, whereas here the new preludes and new sequels suggest that the original nucleus has passed through the hands of writers in touch with those vicissitudes of thought which can be studied more completely elsewhere. It is not to be supposed that the elimination of all later passages and traces of revision will give us Zephaniah's prophecies in their original extent. In fact the internal religious and social conditions in i. 4–6 or iii. 1–4 do not compel a date before Josiah's reforms. The doom of Cush is still in the future in Ezek. xxx. 4; and if the impending fall of Nineveh (ii. 13) implies an early date, yet it is found in writings which have later additions (Nahum), or which are essentially later (Jonah, *cf.* Tobit xiv. 4 [LXX.], 8, 10, 15); *cf.* also the use of Assyria for Babylon (Ezra vi. 22) or Syria (Zech. x. 10). Historical references in prophecies are not always decisive (Ezek. xxxii., for example, looks upon Edom and Sidon as dead), and while the continued revision of the book allows the presumption that the tradition ascribing its inception to the time of Josiah may be authentic, it is doubtful how much of the original nucleus can be safely recognized.

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ZEPHYRINUS, ST., bishop of Rome from about 198 to 217, succeeded Victor I. The controversies on doctrine and discipline that marked his pontificate are associated with the names of Hippolytus and of Calixtus, his principal adviser and afterwards his successor.

ZEPHYRUS, in Greek mythology, the west wind, son of the Titan Astraeus and Eos, the dawn. He was the husband of Chloris, the goddess of flowers, by whom he had a son, Carpus, the god of fruit (Ovid, *Fasti,* v. 197).

See also FLORA; HARPIES; HYACINTHUS.

ZEPPELIN, FERDINAND, COUNT VON (1838–1917), German airship inventor, was born at Constance, Baden, on July 8, 1838. He was educated for the army and received a commission at the age of 20. He served, as a volunteer, in the Federal army during the American Civil War and whilst in America made his first balloon ascent. Returning to Germany he saw active service in the Austrian War of 1866 and in the Franco-German War of 1870. In 1891 he retired from the army with the rank of general and thenceforth devoted his energies to the study of aeronautics. In 1900 he built an airship, which rose from the ground and remained in the air for 20 minutes, but was wrecked in landing. In 1906 he made two successful flights at a speed of 30 m. an hour, and in 1907 attained a speed of 36 miles. From that time onwards his airship construction made steady progress and many Zeppelin airships took part in the World War, though with heavy losses under attack. (*See* AIRSHIP.) He died at Charlottenburg on March 8, 1917.

See *Eine Festgabe zu seinem 75. Geburtstag von Luftschiffbau Zeppelin* (Stuttgart, 1913).

ZERBST, a town of Germany, in the *Land* of Anhalt, situated on the Nuthe, 11 mi. N.W. of Dessau and 27 mi. S.E. of Magdeburg by railway. Pop. (1939) 23,725. Zerbst is an ancient town, mentioned in 949, which in 1307 came into the possession of the Anhalt family. It is still surrounded in part by old walls and bastions. It contains five churches, one of which (St. Nicholas), built in 1446–88, is a good example of the late Gothic style as developed in Saxony, with its spacious proportions, groined vaulting, and bare simple pillars. The town hall dates from about 1480, but it was disfigured by additions in the beginning of the 17th century. The palace (1681–1750) has been used as a depository of archives since 1872. There are several quaint old houses, with high gables, in the market-place, in the middle of which stand a Roland column, of about 1445, and a bronze figure known as the *Butterjungfer* (butter-girl), of uncertain origin and meaning. There were here formerly a Franciscan monastery, with fine cloisters, founded in 1250, a Cistercian nunnery of 1214, and an Augustinian monastery of 1390, a hospital since 1525.

ZERMATT, a mountain village (5,315 ft. above sea-level) at the head of the Visp valley and at the foot of the Matterhorn, in the canton of the Valais, Switzerland. It has about 960 permanent inhabitants, German-speaking and Roman Catholics. It is $22\frac{1}{4}$ mi. by rail from Visp in the Rhône valley, and there is also a railway from Zermatt past the Riffel inns to the very top of the Gornergrat (10,289 ft.). Formerly Zermatt was called "Praborgne," and this name is mentioned in the Swiss census of 1888. Its originally Romance population seems to have been Teutonized in the course of the 15th century, the name "Matt" (now written "Zermatt," *i.e.,* the village on the meadows) first occurring at the very end of that century.

See E. Whymper, *Scrambles in the Alps* (1871).

ZERO, the figure 0 in the Arabic notation for numbers meaning nought, or cipher. The Sanskrit name for the figure was *śūnya* (void), and this term passed over into Arabic as *aṣ-ṣifr,* or *ṣṣifr.* The old Latin writers on arithmetic translated or transliterated the Arabic word as *zephyrum;* this in Ital. took on such forms as *zeuero, zepiro,* and became contracted to *zero,* borrowed by F. *zéro,* whence it came late into English. The Spanish form *cifra,* more closely resembling the original Arabic, gave O.Fr. *cifre,* mod. *chiffre,* also used in the sense of monogram, and English "cipher" which is thus a doublet. Although no character for zero is found in India before the 9th century, there is literary evidence for the belief that it was known much earlier. In the Maya inscriptions in Central America there appears a character for zero, but only in connection with the calendar.

ZEROMSKI, STEPHEN (1864–1925), Polish novelist, poet and dramatist, was born at Strawczyn on Nov. 14, 1864. Banished from Poland by the Russian Government early in his life, he first attracted attention by a collection of tragic tales entitled *The Ravens and the Crows are Picking us to Pieces* (1895, Eng. trans. 1906). In the publication of *The Homeless* (1900) Zeromski supplied a generic name for all his Polish heroes. His pessimistic philosophy finds expression in the novel *Aryman takes Revenge* (1904), while the triumph of evil over good is vividly treated in *The Story of Sin* (2 vol., 1906) describing the slow and terrible

downfall of a woman of culture. In his epic poem *Ashes* (2 vol., 1904) he delineates the minds of the Polish people after the Partition and their efforts to liberate their country by serving in the Napoleonic legions. During the World War Zeromski published his great trilogy *The Fight with Satan—The Conversion of Judas* (1916), *The Blizzard* (1918), *Charitas* (1919)—a kind of epilogue and synthesis of his previous work and at the same time an autobiography of his own life. After the achievement of national independence, Zeromski wrote his drama, *The Broken Spell* (1924) in which the hero dedicates himself to the services of a resuscitated Poland. He died on Nov. 20, 1925.

See S. Brzozowski, *O Stefan Zeromski* (Warsaw, 1905); W. Jampolski, *Stefan Zeromski, the Spiritual Leader of the Race* (Lwów, 1918).

ZETKIN, KLARA (1857–1933), German communist, was born on June 5, 1857, at Wiederan, Saxony, and educated at the university of Paris, becoming a school teacher. She presently became editor of *Gleichheit,* the organ of the Social Democratic Party for women. Klara Zetkin was a member of the Communist Party from its foundation in 1919, and was one of its most fiery orators. She became a member of the Reichstag in 1920.

ZETLAND, 2ND MARQUESS OF: *see* RONALDSHAY, LAWRENCE JOHN LUMLEY DUNDAS.

ZEUGLODON or **BASILOSAURUS,** a genus of extinct late Eocene whales up to 65 ft. in length. Smaller relatives of *Basilosaurus* are the oldest known Cetacea (*q.v.*).

ZEUS, the Greek counterpart of the Roman god, Jupiter (*q.v.* for the etymology of the name). It is probable that Zeus had already been conceived as a personal and pre-eminent god by the ancestors of the leading Hellenic tribes before they entered the peninsula, which became their historic home. In the first place, his pre-eminence is obviously pre-Homeric; for Homer attests for us the supremacy of Zeus in his day, say 950 B.C.; and appreciating how slow was the process of religious change in the earlier period, we shall believe that the god had won this position long before the Homeric age. In the next place, we cannot trace the origin of his worship back to any special stock or particular locality; his unquestionable association with Olympus and Thessaly is only what we should expect, seeing that many at least of the Greeks must have entered Greece that way.

To appreciate the Homeric Zeus, we must distinguish the lower mythologic aspect of him, in which he appears as an amorous and capricious deity lacking often in dignity and real power, and the higher religious aspect, in which he is conceived as the all-father (*see* GREEK RELIGION). In fact, later Greek religion did not advance much above the high-water mark of the Homeric, although the poets and philosophers deepened certain of its nobler traits. But Homer we now know to be a relatively late witness in this matter. Yet traces of a pre-deistic and animistic period survived here and there; for instance, in Arcadia we find the thunder itself called Zeus (Ζεὺς κεραυνός) in a Mantinean inscription, and the stone near Gythium in Laconia, on which Orestes sat and was cured of his madness, evidently a thunder-stone, was named itself Ζεὺς καππώτας, which must be interpreted as "Zeus that fell from heaven" (Pausan iii. 22. 1.); we here observe that the personal god does not yet seem to have emerged from the divine thing or divine phenomenon.

The day is now past when scholars could discover in the ritual of Zeus *Lukaios* (*see* LYCAON), or the Dipolia, the cult of a wolf —or ox-totem—somehow blended with Zeus; but certainly a characteristic of his earliest ritual was human sacrifice. We find it again in the story of the house of Athamas and in the worship of *Zeus Laphustios* ("Zeus the Glutton"), of Thessaly (Herod. vii. 197), and other examples are recorded. The cruel rite had ceased in the Arcadian worship before Pliny wrote, but seems to have continued in Cyprus until the reign of Hadrian. It was found in the worship of many other divinities of Hellas in early times, and no single explanation can be given that would apply to them all. A hypothesis favoured by Frazer, that the victim is usually a divine man, a priest-king incarnating the god, may be well applied to the Athamantid sacrifice and to that of King Lycaon; for he derives his name from the divinity himself, and according to one version (Clemens, *Protrept* p. 31 P.) he offers his own child; and the legend presents one almost unique feature, which is only found elsewhere in legendary Dionysiac sacrifice, the human flesh is eaten, and the sacrifice is a cannibalistic-sacrament, of which the old Mexican religion offers conspicuous example. Yet it is in this religion of Zeus that we see most clearly the achievement of progressive morality; Zeus himself punishes and abolishes the savage practice.

We can now consider the special attributes of the anthropomorphic god. His character and power as a deity of the sky, who ruled the phenomena of the air, so clearly expressed in Homer, explains the greater part of his cult and cult-titles. More personal than Ouranos and Helios—with whom he has only slight associations—he was worshipped and invoked as the deity of the bright day (*Amarios*), who sends the rain, the wind and dew (*Ombrios, Huetios, Ourios*), and such a primitive adjective as *diipetēs* applied to things "that fall from heaven," attests the primeval significance of the name of Zeus. But the thunder was his most striking manifestation, and no doubt he was primevally a thunder-god, (*Keraunios, Astrapaios*). Much of his ritual was weather-magic; the priest of Zeus *Lukaios* in time of drought, was wont to ascend Mt. Lycaeum and dip an oak-bough in a sacred fountain, and by this sympathetic means produce mist (Pausan. viii. 38, 3). A god of this character would naturally be worshipped on the mountain-tops, and that these were very frequently consecrated to him is shown by the large number of appellatives derived from the names of mountains. But probably in his earliest Hellenic period the power of Zeus in the natural world was not limited to the sky. A deity who sent the fertilizing rains would come to be regarded as a god of vegetation, who descended into the earth and whose power worked in the life that wells forth from the earth in plant and tree. Homer calls the god of the lower world *Zeus Katachthonios* (*Iliad,* ix. 457), and the title of *Zeus Chthonios,* which was known to Hesiod, occurred in the worship of Corinth (Hesiod, *Works and Days,* 456; Pausan. ii. 2, 8).

A glimpse into a very old stratum of Hellenic religion is afforded us by the records of Dodona. A Dodonean liturgy has been preserved which, though framed in the form of an invocation and a dogma, has the force of a spell-prayer—"Zeus was and is and will be, O great Zeus: earth gives forth fruits, therefore call on Mother Earth" (Pausan. x. 12, 10). Zeus, the sky-god, is seen here allied to the earth-goddess, of whom his feminine counterpart, Dione (*q.v.*), may have been the personal form. And it is at Dodona that his association with the oak is of the closest. His prophet-priests, the *Selloi,* "with unwashed feet, couching on the ground" (Homer, *Iliad,* xvi. 233), lived about the sacred oak, which may be regarded as the primeval shrine of the Aryan god, and interpreted its oracular voice, which spoke in the rustling of its leaves or the cooing of its doves. Zeus, we may believe, long remained at Dodona such as he was when the Hellenic tribes first brought him down from the Balkans, a high god supreme in heaven and in earth.

We may also believe that in the earliest stages of worship he had already acquired a moral and a social character. The Homeric view of him as the all-father is a high spiritual concept, but one of which many savage religions of our own time are capable. The family, the tribe, the city, the simpler and more complex organisms of the Hellenic polity were specially under his care and direction. In spite of the popular stories of his amours and infidelities, he is the patron-god of the monogamic marriage, and his union with Hera (*q.v.*) remained the divine type of human wedlock.

He was also the tutelary deity of the larger organization of the phratria; and the altar of *Zeus Phratrios* was the meeting-point of the *phrateres,* when they were assembled to consider the legitimacy of the new applicants for admission into their circle (Demosth. *Contra Macartatum,* 1078, i.).

His religion also came to assist the development of certain legal ideas, for instance, the rights of private or family property in land; he guarded the allotments as *Zeus Klarios* (Pausan. viii. 53, 9), and the Greek commandment, "thou shalt not remove thy neighbour's landmark," was maintained by *Zeus Horios,* the god of boundaries, a more personal power than the Latin Iuppiter Terminus (Plato, *Laws,* 842 E).

His highest political functions were summed up in the title *Polieus*, a cult-name of legendary antiquity in Athens, and frequent in the Hellenic world.

His consort in his political life was not Hera, but his daughter Athena Polias. He sat in her judgment court ἐπὶ Παλλαδίῳ, where cases of involuntary homicide were tried (Corp. Inser. Attic. iii. 71 and 273). With her he shared the chapel in the council-hall of Athens dedicated to them under the titles of *Boulaios* and *Boulaia*, "the inspirers of counsel," by which they were worshipped in many parts of Greece (Antiphon vi. p. 789; Pausan. i. 3. 5; *cf. Corp. Inser. Attic.* iii. 683). The political assembly and the law-court were consecrated to *Zeus Agoraios*, and being the eternal source of justice he might be invoked as *Dikaiosunos* "The Just." As the god who brought the people under one government he might be worshipped as *Pandemos* (*Corp. Inser. Attic.* iii. 7); as the deity of the whole of Hellas, he became *Panhellenios*, perhaps about the time of the Persian wars, when thanksgiving for the victory took the form of dedications and sacrifice to "Zeus the Liberator" *Eleutherios* (Simonides, *Frag.* 140 [Bergk]; Strab. 412). Finally, in the formulae adopted for the public oath, where many deities were invoked, the name of Zeus was the master word.

It remains to consider briefly certain moral aspects of his cult. The morality attaching to the oath, so deeply rooted in the conscience of primitive peoples, was expressed in the cult of *Zeus Horkios*, the god who punished perjury (Pausan. v. 24. 9). The whole history of Greek legal and moral conceptions attaching to the guilt of homicide can be studied in relation to the cult-appellatives of Zeus. The Greek consciousness of the sin of murder, only dimly awakened in the Homeric period, and only sensitive at first when a kinsman or a suppliant was slain, gradually expands till the sanctity of all human life becomes recognized by the higher morality of the people; and the names of *Zeus Meilichios*, the dread deity of the ghost-world whom the sinner must make "placable," of *Zeus Hikesios* and *Prostropaios*, to whom the conscience-stricken outcast may turn for mercy and pardon, play a guiding-part in this momentous evolution.

But it was in the poets and philosophers that this evolution attained its end. Most of them were believers in a supreme power, present always and everywhere, and some of them—Empedocles, Aeschylus, Plato—gave to this supreme power the name of Zeus. "Zeus, whosoever he is,—if this name be pleasing unto him, by this name do I call him,—weighing all things in the balance, nought can I conjecture save only Zeus." (Aeschylus, *Agamemnon*, 160 *et seq.*; *cf.* frag. 70, Naucks 2nd ed.). He is the spirit of the world, the law of the universe, the universal reason, and all other gods are only parts or manifestations of him (*cf.* Diog. Laert. vii. 147). Moreover, as we may see from the "hymn" of Cleanthes (frag. 48), and from St. Paul's quotation from it or Aratus (Acts xvii., 28—Arat., phaen. 5), he was conceived by the Stoics as the father of the human race, who "alone of mortal things that live and move upon the earth" were created in his image.

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ZEUXIS, one of the best known Greek painters, flourished about 420–390 B.C., and described himself as a native of Heraclea, probably the town on the Black Sea. He was, according to one account, a pupil of Demophilus of Himera in Sicily, the other statement being that he was a pupil of Neseus of Thasos. Afterwards he appears to have resided in Ephesus. His known works are—

1. Zeus surrounded by Deities.
2. Eros crowned with Roses.
3. Marsyas bound.
4. Pan.
5. Centaur family.
6. Boreas or Triton.
7. Infant Heracles strangling the serpents in presence of his parents, Alcmena and Amphitryon.
8. Alcmena, possibly identical with 7.
9. Helena at Croton.
10. Penelope.
11. Menelaus.
12. Athlete.
13. An old Woman.
14. Boy with grapes.
15. Grapes.
16. Monochromes.
17. Plastic works in clay.

In ancient records we are told that Zeuxis, following the initiative of Apollodorus, had introduced into the art of painting a method of representing his figures in light and shadow, as opposed to the older method of outline, with large flat masses of colour for draperies, and other details, such as had been practised by Polygnotus and others of the great fresco painters. The new method led to smaller compositions, and often to pictures consisting of a single figure, on which it was more easy for the painter to demonstrate the various means by which he obtained perfect roundness of form. The effect would appear strongly realistic, as compared with the older method, and to this was probably due the origin of such stories as the contest in which Zeuxis painted a bunch of grapes so like reality that birds flew towards it.

ZHITOMIR or **JITOMIR,** a town in the Ukrainian S.S.R., in 50° 19′ N., 28° 40′ E., on the Teterev river, a left bank tributary of the Dnieper, and at the terminus of a branch railway from Berdichev (1939) 66,306. Pop. (1939) 95,090. There are iron-smelting works, and a brewing industry, in connection with which a hop fair is held in early September. Its position on the road west from Kiev gave it early importance and it dates back to the time of the Scandinavian expansion (9th century). The Tatars plundered it in the 13th, 14th and 17th centuries. In 1320 it became part of Lithuania, but was afterwards annexed by Poland and when the Cossacks rose against their chief Bogdan Chmielnicki (1648) they sacked the town. Russia occupied it, along with the rest of the Ukraine, in 1778. During World War II Zhitomir was captured by the Germans in 1941 but was subsequently reoccupied by soviet troops in 1943.

ZHOB, a valley and river in the north-east of Baluchistan, India. The Zhob is a large valley running from the hills near Ziarat first eastward and then northward parallel to the Indus frontier, till it meets the Gomal river at Khajuri Kach. Its importance is due to its being the shortest route between the North-West Frontier Province and Quetta; it dominates all the Pathan tribes of Baluchistan by cutting between them and Afghanistan. Up to the year 1884 it was practically unknown to Europeans, but the Zhob Valley Expedition of that year opened it up, and in 1889 the Zhod Valley and Gomal Pass were taken under the control of the British Government. The Zhob Valley was the scene of punitive British expeditions in 1884 and 1890. In 1890 Zhob was formed into a district or political agency, with its headquarters at Fort Sandeman. It was much disturbed during the third Afghan war of 1919. The district has an area of 9,626 sq.m.; pop. (1921) 56,668, mostly Pathans of the Kakar tribe.

See A. W. C. McFall, *With the Zhob Field Force* (1895); R. Bruce, *Forward Policy* (1900); T. H. Holdich, *Indian Borderland* (1901); *Zhob District Gazetteer.*

ZHUKOVSKY, VASILI ANDREYEVICH (1783–1852), Russian poet, born in the government of Tula, on Jan. 29, 1783, was the earliest of the Russian poets of the golden age of Russian poetry, and a precursor of Pushkin. The volume of his original work is small, consisting of a few beautiful lyrics and elegies. His greatest work was the opening up of the knowledge of English and German poetry in Russia by a series of translations. Brückner (*Gesch. v. Russ. Lit.*) calls him "the most original translator in the world's literature." He began by a translation of Gray's *Elegy;* he went on to the more famous poems of the English romanticists, and it has been asserted that in some cases his versions have greater poetic power than their originals. He turned Fouque's *Undine* into Russian verse. His last great work was a version of the *Odyssey* (1847). Zhukovsky was tutor to Alexander II., and he used his favour at court to help both Pushkin and Gogol. His last years were spent in Germany, and he died at Baden-Baden in 1852.

ZIEM, FÉLIX FRANÇOIS GEORGE PHILIBERT (1821–1911), French painter, was born at Beaune (Côte d'Or) in 1821. He studied at the art school of Dijon, where he gained the *grand prix* for architecture. In 1839 he went to Rome and

from 1845 to 1848 travelled in the south of France, Italy and the East, where he found the glowing sunlight and the rich colour peculiarly suited to his temperament. Many of his paintings are in American private collections, but two of his finest pictures, "The Doge's Palace in Venice" (1852), and a marine-painting, are at the Luxembourg museum, and a "view of Quai St. Jean, Marseilles" at the Marseilles gallery.

See *Félix Ziem,* by L. Roger-Milès (*Librairie de l'art,* Paris).

ZIETEN, HANS JOACHIM VON (1699–1786), Prussian general-field-marshal, began his military career as a volunteer in an infantry regiment. In 1741 Frederick the Great made him colonel of the newly formed hussar regiment, and his promotion was rapid. He served with distinction in the first Silesian War, and still more in the second. His hussars, reorganized in the short interval of peace, were considered the best of their arm in Europe. Zieten fought the brilliant action of Moldau Tein almost on the day he received his commission as major-general. In the next campaign he led the famous *Zietenritt* round the enemy's lines to deliver the king's order to a distant detachment. When the Seven Years' War broke out in 1756 Zieten had just been made lieutenant-general. At Reichenberg and Prag he held important commands. At the disastrous battle of Kolin (June 18, 1757) his left wing of cavalry was the only victorious corps of troops, while at Leuthen he was brilliantly successful. Almost the only error in his career of battles was his misdirection of the frontal attack at Torgau, but he redeemed the mistake by his brilliant assault on the Siptitz heights. At the peace, he retired, and died in 1786.

ZIGGURAT, in architecture, a common temple form in Chaldea and ancient Babylonia and Assyria, which consists either of a stepped pyramid or of a somewhat similar shape in which the flat terraces of the ordinary stepped pyramid are replaced by an inclined plane ascending spirally from the ground to the summit. Ziggurats were usually great mounds of sun-dried brick with the exterior walls faced with a coating of burned, glazed brick or tile. On the summit there was frequently a shrine to the deity to whom the temple was erected. It is probable that the ziggurat form originated in the attempt to obtain high observatories from which the stars, so important in Chaldean religion and magic, might be observed.

ZIGZAG, in architecture and the decorative arts, an ornament formed by a succession of chevrons. It usually takes the shape of a band, changing direction at points equidistant from each other by angles usually acute, in such a manner that alternate segments are parallel to each other. The zigzag is one of the most primitive ornamental forms, both on pottery and in textiles. In Egyptian work it is frequently used for tomb ceilings and walls, evidently imitating matting or cloth decorations. Its most important architectural use is in some of the Romanesque styles, especially the Norman work in France and England.

ZIMBABWE, a Bantu name, probably derived from the two words *zimba* ("houses") and *mabgi* ("stones"), given to certain ruins in south-east Africa. The mediaeval Portuguese applied it as a generic term for the capital of any considerable chief and to several distinct places. From about 1550 onwards the Zimbabwe generally referred to by Portuguese writers was at a spot a little north of the Afur district, not far from the Zambezi. Before this the capital of the Monomotapa was situated much farther south, and it may plausibly be identified with the extensive ruins near Victoria (Mashonaland), now generally called Zimbabwe.

These ruins, discovered by Adam Renders in 1868 and explored by Karl Mauch in 1871, became well known to English readers from J. T. Bent's account of the *Ruined Cities of Mashonaland.*

The explorations conducted in 1905 proved that the mediaeval objects were necessarily contemporaneous with the foundation of the buildings, and that there was no super-position of periods of any date whatsoever. The plan and construction of Zimbabwe are by no means unique, and this site only differs from others in Rhodesia in respect of the great dimensions and the massiveness of its individual buildings. It may therefore be dated to a period not earlier than the 14th or 15th century A.D., and attributed to the same Bantu people the remains of whose stone-fenced *kraals* are found between the Limpopo and the Zambezi.

The three distinct, though connected, groups of ruins at Zimbabwe are commonly known as the "elliptical temple," the "acropolis," and the "valley ruins." The first is doubly misnamed; it is not a temple and its contour is too unsymmetrical to be described properly as elliptical. It is an irregular enclosure over 800ft. in circumference, with a maximum length of 292ft. and a maximum breadth of 220ft., surrounded by a dry-built wall of extraordinary massiveness. This wall is in places over 30ft. high and 14ft. wide, but is erratic in outline and variable in thickness. On the south and south-east, the wall is decorated by a row of granite monoliths beneath which runs a double line of chevron ornament. The interior has been much destroyed by the ravages of gold-seekers and amateur excavators. The scheme was a combination of such a stone *kraal* as that at Nanatali with the plan of a fort like those found about Inyanga. The only unique feature is the occurrence of a large and a small conical tower at the southern end.

The "Acropolis" is a hill rising 200ft. to 300ft. above the valley, fortified with the minutest care and with extraordinary ingenuity. The principles of construction, the use of stone and cement, are the same as in the "elliptical" *kraal;* there is no definite plan, the shape and arrangement of the enclosures being determined solely by the natural features of the ground. Between this and the "elliptical" *kraal* are the "valley ruins," consisting of smaller buildings, perhaps the dwellings of traders who bartered the gold brought in from distant mines. Zimbabwe was probably the distributing centre for the gold traffic carried on in the middle ages between the Monomotapa and the Mohammedans of the coast.

See ARCHAEOLOGY; AFRICA: *Archaeology and Antiquities;* MONOMOTAPA; D. Randall-MacIver, *Mediaeval Rhodesia* (1906); *Journal of Anthrop. Inst.,* vol. xxxv.; *Geog. Journal* (1906). *See* also Mauch's report in *Ausland* (1872), which is of bibliographical interest; Bent's *Ruined Cities of Mashonaland* (1892); R. N. Hall, *Great Zimbabwe* 1905); *Prehistoric Rhodesia* (1909).

ZIMMERMANN, ARTHUR (1859–1940), German diplomat was born May 8, 1859, at Frankenstein. After having been vice-consul at Shanghai and acting consul in 1900 at Tientsin, he entered the Foreign Office in 1902 and rose by 1910 to be a director of the political section. In 1911 he was appointed under-secretary, and in Nov. 1916 secretary of state in succession to Von Jagow. In this capacity he addressed to America the note of Jan. 31, 1917, on the subject of U-boat warfare. He was also the author of the invitation of Jan. 19, 1917, to Mexico to enter into alliance with Germany and to sound Japan as to her willingness to co-operate. For Mexico the price of this alliance was to be the American States of New Mexico, Texas and Arizona. This proposal, which was sent through the medium of Von Eckhardt, the German minister to Mexico, was intercepted in America and President Wilson was in a position to publish it on March 1, 1917. The disclosure was one of the primary causes resulting in America's declaration of war upon Germany. Zimmermann retired on Aug. 5, 1917, shortly after the resignation of Bethmann Hollweg.

ZINC, a metallic chemical element (symbol Zn, atomic number 30, atomic weight 65·38). Zinc as a component of brass had currency in metallurgy long before it became known as an individual metal. The word zinc (in the form *zinken*) was first used by Paracelsus, who regarded it as a bastard or semi-metal; but the word was subsequently used for both the metal and its ores. Moreover, zinc and bismuth were confused, and the word *spiauter* (the modern spelter) was indiscriminately given to both these metals. In 1597 Libavius described a "peculiar kind of tin" which was prepared in India, and of which a friend had given him a quantity. From his account it is quite clear that this metal was zinc, but he did not recognize it as the metal of calamine. It is not known to whom the discovery of isolated zinc is due; but we do know that the art of zinc-smelting was practised in England from about 1730. The first continental zinc-works were erected at Liége in 1807.

Occurrence.—Zinc does not occur free in nature, but in combination it is widely diffused. The chief ore is zinc blende, or sphalerite (*see* BLENDE), which generally contains, in addition to zinc sulphide, small amounts of the sulphides of iron, silver and

cadmium. It may also be accompanied by pyrites, galena, arsenides and antimonides, quartz, calcite, dolomite, etc. It is widely distributed, and is particularly abundant in Germany (the Harz, Silesia), Austro-Hungary, Belgium, the United States and in England (Cumberland, Derbyshire, Cornwall, North Wales). Second in importance is the carbonate, calamine (*q.v.*) or zinc spar, which at one time was the principal ore; it almost invariably contains the carbonates of cadmium, iron, manganese, magnesium and calcium, and may be contaminated with clay, oxides of iron, galena and calcite; "white calamine" owes its colour to much clay; "red calamine" to admixed iron and manganese oxides. Calamine chiefly occurs in Spain, Silesia and in the United States. Of less importance is the silicate, $Zn_2SiO_4{\cdot}H_2O$, named electric calamine or hemimorphite; this occurs in quantity in Altenburg near Aix-la-Chapelle, Sardinia, Spain and the United States (New Jersey, Pennsylvania, Missouri, Wisconsin). Other zinc minerals are willemite (*q.v.*), Zn_2SiO_4, hydrozincite or zinc bloom, $ZnCO_3{\cdot}2Zn(OH)_2$, zincite (*q.v.*) or red zinc ore, ZnO, and franklinite, $3(Fe,Zn)O{\cdot}(Fe,Mn)_2O_3$.

Production.—Until about 1833 the supply of zinc was almost entirely obtained from Germany, but in this year Russia began to contribute about 2,000 tons annually to the 6,000 to 7,000 derived from Germany. Belgium entered in 1837 with an output of about 2,000 tons; England in 1855 with 3,000; and the United States in 1873 with 6,000 tons. The last country now produces about one-third of the world's supply. The present state and general trend of the industry is shown by the following statistics for output of smelter and electrolytic zinc (in metric tons) for the chief producing countries and for the world's production.

Year	1933	1935	1937
U.S.A.	278,669	381,591	505,212
Belgium	137,300	181,740	225,579
Canada	83,412	135,645	143,964
Poland	82,705	84,606	107,174
Australia	54,822	68,752	70,869
France	51,958	47,443	60,427
Germany*	50,867	123,198	163,200
United Kingdom*	41,717	61,433	63,138
World output	983,000	1,332,000	1,621,000

*Some secondary metal included. "Minerals Yearbook 1938," U.S. Bureau of Mines.

Properties.—Zinc is bluish white, with a high lustre when fractured. It fuses at 419° C and under ordinary atmospheric pressure boils at 918° C. Its vapour density shows that it is monatomic. The molten metal on cooling deposits crystals belonging to the hexagonal system, and freezes into a compact crystalline solid, which may be brittle or ductile according to circumstances. If zinc be cast into a mould at a red heat, the ingot produced is laminar and brittle; if cast at just the fusing-point, it is granular and sufficiently ductile to be rolled into sheet at the ordinary temperature. According to some authorities, pure zinc always yields ductile ingots. Commercial "spelter" always breaks under the hammer; but at 100° to 150° C it is susceptible of being rolled out into a very thin sheet. Such a sheet, if once produced, remains flexible when cold. At about 200° C, the metal becomes so brittle that it can be pounded in a mortar. The specific gravity of zinc cannot be expected to be perfectly constant; according to Karsten, that of pure ingot is 6·915, and rises to 7·191 after rolling. The coefficient of linear expansion is 17×10^{-6} between 20° and 100°. The specific heat is 0·0929 from 18° to 100°. Compact zinc does not tarnish much in the air. It is fairly soft, and clogs the file. If zinc be heated to near its boiling-point, it catches fire and burns with a brilliant light into its powdery white oxide, which forms a reek in the air (*lana philosophica*, "philosopher's wool"). Boiling water attacks it appreciably, but slightly, with evolution of hydrogen and formation of the hydroxide, $Zn(OH)_2$. A rod of perfectly pure zinc, when immersed in dilute sulphuric acid, is so very slowly attacked that there is no visible evolution of gas; but, if a piece of platinum, copper or other more electro-negative metal be brought into contact with the zinc, it dissolves readily, with evolution of hydrogen and formation of the sulphate. The ordinary impure metal dissolves at once, the more readily the less pure it is. Cold dilute nitric acid dissolves zinc as nitrate, with evolution of nitrous oxide. At higher temperatures, or with stronger acid, nitric oxide, NO, is produced besides or instead of nitrous oxide. Zinc is also soluble in soda and potash solutions, but not in ammonia.

Applications.—Zinc is largely used for "galvanizing" iron, sheets of clean iron being immersed in a bath of the molten metal and then removed, so that a coat of zinc remains on the iron, which is thereby protected from atmospheric corrosion. For the same purpose zinc may be sprayed on to other metals, or it may be deposited electrolytically. It is also a constituent of many valuable alloys; brass, Muntz-metal, pinchbeck and tombac are examples.

Zinc forms only one oxide, ZnO, from which is derived a well-characterized series of salts. It is chemically related to cadmium and mercury, the resemblance to cadmium being especially well marked; one distinction is that zinc is less basigenic. Zinc is capable of isomorphously replacing many of the bivalent metals, *e.g.*, magnesium, manganese, iron, nickel, cobalt and cadmium, in certain salts.

Zinc Oxide, ZnO, is manufactured for paint by two processes —directly from the ore mixed with coal by volatilization on a grate, and by oxidizing the vapour given off by a boiling bath of zinc metal. The oxide made by the latter method has generally a better colour, a finer texture, and a greater covering power. It is an infusible solid, which is intensely yellow at a red heat, but on cooling becomes white. This at least is true of the oxide produced from the metal by combustion; that produced from the carbonate, if once made yellow at a red heat, retains a yellow shade permanently. Crystalline zinc oxide is obtained by heating the nitrate, or by heating the chloride in a current of steam. It is insoluble in water, but dissolves readily in all aqueous acids, with formation of salts. It also dissolves in aqueous caustic alkalis, including ammonia, forming "zincates" [*e.g.*, $Zn(OK)_2$]. Zinc oxide is used in the arts as a white pigment (zinc white); it has not by any means the covering power of white lead, but offers the advantages of being non-poisonous and of not becoming discoloured in sulphuretted hydrogen. It is used also in ointments, as a polish for glass, and in dental cements.

Zinc Hydroxide, $Zn(OH)_2$, is prepared as a gelatinous precipitate by adding a solution of any zinc salt to pure aqueous caustic potash. It is a white powder, is insoluble in water, but soluble in excess of alkali and in acids.

Zinc Peroxide, obtained from zinc sulphate and barium peroxide, or by electrolysis of neutral zinc chloride solutions in the presence of hydrogen peroxide, is a valuable antiseptic, being odourless and non-irritant; it is much used for skin troubles under various proprietary names (*e.g.*, dermogen), and as produced commercially contains about 50% of ZnO_2 together with hydroxide and moisture.

Zinc chloride, $ZnCl_2$, is produced by heating the metal in dry chlorine gas, or by heating a mixture of zinc sulphate and sodium chloride. It condenses as a white translucent mass, boiling at about 700°. Its vapour density at 900° C corresponds to $ZnCl_2$. It is extremely hygroscopic and is used in synthetical organic chemistry as a condensing agent. It dissolves in a fraction of its weight of even cold water and in any proportion of boiling water, forming a syrupy solution. A solution of zinc chloride is easily produced from the metal and hydrochloric acid; it cannot be evaporated to dryness without considerable decomposition of the hydrated salt into oxychloride and hydrochloric acid, but it may be crystallized as $ZnCl_2{\cdot}H_2O$. A concentrated solution of zinc chloride converts starch, cellulose and a great many other organic substances into soluble compounds; hence the application of the fused salt as a caustic in surgery and the impossibility of filtering a strong $ZnCl_2$ solution through paper. (*See* CELLULOSE.) The solution is also used as a flux in soldering.

Zinc chloride solution readily dissolves the oxide with the formation of oxychlorides, some of which are used as pigments, cements and for filling teeth in dentistry. A solution of the oxide in the chloride has the property of dissolving silk, and hence is employed for removing this fibre from wool.

Zinc sulphide, ZnS, occurs in nature as blende (*q.v.*), and is artificially obtained as a white precipitate by passing sulphuretted hydrogen into a neutral solution of a zinc salt. It dissolves in mineral acids, but is insoluble in acetic acid.

Zinc sulphate, $ZnSO_4+7H_2O$, or white vitriol, is prepared by dissolving the metal in dilute sulphuric acid, concentrating, and cooling the solution. The hydrated salt crystallizes out on cooling, forming colourless orthorhombic prisms, usually small and needle-shaped. They are permanent in the air. According to Poggiale, 100 parts of water dissolve respectively of ($7H_2O$) salt, 115·2 parts at 0°, and 653·6 parts at 100°. At 39° C the crystals lose one, and at 100° six of their molecules of water; the remaining molecule goes off at 250°. The anhydrous salt, when exposed to a red heat, breaks up into oxide, sulphur dioxide and oxygen. An impure form of the salt is prepared by roasting blende at a low temperature. In the arts it is employed in the preparation of varnishes, and as a mordant for the production of colours on calico. A green pigment known as *Rinmann's green* is prepared by mixing 100 parts of zinc vitriol with 2·5 parts of cobalt nitrate and heating the mixture to redness, to produce a compound of the two oxides. Zinc sulphate, like magnesium sulphate, unites with the sulphates of the potassium metals and of ammonium into crystalline double salts, $ZnSO_4{\cdot}R_2SO_4+6H_2O$, isomorphous with one another and with the magnesium salts.

Zinc Carbonate, $ZnCO_3$, occurs in nature as the mineral calamine (*q.v.*), but has never been prepared artificially, *basic carbonates,* $ZnCO_3{\cdot}xZn(OH)_2$, where x is variable, being obtained by precipitating a solution of the sulphate or chloride with sodium carbonate; the basic salt is used as a pigment.

Of zinc phosphates we notice the minerals hopeite, $Zn_3(PO_4)_2{\cdot}4H_2O$, and tarbuttite, $Zn_3(PO_4)_2{\cdot}Zn(OH)_2$, both found in Rhodesia.

Analysis.—From neutral solutions of its salts zinc is precipitated by sulphuretted hydrogen as sulphide, ZnS—a white precipitate, soluble, but by no means readily, in dilute mineral acids, but insoluble in acetic acid. In the case of the acetate precipitation is quite complete; from a sulphate or chloride solution the greater part of the metal goes into the precipitate; in the presence of a sufficiency of free HCl the metal remains dissolved; sulphide of ammonium precipitates the metal completely, even in the presence of ammonium salts and free ammonia. The precipitate, when heated, passes into oxide, which is yellow when hot and white after cooling; and, if it be moistened with cobalt nitrate solution and re-heated, it exhibits a green colour after cooling.

Zinc may be quantitatively estimated by precipitating as basic carbonate, which is dried and ignited to zinc oxide. It may also be precipitated as zinc ammonium phosphate, NH_4ZnPO_4, which is filtered on a Gooch crucible and dried at 105°. Volumetric methods have also been devised.

PHARMACOLOGY AND THERAPEUTICS

Zinc chloride is a powerful caustic, and is prepared with plaster of Paris in the form of sticks for destroying warts, etc. The salt is a corrosive irritant poison when taken internally. The treatment is to wash out the stomach or give such an emetic as apomorphine, and, when the stomach has been emptied, to administer demulcents such as white of egg or mucilage. Numerous other salts of zinc, used in medicine, are of value as containing this metal. Certain others are referred to in relation with the important radical contained in the salt. Those treated here are the sulphate, oxide, carbonate, oleate and acetate. All these salts are mild astringents when applied externally, as they coagulate the albumen of the tissues and of any discharge which may be present. In virtue of this property they are also mild haemostatics, tending to coagulate the albumens of the blood and thereby to arrest haemorrhage. *Lotio Rubra,* the familiar "Red Lotion," a solution of zinc sulphate, is widely used in many catarrhal inflammations, as of the ear, urethra, conjunctiva, etc. There are also innumerable ointments.

These salts are extensively employed internally especially in the treatment of the more severe and difficult cases of nervous disease. The sulphate is an excellent emetic in cases of poisoning, acting rapidly and without much nausea or depression. For these reasons it may also be given with advantage to children suffering from acute bronchitis or acute laryngitis. *See* also *Zinc peroxide* (above).

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ZINC PRODUCTION

The United States is the principal producer of both zinc ore and spelter. The Joplin area in Missouri has long been the principal mining region, but large deposits are worked in the Upper Mississippi region, Franklin Furnace (New Jersey) and, since the application of improved methods of zinc concentration, in the western States. Australia is next to the United States as a zinc producer, most of the ore being obtained from the Broken Hill district (New South Wales). Tasmania also has important deposits and occurrences are known in Australia.

In Canada, the most important deposits of the metal occur in British Columbia and Quebec, these two provinces sharing practically the whole of the Canadian production in the proportions of four-fifths and one-fifth respectively. The principal countries in Europe participating in the zinc industry are Germany, Italy, Poland and Spain. For many years Germany ranked second only to the United States. Her most important deposits were in Upper Silesia, which yielded about three-fourths of the total German production. Before the World War the European industry was almost wholly controlled by the German zinc convention.

In Italy the chief mines now worked are in Sardinia, though occurrences of ore are found in Lombardy, Piedmont and Tuscany. During the post-War period Poland produced more zinc ore than any other European country, her richest mines being situated in Silesia; her exports in 1923 amounted to 80,000 long tons. In Spain the chief zinc-mining centres are in the provinces of Santander and Murcia. The ores of Santander are mainly calamine, while those of Murcia are principally blende and galena. Mention should be made of the zinc-ores mined in the United Kingdom. These are almost invariably blende associated with galena, and occur chiefly in North Wales, the north of England, the Isle of Man and at Dumfries in Scotland.

In the following table the production of zinc in the principal countries of the world is set out for the three years, 1918, 1923 and 1925.

	Long Tons		
	1918	1923	1925
United States	462,435	455,745	511,559
Australia	9,444	41,153	45,698
Canada	11,227	26,972	34,358
Germany	232,000	39,400	57,705
Italy	1,169	3,622	6,374
Poland	..	90,000	112,507
Spain	15,644	10,746	140,300
United Kingdom	50,000	33,000	42,000
Belgium	9,096	144,677	179,130
France	18,052	48,541	70,000
Japan	39,203	13,671	14,000*
Netherlands	..	16,185	20,778
Yugoslavia	..	2,400	2,196†
Sweden	..	1,194	4,598
Norway	..	3,722	6,698

*Approximate. †Crude and refined zinc.

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ZINCITE, a mineral consisting of zinc oxide (ZnO), crystallizing in the hemimorphic-hemihedral class of the hexagonal system. Distinct crystals are of rare occurrence; they have the form of a hexagonal pyramid terminated at one end only by a basal plane. There is a perfect cleavage parallel to the basal plane, and usually the mineral is found as platy foliated masses. The blood-red colour and the orange-yellow streak are characteristic features. The hardness is 4·5, sp.gr., 5·6. Some manganese is usually present replacing zinc. It is known only from Sterling Hill and Franklin Furnace in Sussex county, N.J.

ZINDER, a town on the northern margin of the central Sudan. Pop. (1939) 10,400, of whom 100 were Europeans. It forms part of the French colony of Niger, of which the capital, at first Zinder, was in 1926 moved to Niamey. Its ruler was formerly subordinate to Bornu, but with the decline of that kingdom he shook off the yoke of the sultan, and on the conquest of that country by Rabah (*q.v.*) seems to have maintained his independence. The country of which Zinder is the capital is known as Damerghu. It is semi-fertile, and supports considerable numbers of horses and sheep, besides troops of camels. By the Anglo-French agreement of June 1898 it was included in the French sphere. The town was occupied in July 1899, after a slight resistance. A French post (named Fort Cazemajou) was built outside the town on a mound of huge granite blocks. Zinder was the first point in the Sudan reached by F. Foureau after his great journey across the Sahara *via* Air in 1899. Subsequently Commandant Gadel, from his headquarters at Zinder, mapped and pacified the surrounding region, and sent out columns of *meharistes* (camel-corps) which occupied the oasis of Air and Bilma in 1906. Zinder is a large and fine town surrounded with high earthen walls, very thick at the base and pierced with seven gates.

See Cazemajou, in *Bul. Com. de l'Afrique Française* (1900); F. Foureau, in *La Géographie* (December 1900), *D'Alger au Congo par le Tchad* (Paris, 1902); Joalland, in *La Géographie,* vol. iii. (1901); E. Arnaud and M. Cortier, *Nos Confins Sahariens* (Paris, 1908); C. Jean, *Les Touareg du Sud-Est* (Paris, 1909).

ZINGARELLI, NICCOLO (1752–1837), Italian composer, was born at Naples on April 4, 1752, the son of Riccardo Tota Zingarelli, a singing-master and soloist. His first dramatic work, *I quattro Pazzi,* was produced at the conservatorio in 1768. He then gave violin lessons for a time, but in 1781 produced his first opera, *Montesuma,* at the San Carlo and afterwards in Vienna, where it was highly commended by Haydn. He finally settled in Milan, with introductions to the viceregal court, and over a period of eleven years produced a series of operas for the Scala, an oratorio of the Passion, and several cantatas. In 1789 he went to Paris to write an opera for the Académie royale de musique. This work, *L'Antigone,* for which Marmontel provided the libretto, was performed on April 30, 1790, but Paris was no place for Zingarelli during the Revolution, and he fled into Switzerland and returned to Milan early in 1791.

In 1792 he won the appointment, by open competition, of master of the chapel at the cathedral. He first achieved an international reputation by a series of comic operas, beginning with *La Secchia rapita* in 1793. His finest work was, however, *Romeo and Juliet,* played at the Scala in 1796. From 1794–1804 Zingarelli was master of the chapel at Loreto, and during this time, although he also wrote operas, he was chiefly inspired to compose sacred music, contributing largely to the enormous collection of manuscript works, the property of the church, known as the *Annuale di Loreto.* In 1804 he went to Rome as master (maestro di capella) of the Sistine chapel and in 1805 produced one of his most successful works, "The Destruction of Jerusalem," which held the stage for five years. His last opera, *Berenice,* received a hundred consecutive performances.

At the "King of Rome" celebrations, when Napoleon ordered a Te Deum to be sung in Rome, Zingarelli's principles did not allow him to undertake the performance, and on his refusal he was arrested and brought before the emperor in Paris. But Napoleon at once released him and provided him with a pension. Zingarelli's post in Rome had been taken by Fioravanti, but in 1813 he was appointed director of the Real Collegio di Musica at Naples and in 1816 maestro di cappella at the cathedral. Zingarelli's gift for melody was remarkable. He was a deeply religious man and was rigorous in his exclusion of secular music from church performances. He died in 1837.

ZINGIBERACEAE, a family of monocotyledonous plants, chiefly tropical, characterized by its irregular flowers. The various parts of the plants are usually more or less aromatic. Forty genera and about 900 species are recognized. Among the economic species are ginger (*q.v.*) (*Zingiber officinale*), cardamoms (*q.v.*) (*Elettaria cardamomum* and *Amomum cardamomum*), grana-paradisi (*Aframomum*) and turmeric (*q.v.*) (*Curcuma longa*), the latter used in making curry powder. Various species of *Alpinia, Hedychium, Phaeomeria* and other genera are cultivated for ornamental purposes. *See* K. Schumann, "Zingiberaceae," *Pflanzenreich,* 20 (iv 46): 1–459, fig. 1–52 (1904).

ZINNIA, a genus of the family Compositae, containing about a dozen species of tender annual or perennial herbs or undershrubs, found wild from the southern United States and Mexico to Chile. The numerous single and double garden forms are mostly derived from *Zinnia elegans,* and grow about 2 ft. high, producing flowers of various colours, the double ones being about the size of asters, and very handsome. The colours include white, yellow, orange, scarlet, crimson and purple. Zinnias do best in a rich deep loamy soil, in a sunny position. They should be sown on a gentle hotbed at the end of March and planted out only after settled warm weather.

ZINOVIEV, GRIGORY EVSEEVICH (1883–1936), Russian politician, was born in Sept. 1883 at Elisavetgrad (Zinovievsk). He studied chemistry and later law at Bern. He was a revolutionary before he was 20, and in 1903 met Lenin. He was head of the Bolshevik party in Bern and during 1903–4 started Bolshevik propaganda in South Russia. Apart from his activities abroad, he came into prominence in Russia during 1906–8 as a member of the Bolshevik St. Petersburg committee of the R.S.D.P., by his organization of the attempted Kronstadt rising after the dispersal of the first Duma, his editorship of the Bolshevik paper *Vpered* (Forward), and of *The Social Democrat,* the central organ of the party. In 1908 he was arrested and imprisoned but was released. He went abroad and did not return until the revolution in 1917. During these nine years Zinoviev worked hard for his party. He was a member of the central committee, co-editor of the principal Bolshevik publications, and representative of the party at the Copenhagen congress of the International. In 1912 he went with Lenin to Galicia to control from the nearest possible point the growing labour movement in Russia. In Galicia he founded the foreign bureau of the central committee, which guided the party work in Russia and the activities of the Bolshevik group in the Duma. Zinoviev edited with Lenin *Against the Tide,* a work of propaganda against World War I; and at the Zimmerwald conference (1915) they began to organize the Communist International. On the outbreak of the March revolution (1917) they returned to Russia and began to prepare the way for the revolution. Zinoviev was co-editor of *Pravda* and, after its suppression, of *The Proletarian* and *The Worker.* He thus became one of the leading figures in Russia. In 1919 he was elected president of the Communist International, and after the death of Lenin in 1924 was one of the most zealous upholders of pure "Leninism." But in 1926 he was expelled from the political bureau, and in 1927 from the Communist party. He was readmitted in 1929; but in Jan. 1935 he and Kamenev (*q.v.*) were exiled for counter-revolutionary activities. On Aug. 25, 1936, convicted of high treason together with Kamenev and 14 others, he was shot. His alleged letter to English communists was a factor in the British general election of Oct. 1924.

ZINOVIEVSK, Ukrainian S.S.R.: *see* KIROVOGRAD.

ZINZENDORF, NICOLAUS LUDWIG, COUNT OF ZINZENDORF AND POTTENDORF (1700–1760), German religious and social reformer, was born on May 26, 1700, at Dresden. Both

his parents belonged to the Pietist circle, and the lad had Philipp Jakob Spener for his godfather. His school days were spent at Halle amidst Pietist surroundings, and in 1716 he went to the University of Wittenberg, to study law and fit himself for a diplomatic career. Three years later he was sent to travel in Holland, in France, and in various parts of Germany. During a lengthened visit at Castell he fell in love with his cousin Theodora; but her mother objected to the marriage, and Theodora married Count Henry of Reuss. Zinzendorf took this rebuff as a call to special work for God, and he now resolved to settle down as a Christian landowner, spending his life on behalf of his tenantry at Berthelsdorf. His intention was to carry into practice the Pietist ideas of Spener.

The "band of four brothers" (Rothe, pastor at Berthelsdorf; Melchior Schäffer, pastor at Görlitz; Francis von Wattewille, a friend from boyhood; and himself) set themselves to create a revival of religion. From the printing-house at Ebersdorf large quantities of books and tracts, catechisms, collections of hymns and cheap Bibles were issued; and a translation of Johann Arndt's *True Christianity* was published for circulation in France. Zinzendorf seems to have doubted the wisdom of Spener's plan of not separating from the Lutheran Church, and began to think that true Christianity could be best promoted by free associations of Christians, which in course of time might grow into churches with no State connection. Zinzendorf offered an asylum to a number of persecuted wanderers from Moravia (*see* MORAVIAN BRETHREN), and built for them the village of Herrnhut on a corner of his estate of Berthelsdorf. The refugees who came to this asylum (between 1722 and 1732—the first detachment under Christian David) from various regions where persecution raged, belonged to more than one Protestant organization. Zinzendorf devoted himself to them.

Gradually Zinzendorf was able to organize his refugees into something like a *militia Christi,* based not on monastic but on family life. He established a common order of worship in 1727, and soon afterwards a common organization, which has been described in the article MORAVIAN BRETHREN. He travelled widely on behalf of the Moravians, visiting America in 1741–42 and spending a long time in London in 1750. Missionary colonies had by this time been settled in the West Indies (1732), in Greenland (1733), amongst the North American Indians (1735); and before Zinzendorf's death the Brethren had sent from Herrnhut missionary colonies to Livonia and the northern shores of the Baltic, to the slaves of North Carolina, to Surinam, to the negro slaves in several parts of South America, to Travancore in the East Indies, to the Copts in Egypt and to South Africa.

In 1752 Zinzendorf lost his only son, Christian Renatus, whom he had hoped to make his successor; and four years later he lost his wife Erdmute, who had been his counsellor and confidante in all his work. Zinzendorf remained a widower for one year, and then (June 1757) contracted a second marriage with Anna Nitschmann. He died on March 9, 1760, leaving John de Wattewille, who had married his eldest daughter Benigna, to take his place at the head of the community.

See A. G. Spangenberg, *Leben des Grafen von Zinzendorf* (Barby, 1772–75); L. von Schrautenbach, *Der Graf v. Zinzendorf* (Gnadau, 1871; written in 1782, and interesting because it gives Zinzendorf's relations to such Pietist rationalists as J. K. Dippel); F. Bovet, *Le Comte de Zinzendorf* (1860; Eng. trans. *A Pioneer of Social Christianity,* by T. A. Seed, 1896); B. Becker, *Zinzendorf im Verhältniss z. Philosophie u. Kirchenthum seiner Zeit* (Leipzig, 1886); H. Römer, *Zinzendorf's Leben und Werken* (Gnaudau, 1900), and other literature mentioned under MORAVIAN BRETHREN.

ZION, a city of Lake county, Illinois, U.S.A., on Lake Michigan, 45 m. N. by W. of Chicago. It is served by the Chicago and North Western and the Chicago, North Shore and Milwaukee railways. Pop. 5,580 in 1920, 20% foreign-born white, and was in 1940, 6,555 by the federal census. It is the centre of a fruit-growing, truck-gardening and dairying district, and has a variety of manufacturing industries. Zion City (as it was called at first) was founded in 1901 by John Alexander Dowie (*q.v.*) to be the headquarters of the "Christian Catholic Apostolic Church in Zion." It was chartered as a city in 1902.

ZION, originally the name of the Jebusite stronghold at Jerusalem captured by David (2 Samuel v.). This was probably on the southern part of the eastern hill. Above it was built the temple, and later the name was extended to the whole hill. Finally it became a synonym for the city of Jerusalem, whose inhabitants are personified as "the daughter of Zion." *See* JERUSALEM.

ZIONISM is the lineal heir of the attachment to Zion which led the Babylonian exiles under Zerubbabel to rebuild the Temple, and which flamed up in the heroic struggle of the Maccabees against Antiochus Epiphanes.

During the middle ages, though the racial character of the Jews was being transformed by their Ghetto seclusion, the national yearning suffered no relaxation. The nationalist spirit of the mediaeval Jews is sufficiently reflected in their liturgy, and especially in the works of the poet, Jehuda Halevi.

The strength of the nationalist feeling was practically tested in the 16th century, when a Jewish impostor, David Reubeni (*c.* 1530), and his disciple, Solomon Molcho (1501–1532), came forward as would-be liberators of their people. Throughout Spain, Italy and Turkey they were received with enthusiasm by the bulk of their brethren. In the following century the influence of the Christian Millennarians gave a fresh impulse to the national idea. Menasseh ben Israel (1604–1657) co-operated with English Millennarians to procure the resettlement of the Jews in England as a preliminary to their national return to Palestine. In 1666 a leader appeared at Smyrna, in the person of a Jew named Sabbatai Sebi (1626–1676), who proclaimed himself the Messiah. The news spread like wildfire, and despite the opposition of some of the leading rabbis, the Jews everywhere prepared for the journey to Palestine. Throughout Europe the nationalist excitement was intense. Even the downfall and apostasy of Sabbatai were powerless to stop it. The bulk of the people refused for a whole century to be disillusioned.

The reaction arrived in 1778 in the shape of the Mendelssohnian movement. The growth of religious toleration, the attempted emancipation of the English Jews in 1753, and the Judeophilism of men like Lessing and Dohm, showed that a new era was at hand. Moses Mendelssohn (1729–1786) sought to prepare his brethren for their new life as citizens of the lands in which they dwelt, by emphasizing the spiritual side of Judaism and the necessity of Occidental culture. His efforts were successful. The nationalist spirit showed signs of yielding before the hope or the progress of local political emancipation. In 1806 the Jewish Sanhedrin convened by Napoleon virtually repudiated the nationalist tradition. The new Judaism, however, had not entirely destroyed it. It had only reconstructed it on a different foundation. Mendelssohnian culture, by promoting the study of Jewish history, gave a fresh impulse to the racial consciousness of the Jews. From this race consciousness came a fresh interest in the Holy Land. It was an ideal rather than a politico-nationalist interest—a desire to preserve and cherish the monuments of the ancient national glories. It took the practical form of projects for improving the circumstances of the local Jews by means of schools, and for reviving something of the old social condition of Judea by the establishment of agricultural colonies. In this work Sir Moses Montefiore, the Rothschild family, and the Alliance Israélite Universelle were conspicuous. More or less passively, however, the older nationalism still lived on—especially in lands where Jews were persecuted—and it became strengthened by the revived race consciousness and the new interest in the Holy Land. Christian Millennarians also helped to keep it alive. Lord Ashley, afterwards Lord Shaftesbury, Col. Gawler, Walter Cresson, the United States consul at Jerusalem, James Finn, the British consul, Laurence Oliphant and many others organized and supported schemes for the benefit of the Jews of the Holy Land on avowedly Restoration grounds. Another vivifying element was the re-opening of the Eastern Question and the championship of oppressed nationalities in the East by the Western Powers. In England political writers were found to urge the re-establishment of a Jewish State under British protection as a means of assuring the overland route to India (Hollingsworth, *Jews in Palestine,* 1852). Lord Palmerston was not unaffected by this idea (Finn,

Stirring Times, vol. i pp. 106–112), and both Lord Beaconsfield and Lord Salisbury supported Laurence Oliphant in his negotiations with the Porte for a concession which was to pave the way to an autonomous Jewish state in the Holy Land. George Eliot's *Daniel Deronda,* which appeared in 1876, was a striking illustration of the sympathy with which Jewish national aspirations were regarded by cultivated western minds.

In the middle of the 19th century, Zionism, or what the next generation of Jews was to know as Zionism, was already being preached in western Europe by Moses Hess (1812–1875) and in eastern Europe by Hirsch Kalischer (1795–1874) and Perez Smolenskin (1842–1885). A powerful impetus was given to the movement by the rise and spread of anti-Semitism, which, in one form or another, began to harass the Jews and embitter their lives in nearly every part of Europe. In Russia it reached its climax in 1882, when murder and pillage raged unchecked through the Jewish pale of settlement. It was in this fateful year that the immediate precursor of Theodor Herzl, the founder of the Zionist organization, appeared in the person of Leo Pinsker of Odessa (1821–1891), whose "auto-emancipation" was a plea for the solution of the Jewish problem by the re-establishment of a Jewish nation living its own life on Jewish soil. The "back to Zion" movement soon began to assume a practical form. A society known as *Choveve Zion* ("Lovers of Zion") was formed for the purpose of promoting Jewish colonization in Palestine.

A new chapter opened in 1896 with the publication of a pamphlet entitled *The Jewish State* by Theodor Herzl (*q.v.*). In his "Jewish state" he elaborated in detail a scheme for the establishment of an autonomous Jewish commonwealth in Palestine under the suzerainty of the sultan. This scheme secured a large amount of popular support throughout Europe and in 1897 the first international Zionist congress met at Basle. The congress established the Zionist Organization for the purpose of giving effect to the following program: "Zionism strives to create for the Jewish people a home in Palestine secured by public law. The congress contemplates the following means to the attainment of this end: (1) The promotion on suitable lines of the colonization of Palestine by Jewish agricultural and industrial workers. (2) The organization and binding together of the whole of Jewry by means of appropriate institutions, local and international, in accordance with the laws of each country. (3) The strengthening and fostering of Jewish national sentiment and consciousness. (4) Preparatory steps towards obtaining government consent where necessary to the attainment of the aim of Zionism."

In 1901 and again in 1902 Dr. Herzl had audiences with the sultan, Abdul Hamid, but the negotiations led to nothing. He now sought from the British government a grant of territory on an autonomous basis in the vicinity of the Holy Land, which would provisionally afford a refuge and a political training-ground for persecuted Jews. A site was suggested in the Sinai peninsula, but owing to the waterless character of the country the project was given up. Then Joseph Chamberlain suggested the uninhabited highlands of the East Africa Protectorate, and in 1903 the British government made the Zionist Organization a provisional offer of an area of 6,000 sq.mi. in the Guas Ngishu plateau. This offer was warmly appreciated as a mark of British goodwill, but it gave rise to sharp differences of opinion between a minority who urged its acceptance and a much larger body of Zionists who were alarmed at any suggestion of the diversion of Zionist energies from Palestine. In the end the project was shelved by the seventh Zionist congress (1905).

Meanwhile Zionism had suffered an irreparable blow by the death of Dr. Herzl (1904). He was succeeded by David Wolffsohn, a banker of Cologne. The movement was further shaken by the dissensions which followed the rejection of the East African project. Israel Zangwill led an influential minority which combined with certain non-Zionist elements to found a rival organization under the name of the ITO (Jewish Territorial Organization) with a view to taking over the East African offer or establishing an autonomous place of refuge elsewhere. On the other hand, the Zionist Organization had now dedicated itself irrevocably to Palestine, and under the auspices of Wolffsohn fresh negotiations were opened with the Porte. These, however, were rendered hopeless by the Turkish revolution, which postulated a united Ottoman nationality, and resolutely set its face against any extension of the racial and religious autonomies under which the integrity of the empire had already severely suffered.

A Zionist bibliography has been published by the Federation of American Zionists. Besides the works already cited in the body of this article, *see,* on the early nationalist movement Graetz, *Geschichte der Juden,* under the heads of the various pseudo-Messiahs and their adherents. Jewish agricultural colonies will be found discussed very fully in *The Jewish Encyclopedia,* vol. i pp. 240–62. For early Zionist projects see *Publications of the American Jewish Historical Society,* No. 8, pp. 75–118; Laurence Oliphant, *Land of Gilead;* Mrs. Oliphant, *Life of Laurence Oliphant,* pp. 168 *et seq.* The Zionist movement since 1895 is fully recorded in its official organ, *Die Welt* (Vienna). For proceedings of the congresses *see* the *Official Protocols* published for each year by the society "Erez Israel" of Vienna; also Herzl, *Der Baseler Congress* (Vienna, 1897). On the movement generally, *see* Herzl's *Zionistische Schriften,* edited by Dr. Leon Kellner; *Ten Years of Zionism* (Cologne, 1907); Nordau, *Zionism, Its History and Its Aims* (1905); J. de Haas, *Zionism, Jewish Needs and Jewish Ideals;* also articles by I. Zangwill in *Cosmopolis* (Oct. 1897), *Contemporary Review* (Oct. 1899) and *Fortnightly Review* (April 1910); Dr. Gaster in *Asiatic Quarterly Review* (Oct. 1897); H. Bentwich in *Nineteenth Century* (Oct. 1897), and *Fortnightly Review* (Dec. 1898); Reich in *Nineteenth Century* (Aug. 1897); Lucien Wolf, "The Zionist Peril," *Jewish Quarterly Review* (Oct. 1904). On the ITO *see* pamphlets and leaflets published by the Jewish Territorial Organization; also the *Report of the Commission on Cyrenaica* (1909). (L. W.; X.)

LATER PERIOD

As the prospects of obtaining a charter from the sultan gradually receded, sharp differences of opinion developed within the Zionist ranks. The "practical" Zionists, who included most of the Zionist leaders in Russia, pressed for an immediate start to be made in Palestine. The "political" Zionists, whose strength was in western and central Europe, still clung to the charter as an essential prerequisite, protesting that Zionist resources should not be dissipated on petty colonization. The "practical" Zionists won their first important success in 1908, when a Zionist agency was established at Jaffa. The political field was not abandoned, but the movement now began to throw itself more and more vigorously into the actual settlement of Jews on the soil of Palestine. For this purpose its main financial instrument was the Jewish National fund, which in 1914 owned property in Palestine to the value of £144,000, as compared with £35,000 in 1909 and £11,000 in 1907, when its active operations began. The marked quickening of the pace which dates from 1910 reflects the change in the direction of Zionist policy, though the resources of the movement were still small in comparison with those which were lavished upon the Jewish settlements in Palestine by Baron Edmond de Rothschild. It was Baron Edmond who came to the assistance of the struggling colonists in 1883, and it was due mainly to him that a number of Jewish agricultural colonies were already in existence in Palestine when his efforts began to be supplemented by those of the Zionist Organization. In 1914 Palestine had a Jewish population of about 90,000, including about 13,000 settlers in 43 agricultural colonies. The total number of Jewish immigrants between 1882 and 1914 has been estimated at about 45,000. In the period immediately before World War I, the Zionist Organization showed a growing tendency to interest itself in the revival of Hebrew culture in Palestine as well as in the settlement of Jews on the land. In 1913 the eleventh Zionist congress, while approving an ambitious program of rural colonization, also resolved that steps should be taken towards the early establishment in Jerusalem of a Hebrew university.

The outbreak of World War I, followed almost immediately by the intervention of Turkey on the side of the Central Powers, brought Zionist work in Palestine to a standstill. A new world was in the making, and it was now at least conceivable that the Zionists might secure something like the charter on which they had originally staked their hopes. Political Zionism was again in the ascendant. The initiative was taken by a group of Zionists in Great Britain, headed by Dr. Chaim Weizmann of Manchester university. The Zionists now proposed that Great Britain should make it part of its policy to provide in the peace settlement for the establishment in Palestine of a national home for the Jews.

The Balfour Declaration.—Meanwhile, a new situation was developing in the eastern theatre of war, and a British conquest of Palestine was becoming a possibility of the near future. At the same time, the hour of decision was approaching in the United States, where there was a Jewish population of over 3,000,000, while Russia, where the Jews were still more numerous, was steadily drifting into chaos. A declaration in favour of Zionism would help to rally Jewish opinion throughout the world to the side of the Allies. Further, the settlement in Palestine of a Jewish population attached to Great Britain by ties of interest and sentiment might well be of value in guaranteeing the permanent security of the approaches to the Suez canal. To these practical motives was added a genuine desire to contribute towards the solution of the Jewish problem, in which British statesmen had shown themselves sympathetically interested long before the war.

All these considerations played their part in bringing the British government into closer relations with the Zionist leaders. With Sir Mark Sykes as the principal intermediary, an exchange of views began in Feb. 1917, with the result that on Nov. 2 the foreign secretary, Mr. Balfour, wrote to Lord Rothschild:—

"Dear Lord Rothschild—I have much pleasure in conveying to you on behalf of His Majesty's Government the following declaration of sympathy with Jewish Zionist aspirations, which has been submitted to and approved by the Cabinet: 'His Majesty's Government view with favour the establishment in Palestine of a national home for the Jewish people, and will use their best endeavours to facilitate the achievement of this object, it being clearly understood that nothing shall be done which may prejudice the civil and religious rights of existing non-Jewish communities in Palestine or the rights and political status enjoyed by Jews in any other country.' I should be grateful if you would bring this Declaration to the knowledge of the Zionist Federation."

The Balfour Declaration, as it has come to be called, was the act of Great Britain, but it was issued with the knowledge and concurrence of the Allied Powers. France formally associated itself with the declaration in Feb. 1918, and Italy in the following May. As for the United States, President Wilson had personally intervened to make it clear that he would welcome a British pronouncement in favour of Zionism, and soon after the declaration was issued, he publicly expressed his satisfaction. In 1922 resolutions associating the United States with the policy embodied in the declaration were unanimously adopted by both houses of congress.

British Mandate for Palestine.—In Dec. 1920, the proposed terms of the Palestine mandate were submitted by the British government to the League of Nations for confirmation by the council. There was a succession of unforeseen delays, but a slightly modified draft was eventually approved by the council at its meeting in London on July 24, 1922. A few weeks earlier, the British government had issued a statement of British policy in Palestine, in which it interpreted the Balfour Declaration as meaning, "not the imposition of a Jewish nationality upon the inhabitants of Palestine as a whole, but the further development of the existing Jewish community, in order that it may become a centre in which the Jewish people, as a whole, may take, on grounds of religion and race, an interest and a pride." The mandate came into full operation on Sept. 29, 1923. In its final form, it recites the Balfour Declaration in the preamble, and includes among its provisions various articles dealing with Jewish immigration.

Zionism at Work.—The return to normal conditions was marked by the San Remo decision of April 1920, which was followed by the establishment in Palestine of a civil administration in the following July. Subject to the general control of the government, the Zionist Organization was for the first time in a position to bring in immigrants and to purchase land. Between 1918 and 1936 about 280,000 Jews immigrated to Palestine, of whom 61,854 entered in 1935. During the same period there were about 30,000 Jewish emigrants, of whom about 25,000 were post-war settlers, leaving a net immigration of about 255,000. The Jewish population, which was about 95,000 in 1914, was reduced during the war to about 55,000. It was returned at 84,000 at the census of Oct. 1922, was officially estimated at 108,000 in March 1925, and had risen to nearly 400,000 at the end of 1936. The area of land in Jewish possession rose from 177 sq.mi. in 1914 to 545 sq.mi. in 1936, and the total Jewish population of the rural areas from 13,000 to 90,000. With the exception of about 30 sq.mi. of state and waste lands, all the land acquired after World War I was bought, often at inflated prices, in the open market, and in addition to the heavy expenditure in which they have thus been involved, the Jewish National fund and other Jewish bodies have had to sink large amounts of capital in improvements, including in particular the drainage of marshes. There has been a considerable increase, which has been particularly marked since 1924, in the Jewish population of Jerusalem and Haifa. In the neighbourhood of Jaffa, the Jews have built up the rapidly expanding urban settlement of Tel Aviv, which had in March 1937 a population of 140,000, as compared with 13,000 in Dec. 1922, and 2,000 in Aug. 1914. The rapid growth of the towns is connected with the industrial development of Palestine, which in turn is largely due to the influx of private Jewish capital. In 1933 it was estimated that since 1920, 4,055 industrial enterprises had been established in Palestine, representing in the aggregate an investment of £4,500,000, which was predominantly Jewish. An important factor in the industrial and general development of Palestine is the Palestine Electric corporation, which has been largely financed from Jewish sources and which is supplying Jaffa and Haifa with electric light and power.

Education.—Since World War I, the Jewish organizations have largely extended the scope of their educational work in Palestine. At the end of 1935 they controlled 492 schools of various grades and categories with 51,314 pupils. Public health work on a large scale is done by the Hadassah Medical organization, the Jewish National council and other Jewish bodies. A Jewish technical institute was opened at Haifa in Feb. 1925 and the Zionist Organization also maintains an agricultural institute at Tel Aviv.

In April 1925, Lord Balfour formally inaugurated the Hebrew University of Jerusalem, consisting, in its first stages, of three research institutes, devoted respectively to chemistry, microbiology and tropical medicine, and Jewish and oriental studies.

In all these institutions the language is Hebrew, which has already become the Jewish vernacular in Palestine and is the mother-tongue of the whole of the new generation. (L. St.; X.)

ZIONISM 1929–39

The Unrest of 1929.—Jewish immigration to Palestine had reached its first peak in 1924–25, to fall off sharply immediately thereafter. The following years witnessed large Jewish unemployment in Palestine and an emigration surpassing the number of immigrants. In 1929, at the Zionist congress at Zurich, a Jewish Agency composed of Zionists and non-Zionists was formed with strong American participation. At the same time the long smouldering Arab discontent with Zionism and with the British policy supporting it came to a head in violent outbreaks. Religious agitation had centred for some time around the respective Jewish and Mohammedan rights of the western wall (the Wailing Wall) of the Herodian Temple. But what had started as a religious conflict soon became a national conflict, Christian Arabs uniting with the Mohammedans. The new revolt surpassed by far the former open outbreak of Arab discontent in 1921. The British government sent out a commission of inquiry. Its report thought the disturbances caused by the Arab fear of a Jewish majority and of dispossession of their land. A British White Book on Oct. 20, 1930, accepted the recommendations of the commission regarding restrictions of immigration and land purchase. It was violently attacked by the Zionists and was reinterpreted in a way favourable to Zionist aspirations in a letter by the prime minister, Ramsay MacDonald, to the president of the Zionist Organization, Dr. Weizmann, on Feb. 13, 1931.

The New Prosperity and the New Unrest.—The wave of anti-Semitism rising in Germany with Hitler's advent to power and its spread to neighbouring countries increased rapidly Jewish immigration to Palestine after 1934. Most of the new immigrants came from Poland and Germany; some brought considerable capital with them, which they invested in new industries and in building developments, especially in Tel Aviv and Haifa. The highest official figure for Jewish immigration in Palestine in any single year was reached in 1935 with 61,854. Tel Aviv grew in population to more than 150,000, and the number of Jews in the whole of Palestine was estimated at 500,000, or a third of the country's total population. Yet it was this growing realization of Zionist hopes which increased the fears and resentment of the Arab population. The unrest which the events of 1936 provoked in the whole near east expressed itself in a revolu-

tion of the Palestine Arabs against Zionism and Great Britain, which assumed serious proportions and surpassed by far the preceding Arab revolts, not only in duration and scope but also in leadership and in the support which it found in all Arab countries, including Egypt.

The outbreak occurred in April 1936. Material damages and loss of human life were great. The British government dispatched in Nov. 1936 a royal commission under the chairmanship of Earl Peel to Palestine which reported in July 1937. In its findings it expressed great sympathy for Zionist aspirations and a warm recognition of the splendid Zionist achievements, but stressed at the same time the genuine character of Arab nationalism and of Arab fears. Palestine was an A mandate like Iraq or Syria and the inhabitants were thus entitled to democratic self-government and felt their expectations frustrated by Zionism. The aspirations of Zionism and of the Arabs being, as the commission declared, mutually exclusive and irreconcilable, it suggested the partition of Palestine into a smaller Jewish state which would comprise the fertile plains along the Mediterranean shore and the land of Galilee, while the Arabs would receive the hills and the deserts of the interior. Both states should be made independent and should enter into treaty relations with Great Britain which would retain Jerusalem and Bethlehem and a strip of land connecting these cities with the sea as a mandated territory. The Zionist congress meeting in Zurich in 1937 accepted, though reluctantly, the principle of partition but expressed the hope for a larger Jewish share. The Arabs opposed the idea of partition and were supported by the whole Arab world and its governments which made the issue of the future of the Palestinian Arabs one of the strongest causes uniting the Arab world.

New violence flared up in the summer of 1937 and was met this time by very strong government measures. The leading Arab committee was outlawed, its members deported or imprisoned, while its recognized leader, the mufti of Jerusalem, fled abroad. Military courts were instituted and vast military operations for the control of the country undertaken. Nevertheless the revolt continued unbroken during 1938 and gained even in intensity, especially after Zionist extremists, the Revisionists, resorted to terrorist acts of retaliation. By the fall of 1938, in spite of all the energetic countermeasures of the government and the large number of Arab victims, great parts of the country were under rebel control, who took over the functions of government; cities like Hebron, Bethlehem and Ramallah were in their hands and all normal traffic throughout the country was suspended. The revolt began only to subside in 1939.

During these years the development of Zionism had been affected in various ways by the events in the country. A heavy crisis in the citrus industry, the spread of the disorders, the political uncertainty, all that combined to create, after a period of great prosperity, a period of relative economic depression. Jewish immigration was reduced to about 12,000 yearly. Nevertheless, partly with the help of the government, the number of Jewish unemployed was kept small. Political attention was centred largely in London and in the United States, where the active sympathy of wide and influential circles was enlisted for Zionism. Meanwhile a commission appointed by the government under the chairmanship of Sir John Woodhead to report on the proposed partition submitted its report in Oct. 1938. Its members could not agree on any definite proposal. Under these circumstances the government declared in Nov. 1938 that it would drop the partition scheme and try to promote an understanding between the Arabs and the Zionists by direct negotiations in London.

By the beginning of 1939 the British government met in London with delegates of the Jewish Agency and of the Arabs. The case of the latter was supported with certain vigour by delegates from Egypt, Iraq and Saudi Arabia who proposed an independent Arab Palestine with full minority rights for the Jewish national home. Thus no common ground between Zionist and Arab aspirations could be found. The proposals made by the government in March 1939 were rejected by both sides. The British government saw itself now forced to suggest a solution of its own in its White Paper of May 17, 1939, which rejected the idea of a Jewish state as contrary to British obligations to the Arabs, and foresaw an independent Palestine which would safeguard the essential interests of Arabs and Jews alike. This independent state should come into existence after a transitional period of ten years. Meanwhile a Jewish immigration of 75,000 should be allowed over the next five years, while after that further Jewish immigration would depend upon Arab agreement. Measures for the regulation of the sale of land were also introduced. These British proposals were rejected by the Arabs and by the Zionists. The Jews in Palestine answered with a general strike and their more radical elements resorted to terrorism. Meanwhile immigration of Jews went on, often illegally. The Zionist congress at Geneva in the summer of 1939 voiced a protest against any restriction of Jewish immigration and against the policy expressed in the statement of May 1939.

World War II, which broke out in Sept. 1939, threw its shadow over Palestine, especially after Italy's entry into the war. As in World War I, the future of Palestine seemed again open for international deliberations, and the attention of Zionist circles was devoted to enlisting public opinion, especially in the United States, for a Zionist solution of the Palestinian and of the Jewish problem.

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ZIRCON, a mineral composed of zirconium silicate, sometimes used as a gem stone. It is believed that the name comes from the Arabic *zargun,* and is essentially the same as "jargoon," the name given to certain varieties of zircon. The mineral crystallizes in the tetragonal system, generally in combinations of square prisms and square pyramids (figs. 48 and 49, CRYSTALLOGRAPHY). It is isomorphous with cassiterite and rutile, and like these may form geniculated twins. There is no distinct cleavage, and the mineral breaks with a conchoidal fracture. The hardness is about 7·5. The specific gravity has a very wide range, extending from 4·0 to rather more than 4·7, being thus greater than that of any other gem stone. Rarely colourless, zircon is usually brown or red, sometimes orange, yellow, green or blue, and occasionally parti-coloured or zoned. While common zircon is opaque, the gem varieties are transparent.

The effect of heat on zircon is remarkable. Most coloured zircons, exposed to a high temperature, either change or lose their colour, but this loss is attended by a gain in brilliancy. The "Matura diamonds" of Ceylon are zircons which have been thus artificially decolorized. Certain zircons when heated in a Bunsen-flame glow with an orange incandescence, while others may emit an orange glow when ground on a copper wheel fed with diamond dust. Some zircons when heated undergo remarkable changes in specific gravity and refractive indexes, and the suggestion has been made that there are at least three modifications of zirconium silicate. Zircon is used as a source of zirconia in various preparations, for incandescent gas mantles, etc. It was in this mineral that zirconia was originally discovered by M. H. Klaproth in 1789, while it has been found to contain small amounts of hafnium.

When fit for use as a gem stone it is often known as "noble" or "precious zircon." The red and orange stones are termed hyacinth (*q.v.*) and jacinth, while those of all other colours, as also the colourless transparent zircons, are called jargoons (*q.v.*). The gem varieties are found in detrital deposits, especially in Ceylon, New South Wales, Queensland and Siam, with sapphire, etc.

Zircon is an accessory constituent of many rocks, especially granite, and it forms an important constituent of the zircon-syenite of Norway. Being but little subject to alteration, it is common in secondary deposits, as in auriferous and other sands, occurring usually in small characteristic crystals.

ZIRCONIUM, a metallic chemical element, so called from the identification of its oxide, zirconia, by Klaproth (1789) in the mineral zircon (symbol Zr, atomic number 40, atomic weight 91·2). It was first isolated by J. J. Berzelius in 1824, who heated potassium zirconifluoride, K_2ZrF_6, with potassium and obtained an iron gray powder, which was, however, impure.

Preparation.—Preparation of the pure metal is difficult, owing to the facility with which zirconium combines with hydrogen, oxygen, nitrogen, boron, carbon and silicon and forms alloys with such metals as aluminum and magnesium. Specimens containing more than 99·6% of zirconium were obtained by pressing the impure metal into rods which could be used as electrodes. When an electric arc was struck across such electrodes in an atmosphere of hydrogen or ammonia under 11 mm. pressure, the metal of the positive electrode fused and fell in iron gray drops on the negative electrode. This procedure is allied to the method for obtaining pure zirconium by heating its hydride or nitride *in vacuo.* By electrical heating of zirconium tetrachloride with sodium in an evacuated bomb, ductile metal was produced which when fashioned into rods gave a shiny surface on burnishing and a similar product was obtained in the reduction of zirconia by metallic calcium. Pure zirconium is deposited on a heated tungsten filament when the vapour of zirconium iodide is passed over the filament. Colloidal zirconium has been obtained by dialysis of the reduction product of potassium zirconifluoride with potassium. The melting point of zirconium has been variously given as 1,530° C. and 1,700° C. Its specific gravity is 6·4.

COMPOUNDS

Ferrozirconium (20% Zr), employed as a scavenger in steel castings, is made by heating zirconia and ferric oxide with aluminium in graphite crucibles. The addition of about 0·34% of zirconium to armour plating steel containing 3% of nickel adds to the tensile strength of the metal.

Hydrofluoric acid, even when dilute, hot concentrated sulphuric acid and aqua regia attack zirconium energetically, whereas hydrochloric and nitric acids dissolve it very slightly. It is oxidized on fusion with alkali hydroxides or nitre. At red heat zirconium reduces boric oxide, silica, titania and metallic oxides such as chromic oxide. Its great affinity for oxygen explains the employment of zirconium and its alloys as cleansing agents (scavengers for oxygen and nitrogen) in metallurgy. The commercially important zirconium minerals are (1) baddeleyite (brazilite), the native zirconia found in large quantities in Brazil (São Paulo and Minas Geraes); (2) zirkelite, a mixture of brazilite with zircon silicates, also found in Brazil; (3) zircon, $ZrSiO_4$, mined in Colorado. Following on their discovery of hafnium (*q.v.*) Coster and Hevesy report (1923) that most zirconium ores contain very appreciable quantities of this new element, the amount rising in certain instances to 10 or 20%.

Crystallised zirconia, ZrO_2, is obtained in colourless quadratic crystals by heating zirconium tetrafluoride with boric oxide. Owing to its refractory character and high melting point (given as 2,653±10° C or as 3,000° C) it has been recommended for furnace linings, crucibles, muffles and pyrometer tubes. It has also been used in enamels and in porcelain and opaque glasses. The first incandescent mantles made by A. v. Welsbach consisted principally of zirconia but this oxide is now superseded by thoria and ceria. In the Nernst lamp the incandescent body is chiefly zirconia (85%) with yttrium oxides (15%). Zirconium tetrafluoride, ZrF_4, obtained by heating zirconia with ammonium fluoride in highly refracting crystals, dissolves in water to form the hydrate, $ZrF_4,3H_2O$, and combines with alkali fluorides to yield several types of double fluorides employed in the isolation of the metal by reduction with potassium or sodium. The commonest type is exemplified by the potassium salt, K_2ZrF_6.

Zirconium tetrachloride, prepared by passing chlorine saturated with the vapour of carbon tetrachloride over zirconia heated in a silica tube at 600° C, is a white crystalline sublimate volatilising at 300° C and hydrolysed by water to zirconyl chloride, $ZrOCl_2$, which forms a crystalline octahydrate. Zirconium sulphate, $Zr(SO_4)_2,4H_2O$, forms colourless crystals prepared by dissolving zirconia in concentrated sulphuric acid and diluting slightly with water. It is also regarded as a zirconyl acid sulphate, $[ZrO(SO_4)_2]H_2,3H_2O$.

Other Salts.—Many other zirconyl salts are known including the nitrate which crystallises from aqueous solutions as $ZrO(NO_3)_2,2H_2O$. Zirconium tetra-acetylacetone, $Zr\{CH(CO\cdot CH_3)_2\}_4,10H_2O$, obtained by the interaction of zirconyl nitrate, acetylacetone and aqueous sodium carbonate, crystallises from alcohol or acetylacetone in anhydrous colourless prisms melting at 193–195° C. When zirconium tetrachloride reacts with acetylacetone, benzoylacetone or dibenzoylmethane in anhydrous media, compounds are obtained of the general formula $[ZrDk_3]Cl$, where Dk is the univalent diketone radical (G. T. Morgan and A. R. Bowen, 1924).

Zirconium carbide, ZrC, a hard metallic substance, produced from zirconium and carbon in the electric furnace (H. Moissan and Lengfeld, 1896) is used as an abrasive and for cutting glass. A mixture of this carbide (90%) with ruthenium (10%) has been suggested as a filament for incandescent lamps.

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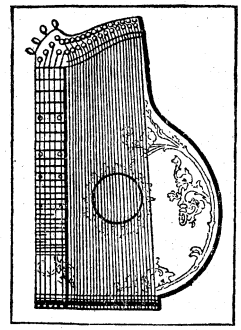
(G. T. M.)

ZITHER, a name applied in modern Germany to the ancient cithara (*q.v.*), to the cittern (*q.v.*), and to a derived instrument which is a kind of psaltery, consisting of a shallow, horizontal sound-chest with strings stretched above it which are plucked and thrummed, with plectrum and fingers, by the performer. (*See* illustration.) Zithers, which are made in various sizes, are the favourite instruments of the peasants in the Swiss and Bavarian highlands, and are sometimes heard also in the concert halls in Germany. The *Streichzither,* or bowed zither, is another variety of the instrument. There are four strings corresponding to those of the violin or viola, but the tone is nasal and glassy.



FROM GROVE, "DICTIONARY OF MUSIC" (MACMILLAN)

THE ZITHER, OR CITHARA, AN ANCIENT MUSICAL INSTRUMENT HAVING 36, 38 OR 42 STRINGS

ZITTAU, a town of Germany, in the extreme south-east of the *Land* of Saxony, on the left bank of the Mandau, near its confluence with the Neisse, by rail 48 mi. E.S.E. of Dresden and at the junction of lines to Reichenberg, Hermsdorf, Görlitz, Oybin and Löbau. Pop. (1939) 38,271. Zittau is of Wendish origin (Chytawa is its Wendish name), and was made a town by Ottocar II. of Bohemia. It was one of the six towns of the Lusatian League (1346), at which period it belonged to Bohemia. It suffered severely in the Hussite wars and in the Thirty Years' War.

ZIWAR, AHMAD PASHA (1864–1945), G.C.M.G. (1925), Egyptian statesman, was born at Alexandria on Nov. 14, 1864, the son of Ziwar Bey. He was educated at the college of Lazarists, Alexandria, and at the Jesuit university of St. Joseph, Beirut. He studied law at Aix-en-Provence, and held office as supreme judge at the Cairo court of appeal from 1899 to 1913, when he became governor of Alexandria. From 1918 to 1924 he held various government offices, being for a time minister of education and also minister plenipotentiary in Rome.

At the end of 1924 Ziwar Pasha formed a ministry in succession to the Zaghlul ministry, which had been compelled to resign in November after the murder of Sir Lee Stack. Ziwar Pasha reestablished good relations with Great Britain and took action to prevent political agitation among young students. He also came to an agreement with the British government on the rights of Egypt in the waters of the Blue Nile. In the elections of February-March, 1925 the parties opposed to Zaghlul obtained a very small majority of 6, and Ziwar Pasha then formed a coalition cabinet, which proved to be short-lived, for the new chamber immediately chose Zaghlul as its president. Ziwar Pasha thereupon immediately resigned and advised the king to dissolve parliament. But the elections had to be postponed owing to the need of framing a new electoral law. Ziwar withdrew his resignation, and continued to direct the government. He spent some months in Europe, and on his return proceeded to reconstruct his cabinet. Ziwar resigned on June 5, 1926. He died Aug. 21, 1945.

ŽIŽKA, JOHN (*c.* 1376–1424), Bohemian general and Hussite leader, was born at Trocnov in Bohemia. He lost an eye in the civil wars under Wenceslaus IV. Connected with the court from his youth, he held the office of chamberlain to Queen Sophia. The Hussite movement first brought him into prominence. When a temporary armistice was concluded between the partisans of King Sigismund and the citizens of Prague, Žižka joined the advanced Hussites at Tabor, helped to organize the new military community and became one of the four "captains of the people" (*hejtmane*) at its head. On receiving an appeal from the citizens of Prague to help against Sigismund, king of the Germans and king of Hungary, who had invaded Bohemia, claiming the crown as the heir of his brother Wenceslaus, the Taborites marched to Prague and on July 14, 1420, largely through Žižka's heroism, repulsed an attack by Sigismund's forces, on their position on the Vitkov hill, where the suburb of Žižkov now stands, forcing Sigismund to raise the siege. On Aug. 22, 1420, the Taborites left Prague and returned to Tabor.

Žižka was now engaged in constant, and invariably successful, warfare with the partisans of Sigismund, particularly with the powerful Romanist, Ulrich of Rosenberg. At the meeting of the Estates of Bohemia and Moravia at Caslav (June 1, 1421), Žižka was elected member for Tabor to the provisional government. He summarily suppressed some disturbances by the

Adamite sect, continued his campaigns against the Romanists and adherents of Sigismund, and, having captured a small castle near Litoměřice (Leitmeritz), retained possession of it—the only reward for his great services that he ever received or claimed. According to Hussite custom, he gave the biblical name of "Chalice" to this new possession, and henceforth adopted the signature of "Žižka of the Chalice." In 1421, while besieging the castle of Rábi, he lost the use of his remaining eye. Though now totally blind, he retained his command, and on Jan. 6, 1422, severely defeated Sigismund at Nebovid, Kutna Hora, and again at Německy Brod (Deutschbrod) on Jan. 10. Early in 1423 internal dissensions among the Hussites led to civil war. Žižka, as leader of the Taborites, defeated the men of Prague and the Utraquist nobles at Hořic on April 27, and when the armistice of Konopist (June 24) was followed by renewed civil war, he once again defeated the Utraquists, under Borek, at Strachov, near Králové Hradec (Aug. 4, 1423).

Žižka now made a brilliant, although unsuccessful attempt to invade Hungary, which was under the rule of his old enemy King Sigismund. In 1424, civil war having again broken out in Bohemia, Žižka decisively defeated the Praguers and Utraquist nobles at Skalic (Jan. 6), and at Malesov (June 7). In September he marched on Prague, but on the 14th of that month peace was concluded between the Hussite parties who agreed to make a combined attack on Moravia, part of which was still held by Sigismund's followers. Žižka was given the command, but before reaching the frontier, he died of the plague at Pribyslav (Oct. 11, 1424).

See Count Lützow, *Bohemia: an Historical Sketch* (1896); Louis Léger, *Jean Žižka* in *"Nouvelles études Slaves," deuxième série* (1886).

ZLATOUST, a town in the Chelyabinsk region of the Russian S.F.S.R., 1,925 ft. above sea level on the Ai, a tributary of the Ufa river, in 55° 10′ N., 59° 40′ E., on the Ufa-Chelyabinsk railway. Pop. (1939), 99,272. The town has smelting works and manufactures machinery; there is a meteorological and magnetic observatory.

ZLOTY, post-war monetary unit of Poland. Following the collapse of the Polish mark, instituted immediately after the World War, the zloty was substituted in 1924. It was then made equivalent to the gold franc, at a parity of 25.22 zlotys to the pound sterling, and was backed partly by gold and gold exchange, and partly by other forms of security. Events soon showed that the new currency had been introduced before the country was ready to support it, and during 1925 and 1926 renewed depreciation set in. In 1927 a second attempt at stabilization was made. A foreign stabilization loan was issued, and the proceeds used to give a gold exchange backing to the new zloty, the value of which was fixed at 43.38 to the £1 sterling; in 1938 it fluctuated between 24¼ and 26¾ to the £1. (*See* CURRENCY.)

ZNAIM: *see* ZNOJMO.

ZNOJMO (*Znaim*), in Moravia, on the Dyje. A settlement is believed to have existed here from prehistoric time. The present town was founded in 1226 on the site of the old capital, destroyed in 1145. Lying at the junction of old granites and tertiary strata Znojmo manufactures clay products and stoneware. It is also famous for its extensive fruit and vegetable farms, which supply bottling factories. Among its old buildings are a 12th century Romanesque castle chapel (the Heiden-Tempel) a 14th century Gothic church and a 15th century town hall with Gothic tower (250 ft.). Population 24,952, mostly German.

ZOBEIR RAHAMA (1830–1913), Egyptian pasha and Sudanese governor, came of the Gemaab section of the Jaalin, and was a member of a family which claims descent from the Koreish tribe through Abbas, uncle of Mohammed. He was the most energetic and intelligent of the Arab ivory and slave traders who about 1860 established themselves on the White Nile and in the Bahr-el-Ghazal. Nominally a subject of Egypt, he raised an army of several thousand well-armed blacks and became a dangerous rival to the Egyptian authorities. At the height of his power Zobeir was visited (1871) by Georg Schweinfurth, who found him "surrounded with a court which was little less than princely in its details" (*Heart of Africa,* vol. ii., chap. xv.). In 1869 an expedition sent from Khartum into the Bahr-el-Ghazal was attacked by Zobeir and completely defeated, its commander being slain. Zobeir represented that he was blameless in this matter, received a "pardon," and was himself appointed governor of the Bahr-el-Ghazal, where he was practically independent. In 1873 he attacked the sultan of Darfur, and the khedive Ismail gave him the rank of bey and sent troops to co-operate. After he had conquered Darfur (1874), Zobeir was made a pasha, but he demanded the governor-generalship of the new province, and went to Cairo in the spring of 1876 to press his title. The Egyptian authorities prevented his return, though he was allowed to go to Constantinople at the outbreak of the Russo-Turkish War. In 1878, however, his son Suleiman, having got possession of the Bahr-el-Ghazal, defied the authority of General Gordon, the new governor-general. Gordon sent Romolo Gessi against Suleiman and his ally Rabah (*q.v.*), who was subdued after an arduous campaign and executed.

During the campaign Zobeir offered, if he were allowed to return to the Sudan, to restore order and to pay a revenue of £25,000 a year to the khedive. Gordon declined this help, and subsequently, for his instigation of the revolt, Zobeir was condemned to death, but the trial was a farce, the sentence was remitted, and he remained at Cairo, now in high favour with the khedival court. In March 1884, Gordon, who had been sent to Khartum to effect, if possible, the relief of the Egyptian garrisons in the Sudan, astonished Europe by requesting that Zobeir, whose son he had overthrown and whose trade he had ruined, should be sent to Khartum as his successor. Zobeir, described by Sir Reginald Wingate, who knew him well, as "a quiet, far-seeing, thoughtful man of iron will—a born ruler of men" (*Mahdiism and the Egyptian Sudan,* book v.), might have been able to stem the mahdist movement. But to reinstate the notorious slave-dealer was regarded in London as too perilous an expedient, even in the extreme circumstances then existing, although Colonel Stewart (Gordon's companion in Khartum), Sir Evelyn Baring and Nubar Pasha in Cairo, and Queen Victoria and Mr. Gladstone, all favoured such a course. In March 1885 Zobeir was arrested in Cairo by order of the British government for treasonable correspondence with the mahdi and other enemies of Egypt, and was interned at Gibraltar. In August 1887 he was allowed to return to Cairo, and after the reconquest of the Sudan was permitted (1899) to settle in his native country. He established himself on his estates at Geili, some 30 m. N. of Khartum, where he died on Jan. 5, 1913.

See GORDON, CHARLES GEORGE, and the authorities there cited.

ZODIAC, in astronomy and astrology, a zone of the heavens within which lie the paths of the sun, moon and principal planets (ὁ ζωδιακὸς κύκλος from ζῴδιον "a little animal"). It is bounded by two circles equidistant from the ecliptic, about 18 degrees apart; and it is divided into 12 signs, and marked by 12 constellations. These 12 constellations, with the symbols of the signs which correspond to them, are as follows:—

Aries, the Ram	♈	Libra, the Balance	♎
Taurus, the Bull	♉	Scorpio, the Scorpion	♏
Gemini, the Twins	♊	Sagittarius, the Archer	♐
Cancer, the Crab	♋	Capricornus, the Goat	♑
Leo, the Lion	♌	Aquarius, the Water-carrier	♒
Virgo, the Virgin	♍	Pisces, the Fishes	♓

In the technical sense of the word the 12 "signs" are geometrical divisions 30 degrees in extent counting from the position of the sun at the vernal equinox. In the time of Hipparchus the signs corresponded fairly closely with the constellations; that is to say, the first sign (called Aries) corresponded with the constellation Aries. Owing to precession there is now a discrepancy amounting to the breadth of a whole sign, so that the sign Aries is occupied by the constellation Pisces. (*See* CONSTELLATION.)

ZODIACAL LIGHT, a faint illumination of the sky, surrounding the sun and elongated in the direction of the ecliptic on each side of the sun. It is lenticular in form, brightest near the sun, and shades off by imperceptible gradations, generally becoming invisible at a distance of 90° from the sun. Until a recent

time it was never observed except in or near the zodiac; hence its designation. The most favourable time for evening observation in the northern hemisphere is during the months of February and March. In the tropics, where the ecliptic is nearly perpendicular to the horizon, it may be seen after the end of twilight on every clear evening, and before twilight on every clear morning, unless blotted out by moonlight. It then presents a nearly vertical wedge-shaped form, the base of which extends 15° or 20° on each side of the point at which the ecliptic intersects the horizon. The point of the wedge is quite indefinite, the extremely diffuse light gradually fading into invisibility at a height which may range from 50° to 70° or even more, according to the keenness of the observer's vision.

It is clear that the light proceeds from a region surrounding the sun, lenticular in form, the axis of the lens being nearly perpendicular to the ecliptic, while the circumference extends at least to the orbit of the earth. The hypothesis which best explains all the phenomena is that the light is that of the sun reflected from an extremely tenuous cloud of particles having the form and extent described, and becoming more and more tenuous as the earth's orbit is approached until, immediately outside the orbit, it fades into complete invisibility. It has been shown by Fath that the spectrum is identical with that of sunlight.

Intimately connected with the zodiacal light is the *Gegenschein,* or counter-glow, a faint illumination of the sky in the region opposite the sun, which may generally be seen by a trained eye when all the conditions are favourable. The Milky Way renders it invisible during the months of June, July, December and January. Its light is so faint and diffuse that it is impossible to assign dimensions to it, except to say it covers a region of several degrees in extent. Barnard, the most successful observer, assigns diameters of 5° or even 10° or more. The explanation is uncertain.

ZOFFANY, JOHANN (1733–1810), British painter, whose father was architect to the prince of Thurn and Taxis, was born in Frankfort-on-Main. He ran away from home at the age of 13 and went to Rome, where he studied art for nearly 12 years. In 1758 he left for England, and after undergoing some hardships was brought into fashion by royal patronage, and in 1769 was included among the foundation members of the Royal Academy. He went to Florence in 1772 with an introduction from George III. to the grand duke of Tuscany, and remained until 1779. He lived (1783 to 1790) in India, executing some of his best-known paintings; but the last 20 years of his life were spent in England. He died in 1810 and was buried in Kew churchyard.

ZOG 1, Ahmed (1895–), King of the Albanians, was head of the Zogolli, one of the four ruling families of the Mati district and was educated at a military school at Monastir and in Constantinople. He first distinguished himself as a supporter of the prince of Wied in 1914. During the World War he fought for the Austrians. He became minister of the interior (Jan.–Nov. 1920), and organized resistance to the Yugoslav incursions during the autumn. He was commander-in-chief of the national forces under the "Sacred Union" cabinet (Oct.–Dec. 1921), and again distinguished himself against the Yugoslavs. As minister of the interior in Djafer Ypi's cabinet (Dec. 1921–Dec. 1922), he suppressed a serious insurrectionary movement in March 1922, and disarmed the lowlanders. Becoming prime minister, Dec. 1922, he governed with ability, pursuing a sound anti-irredentist and constructive policy. Towards the end of 1923 he was accused by the Democratic party of obstructing various progressive and agrarian reforms. Following an attempt upon his life he resigned in Feb. 1924, but his influence remained. A revolt against him and his colleagues took place in June, and he sought refuge in Yugoslavia. But skilfully turning to his advantage Yugoslavian policy, he returned to Albania in Dec. 1924 and ousted his successor, Archbishop Fan Noli. His election as president of the Albanian republic on Feb. 1, 1925, ushered in a period of internal tranquillity. He was proclaimed king at Tirana on Sept. 1, 1928. On April 27, 1938, he married Countess Geraldine Apponyi of Hungary; a son being born to them on April 5, 1939. Three days later, on the Italian occupation of Albania, the King and Queen became exiles. (*See* Albania.) (J. Sw.)

ZOÏLUS (*c.* 400–320 B.C.), Greek grammarian of Amphipolis in Macedonia. Zoïlus appears to have been at one time a follower of Isocrates, but subsequently a pupil of Polycrates. Zoïlus was chiefly known for the acerbity of his attacks on Homer (which gained him the name of Homeromastix, "scourge of Homer"), chiefly directed against the fabulous element in the Homeric poems. Zoïlus also wrote against Isocrates and Plato, who had attacked the style of Lysias of which he approved. The name Zoïlus came to be generally used of a spiteful critic.

See U. Friedländer, *De Zoilo aliisque Homeri Obtrectatoribus* (Königsberg, 1895); J. E. Sandys, *History of Classical Scholarship* (2nd ed. 1906).

ZOISITE (named after Baron Zois who first observed it), a rock-forming mineral of the composition of $HCa_2Al_3Si_3O_{13}$, crystallizing in the rhombic system. Crystals are usually prismatic, deeply striated parallel to their length and have a perfect 010 cleavage. Two varieties are optically distinguishable; in α-zoisite the plane of the optic axes is parallel to the cleavage (010), while in β-zoisite it is normal to this plane. The resemblance to the monoclinic clinozoisite of the same chemical composition (*see* Epidote) is revealed when the crystallographic orientation of zoisite is adjusted so that the plane of cleavage is basal (001) and the zone of elongation and striation the *b* axis. The colour of the mineral is white or grey, but a manganiferous variety (thulite) is pink and pleochroic. The hardness is 6·5 and the sp.gr. 3·3.

Zoisite is characteristically a product of dynamic metamorphism and is an essential constituent of saussurite, the zoisite of this aggregate being derived from the anorthite molecule of plagioclase. It is chiefly developed in crystalline schists.

Thulite occurs with blue vesuvianite at Telemarken in Norway and with withamite gives the red colour to the well known *porfido rosso antico* or hornblende-porphyrite of Djebel Dokhan in Egypt. Zoisite has not been prepared synthetically. (C. E. T.)

ZOLA, ÉMILE ÉDOUARD CHARLES ANTOINE (1840–1902), French novelist, was born in Paris on April 2, 1840, his father being an engineer, part Italian and part Greek, and his mother a Frenchwoman. The father seems to have been an energetic, visionary man, who, dying while his only son was a little lad, left to his family no better provision than a lawsuit against the municipality of the town of Aix. It was at Aix, which figures as Plassans in so many of his novels, that the boy received the first part of his education. Thence he proceeded, in 1858, to Paris. His first book, *Contes à Ninon,* appeared on Oct. 24, 1864, and attracted some attention, and in Jan. 1866 he determined to abandon clerking and take to literature. Vigorous and aggressive as a critic, his articles on literature and art in Villemessant's paper *L'Événement* created a good deal of interest. So did the gruesome but powerful novel, *Thérèse Raquin* (1867). Meanwhile, with characteristic energy, Zola was projecting something more important: the creation of a world of his own, like that of Balzac's *Comédie Humaine*—the history of a family in its various ramifications during the Second Empire. The history of this family, the Rougon-Macquart, was to be told in a series of novels containing a scientific study of heredity—science was always Zola's *ignis fatuus*—and a picture of French life and society. The first novel of the series, *La Fortune des Rougon,* appeared in book form at the end of 1871. It was followed by *La Curée* (1874), *Le Ventre de Paris* (1874), *La Conquête de Plassans* (1875), *La Faute de l'Abbé Mouret* (1875), *Son Excellence Eugène Rougon* (1876)—all books unquestionably of immense ability, and in a measure successful, but not great popular successes. Then came *L'Assommoir* (1878?), the epic of drink, and the author's fortune was made. Edition followed edition. He became the most discussed, the most read, the most bought novelist in France—the sale of *L'Assommoir* being even exceeded by that of *Nana* (1880) and *La Débâcle* (1892). From the *Fortune des Rougon* to the *Docteur Pascal* (1893) there are some 20 novels in the *Rougon-Macquart* series, the second half of which includes the powerful novels *Germinal* (1885) and *La Terre* (1888). In 1888 Zola departed from his usual vein in the idyllic story of *Le Rêve.* Zola also wrote a series of three romances on cities, *Lourdes, Rome, Paris* (1894–98), novels on the "gospels"

of population (*Fécondité*) and work (*Travail*), a volume of plays, and several volumes of criticism.

Zola played a very important part in the Dreyfus affair, which convulsed French politics and social life at the end of the 19th century. At an early stage he came to the conclusion that Dreyfus was the innocent victim of a nefarious conspiracy, and on Jan. 13, 1898, with his usual intrepidity, he published in the *Aurore* newspaper, in the form of a letter beginning with the words *J'accuse,* a terrible denunciation of all those who had had a hand in hounding down that unfortunate officer.

Zola's object was a prosecution for libel, and a judicial inquiry into the whole *affaire,* and at the trial, which took place in Paris in February, a fierce flood of light was thrown on the case. The chiefs of the army put forth all their power, and Zola was condemned. He appealed. On April 2, the Cour de Cassation quashed the proceedings.

A second trial took place at Versailles, on July 18, and without awaiting the result Zola, by the advice of his counsel and friends, and for reasons of legal strategy, abruptly left France and took refuge in England. Here he remained in hiding, writing *Fécondité,* until June 4, 1899, when, immediately on hearing that there was to be a revision of the first Dreyfus trial, he returned to Paris.

On the morning of Sept. 29, 1902, Zola was found dead in the bedroom of his Paris house, having been accidentally asphyxiated by the fumes from a defective flue. He received a public funeral, at which Captain Dreyfus was present. Anatole France delivered an impassioned oration at the grave. At the time of his death Zola had just completed a novel, *Vérité,* dealing with the incidents of the Dreyfus trial. A sequel, *Justice,* had been planned, but not executed.

Zola's literary position would have more than qualified him for the French academy. He was several times a candidate in vain. (F. T. M.)

See *Émile Zola, Novelist and Reformer* (1904), giving a full account of his life and work, by E. A. Vizetelly, who translated and edited many of his works in English; also P. Alexis, *Émile Zola, Notes d'un ami* (1882); F. Brunetière, *Le Roman Naturaliste* (1883); *Journal des Goncourt* (1888–92) vols. iii, v and vi; E. Hennequin, *Quelques Écrivains français* (1890); R. H. Sherard, *Émile Zola: a biographical and critical study* (1903); A. Laporte, *Émile Zola, l'homme et l'œuvre* (1894) with a bibliography. L. Deffoux and E. Zavie, *Le Groupe de Médan, Émile Zola, Guy de Maupassant, etc.* (1920); R. Oehert, *E. Zola als Theaterdichter* (1920); E. Rostand, *Deux Romanciers de Provence: H. d'Urfé et E. Zola* (1921); E. A. A. L. Seillière, *E. Zola* (1923); A. Baillot, *E. Zola. l'homme, le penseur, le critique* (1924); M. Josephson, *Zola and his Time* (1929). For the proceedings against Zola see *Le Procès Zola* (2 vols., 1898).

ZOLLVEREIN: *see* CUSTOMS UNION; TARIFFS and GERMANY: *History.*

ZONARAS, JOANNES (JOHN), Byzantine chronicler and theologian, flourished at Constantinople in the 12th century. Under Alexius I Comnenus he held important official positions, but in the succeeding reign he retired to Hagia Glykeria (one of the princes' islands), where he reluctantly yielded to the pressure of his friends to compose a profane history. This work, Ἐπιτομὴ Ἱστοριῶν (compendium of history), in 18 books, extends from the creation of the world to the death of Alexius (1118). Zonaras is chiefly valuable for preserving in his work the first 21 books of Dio Cassius (Zon. 7–8).

Complete edition in Migne, *Patrologia Graeca,* cxxxiv, cxxxv, cxxxvii. Translation in Cary's *Dio Cassius,* Loeb Classical Library.

ZONE, EQUISIGNAL, a term in radio denoting the region in which the two distinctive signals from an equisignal radio beacon (*q.v.*) are received with equal intensity.

ZONING. The zoning of cities has had considerable influence on their architecture and on the preservation of their amenity. As practised in modern times it is a new movement and is still in the experimental stage.

Zoning in Europe.—What has come to be called zoning in English-speaking countries had its first inspiration and derived its name from the building regulations applied in Central Europe before 1909. After 1875 German and Swedish cities applied zoning regulations to the zones around their built areas, with a view to controlling the heights and densities of buildings in town extensions. The effect of the German laws, and of the fairly rigid control exercised under them, has been to procure a greater spaciousness and uniformity of development than would have occurred under ordinary building regulations.

When the Town Planning act was passed in England in 1909, it had for its general object the control of the development of land likely to be used for building purposes. In so far as it provided for regulation of heights, densities and uses of buildings it related primarily and almost solely to entirely new building development. The fact that it is so limited has prevented it from being an effective instrument in procuring architectural control. But part of its object is to provide such control over new developments. Section 59 (2) in the original act of 1909 was as follows:

"Property shall not be deemed to be injuriously affected by reason of the making of any provisions inserted in a town planning scheme, which, with a view to securing the amenity of the area included in the scheme or any part thereof, prescribe the space about buildings or limit the number of buildings to be erected, or prescribe the height or character of buildings, and which the Ministry of Health, having regard to the nature and situation of the land affected by the provisions, consider reasonable for the purpose."

It is noteworthy that the purpose for which the restrictions in an English scheme are imposed is to secure the "amenity of the area." For the reason given, the law has not influenced the redevelopment of built-upon areas. Being primarily intended to regulate residential buildings it has had little effect also on the architecture of other buildings. It has introduced into England a spacious type of development for the cottages of the working classes. On the whole, it has improved cottage architecture and introduced a better arrangement and grouping of buildings.

In town planning schemes public authorities may take power to approve or disapprove the elevation of, and the materials to be used in, buildings. For the purpose of exercising this power the authority must constitute a special advisory committee of those members of which one shall be an architect nominated by the Royal Institute of British Architects.

Zoning in the United States.—Contrary to what has happened in England zoning in the United States has been too limited in its application to undeveloped areas and has been chiefly applied to areas already built upon.

In New York zoning has exercised a greater influence on architecture than in any other city. New York was the first city in the western continent to impose zoning regulations. Its Zoning resolution was passed in 1916 and had for its object the restriction of the height and bulk of buildings and the regulation of their uses. It did not directly attack the problem of density, except by restricting height and bulk.

New York was zoned just when the steel frame and the elevator had begun to have a profound influence on building and architecture (*q.v.*). After the passing of the act enormous changes took place in the city, and an extensive rebuilding program was carried out.

The zoning law in New York is intended to relieve street congestion, for, other things being equal, it is obvious that such congestion is directly proportionate to the bulk of the buildings flanking the street. The Paris law limits the straight vertical height to 20 metres; above that, additional storys must remain within the arc of a circle of fixed radius. The London regulations permit of 80 ft. vertical height and two supplementary storys which must remain behind a sloping line of 75 deg. from the horizontal. In New York the vertical height is now determined by the width of the street, but varies according to the "zone" or district in which the given property is situated. These districts are classified as follows: "One-time" districts, "one-and-one-half-time" districts, "two-time" districts and "two-and-one-half-time" districts. That is to say, the straight vertical height may be equal to the width of the street in residence zones; it may be one-and-one-half times the width of the street in certain residence and business zones; twice the width in the principal business centres and two-and-one-half times in the Wall street financial section. For the purpose of the law, no street is considered less than 50 ft. or more than 100 ft. wide. Additional storys above the vertical

height must remain back of a line drawn from the centre of the street through a point on the top front of the vertical height.

The salient feature of New York is its towers, and it was considered wise, in framing the zoning law, to permit the erection of a tower, which may rise to an indefinite height (limited only by structural possibilities and economic conditions), upon 25% of the total lot area. This has resulted in a very surprising and interesting form of architecture (*q.v.*). In Paris certain buildings of a monumental nature, either religious or governmental, may exceed the height limit. In London, towers purely for architectural embellishment but not for human occupancy, may pass the legal height. In New York no restriction is made as to occupancy of the tower provided that the building remains within the given "envelope." Furthermore, the so-called "dormer" permit allows certain portions of the front of each building to rise slightly in excess of the maximum vertical height to give variety of outline. Above this the buildings are usually stepped back, forming a pyramidal series of terraces which vie with the storied magnificence of the hanging gardens of Babylon. The law has produced two other interesting results: first, the virtual elimination of interior light courts, these being cut in the side in order to preserve a base for the central tower; second, the tendency to assemble larger and larger plottage so that the 25% tower will be large enough to warrant construction of a great number of tower stories.

The example of New York has been followed in hundreds of U.S. cities, where no part of city planning has been so popular as zoning. No effect of zoning has impressed itself on the public consciousness more than its effect on the architectural treatment of buildings. The important needs in connection with the further development of zoning, as a means of promoting art and amenity in connection with city building, whether directly owing to extended power under restrictive legislation, or indirectly by further use of existing powers, are: the inclusion of zoning as part of comprehensive city plans so that it will deal constructively with building expansion and reconstruction of complete urban areas comprising all parts of a city or a region; the further extension of zoning in regard to restriction of density, parallel with further strengthening of provisions in regard to heights and uses, so as to secure more light and air in buildings, a better display of buildings and less congestion on adjacent streets than at present. Further restriction on height should be based on the principle that the primary need is to obtain adequate spaces about buildings of all heights, and not to obtain lower buildings as an object in itself. (*See* also TOWN AND CITY PLANNING.)

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ZOOLOGICAL COLLECTING. The techniques of zoological collecting and preparation or preservation of specimens differ radically for the various groups of animals, and special directions, and special apparatus, may be needed. The means of collecting marine animals fall into the province of oceanography (*see* OCEAN AND OCEANOGRAPHY), and are dealt with in a separate section below. Fresh water collecting, in the interests of limnology, may require many of the oceanographic techniques. The study of the animal life of the high seas and of the deep sea requires elaborate apparatus and an ocean-going vessel, and thus falls into the province of organized scientific expeditions or of special institutes.

The preservation of invertebrate animals requires so great a variety of techniques that the reader must be referred to the bibliography at the end of this article. This applies also to the collecting of insects, for which excellent and inexpensive pamphlets of directions are available. Insect collecting forms one of the best of introductions to natural science.

VERTEBRATES

In the pioneer 18th century zoological collecting was so much focused on birds and mammals and large reptiles that the early manuals of taxidermy all include the collection of museum specimens of fishes and insects as a matter of course, and refer to the preparation of mammals and birds as mounted specimens as a part of museum collecting. The divergence between the collection of specimens for study and the preparation of museum exhibits had its origin in the reorganization of the British museum collections in the 1880s under the direction of William Flower. The exhibition series was segregated in halls open to the public from the reserve material intended for study and research, properly referred to as the study series or as the reference collection. The reference collection, not on public exhibition, being the principal means of research by the scientific staff, became the special charge of the curators. If the curator's interest lay in education, the reference collection was a necessary accessory to the preparation of exhibits. If his interest lay in the increase of knowledge in systematic zoology, the reference collection would become his principal if not his exclusive concern. In the large modern museums, the reference collection in the biological departments is vastly greater than the exhibition series.

The nature of the museum specimens used in the study of birds and mammals brings their preparation more directly into the field of taxidermy, and the museum taxidermist may be charged with collecting such specimens as well as specimens required for exhibition. It will fall to the province of museum taxidermists to aid in the preparation, repair and conservation of the bird and mammal skins preserved for study.

It is especially desirable to call the attention of young people who are attracted by taxidermy to the preparation of study specimens as an alternative. Taxidermy *per se* leads into a limited field requiring artistic talent for success. Collecting of study specimens of birds and mammals leads into scientific studies, and is an excellent preparation and accessory for a career in any field of biology, whether in research or in teaching.

The accumulation of private collections of bird skins is discouraged by the necessary protection of song birds from indiscriminate and wanton killing. Certain birds, however, like the English sparrow and starling and the various game birds, which can be hunted under legal restrictions, serve excellently for the amateur who wishes to learn to make a study skin. The use of borax as a preservative avoids the necessity of using the dangerous white arsenic. The essential requirement for such skins is accuracy of record—the locality, date, collector's name, colours of eye, bill, any bare skin, feet, breeding condition and any other notes that contribute to the natural history of the species. The essential data are placed on a label attached to the skin; a good collector will keep a catalogue record of his specimens with additional notes. A considerable series of specimens of each species of bird is a necessity, as the plumages of male and female vary with age and with the season. Nestlings, if collected, should be preserved in alcohol; they should never be collected unless positively identified as to species.

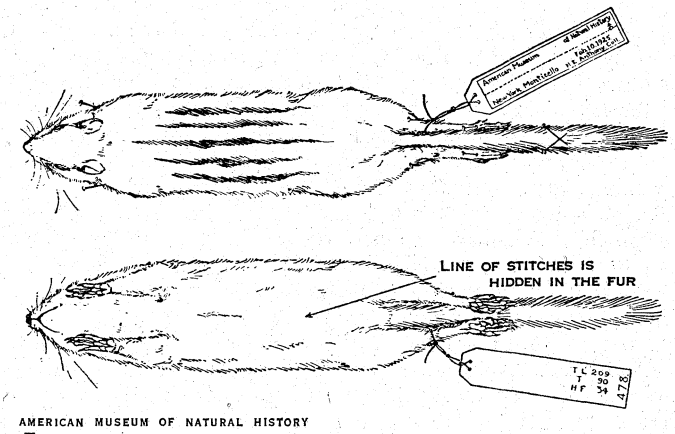
AMERICAN MUSEUM OF NATURAL HISTORY

FIG. 1.—STUDY SKIN OF A BIRD, PREPARED FOR A MUSEUM COLLECTION

Birds' eggs were formerly greatly in vogue for private collections. All migratory birds in the United States and Canada are now strictly protected by state and federal laws against the collecting of their eggs, which may be taken only by special permit for scientific purposes. Even with such permits, egg collecting is to be discouraged, since large collections exist in almost every museum, and additional specimens are not required for scientific studies.

No restrictions apply to the collecting of small mammals such as mice, gophers, moles and shrews; and the larger game mammals and the fur bearers can also be collected during the legal season for hunting them, which varies from state to state. The study specimen of a mammal includes the cleaned skull with the prepared study skin, and a system of numbered tags required to identify the associated skulls and skins properly. In the study of mammals, specimens preserved in alcohol or formalin may supplement the dry skin and skull, and such specimens are especially important in the bat group, in which the peculiar skin characters of

the head and wing membranes are largely lost in drying. Juvenile specimens, especially the newborn young, should be similarly preserved rather than skinned. Skeletons also form a desirable supplement for any adequate study of a species of mammal, and are essential for the use of the taxidermist in the preparation of a mounted specimen. Thus an adequate representation of a single species of mammal, as for birds, will require a considerable series of specimens. For small mammals and birds, powdered borax, liberally applied to the inside of the skin while skinning, will be sufficient as a preservative.



AMERICAN MUSEUM OF NATURAL HISTORY

FIG. 2.—FINISHED STUDY SKIN OF A SMALL MAMMAL FROM ABOVE AND BELOW

The collecting of mammals involves a great variety of techniques of hunting and trapping. For all small forms the ordinary spring mousetrap is the most essential equipment, but it is essential to use the over-size "museum special," as the ordinary trap is quite certain to strike the animal across the skull and ruin this most essential part of the specimen. Shooting, snaring, capture in live traps, pitfalls and other methods, limited only by the ingenuity of the hunter, will be required for the collection of mammals of different sizes and varying habits.

Fishes, amphibians and reptiles collected for study, except for skeletal material (and except for very large specimens), are preserved by placing the entire animal in alcohol or formalin. For permanent storage it is essential that all formalin specimens be transferred to alcohol. Labelling may consist of numbered tags of metal (pure tin or aluminum), of special waterproof paper, or of parchment. Such numbers must be accompanied by a carefully kept catalogue for the corresponding information about locality, etc. Field labels written with soft pencil on slips of bond paper, if wrapped with the specimens so that they cannot rub, are satisfactory. The principal attention required for good preservation of such specimens is that the body cavity and thick muscular parts of the body must either be injected with the preservative, with a large hypodermic needle, or must be opened by means of ample cuts to permit the fluid to enter. Specimens immersed in preservative must be examined for the first few days until they are firm; any portion that remains soft will require further opening or transfer to fresh preservative.

Skulls and skeletons of such large creatures as crocodiles and alligators, large turtles and of large reptiles in general are especially desired by museums. For field collecting such material needs only to have most of the flesh removed, the brains extracted from the skull, and the roughed out skeleton or skull dried. Protection from flies and from offensive decay is accomplished by rapid drying, but in wet climates thorough soaking in borax solution or rubbing with dry borax, drying over fire and packing into sealed containers may be essential. Paper labels for such material must be protected from rubbing.

Persons interested in natural history, especially if travelling in foreign countries, or stationed in a foreign region, should correspond with any one of the larger museums about animals of special interest to be looked for on their routes or near their stations. Such letters usually receive courteous and even enthusiastic attention; the unpacking of small incoming lots of material from miscellaneous sources forms one of the attractive elements of museum work.

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(K. P. S.)

MARINE COLLECTING

Marine collecting presents a number of special problems because of the vastness of the sea, the great depth at which many of the animals live and the difficulty of caring properly for many of the delicate forms while in the field. The marine collecting area comprises about 71% of the earth's surface, and most parts can be reached only by sea-going vessels. About 77% of the bottom area is covered by water over 9,800 ft. (nearly 2 mi.) in depth, and the greatest depth is over 6 mi. Animal life is found not only on the bottom but also to some extent throughout the entire water mass, hence collecting on the high seas must be adapted to all of these circumstances, and it is therefore an undertaking for specially organized and equipped expeditions. However, a most important part of marine collecting can be done with simple equipment in the intertidal zone or in shallow coastal waters. Fortunately, also, it is here that the greatest abundance and variety of plant and animal life is produced. The great depths are relatively barren.

Early systematic collecting of bottom (benthic) animals was limited to the intertidal and shallow water zones and it was believed (E. Forbes, 1843) that no animals lived at depths greater than about 300 to 700 metres. Before this time some collections had been reported by Sir John Ross (1819) from depths of 1,800 metres, but these were discredited as being uncertain. However, in 1860 undisputed collections of marine animals were made from a submarine cable which, in being repaired, was raised from a depth of 2,160 m. where the animals had attached and grown. Thus, interest was stimulated in collecting and exploring the great depths to determine what mysteries of life might lie hidden in this forbidding environment and to learn the factors controlling life in the sea. Likewise, the vast abundance and importance of the planktonic or floating life was not realized until about 1846 when J. Müller is said to have used for the first time a fine-meshed cloth net drawn through the water as a collecting device.

The earliest large-scale marine collecting expedition was that of H.M.S. "Challenger" 1873–76, during which time vast areas of the Atlantic and Pacific were explored. Since then much marine collecting has been done by research ships of various nations, and animal life has been collected and studied from many positions in all oceans, but vast coastal and oceanic areas are still unexplored by collectors. In all of these expeditions the collecting has usually not been an end in itself but rather a necessary part in gathering data of importance to fisheries or to general marine biology (*q.v.*).

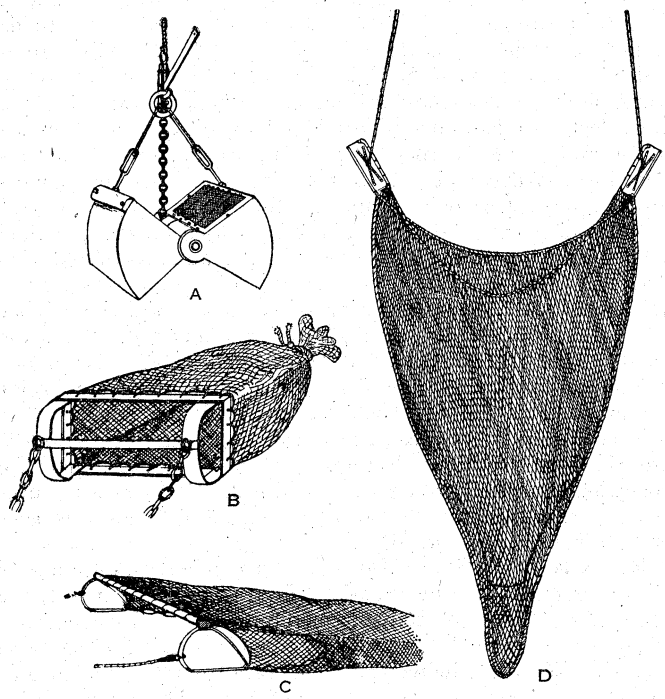
Methods and Gear Used in Collecting.—Collecting is either for qualitative or quantitative purposes. The first is the simpler because the objective is merely to obtain the organisms, whereas in the second it is necessary to know as nearly as possible how many species or individuals were taken from a definite area of the bottom or from a known volume of water. This requires careful collecting in order that the numbers can be correlated with other ecological data bearing on the distribution and biology of the organisms.

Intertidal and shallow-water collecting for bottom-living animals requires only simple equipment. Where the bottom is composed of mud and sand, a long-handled shovel or rake is needed for digging out the burrowing forms and a screen for sieving out the smaller animals from the loose material. A mixture of mud and sand usually yields more animals than does a beach of pure sand. The latter, however, is not without its characteristic type

of life and sometimes in surprising numbers, especially certain worms (*Thoracophalia,* for example), the little sand crabs (*Emerita,* etc.), the wedge shells *Donax* and, at high-tide level, the sand hoppers. The animals that are found on mud-sand bottoms are numerous and varied. Commonly they are of the burrowing types, such as clams and worms, and their presence is revealed to the collector by little characteristic mounds, holes or markings on the surface of the mud. The best collecting for variety of forms is, however, on rocky or coral reefs. Here a strong chisel-edged bar is useful for prying loose limpets, mussels, sea stars and many other forms that are attached to the rocks, or for breaking up old coral and shell encrustations or for rolling over rocks to expose retreats that usually teem with life. The tide pools left by the receding tide yield many additional forms including nudibranchs, fishes and cephalopods. The attached algal plants should be searched for the many animals that attach to or hide among their fronds. Eel grass (*Zostera*) beds in shallow water are favorite collecting places. Here attached to or living among the leaves can be found an abundance of hydroids, bryozoa, skeleton shrimp and such characteristically eel-grass inhabitants as the sea anemone *Epiactis,* and the sessile jellyfish *Haliclystus.* Dip nets or hand seines drawn through the disturbed eel grass are sure to capture a variety of small fish and invertebrates.

Among the more profitable of collecting places are the submerged portions of wharf piles or floats where fouling organisms and the animals associated with them can be scraped off with rakes or dip nets. Here the wood too should be examined for the destructive wood-boring forms such as the shipworm *Teredo* and the gribble *Limnoria.*

Shallow-water benthic animals are often cast up on the beach by action of waves during storms, and sometimes also pelagic forms normally found only on the high seas are drifted ashore in this way. The collector takes advantage of this and also watches



FROM SVERDRUP, JOHNSON, AND FLEMING, "THE OCEANS" (PRENTICE-HALL)

FIG. 3.—GEAR FOR BIOLOGICAL COLLECTING: (A) PETERSEN GRAB. (B) DREDGE. (C) BEAM TRAWL. (D) OTTER TRAWL

for the many small animals that he can find among the rootlike holdfasts of deep-growing seaweeds that have been torn loose from the bottom and drifted onto the beach.

Deep-water collecting for benthic animals requires special equipment operated from boats provided with winches for reeling in line. The standard equipment includes dredges or trawls (fig. 3, B,C,D). The dredge consists of a strong iron frame to which a bag or net of strong web or wire screen such as hardware cloth is attached. This bag retains the animals that are scooped up from the bottom by the edge of the dredge frame as it is dragged forward over the bottom by a long wire cable or rope operated from a winch aboard a slowly moving ship. The edge of the frame may be constructed with flares or teeth to dig into the bottom. Usually the frame is rectangular and is about 2 to 5 ft. in length, depending upon the size of boat and winch facilities. The trawl, a modification of the dredge, is designed to fish free in the water or to skim over the bottom rather than to dig into it. There are three main types: the beam, the Agassiz and the otter trawls. In the beam trawl the mouth of the net is held open by a beam of iron or wood so arranged as to glide over the bottom on sledlike runners, while a lead line holds the lower lip of the net in contact with the bottom. The Agassiz trawl is a modification of the beam trawl. In it the mouth of the net has both upper and lower lead lines, hence it fishes properly no matter which side of the trawl is applied to the bottom. For scientific collecting a 10 or 15-ft. beam is ample but for commercial fishing the beam may be much longer. In the otter trawl the mouth of the net is held open by means of otter boards so arranged that they are forced apart by the water when being towed forward by a line attached to each.

The trawls are more efficient than are the dredges for collecting active animals such as fish or shrimps. They are not practicable for collecting on rocky bottoms. Dredging and trawling in very deep water is a laborious operation, sometimes requiring as much as 12 hours for one haul at a depth of 3000 fathoms. Often only a few animals are caught at these depths but these are of exceptional interest because of their strange habitat.

Dredges and trawls are most useful for qualitative collecting because it is difficult to know accurately how much bottom has been covered in sampling. For quantitative collecting of small sessile animals in shallow water the Petersen grab is used (fig. 3, A). It consists of hinged heavy iron jaws that are held open by a mechanism that is released when the instrument strikes the bottom. Upon being lifted from the bottom the jaws close over a definite area (usually 0.1 sq. metre) of the bottom, scooping up the bottom material together with the contained animals.

The collecting of pelagic animals may be considered in two parts: (1) the floating animals (zooplankton) and (2) the strong-swimming animals (nekton).

The zooplankton, composed mainly of such feeble swimmers as copepods, euphausiids, chaetognaths, various larvae, and the dinoflagellates, is collected in various ways all of which utilize some type of screening device, such as the plankton tow net. In simple form the tow net (fig. 4) consists of a ring to which is attached a conical bag of gauze, usually of silk bolting cloth which is so woven that the screening apertures are uniform and not readily changed in size. When the net is drawn through the water, the organisms are screened out and concentrated in a bottle or jar fastened into the apex of the net. There is a great range in size of plankton organisms, hence the fineness of the net used is determined by the minimum size of the animals to be caught. For general zooplankton collecting a No. 8 type bolting cloth with screening apertures of about 0.205 mm. is practicable, though many of the smallest organisms escape. Some protozoan forms, for example the smaller ciliates and dinoflagellates, pass through the finest nets. To obtain a quantitative estimate of these small members of the plankton, it is necessary to collect them by means of centrifuging a known quantity of sea water.

For collecting planktonic animals from subsurface levels, closing nets are used. These can be lowered to the desired depth and there opened by means of a special mechanism operated by a "messenger" which glides down the towing wire. When the tow is completed the net can again be similarly closed to prevent any further fishing while it is being hoisted to the surface.

Some quantitative nets are provided with a small cyclometer which records the amount of water that has flowed through the net. George H. Clark and D. F. Bumpus (1940) developed a plankton sampler of this type which can be used in series, thus collecting plankton from several water strata simultaneously.

A. C. Hardy (1939) devised a continuous plankton recorder which collects quantitatively at a given depth (10 m.) along the route of a ship back of which the recorder may be towed for many miles.

For collecting fishes and other nektonic animals, nets, seines, hooks and harpoons are used, but these are best considered under fisheries (*q.v.*), nets and seining.

The use of lights for attracting and collecting swimming animals at night sometimes yields many forms not readily collected during the daytime. Even some bottom living forms may swim to the surface where they can be scooped up with hand nets.

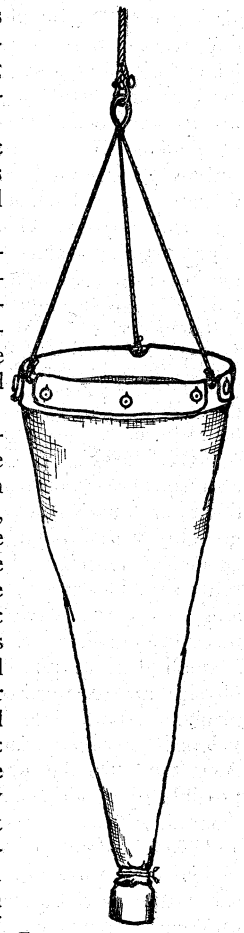


FIG. 4.—PLANKTON TOW NET

Care of Material Collected.—A definite part of the task of collecting is the care of the material while in the field or en route to its destination in the laboratory, museum, or aquarium. Unless means are available for a steady or frequent change of fresh sea water in which to keep the animals, most of them soon die. Benthic animals when crowded into a bucket, as is often done, usually survive best if covered with wet seaweed rather than with water which soon becomes warm and exhausted of its oxygen or charged with metabolic wastes. If the animals are of a flabby type and need the support of water, a quantity of sea lettuce (*Ulva*) kept in the bucket with them is of aid. Intertidal and tidepool animals are the hardiest and should be collected for aquarium specimens in preference to the more delicate forms of deep water. On expeditions or on long collecting trips most or all of the material will need to be preserved in a manner consistent with its future use for study or display. Alcohol, 70%, is the best general preservative, but formalin is more economical and serves as well where some hardening of the tissues is not deleterious. Five parts formalin to 95 parts sea water is suitable to preserve most small animals. Basic formalin may be used for organisms such as the foraminifera and echinoderm larvae with delicate calcareous skeletons if alcohol is not available.

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ZOOLOGICAL GARDENS (Zoos), institutions in which live animals are kept in captivity. The custom of keeping collections of living wild animals is as old as recorded history. In ancient China, Wen, the first king of the Chou dynasty, in the early part of the 12th century B.C. maintained near his palace a "garden of intelligence" in which were exhibited specimens from the various provinces in the empire. In ancient Egypt menageries were kept as adjuncts to the temples, but the Empress Hatasu in the 18th dynasty had a "garden of acclimation" and sent a fleet to the land of Punt (the first expedition for live animals), that brought back dogs, monkeys, leopards and giraffes. There is an obelisk in the British museum describing the capture of animals by Ashur Akbar, one of the early kings of Nineveh. These were brought to the capital, and "by each animal was placed its name." Solomon had his monkeys and peacocks, and Nebuchadrezzar his lions. Ancient Greeks maintained collections of birds, and later, of mammals; Aristotle kept a collection of live things secured for him by the men of Alexander's army. The Romans had collections far exceeding in numbers anything of today, with hundreds of lions, tigers and leopards. Most of these were used in the arenas in gladiatorial and other combats. In 29 B.C. Octavius Augustus, himself quite an amateur of natural history, maintained a collection of 420 tigers, 260 lions, 600 African animals including cheetahs, panthers and other carnivores, 1 rhinoceros, 1 hippopotamus, several seals, bears, elephants, eagles, 36 crocodiles, and "1 serpent 25 metres long." During mediaeval times zoos were again restored, sometimes as civic institutions as in Florence, but more often as private menageries of the nobility. In 797 the caliph of Baghdad, Haroun el Raschid, sent an elephant and some monkeys to the Emperor Charlemagne. In the 13th century Marco Polo reported the collection of lions, tigers, leopards, hippopotamus and wild asses in Kubla Khan's palace at Xanadu, and another menagerie with stables for elephants and rhinoceros. Henry I (1100–35) established a royal menagerie at Woodstock, Oxfordshire, England. Later this was transferred to the Tower of London. In 1829 the animals were taken over by the Royal Zoological society, and this collection was the origin of the famous zoo at Regent's park, London. Rulers in continental Europe maintained royal menageries at Madrid, Vienna, Versailles and elsewhere. Pope Leo X had a menagerie in the Vatican. Monkeys and civet cats are listed, and he received an elephant as a present from Manuel I of Portugal. Zoos were established in 1554 by the elector Augustus I at Dresden, by Frederick William in 1640 at Potsdam, by Prince Eugene of Savoy at Belvedere, Austria, in 1716; and in 1752 the imperial menagerie was founded at Schönbrunn, Vienna. Louis XIV appropriated £5,400 a year for the upkeep of his menagerie at Versailles, which received presents of animals from numerous French emissaries abroad. Louis XV had little interest in the zoo, although in 1770 a two-horned rhinoceros arrived, the first seen in Europe since Roman times. In 1793 the Jardin des Plantes was established in Paris in connection with the museum of natural history. In the 19th century zoos were established in numbers throughout the world.

Africa.—The zoological garden at Giza, Cairo, consists of a beautiful park and a large collection, chiefly of African mammals, maintained by the government. The zoological garden at Khartoum is maintained by the municipality and is one of the few old world zoos to which admission is not charged. The game department of the Sudan controls the collection and from time to time supplies fine specimens to other institutions. The large zoo at Pretoria is supported by the government, and there is an excellent collection also at Johannesburg.

North America.—In 1945 there were more than 30 zoos in Mexico, Canada and the United States, a number of them of considerable size. In Canada, the Quebec Zoological society exhibits a collection made up chiefly of Canadian species; Toronto includes numerous exotic species, and at the annual Toronto exposition a children's zoo is one of the most attractive features. In Mexico, kings of the Aztecs had zoological collections before the Spanish conquest, and a zoo is still maintained at Chapultepec. In the United States, nearly all large cities have zoological gardens, the first of these having been established at Philadelphia in 1874; Cincinnati followed. Some of the larger zoos are in the Bronx, New York, St. Louis, Detroit, Chicago—one in Lincoln park and a magnificent display at Brookfield—and San Diego. These exhibit some of their collections in open-air, barless pits of the type originated by the Hagenbecks at Stellingen, Germany. These zoos are supported by grants from their respective cities and from funds of local zoological societies. Some charge admission, the proceeds of which are devoted to the institution. The profits from refreshment stands are sometimes used for the purchase of animals. The United States National Zoological park in Washington was established in 1890 by congress "for the advancement of science and the education and recreation of the people," and is supported by the United States government. The park itself consists of 175 acres of hills and woods with Rock creek flowing through. It contains several modern buildings and a large collection of specimens.

South America.—At Buenos Aires there is an extensive collection maintained by the federal district. There are other notable good zoos at Concepción and Santiago in Chile and a small but beautiful zoological-botanical garden at Belém, Para, Brazil, specializing in Amazonian birds and animals.

Asia.—The zoo at Alipore, Calcutta, was established in 1875 by the government of Bengal and is the largest in India. There is an outstanding zoo at Bombay, and an excellent one at Karachi; and many of the native princes maintain private collections. Singapore, Batavia and especially Surabaya have interesting zoos. There is a good collection at Fort de Kock on the west coast of Sumatra, and another at Johore Bahru, property of the crown prince. In Japan there are a dozen zoological collections, large and small, as well as numerous private aviaries. Notable ones are at Tokyo, Nagoya, Kyoto, Osaka and Kobe, the last-named situated on a hill overlooking the city and harbour. The zoo in Shanghai, though small, contains some interesting Chinese animals.

Australia and New Zealand.—There are large zoological gardens at Sydney, Melbourne, Adelaide and Perth; smaller ones at Brisbane and at Wellington and Auckland, New Zealand. The one at Wellington has a well selected group of New Zealand fauna.

Europe.—Zoological gardens are favourite public institutions in many cities of Europe. In France a modern and model zoo was built at Vincennes for the Paris exposition in 1937. The Jardin d'Acclimatation was founded in 1858 in the Bois de Boulogne. The old Jardin des Plantes in Paris was improved between 1918 and 1939, with some new buildings and an outstanding vivarium for the smaller creatures. Switzerland has two zoos, one at Basle and one at Zurich, the latter attractively arranged in a series of terraces. In Germany, in the years between World Wars I and II, a great deal of development was done in approximately 20 zoos, the larger ones being Berlin, Frankfurt-on-Main, Munich (the Geo-Zoo, so-called because the animals were grouped according to continent of origin), Dresden, Leipzig and Cologne. The Hagenbeck Garden at Stellingen became an outstanding show place and animal distributing centre. Smaller but attractive zoos are at Düsseldorf, Elberfeld and Hanover. Several of these were destroyed by bombs during World War II. Vienna boasts of the Schönbrunn, one of the oldest zoos in Europe. Budapest maintained an attractive collection with especially fine groups of European birds. At Antwerp a large menagerie was founded by the Royal Zoological society in 1843. In England the most notable zoo is of course the garden of the London Zoological society in Regent's park. The park is small but the collection has always been one of the finest. The society also has a large open-air zoo at Whipsnade, where herds are maintained rather than individual specimens. Manchester and Clifton have smaller zoological parks. The Edinburgh zoo, beautifully situated in hilly terrain, has long been famous for its extensive collection of penguins. The zoo in Dublin is famous for its lions, having had more than 100 born there during the 19th century. In both Amsterdam and Rotterdam important zoological gardens were established, the former being larger and with a magnificent collection from the East Indies, as well as a fine aquarium. The Skansen zoo in Stockholm is built on an elevated area reached by an escalator, and limits its exhibits to the fauna of northern Europe. At Moscow is the largest zoo in the U.S.S.R., with superb collections of northern animals and a good representation also of exotic species. This zoo is divided into two parts, one of small enclosures, and the other with large paddocks for herds of ruminants. Most of the cities and large towns in Europe have some sort of zoological collection maintained by the cities, by local societies or sometimes as commercial enterprises. In Rome there is a large and very popular zoo with a number of barless pits. Lisbon has a city zoo, small but attractive. In Madrid there remain only parts of the original royal menagerie.

Management of Zoos.—The first object of a zoological garden is the exhibition of its collection to the public. A few animals well shown are immensely more attractive than great numbers inadequately housed and cared for. Considerable research has been done on conditions leading to the welfare of these animals. Studies in diet, ventilation, lighting, heating, artificial sunlight, glass penetrated by ultra-violet rays, and air conditioning have improved conditions in many zoos. Some maintain biological laboratories for research on various phases of animal life and diseases of animals in captivity, and many volumes of natural history have been based on studies made in zoos. As the welfare of animals depends in general upon the same conditions as the welfare of human beings, some of these studies have been of value to medical science. A great deal of work has been done in zoos on experimental animal behaviour. Some zoos are associated with museums that receive and preserve animals which die in the zoo. Many species new to science have been described from captive specimens.

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ZOOLOGICAL GEOGRAPHY. Zoological distribution, also known as zoogeography, is the science dealing with the distribution of animals over the surface of the globe. It is concerned not only with present conditions but also with those of former geological periods and with the mode in which the present arrangement has arisen. The study of the present distribution of animals may be of two extreme types, whose fields overlap. It is possible to investigate the details of the occurrence of a species in a small district, relating the facts discovered not only to the physical and chemical conditions of its environment but also to its neighbours both plant and animal. Such a study (still very undeveloped) is called ecology (*q.v.* and *see* also DISTRIBUTION OF ANIMALS). On the other hand, it has long been known that it is possible to divide the land of the world into regions separated from other land masses either entirely, as in the case of Australia and New Zealand, or very nearly, as in the case of Africa. Such regions may possess characteristic faunas and the investigation of the nature of these and an elucidation of the resemblances and differences that they present, form the subject matter of the aspect of zoological distribution dealt with here. To those early naturalists who believed in the independent creation of all the species of animals, their irregular distribution over the world must either have presented no problem or have been inexplicable. When, however, Charles Darwin showed that the existing distribution received a ready explanation on the theory of the evolutionary origin of species, and that its details might be used to throw light on the mechanism that had brought about evolution, the whole subject acquired a new interest. The division of the world into zoological regions established by P. L. Sclater in 1858 received much attention and was the subject of much discussion in the light of natural methods of dispersal through geologic time.

The differences that separate the faunas of the zoological regions are not dependent on climate or temperature. For example, the mammal fauna of North America is, on the whole, very similar to that of northern Asia and Europe, while the faunas of Patagonia and Australia, which present a similar range of climatic conditions, differ completely not only from those of the northern areas but also from each other. Furthermore, the mammal fauna of South America is in some respects a unit, although that continent stretches throughout the tropics and into the antarctic regions of Tierra del Fuego. Thus the factors that have led to the distribution of existing animals into regions are not discoverable in present day conditions but must lie in the past, and they can only be discovered by an investigation of the history of the animals that compose the fauna, and of the changes in the distribution of land and water that have taken place during geological time.

The zoogeographical regions at present recognized are as follows:—

1. Palaearctic, including Europe and Iceland; Asia, including Japan, north of the Himalayas and of the Yangtze-kiang watershed; Iran and Asia west of the Indus; and Africa north of the Sahara, including the Azores.

2. Nearctic, comprising the whole of America north of Mexico.

These two regions are conveniently grouped as Holarctica.

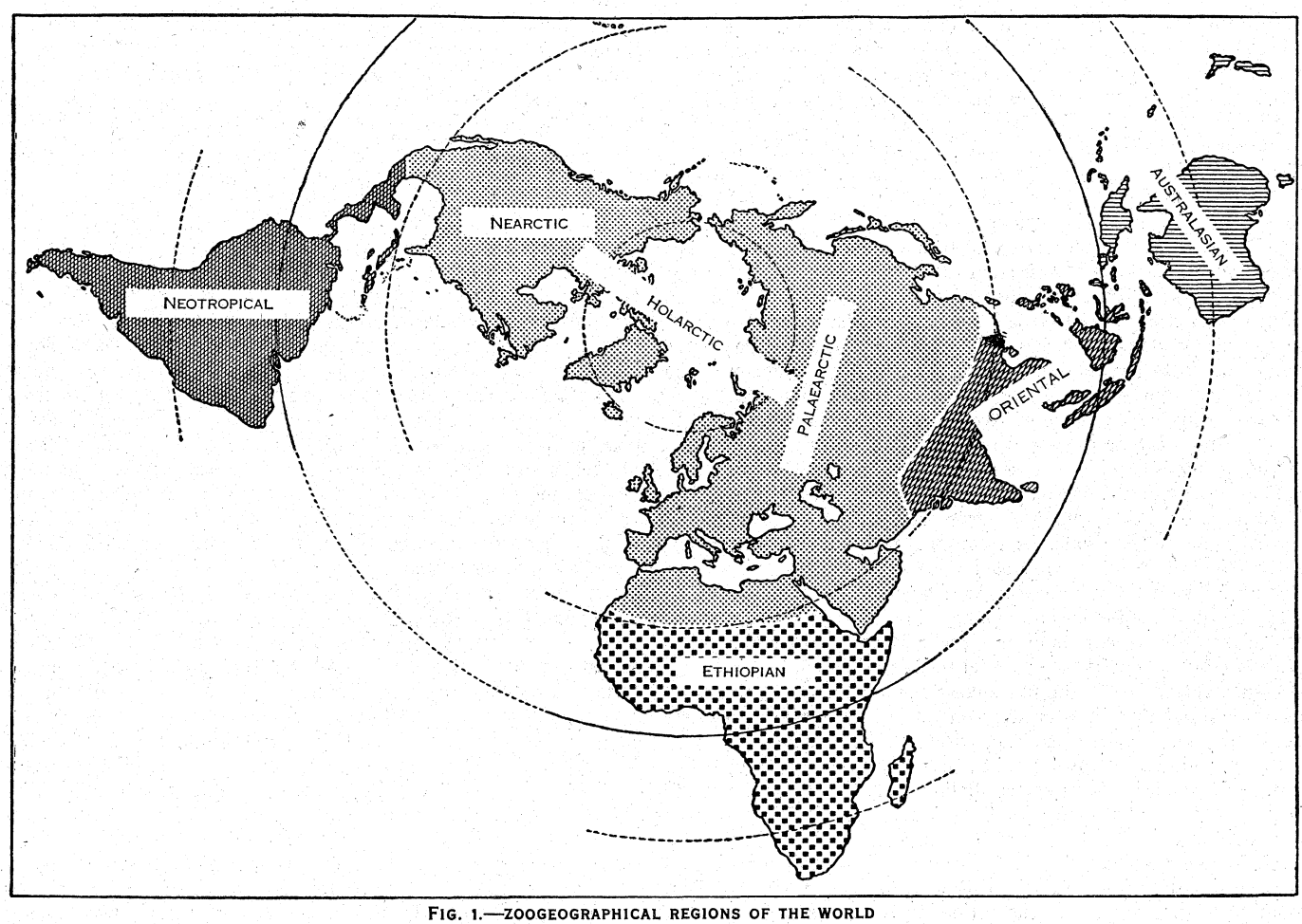

FIG. 1.—ZOOGEOGRAPHICAL REGIONS OF THE WORLD

To the south of Palaearctica lie two distinct regions, each a peninsula projecting from the great northern land mass into the wide seas of the southern hemisphere. They are:

3. The Ethiopian region, comprising the whole of Africa south of the Sahara, with Madagascar and the Mascarene islands.

4. The Oriental region, comprising India and Ceylon, Siam and southern China, and the Malay archipelago.

Bearing a somewhat similar relation to the Nearctic region is:—

5. The Neotropical region, comprising the whole of America from the Mexican escarpment southward, and the Antilles.

Finally more isolated than any is:—

6. The Australasian region, including Australia with Tasmania and New Guinea, New Zealand, and the islands of the Pacific.

Many minor modifications of these regions have been suggested which, although they may be useful, especially in the study of certain groups, are not of great significance. Thomas Huxley, Max Weber and others have grouped these six regions into three main realms, as follows:—

1. Arctogaea comprising Holarctica, the Ethiopian and Oriental regions.

2. Neogaea, comprising the Neotropical region.

3. Notogaea, comprising the Australasian region.

This arrangement has the merit of emphasizing the distinctness of the Neotropical and Australasian regions. All of these terms correspond to natural faunal distinctions and retain their usefulness in descriptive animal geography.

NOTOGAEA AND NEOGAEA

Notogaea.—Notogaea is by far the most distinct of the three realms. That portion of the area which alone is inhabited by mammals (New Guinea, Australia and Tasmania) is the home of the only monotremes known; *Proechidna* restricted to New Guinea, and *Echidna* and *Ornithorhynchus* in the other two areas. The great majority of the other mammals are marsupials. One of the two natural divisions of the marsupial group is confined to Australia; the other is shared by Australia with the Americas. The only higher mammals found in Notogaea are rodents and bats, together with a pig in New Guinea, the native dog or dingo in Australia, and man himself throughout the realm. There is every reason to believe that the pig and dog were introduced by man. The bats present no special features; some of them indeed belong to forms with a world-wide range. The rodents on the other hand are often of peculiar genera not found elsewhere, but are all members of the family Muridae, which have unusual powers of dispersal. Thus Notogaea so far as its mammal fauna is concerned is remarkable not only for the presence of many animals entirely peculiar to it, but also by the absence of all representation of the higher eutherian orders. There are no insectivores, carnivores, armadillos, pangolins, hoofed animals, or primates, types of mammals whose members are to be found in all other regions. The absence of these forms receives a simple and complete explanation if Notogaea has been separated from all other land-masses since a period that preceded the evolutionary development of these orders, or indeed of the primitive mammalian stem from which they arose. Existing palaeontological evidence suggests that this period cannot have been later than the end of the Cretaceous times, and it may be necessary to set it back at least as far as the end of the Lower Cretaceous if certain Mongolian discoveries be correctly interpreted.

The Australian polyprotodont marsupials form a series, the more primitive of which are small mammals of insectivorous and commonly arboreal habits. These forms have their headquarters in Australia, in which the majority of forms are found, but some of them extend on into New Guinea and into the Aru and neighbouring islands. From this primitive group have arisen forms (*Myrmecobius*), which have very small teeth and are committed to a diet of ants; others (the bandicoots), which are in part herbivorous, although they certainly also eat animal food.

One of them is a little hopping animal, superficially recalling the jerboas. On the other hand there is a series of forms that become progressively more and more highly specialized for a carnivorous diet, resulting finally in *Thylacinus,* an animal as large as the collie dog, capable of killing and eating sheep. This group of marsupials is represented in the Americas by the various types of opossums in tropical America and by the curiously primitive *Caenolestidae* of the Andean region. During early Tertiary times, opossums similar to those now living in North America ranged over North America and Europe, and a perfectly typical member of the same family is known from the Upper Cretaceous rocks of North America. Thus the possession in common of Polyprotodonta by Arctogaea and Neogaea on the one hand and Notogaea on the other, does not necessarily imply that these realms were connected with one another after the end of the Cretaceous. The fact that the polyprotodonts of Notogaea have radiated into such diverse forms whilst those of Arctogaea are restricted essentially to one type, may be explained by the absence of the competition of higher mammals in one case, and its presence in the other.

The diprotodont marsupials are peculiar to Notogaea. The diprotodonts as a group are herbivorous. The most primitive family, that of the phalangers, contains many animals all essentially arboreal in habit, varying in size from that of a mouse to that of a cat. They take in Australia much the same place that is occupied by the squirrels and monkeys in other parts of the world, and they often present, as in the development of a flying or rather gliding habit, a remarkable parallel to the flying squirrels. An interesting derivative of the phalangers is the koala or native bear, a large animal that lives entirely on the leaves of the eucalyptus trees. From the same group has arisen the wombat, a large, very powerfully-built, burrowing animal, strictly herbivorous in habit, with a remarkable dentition paralleling that of the larger rodents such as the capybara, in its adaptations. Finally the kangaroos and their allies form a very distinct group of terrestrial animals fitted by their elongated hind legs and long tail for a progression by a series of jumps. Their dentition is so arranged as to allow them to crop grass as do the artiodactyls and as they occur in large numbers in relatively open country, they are similar to this group in their general diet and habits.

Thus the Australian marsupials have experienced an adaptive radiation that has fitted them for most of the modes of life known among the more modern types of mammals of other parts of the world and the fact that no diprotodont, either living or extinct, is known from any other part of the world, is a clear indication that the evolution of the group took place in Australia and that it was made possible by the absence of the competition of higher mammals.

It should be possible to establish the truth of the above view by studies of the Australian fossil marsupials. At present, however, except for a single specimen, which is clearly a diprotodont marsupial, and probably a phalanger, from the Upper Miocene of Wynyard, Tasmania, no pre-Pleistocene mammals are known. The Pleistocene mammals include an interesting human skull presenting the characters of the living Australian aborigines, the dingo, some rodents of Australian type and a very large series of marsupials, including representatives of extinct animals. It is an interesting feature that in Pleistocene time the large carnivorous Tasmanian wolf and Tasmanian devil, at present restricted to Tasmania, occurred widely spread in Australia, and it is customary to attribute their disappearance on that continent to competition with the dingo, that animal having never reached Tasmania.

The large carnivorous marsupial, *Thylacoleo,* found in Pleistocene deposits all over Australia is remarkable in that it is related not to the carnivorous polyprotodonts but to the otherwise exclusively herbivorous diprotodonts. Of this order several gigantic forms are found, a kangaroo, *Macropus titan,* perhaps 12 feet in height, *Diprotodon* and its allies, not closely related to any living forms, but as large and heavily built as a rhinoceros, and the giant wombat, *Phascolomus,* which attained a similar size. Thus what little is known of their fossil history emphasizes still more the peculiarity of the Australian marsupials.

It is clear that man did not arise in Australia and that he is as certainly an immigrant into that continent as he is in those Pacific islands, where the date and manner of his coming are recorded. From the occurrence of a fossil human skull in the Pleistocene of Queensland, we know that the human immigration took place as early as Pleistocene times, and from the fact that this skull belongs to the species *Homo sapiens,* which is not known in the early or indeed the middle Pleistocene, it follows that the human immigration was in late Pleistocene times.

Neogaea.—The mammal fauna of Neogaea, that is of South America, is less peculiar than that of Notogaea. It contains no monotremes but there are many living marsupials, the most abundant being the opossums of the family Didelphidae; the other forms, belonging to two genera of which *Coenolestes* is the more important, have ancestors in the Miocene deposits of South America and were certainly evolved in that region and have never spread beyond it. A few shrews are found in Central America, no insectivores at all on the South American continent, and one peculiar family, the Solenodontidae, is restricted to certain islands of the West Indies. It belongs to the suborder Zalambdodonta, which has living representatives in Africa and Madagascar and has been found fossil in a perfectly typical form in the Basal Eocene of North America. The most characteristic South American mammals are, however, the "edentates" belonging to the group Xenarthra. These fall into three groups, the sloths, the anteaters and the armadillos, none of which, except for the occurrence of an armadillo in Texas, is living outside the region. The rodents of South America, which are numerous, belong in the main to peculiar families; the cavies, chinchillas and agoutis are not found elsewhere, while another important group, the octodonts, are represented by forms both in South America and in Africa. There are also representatives of the Myomorpha and tree-porcupines. The Carnivora include dogs, bears and cats, together with many raccoons peculiar to the area. The perissodactyls are represented only by the tapir, while the artiodactyls include the peccaries and llamas, which are now primarily South American, together with certain deer related to North American forms. The Primates are represented by the group Platyrrhina, which is restricted to South America, and by man.

It is clear from this account that the South American mammal fauna is sharply marked off from all others by the possession of groups of animals peculiar to it, but that it is linked with the North American fauna by the presence of deer, raccoons, bears, cats and dogs. The condition of South America differs from that of Australia in the increased number and variety of those animals which may be regarded from the existence of their relatives elsewhere, as immigrants into an area which has long been separated. The abundance and varied nature of those mammal groups peculiar to South America, such as the sloths, armadillos and anteaters, and the platyrrhine monkeys, would suggest that these animals had undergone their evolution in isolation as had the Australian marsupials. It is possible to test the truth of this idea by an investigation of the fossil history of these and other forms, and in South America, unlike Australia, it is possible to do this not only for one horizon but for the whole Tertiary period.

In Pleistocene times South America was inhabited by a fauna far more varied in character and including much larger animals than those now living there. Of the groups that appear to be of South American origin, the Xenarthra were represented not only by armadillos of modern type, but also by the giant armoured glyptodonts and the enormous ground-sloths; each of these groups being sufficiently varied to be divided into three families. The rodents are of the same types as those now living and the Platyrrhina are present. Extinct groups of hoofed mammals are found, falling within the Notoungulata and including most varied animals. There are the following groups: *Typotheria,* the Pleistocene form being an animal about as large as a pig with a gnawing dentition; *Toxodontia,* with a skull 2 feet in length and a dentition not unlike that of the typotheres; and the order Litopterna with a Pleistocene form about as large as a camel.

Living alongside these native animals were carnivores including not only the ancestors of those forms that still exist but also a sabre-toothed tiger, *Smilodon;* and a bear, *Arctotherium,* now ex-

tinct. The perissodactyls include horses, in part belonging to the modern genus *Equus,* and in part to four extinct genera. Proboscidea are represented by several forms less advanced in structure than true elephants and commonly referred to as mastodons.

Thus except that it is richer both in the number of groups represented and in the size of the individuals, the Pleistocene fauna of South America resembles the recent one in that it contains a mixture of mammals that had originated *in situ* with immigrants from the north. When we pass backward to Miocene times, as represented in the Santa Cruz beds, we find an even fuller and more varied representation of the true South American groups, and a complete absence of those that we had assumed to be immigrants. It is natural to believe that the continents of North and South America became connected by a land-bridge sometime between the Miocene and the Pleistocene, and the truth of this conclusion is established by the fact that giant ground sloths and glyptodonts first appear in the North American fauna in Pliocene times.

The mammal fauna of the Miocene of South America contains the following elements. The marsupials include not only opossums essentially of modern type, but also a variety of carnivorous animals closely similar to the Tasmanian wolf, but some like *Borhyaena,* greatly exceeding that animal in size. Relatives of the living *Coenolestes* occur. There is an animal *Necrolestes,* which is supposed to be an insectivore related to the Zalambdodont golden moles of South Africa. All the rodents, which are extremely numerous and varied, belong to the South American families of tree-porcupines, cavies, chinchillas and agoutis. There are a few unmistakable platyrrhine monkeys. Among the Xenarthra, no representatives of the living sloths and anteaters have been found, probably because these animals are restricted to tropical forests and the known mammal fauna is that of the more open, less well watered and considerably colder plain. The armadillos are very varied; the glyptodonts, small compared with their descendants of Pleistocene times, to some extent bridge the gap between the normal armadillos from which they sprang and the later glyptodonts. The ground-sloths, of relatively small size, include the ancestors of the later forms and the three families into which these creatures are divided can already be recognized. The Notoungulata include an immense range of animals adapted to very varied habits. The Typotheria, then small forms which filled the place occupied at present by rabbits, fall into three distinct families, while the Toxodontia include an abundance of forms smaller than their Pleistocene successors. The Entelonychia include a remarkable animal, *Notioprogonium,* with stilted fore-legs and digging claws. The Litopterna, another extinct family represented by a single type in Pleistocene times, included forms which parallel the horses in the reduction of the toes in foot and hand to one. Yet another extinct order, Astrapotheria, includes gigantic creatures unlike any other forms.

Thus the South American fauna of the Miocene is seen to include essentially only those elements most characteristic in the modern fauna, the indicators of the Neogaean realm. The forms of Holarctic origin, some of which, like the tapirs, camelids and various carnivores, now appear to be equally peculiar to South America, are absent in the South American mid-Tertiary, and are known to be present and undergoing rapid evolution in the same era in North America.

Certain of the early types of marsupials in South America, such as the wolflike *Borhyaena,* have been thought to be so closely allied to existing Australian types as to indicate interchange of faunas between Australia and South America by a direct land route or via connections with the Antarctic continent. The resemblance between *Borhyaena* and *Thylacinus* is now interpreted as caused by convergent development from different ancestral stocks. The negative evidence, in the obviously independent course of evolution of the fauna of Neogaea as a whole, seems to be overwhelmingly against any land connections of South America with any continent throughout most of Tertiary time, with reestablishment of the Panama bridge with North America in the Pliocene.

MODERN ARCTOGAEA

The remaining realm, Arctogaea, is much more extensive and less compact than those that we have considered, and it is most convenient to begin its discussion by a consideration of the existing distribution of animals in the various regions of which it is composed.

Nearctic Region.—Covering as it does the whole of North America except the lowlands of Mexico, the Nearctic region exhibits extreme variations in geographical qualities. In the extreme north there is a completely snow-covered arctic area, to the south of which there is a continuous belt of coniferous forest extending from Alaska to New England. In the extreme south lies the Sonoran region which has a warm temperate climate and is largely composed of great treeless plains, although at the mouth of the Mississippi it includes much forest, and in California passes into deserts where the day temperature may be extraordinarily high, reaching in the Mohave desert 120° F.

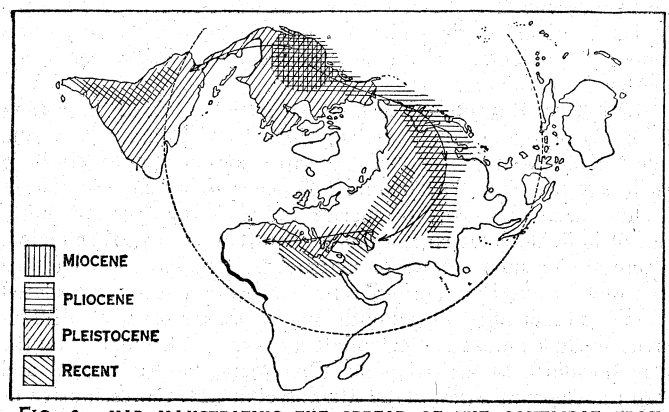

FIG. 2.—MAP ILLUSTRATING THE SPREAD OF THE CAMELIDAE FROM THEIR EVOLUTIONARY HOME IN NORTH AMERICA

In the Arctic zone there are polar bears, arctic foxes, musk oxen, reindeer, lemmings and arctic hares, all of these animals extending round the north pole over the northern lands of Asia and Europe as well as those of North America.

The wooded region includes shrews and the American moles among insectivores; the Canadian porcupine, chipmunks, muskrats, woodchucks, lemmings, beavers and hares among rodents. The carnivores are represented by pumas and lynx, the grey wolf, foxes, bears, otters, skunks, raccoons, wolverines, marten, weasels and the American badger. The artiodactyls are deer of types found in Asia and in Europe—the wapiti corresponds to the red deer, the moose to the European elk and the caribou to the reindeer; mountain sheep and the peculiar Rocky mountain goat; bison extremely close to those of Europe, and various peculiarly American types of deer.

The southern part of the nearctic region exhibits faunal elements much more different from the modern Palaearctic. Such elements include the opossum, apparently not a re-entrant from South America, as might be expected; the neotropical re-entrants, like the armadillo and many types of birds unknown in the old world; and a great variety of iguanid lizards in the southwest. The southeastern forest in the United States appears to be a remnant of a forest widespread in the northern hemisphere in the Cretaceous, as shown by its floral relations with eastern Asia, and by numerous faunal elements, such as the alligator, hell-bender, and various genera of snakes. The most characteristic of the North American mammals is the prongbuck, the "antelope" of common speech in the United States, which represents a distinct type of artiodactyl, nearly intermediate between the Bovidae proper and the deer in the nature of the horns.

Palaearctic Region.—The Palaearctic region greatly resembles the Nearctic in the general character of its mammalian fauna. It contains no monotremes, marsupials, armadillos, hyracoids, Proboscidea, or Primates over the greater part of its area, though representatives of some of these groups occur in the Mediterranean region, which forms a transition between the Palaearctic and the Ethiopian regions. The following groups of animals are common

to Palaearctic and Nearctic areas:—hares and picas, beavers, marmots, ground squirrels, voles and lemmings; martens and weasels, wolverines, brown bears, wolves and foxes; elk (*i.e.*, moose), reindeer, wapiti, bison, big-horned sheep and musk ox either in identical or closely allied species. On the other hand the Palaearctic area includes certain wild sheep, goats, saiga antelope, chamoix, many peculiar deer, camels and true pigs not known in America. It possesses also a number of horses and asses, though no other perissodactyls. The desmans and some other insectivores are peculiar to the old world, as are the dormice, hamsters and jerboas among the rodents, and the tiger and the giant and lesser panda among the carnivores.

Ethiopian Region.—The fauna of Africa south of the Sahara is on the whole strikingly unlike that of the Palaearctic region, and the intervening Mediterranean area does comparatively little to bridge the gap. The mammal fauna is remarkable in that it includes a great variety of species and probably a greater number of individuals of large animals than that of any other region. There are no monotremes or marsupials. The aardvark and the pangolin (*Manis*) are curious forms, probably not closely related to one another nor to the South American anteaters. The Insectivora include among the Zalambdodonta the golden moles and the Potamogalidae known from no other regions of the world, and also the elephant shrews (the Macroscelididae), representative of a group, the Menotyphla, of which the other forms are the tree-shrews of the Malayan subregion. There are many peculiar rodents, the springhaas (*Pedetes*), molerats (Bathyergidae), crested rats (*Lophiomys*) and cane-rats together with many members of the Muridae and true hares. The Carnivora include true dogs, the hunting dog (*Lycaon*) and the long-eared fox (*Otocyon*), spotted hyaenas and the Manhaar jackal (*Proteles*), etc. There are several mongooses and civets. The cats are represented by the lion, leopard and cheetah in addition to very numerous smaller forms; ratels, zorillas and otters represent the Mustelidae. There are elephants of a distinct type, and hyraxes, of two genera which spread northward into Syria but are otherwise exclusively Ethiopian. The perissodactyls are represented by zebras and wild asses, together with two species of rhinoceroses. Among the artiodactyls there is found a remarkable variety of pigs. The hippopotamus is widely distributed throughout the region, while a dwarf form is restricted to the west coast in the neighbourhood of Liberia. The Giraffidae, including true giraffes and okapis, are restricted to the region; the chevrotains of the genus *Dorcatherium* are similar to those found in Malaysia. Deer are completely absent but the hollow-horned ruminants include not only buffaloes but also an extraordinary number of peculiar genera of antelopes. Sheep and goats penetrate into the region only in the mountains of Abyssinia.

The Primates of the Ethiopian region include lemurs belonging to two groups, the Lemuriformes, which are restricted to Madagascar and the Lorisiformes, which do not occur there but are represented by the galagos and pottos, allied to animals living in the Oriental region. Monkeys belonging to the two sub-families of Cercopithecinae and Semnopithecinae occur throughout the forested regions. The most characteristic members of the latter are the typical baboons with short tails and elongated muzzles; these animals are terrestrial in habit and usually live in large tribes; they are at present confined to Africa and Arabia. The dense forests of western equatorial Africa are the home of the giant apes, the chimpanzee and gorilla, which are restricted to the region.

Oriental Region.—The Oriental region proper includes the whole of India south of the Himalayas, Ceylon, Malaysia and the Malay archipelago, including Java, Sumatra, Borneo and Celebes. The region contains no monotremes and marsupials are represented only by the cuscus, which reaches Celebes. The single genus *Manis* represents the pangolins. The Zalambdodont insectivores are unrepresented, while the dilambdodonts include as special forms *Gymnura* and *Hydromys*, which are essentially spineless hedgehogs, and a variety of shrews of the genus *Soriculus*. The Menotyphla are represented by tree-shrews, *Tupaia* and *Ptilocercus*. Galaeopithecus represents a distinct order. The rodents include among many forms of wide distribution certain endemic genera of which the flying squirrels are perhaps the most striking. The carnivores include lions (now only in northwestern India), leopards, tigers, cheetahs and many smaller cats; bears, wolves, foxes and dholes; striped hyaenas, civets and mongooses. The perissodactyls include two species of rhinoceroses belonging to different genera than those in Africa, and a tapir restricted to the forests of the Malayan subregion. Pigs belonging to several species, and chevrotains of the genus *Tragulus* are not found elsewhere. Certain deer are peculiar to the region, the few antelopes include the nilghai and black buck, and there are many and unusual forms of oxen, the buffalo, the gaur and in Celebes the dwarf buffalo *Anoa*. In the mountains the tahr, gorals and takin are curious forms whose relatives are to be met with in the Palaearctic region and possibly in the Rocky mountain goat of North America. Two groups of lemurs occur within the area, the Lorisiformes, including the slender and slow lorises; and the Tarsiiformes with the single living genus, *Tarsius*. Monkeys are widely distributed, though baboons are absent from this region.

The gibbons (*Hylobates*) and siamangs (*Symphalangus*) are found only in the Malayan subregion, and the orang occurs in Borneo and Sumatra.

ANCIENT ARCTOGAEA

Inspection of the foregoing lists, which represent the existing fauna of the various zoogeographical regions, will show that although they are distinct from one another and mingle only incompletely in the transition regions, certain animals such as the tapirs, may occur in widely separated areas not now connected by a practicable land-bridge. The whole distribution of these mammals is inexplicable on the basis of the present distribution of land, water and mountain ranges; it can only be understood in the light of the history of the evolution of mammals, now known through the work of three generations of palaeontologists in very considerable detail. Perhaps the simplest method of explaining this history is to take the mammalian orders in succession and discuss the time and place of origin of their more important families and genera.

Monotremata.—It is clear that the monotremes are a group of very ancient origin, probably Triassic, but that the existing forms are highly specialized and closely related to one another. The only fossil forms known are Pleistocene and belong to the existing genera.

Marsupialia.—Polyprotodont marsupials of the family Didelphidae occur in the Upper Cretaceous of North America. Their remains are found in Eocene, Oligocene and Miocene of North America and Europe and they have inhabited South America throughout the Tertiary. The South American carnivorous borhyaenids appear to be autochthonous, while the Australian dasyurids have no relatives outside Notogaea. The pseudo-diprotodonts, the coenolestids, are represented in South America from the Oligocene to the present day, and have no other relatives. The true diprotodonts have always been Australian; *Wynyardia* from the Middle Miocene of Tasmania is the oldest known form.

Xenarthra.—In older classifications the essentially South American armadillos, anteaters and sloths were united with various old world forms as the "Edentata," a term which proves to be meaningless, since the forms in question—the pangolins, and the aardvarks—are clearly independent orders of mammals. The earliest certainly known Xenarthra are found in the Eocene *Notostylops* beds of South America. Forms in the North American Eocene appear to be related, and it is the most probable hypothesis that South America received its original stock of mammals from the northern continent via land connection in the earliest Tertiary or perhaps even Cretaceous times.

Tubulidentata.—The aardvarks of Africa include only the single genus *Orycteropus*. These have a most peculiar tooth structure, and like the pangolins and anteaters, they are really termite eaters. The range of the order extended to Europe and Persia in the Pliocene, but the earlier Tertiary history is as yet unknown.

Pholidota.—The peculiar ant and termite-eating forms known as the pangolins, covered with large overlapping scales, are found in tropical Asia and in Africa. Their fossil history is still unknown.

Insectivora.—The order Insectivora includes a large number

of forms only distantly related to one another. The Menotyphla at present represented by the elephant shrews of Africa and the tree-shrews of Malay, probably also covers a number of forms whose remains are found in Europe, Mongolia, and North America in rocks of various ages from the Basal Eocene into the Oligocene. It must be admitted however, that the evidence on which these forms are referred to the group, is very slender. Modern classifications tend to emphasize the close relations of this group with the ancestral primates.

The Zalambdodontidae, including the solenodons of the Antilles, *Potamogale* and the golden moles of Africa, together with the Madagascan tenrecs, include not only a perfectly characteristic skull from the Basal Eocene of North America but other forms extending as high as the Oligocene. At any rate the group is of such antiquity that its members have had the whole Tertiary period in which to wander over the world and could then reach any part of it that has been connected by land within that period.

The remaining insectivores, the Dilambdodonta, are first found in the Lower Eocene; the living families are comparatively modern. The erinaceoids first appear in the Oligocene of Europe, North America and Mongolia. The shrews and moles have a similar distribution, while the primitive family of lepticids is confined to the Oligocene and Eocene of North America. Thus the Dilambdodonta appear originally to have been of northern origin, occurring throughout the whole of Arctogaea and entering the southern peninsulas at some late period. *Galeopithecus* has perhaps ancestors in the Eocene of North America and of Europe.

Carnivora.—In Basal Eocene times Europe and North America were inhabited by primitive carnivores belonging to sub-orders the majority of which were not related to any living form. These extinct groups, the Acreodi and pseudo-Creodi, are represented in Europe, Mongolia, and North America in the Eocene and Oligocene, and one or two members of the latter group reached northern Africa in Oligocene times. One form at any rate lived on in India to the Miocene but none ever reached South America. The ancestors of the true carnivores, which fall within the family Miacidae, occur in Basal Eocene and Eocene rocks in Europe, Mongolia and North America. From this family there arose a whole series of forms from which the civets (Viverridae), raccoons (Procyonidae), dogs (Canidae) and Mustelidae arose.

The Viverridae are represented in the Eocene of Europe although not in that of America. They have a long history in the European Tertiary and appear in the Upper Miocene and later deposits of northern India: from a viverrid stock the Hyaenidae seem to have originated. The first forms known, both of the existing genus itself and of the intermediate genus *Ictitherium*, occur in the Pontian Lower Pliocene fauna, which stretches with minor modifications in its character from China to Portugal: no member of the group reached America.

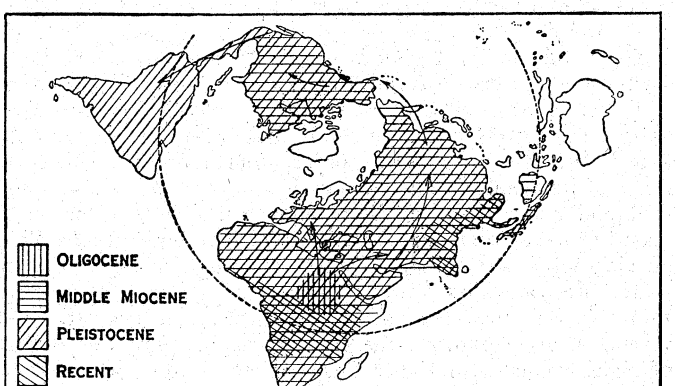

FIG. 3.—MAP ILLUSTRATING THE SPREAD OF THE PROBOSCIDEA FROM THEIR ORIGINAL HOME IN AFRICA

The mustelids first appear in exceedingly similar forms of weasels in the Oligocene of Europe, Mongolia and North America. During its later history the group appears to have been European and North American, the otters and badgers being old world and occurring in later Miocene or Pontian times in the Oriental region.

The Canidae (dogs) have a long, very elaborate and still incompletely understood evolutionary history both in the old and new worlds. One interesting feature is an early separation of the dholelike dogs from the others, dating from Oligocene times. The Oligocene forms of this group are entirely North American, but a single member at any rate seems to occur in the Upper Miocene of Europe. The living representatives are South American, African and oriental, regions which were certainly not inhabited by members of this group until late Tertiary times.

The amphicyonine dogs, which are represented in the Oligocene of North America, occur during Miocene times in both Europe and North America; from this group the Ursidae (bears) appear to have arisen, *Ursavus* being from the Middle Miocene of France and possibly related forms occur in Europe, India, China and North America. They first appear in South America in Pleistocene times.

The Procyonidae are first represented by Lower Miocene forms in North America, and no members of the group appear to have reached Mongolia or Europe. An apparent exception is provided by two animals, *Aelurus* (the panda), now living in the Himalaya, first known from Upper Pliocene deposits in west Europe, and *Aeluropus* (the giant panda), living in Tibet, found fossil in the Pleistocene of Burma. The ancestry and affinities of these forms are however still uncertain.

The Felidae (cats) belong to two independent groups, the Machaerodontinae (sabre-tooth cats) and the Felinae (true cats). Both families occur in the Oligocene of North America and Europe, and their descendants are found in these localities at every horizon between that and the Pleistocene. At this stage the former became extinct, while the latter has living representatives in both subregions. The Middle Miocene of central Africa contains the remains of a feline, and the Oriental region has been inhabited by both sabre-tooth and true cats since Miocene times. Cats of both types first appear in South America in Pliocene deposits. The group appears to be of northern origin and to have colonised the southern projections of Arctogaea during the Miocene at a time when many migrations were taking place.

The Proboscidea first appear in Upper Eocene rocks in Egypt as a small animal, *Moeritherium*, which presents the first traces of their characteristic specialisations. In the Lower Oligocene of Egypt this animal is still found and is there accompanied by its descendant *Palaeomastodon*. This genus gave origin to the later Proboscidea, its immediate descendants being included under the somewhat vague term "mastodon." Mastodons appear in the Lower Miocene of North Africa, Baluchistan and Europe and by mid-Miocene times had reached China and North America. Subsequently in Upper Pliocene times mastodons of special type migrated southward and lived on into Pleistocene times in South America.

The true elephants arose from the mastodons, and their earliest representatives are found in the Pliocene of India. Then they migrated outward, reaching Europe in the Pliocene and North America in Pleistocene times, but they never reached South America.

All the Holarctic members of the order died out at the end of Pleistocene times, one of them, the mammoth, which became adapted to Arctic conditions, living along the front of the great ice-cap which covered northern Europe and North America, until the ice finally disappeared, perhaps about 8000 B.C.

Hyracoidea.—The Lower Oligocene rocks of Egypt which contain the remains of *Palaeomastodon* yield also several genera of large hyracoids. The next representatives of this order are very small animals found in Middle Miocene rocks near Victoria Nyanza, and in South West Africa. In the Lower Pliocene Pontian fauna of Samos and Pikermi near Athens, they are rarely represented by a very large form. The existing animals are Ethiopian, except for a few individuals found in Syria and Arabia. The order thus appears to have arisen and carried out its evolution in Africa. The Lower Oligocene of Egypt also contains the remains of two orders, the Barytheria and Embrithopoda, no representatives of which are found elsewhere. Its fauna

is therefore very isolated and contains only certain creodonts and anthracotheres of northern origin.

Notoungulata.—This extinct order of herbivorous mammals was until recently known only from South America, where it exhibits a number of evolutionary series. Most of these series can be traced upwards from the Eocene (Notostylops beds) of Patagonia into the Miocene or Pleistocene, although it has to be recognized that most of such series are only approximate. A single lower jaw of a member of this order has been found in the Lower Eocene of North America, and more abundant remains of a different genus occur in rocks (the Gashato beds in Mongolia) whose age is not certainly known but is probably Basal Eocene. This animal appears to be the most ancient member of the family yet discovered, and suggests that the group was of northern origin, although its later evolution took place entirely in Neogaea.

Condylarthra.—The Basal Eocene of North America contains numerous remains of small animals that appear to represent a primitive group from which various types of hoofed animals have arisen. The descendants of some of these forms lived on into the Lower Eocene and in a modified form, as the Amblypoda, even to the Upper Eocene. These latter forms had their headquarters in North America, but a single representative of them, of Upper Eocene age, has been found in Mongolia. The Basal and Lower Eocene of Europe contain a few animals which are probably condylarthrans, and the earliest Eocene members of the Litopterna (a group restricted to South America) are essentially identical in structure. Thus this group gives a further indication of the uniformity of the Basal Eocene fauna throughout the Palaearctic region, and of the probable derivation of the South American fauna from members of this widespread group of animals, which, becoming isolated about the beginning of Tertiary time, and not being exposed to the competition of the northern groups, carried on an adaptive radiation, leading to the evolution of many very peculiar groups.

Perissodactyla.—Perissodactyls first appear at the bottom of the Lower Eocene in Europe and North America as small animals, presenting a very uniform structure and including the ancestors of the half-dozen families into which the group becomes divided.

The first of these, the Equidae (horses), is represented in North America at every stage of the Tertiary from the Lower Eocene to the Pleistocene. The remains of these animals provide the longest and most complete evolutionary series known. It is therefore very remarkable that no remains of horses have been found below the Lower Pliocene in Mongolia and China. Horses extremely similar to those of North America, but forming a less complete evolutionary series, are found in Lower, Middle and Upper Eocene rocks in western Europe, and this region possesses the only representatives of a small group, the palaeotheres, which, derived from a horse-stock, reached a large size and very peculiar structure as early as the Upper Eocene, becoming extinct in Lower Oligocene times.

No representatives of the true horses are found in Europe in the Oligocene, and the single form, *Anchitherium,* in the Middle and Upper Miocene, belongs to an aberrant group of forest animals also represented from the Middle Miocene to the Lower Pliocene in North America and in the Lower Pliocene of China. Only in the Lower Pliocene Pontian fauna from China to Portugal and in India, do we again meet with typical members of the horse family in individuals of the genus *Hipparion.* The living genus *Equus*, which is not a descendant of *Hipparion,* appears suddenly in the Upper Pliocene of India and western Europe. South America received its horses in Pliocene times from North America, the peculiar genera of that continent having arisen from a North American Pliocene genus.

The Tapiridae have a probable ancestor in the Lower Eocene of North America and unquestionably ancestral tapirs occur in the Oligocene of Europe and North America. The group appears to have survived in North America until Pleistocene times, reaching South America after the two continents became connected in the Pliocene. In Europe and Japan a Lower or Middle Miocene form is known, and the living genus is represented in Upper Miocene and Lower, Middle and Upper Pliocene deposits. A gigantic form twice the size of the existing ones occurs in the Pleistocene of China. No representatives of this family appear to have been discovered in the Tertiary rocks of India, but it is clear that the existing Bornean form must have reached that region from the Palaearctic region.

The lophiodonts, a group allied to the tapirs but restricted to Eocene and Oligocene times, include cursorial forms, and occur not only in North America and Europe but also very abundantly in Mongolia.

The rhinoceroses present a very complicated evolutionary story not yet fully understood. One primitive group of animals, the amynodonts, somewhat hippopotamus-like in their adaptations, occur in Eocene and Oligocene rocks in Europe, Mongolia, Burma and North America. The cursorial hyracodonts are known only from the Eocene and Oligocene of North America and Mongolia, whilst their associates of such genera as *Diceratherium* occur both in Europe and North America. The evolution of the more normal rhinoceroses is still so little understood that it is impossible to discuss their dispersal; it is however clear that creatures essentially ancestral to the living Sumatran rhinoceroses occur widely spread in the Upper Pliocene and Pleistocene of Europe, in association with forms allied to the African rhinoceroses. The living Indian rhinoceros has apparently been derived from forms present in that area in Pliocene times. One remarkable extinct rhinoceros, *Elasmotherium,* found in the Lower Pleistocene of Russia and Siberia, and very rarely in Germany, has an ancestor in the Pliocene of China.

The Titanotheriidae is a small family of perissodactyls whose first representatives are found at the top of the Lower Eocene of North America. They underwent a very rapid evolution in that continent, soon attaining a gigantic size and a very highly specialised character. In the Middle Eocene of Transylvania a single lower jaw has been found. In the Upper Eocene of Mongolia typical members of American genera of similar age are to be found; fragments of very nearly allied animals have been described from Upper Eocene rocks in Burma, and in the Lower Oligocene of North America and Mongolia their remains are abundant. A few fragments have occurred in presumably Oligocene rocks in eastern Europe, but none have been found in the thoroughly explored deposits of this age in western Europe.

The only remaining group of perissodactyls, the chalicotheres, has a possible ancestor in the Middle Eocene of the United States. It then occurs in the Oligocene both of Europe and North America, is found in Middle Miocene times in India, and is a member of the Pontian fauna of southern Europe. It occurs in the Pleistocene of Central Africa after it had died out in other parts of the world.

The history of the Perissodactyla is of very great importance for the study of geographical distribution as so many fossil forms of the group are well known that relationships existing between the various members can be established with greater certainty than is the case in any other order of mammals. Furthermore many of its members were strange looking animals whose abundant and unmistakable fossil remains make the evidence with regard to its distribution during past times of peculiar reliability. Judging solely from the perissodactyls, it would appear that in Lower Eocene times Europe, Mongolia and North America formed a continuous land-surface, presenting such a variety of vegetation as to allow of the free passage of forest as well as of plains animals. In Upper Eocene times Europe became partially separated from North America, so that certain groups, the palaeotheres and the titanotheres, which are swamp and forest forms, were unable to emigrate freely from one region to the other. Horses however still occurred in very similar forms in the two regions. In Oligocene times this differentiation of fauna became exaggerated, the two areas becoming completely separated from one another. The intense earth movements of Miocene times so altered the geography of the world as to reunite the Palaearctic and Nearctic regions and many forms are common to the two regions at this period. In the succeeding Lower Pliocene

rhinoceroses are very abundant and varied in the Palaearctic and Oriental regions, while they are much more seldom found in America. Oligocene Africa had no perissodactyls but by mid-Miocene times a rhinoceros had reached that continent. South America was colonized by horses and tapirs in Upper Pliocene times, but no member of the group ever reached Notogaea.

Artiodactyla.—General discussion of the past distribution

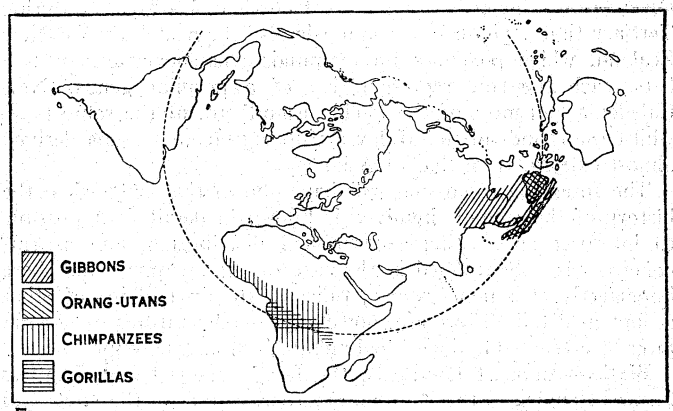

FIG. 4.—MAP OF THE WORLD SHOWING THE DISTRIBUTION OF THE LIVING GREAT APES

of the artiodactyls is rendered difficult by the uncertainty which exists as to the classification of that group.

In the Lower Eocene of North America and Europe occur the most primitive forms, and their successors in the Middle and Upper Eocene are similar in these two regions, but in Upper Eocene times certain special groups make their appearance which are restricted to one or other of the two continents. In North America the ancestors of the camels are found at this time and the entirely American family of the oreodonts is represented. In Europe the Anoplotheriidae take the place of these latter forms, and the long-lived family of the Anthracotheriidae appears as small animals.

In the Oligocene the descendants of all these groups are found and a strange creature *Elotherium*, resembling a gigantic long-legged pig, is represented by very similar forms from both sides of the Atlantic. In this period both in Europe and North America there are peccarylike creatures, and perhaps true pigs in Europe: the anthracotheres reached America at this time but only one of the very large number of European and Indian genera ever reached that continent.

In the Lower Miocene in Europe and Baluchistan there was an amazing variety of anthracotheres ranging from forms as small as a sheep to great creatures as big as a hippopotamus. The last representative of the anthracotheres occurs in rocks of probable Upper Pliocene age in India and Tunis.

It is quite possible that the hippopotamus arose from the anthracotheres. The animal is clearly of Oriental origin, reaching north Africa and Europe in the Upper Pliocene, and widespread over Java, India, Europe, Africa and Madagascar in Pleistocene times.

The camels carried out the whole of their evolution in North America, where they are now extinct. They first left that continent in Lower Pliocene times, a large member of the group occurring in the Lower Pliocene of China, and in India in rocks perhaps of somewhat later date. The llamas reached South America in the Pliocene and a llamalike form survived in North America into Pleistocene times.

The higher artiodactyls (Pecora) are represented in the Upper Eocene of Europe and North America by small animals resembling the existing tragulines. This group of primitive artiodactyls includes one animal *Archaeomeryx* from the Upper Eocene of Mongolia, which is the earliest known form capable of being regarded as a direct ancestor for the Pecora. In Oligocene deposits in Europe, and in Lower Miocene times in Europe and North America occur the remains of animals which are more certainly deer. Deer have a continuous representation in both continents from that time to the present day but the earlier American forms appear to be related to the Virginian deer and its allies, the typical genera being of Asiatic and European origin. The antelopes and their allies first appear in the Lower Miocene of Europe, and the group appears to be definitely of old world origin. It is abundantly represented in the Pontian fauna from China to Spain and is now the most conspicuous element in the Ethiopian region. Antelopes first appear in North America in the Upper Miocene, but are extremely rare there. The history of the group is however still uncertain. The true oxen are clearly derivatives of the antelopes, and the earliest known and most primitive forms occur in the Lower Pliocene of India: they reached Europe in Upper Pliocene times and America only in the Pleistocene. The ancestry of the goats and sheep is still uncertain but the first definite members of the group appear in the Pliocene of India. In North America from the Middle Miocene to the present day there occurs a distinct family of Pecora, the Antilocapridae, represented now only by the prong-horned antelope. No member of the group has ever been found elsewhere.

According to Pilgrim, the earliest known relative of the giraffe is found in the Lower Miocene of Baluchistan: in the Lower Pliocene the group is represented by very varied forms, some gigantic, some indistinguishable from the living giraffes and others nearly similar to the okapi. These occur throughout the entire distribution of the Pontian fauna from China, Persia, South Russia, Samos and Pikermi. Their remains are not found in German deposits of the same age. No fossil giraffes are known from Africa, the only continent at present inhabited by the family, nor did any member of the group ever reach North America.

Primates.—The lowest division of the Primates, the Lemuroidea, is first recognised with certainty in rocks of Lower Eocene age in North America and Europe. These remains belong to two very distinct groups, the Lemuriformes, with a complete dentition and a comparatively elongated face, and the Tarsiiformes, in which the tooth-row is shortened, the eyes are large, the olfactory region and face very small, and the lower jaws meet in front at an acute angle. Representatives of these two groups are found in the Middle and Upper Eocene in Europe and America, and both continue in the Oligocene of Europe, but disappear at this period in North America. The two groups are then unknown in the northern hemisphere, but the Lemuriformes reappear in the Pleistocene of Madagascar in a most varied series of forms, and the Tarsiiformes are represented by the single living genus *Tarsius* in the East Indies. Nothing is certainly known of the remaining group of lemurs, the Lorisiformes, but it is conceivable that *Pronictycebus* from the Upper Eocene of France represents their ancestor.

The higher Primates fall into two completely separate divisions: the platyrrhine and catarrhine apes respectively. Of these the platyrrhines are first found in the Miocene of Patagonia, and none of them occur outside that continent. The first catarrhine is *Parapithecus* from the Egyptian Oligocene, a primitive form presenting distinct points of resemblance to the tarsioids. Associated with this animal is *Propliopithecus*, which is beyond question a member of the highest family, the anthropoid apes. The earliest members of the lower families of old world apes occur in the Lower Pliocene throughout the range of the great Pontian fauna. Their distribution presents one or two points of interest, *e.g.*, the typical baboon is known from the Pleistocene of India, and another strange form closely allied to the living gelada has been found in the east African Pleistocene. The giant apes have a more complete representation as fossils, a fact which is remarkable when the relative rarity of the living groups is taken into account. *Pliopithecus* from the Middle and Upper Pliocene of Europe appears to be essentially an ancestor of the gibbons, whilst the genus *Dryopithecus* has a wide distribution in Europe and Asia in the Middle Miocene and in somewhat later rocks. The closely allied *Sivapithecus* has been claimed as a human ancestor but really presents no definite evidence of such affinities. From *Dryopithecus* and its immediate allies the living giant apes certainly arose, and such evidence as exists is consonant with the view that man also came from the same stock.

CONDITIONS OF DISTRIBUTION

The outline of the history of land-mammals contained in the preceding pages shows that the present distribution of a mammal may tell us nothing whatsoever about the place of its origin, or the time at which it came into its existing habitat. All the great land-masses of the world except Australia and Madagascar have been continuous with one another at some time during the Tertiary period and representatives of all the higher orders have been enabled to cross the bridges between them. The fact that each continent none the less has a distinctive fauna, is because of the extinction which has overtaken the members of every group in some portions of its former range, the differences in the period at which the union of the continents took place, and the peculiarities in the geographical conditions of the bridges which made them available to certain forms whilst they could not be crossed by others. The geographical conditions which may act as barriers to the free dispersal of mammals are very varied. A wide strait of sea cannot be crossed by most mammals but there is evidence that certain creatures have in fact reached islands by some rare and casual mode of distribution not available to most forms.

Madagascar.—Perhaps the best evidence of the possibility of such transference is afforded by Madagascar. Taking the Pleistocene and recent faunas of that island together, we find that it is inhabited by very many genera of lemuriform lemurs, varying in size from animals no bigger than a squirrel to a form with a skull more than a foot in length. Although all the living and the majority of the extinct forms are strictly arboreal some of the larger lemurs were terrestrial and even perhaps aquatic in their habits. There is however no doubt that all these forms despite their very varied appearances are extremely closely related and that they may all have arisen from a form resembling *Lemur* itself.

The only other important element in the Madagascan fauna is the group of many genera included in the Zalambdodont insectivores. All these belong to the single family Centetidae and may have arisen from a single form. The carnivores are represented by a few genera of Viverridae, all extremely peculiar in their structure; the largest and most interesting is the fossa, an animal whose true relationships are obscure. There is another viverrid, *Eupleres,* with very small widely-separated teeth like those of an insectivore, and finally there is a much more typical viverrid, perhaps belonging to *Viverrus* itself. The rodents are included in the single family Nesomyidae, peculiar to the island. The only other forms are bats, including the fruit-bat *Pteropus* not found in Africa, a pig of the genus *Potamochoerus* and a pigmy hippopotamus now extinct.

This fauna is clearly quite different from that of any other part of the world and gives a sound basis for the establishment of Madagascar as an independent region. We know that *Hippopotamus* only came into existence about at the end of the Miocene times and that it first reached Africa in the Pliocene: it is therefore clear that it must be a relatively recent immigrant. If it had crossed over a land-bridge it would necessarily have been accompanied by those other elements of the African fauna which live in close association with it. We should in fact expect to find in Madagascar representatives of those antelopes which live in the forests or swamps which border rivers, the Cape buffaloes and elephants, true monkeys, and an assemblage of carnivores which prey upon them. The complete absence of such forms implies that the hippopotamus did not cross on dry land and it is probable that it reached Madagascar by swimming. The pig is also a water-loving form and may also have swum across. It is clear from their many peculiarities that the viverrids have lived longer in Madagascar: they cannot have crossed on land because of the absence of any associates, and it is most improbable that they swam. The lemurs represent a group well established in Eocene times and their wide radiation again implies a long residence. Finally the centetids are known to have existed in North America in the Basal Eocene. Neither group could have crossed land-bridges without bringing with them other forms, so that it seems clear that they were transported by some other method, the only plausible suggestion is that they crossed on rafts of tangled vegetation washed down from the great rivers, forerunners of the Limpopo and Zambezi, which drained Africa throughout Tertiary times.

Madagascar, in the absence from its fauna of most ungulates and carnivores, is representative of all those islands which have never been connected with the great northern land-masses during Tertiary times. Of such "oceanic islands" the next largest is New Zealand, which possesses no mammals whatsoever except two bats, each the sole representative of a peculiar genus. New Caledonia and most of the Pacific islands are of the same type, whilst the islands of the Malay archipelago have a fauna derived almost entirely from that of Asia.

The foregoing discussion will have shown that only when the history of the animals involved is known in detail, is it possible to interpret an existing geographical distribution, and as this condition is only fulfilled in the case of the mammals and there imperfectly, it is unnecessary to discuss the distribution of other groups in detail. There are, however, certain features of general interest presented by individual members of other groups.

Birds.—Amongst the birds, the large cursorial and flightless forms belonging to the Ratitae, are represented by the emus and cassowaries of Notogaea, the rheas of South America and the ostrich of Africa and Arabia. Extinct ostriches were abundant in Pleistocene times in China and Mongolia, and have been found in the Upper Tertiary of India and the Lower Pliocene of Samos, in association with that great fauna which we have seen to include the ancestors of the living African animals. In addition, in the Pleistocene of Madagascar, there is a series of birds (*Aepyornis*) one of which is the largest known bird, standing some 12 ft. high, with an egg with a capacity of 2 gal. A similar group of forms, very variable as to size and proportions, lived in New Zealand long enough to be hunted by the Maoris, and filled in that island the rôle more normally assumed by ungulates. The occurrence of these giant flightless birds in continental areas is interesting because flightless representatives of other groups are generally restricted to islands where they were not exposed to the attacks of carnivorous mammals: of such forms the most familiar is the dodo, probably allied to the pigeons, which formerly lived in Mauritius, whilst a similar form occurred in Rodriguez. The Chatham islands were inhabited by a whole series of flightless rails.

Reptiles.—The reptiles present an example of a group of animals whose modern distribution is limited by temperature while the broad features of their distribution exhibit much more ancient origins and dispersals than do the mammals. The European reptilian fauna is much impoverished. The British Isles are very nearly at the extreme northern limit of reptile existence, and are inhabited by very few forms; the mud tortoise, *Emys,* which lives in Belgium, is incapable of maintaining itself in England.

While the majority of the orders and families of reptiles are circumtropical or are limited to the tropics in one or more of the tropical regions, there are notable examples of what appear to be relicts of southward dispersal and of dispersal via the Alaskan Holarctic connection. The occurrence of the amphisbaenid lizards, for example, in lower California and Florida, with fossil finds from Mongolia and South Dakota, is such an indication, as is the linking of the two species of true alligators, one in the southeastern United States and one in eastern China by numerous extinct species in western North America.

Amphibia.—The distribution of Amphibia presents some interesting and puzzling features. The caecilians, probably the most archaic group, are strictly confined to the Tropics and occur in the Neotropical, Ethiopian and Oriental regions. The salamanders, a very ancient group, are not now represented in Notogaea. They are at present most abundant and varied in the temperate zone of eastern Asia and North America. The distribution of frogs cannot be intelligently discussed owing to our lack of knowledge of the history of the group.

Fresh-water Fishes.—The distribution of fresh-water fish does not fall easily into the zoo-geographical regions established for

the mammals, a fact which is remarkable because the bony fish are in the main a Cretaceous and Tertiary group. The most archaic of living vertebrates, the lung-fish *Neoceratodus,* now lives solely in two small rivers in southern Queensland, but remains of the same genus have been found in the Pleistocene of South Australia. *Ceratodus* itself is a Triassic form found widely spread all over the world in fresh-water deposits. It is clear that the present restricted distribution has resulted from the extinction of this fish over the greater portion of its former range. The other two dipnoans, *Lepidosiren* of South America and *Protopterus* of tropical Africa, are very closely related to one another, but differ materially from *Ceratodus*. A specimen of *Protopterus* has been found in the Oligocene of Egypt, proving that the group is an ancient one, and its present distribution must depend on factors incapable of analysis. *Polypterus* and its close relative *Calamoichthys,* which are the much modified descendants of the Palaeozoic Palaeoniscidae, are now restricted to tropical Africa, but isolated scales perhaps of the same type occur in the Eocene of Egypt. The sturgeons, belonging to a group which first appears in the Lower Jurassic, are remarkable for their restriction to the temperate waters of the northern hemisphere, where are found all the members of the two existing families. That the only two other living ganoids, the bowfin and the garfish, live in temperate parts of North America, and that both are known from the Eocene of Europe, shows yet again how present distribution may give no clue to former extent of range.

One peculiar family of bony fish, the cichlids, extraordinarily abundant in the great lakes of equatorial Africa, is represented in equal numbers in tropical America, a phenomenon which with the similar distribution of lungfishes and octodont rodents has led to a belief that South America and Africa were connected by a land-bridge until late in Tertiary times. The distribution of mammals makes this view untenable, and when the fossil history of the cichlids comes to be known, it will probably be found either that they once occurred in the northern hemisphere or that the African and American forms are not really closely related. It is impossible to deal in this article with the distribution of invertebrates but the matter is dealt with in the articles dealing with individual groups.

Marine Animals.—The distribution of marine animals depends on many factors. To a considerable extent it is controlled by temperature, many marine forms being capable of life and reproduction only within a narrow range of temperature variation. The seas may be divided into the open oceans and the shallow waters into which detritus derived from the land is carried by rivers.

In the ocean, animals may inhabit three regions; they may live in the surface layers (40 fm.) to a depth where the light intensity becomes negligible and growths of plants is no longer possible: or they may inhabit the midwaters (roughly 40–2,000 fm.) depending ultimately for their food-supply on the remains of dead animals and plants from the surface: or they may live on the ocean bottom even at depths approaching 3,000 fathoms. The fauna of the sea-bottom lives under remarkably uniform conditions; light is absent, the temperature is not far above freezing point, all the food which reaches this region has fallen from the surface of the sea and the bottom is usually soft mud. The abyssal fauna is nearly uniform over the whole world: it includes the great majority of known species of the primitive hexactinellid sponges, and most of the phyla of the animal kingdom are represented, often by forms peculiar in structure and belonging to groups restricted to deep water. Although a more detailed study shows that species and genera may range over only comparatively small areas of the ocean floor, the abyssal fauna is nevertheless remarkably distinct from all others, nearly all its members being recognizable as such at sight.

The free-swimming fauna of the mid-water includes certain radiolarians and medusae. The Crustacea are represented by many forms of prawns, usually bright red in colour, and by a gigantic ostracod. The Mollusca include pteropods and cuttle-fish, but the most abundant forms are fish, very characteristic in their possession of light-producing organs, their black, and in shallower water, silvery colour, and the presence of very large or excessively small eyes.

The pelagic fauna of the surface layers of the ocean consists mainly of transparent animals of delicate structure; it includes the foraminiferan *Globigerina* and many radiolarians, innumerable representatives of the dinoflagellates, some brilliantly phosphorescent, medusae and the floating siphonophores, familiar as the "Portuguese man-of-war." The arrow-worm *Sagitta* is often abundant and certain polychaet worms are of universal occurrence. The Crustacea include immense numbers of copepods, usually very small forms living on diatoms. Other small Crustacea belonging to the Ostracoda are plentiful, while of the higher Crustacea, the schizopods may form a large proportion of the catch. The pelagic molluscs belong largely to the pteropods:

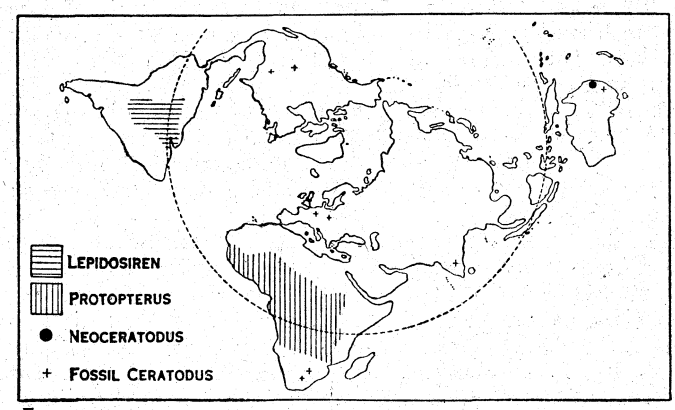

FIG. 5.—MAP OF THE WORLD SHOWING THE DISTRIBUTION OF THE DIPNOI AND THE PLACES WHERE EXTINCT MEMBERS OF THE GENUS CERATODUS HAVE BEEN FOUND

lamellibranchs are absent and gastropods represented by a few special forms. Cephalopods probably form an important element in the pelagic fauna and tunicates belonging to the appendicularians, salps and *Pyrosoma* occur abundantly. The oceanic surface fishes include forms allied to the herrings, with many representatives of the mackerels, flying-fishes and gar-fishes.

The distribution of those animals living near the coast depends very largely on local features such as the nature of the bottom, the salinity, the acidity of the water, the temperature and temperature range, the nature of the currents, and other factors which can only be determined in each individual case. It is therefore impossible to deal with them in this article, but an account will be found in the article DISTRIBUTION OF ANIMALS.

The faunal realms, regions and provinces of the ocean as a whole are far less sharply defined and have received much less attention than has the corresponding zoogeographic partition of the animal life of the land. The distribution of fishes and other animals of commercial importance, however, has been much studied. The subject as a whole has been summarized by A. E. Ortmann (1896) and Sven Ekman (1935).

The primary partitions of the life of the sea, like those of the life of the world as a whole, are essentially ecological. Before geographic distributions can be compared, it is essential to sort the animals into the benthic (bottom-dwelling) types and the pelagic types of the open sea. Within these ecological types, it is useful to distinguish the littoral from the abyssal benthic forms, and to make a similar distinction between the surface zone pelagic forms and the free-swimming forms of the deep sea.

Within these limitations of comparison of faunae, striking geographic features of distribution appear. The secondary partition of the oceanic faunae is clearly dominated by the temperature zones of the sea, modified and confused as they are by the great ocean currents. Arctic, north temperate, tropical, south temperate and antarctic zones are distinguished, often characterized by species and genera rather than by families and orders as is the case with the main faunal divisions of the land.

The tropical belt, with the coral reef habitat strictly limited to it, has a vastly more diverse animal life than have the colder zones. This tropical belt is sharply isolated into the Atlantic and

the Indo-Pacific segments by the land barriers set by the American continents and by Africa and the Isthmus of Suez. It is at first glance extremely astonishing to find that the American land barrier is not the principal partition of the tropical zone at all. The two coasts of Central America prove to be inhabited by distinct faunas between which direct and close relations, species by species, may be traced. For the most part the species of the two coasts form related pairs, the so-called "germinate species." These are of course readily explainable as the result of the long continued Tertiary connection of the Pacific and Atlantic in the Central American region, plus the subsequent species divergence with isolation after the elevation of the Panama connection of the two continents. The marine relations accordingly corroborate the evidence of the South American land fauna.

The major break in the tropical zone is the great area of open ocean between the Americas and the Marquesas and Hawaiian Islands. The maximum wealth of benthic life is centered in the Australasian region, in the shallow island-rich waters between Australia and southeastern Asia. The rich paleontological record of the Mediterranean region indicates that the absence of a large part of this fauna from the Atlantic is the result of progressive extinction and impoverishment during the climatic vicissitudes of the Tertiary.

In the foregoing account it has been assumed that the great continents have been stable in the sense that they contain within themselves great areas, such as Mongolia, eastern Canada, west Australia and south and central Africa, which have been dry land for a period vastly greater than that within which the adaptive radiation and distribution of the mammals has taken place. The truth of this assumption is abundantly demonstrated by geological observations, but the further belief that these old land masses have always occupied the same positions with respect to one another and to the poles has been seriously questioned by A. Wegener.

Wegener holds that in Upper Carboniferous times the whole of the dry land of the world was concentrated into one great continent, subdivided to some extent into independent areas by shallow seas, but essentially continuous. The south pole lay within this land mass in what is now Portuguese West Africa.

The present continents are thought to have arisen from this mass by an actual horizontal displacement, the present coasts, or more accurately the margins of the continental shelfs which face one another across the Atlantic and Indian oceans having formerly been in actual contact. By such drift the Americas were torn away from the western coast of Europe and Africa. Australia and Asia drifted away from Africa on the other side, and the island festoons, New Zealand, the Antilles, Madagascar, etc. have been detached from the neighbouring coast of a continent. These great movements naturally produced great pressures on those continental margins which lay in the direction of motion, and led to the uprising of the coastal mountain ranges which are a marked feature of the earth's morphology.

The continental drift did not take place freely, the large land masses twisted round with respect to one another and became deformed, so that their margins in many cases no longer fit accurately, and small land bridges between the continents persisted long after the main masses had become widely separated.

This remarkable view has been accepted by some geologists and has geological evidence behind some of its basal assumption. Jefferys, however, points out that on geophysical grounds any movement of the continents at all should result in the accumulation of the land masses in the equatorial belt.

Wegener was first led to the proposal of his theory by a consideration of the evidence from the distribution of animals for the former existence of a land bridge between Africa and Brazil. Wegener's view has the very great merit of explaining simply the remarkable facts of the distribution of that peculiar flora, the Glossopteris flora, which in South America, the Falkland Islands, South Africa, Madagascar, India and Australia occurs in late Carboniferous and Permian rocks, usually in association with boulder clays and other evidences of an ice-bound land and arctic climate. It accounts for similarities in the Triassic reptilian faunas of Brazil and South America regions and the extreme resemblance between the land and shallow sea faunas of North America and Europe in Carboniferous times.

But a continuation of these and other land bridges into late Tertiary times, which has been suggested on the evidence of the present distribution of land snails, earthworms and similar groups, seems to be negatived by the distribution of mammals, in which, as W. D. Matthew has shown, the existing distribution of land masses together with a few former land bridges, such as that connecting Asia and America through the Aleutian Islands, are sufficient to account for all the observed facts. The evidence of mammals far outweighs in value that of every other group, because for them alone have we any considerable knowledge of the history of the individual groups.

(D. M. S. W.; K. P. S.)

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ZOOLOGICAL NOMENCLATURE is the system by which names in Latin form are applied to the various divisions of the animal kingdom, especially those of genera and species. Names of higher groups, such as orders, classes and phyla, are relatively few in number and are often determined by common consent rather than strict rules. Although essentially the same in principle and largely in practice, zoological nomenclature is independent of botanical nomenclature. Therefore, the use of a name in botany does not preclude the acceptance of the same name in zoology. The system is binary and (with rare exceptions) binomial, following its first consistent use by Linnaeus in the 10th edition (1758) of his *Systema Naturae*. Prior to that date animals were designated by single words or by descriptive phrases, the so-called polynomials. The advantages of a two-name system were at once recognized; one name for the genus and one for the species. Thus the genus *Felis* included various kinds of cats, such as *Felis leo, Felis tigris,* etc. With increased knowledge and refinements of classification, a third name was approved, that of the subspecies or variety to indicate a subdivision (usually geographic) of a species. This produced the trinomial, as *Felis leo senegalensis*.

In spite of the apparent simplicity of the Linnaean system there was much confusion in its early use, and in 1842 there was issued a set of rules (Stricklandian code) sponsored by the British Association of Science. This laid down certain principles which were still followed in 1945, but complications arose and practice was far from uniform. Other codes appeared, notably those of the Sociéte Zoologique de France and the American Ornithologists' union, the last extensively followed in the United States. The Americans fixed the date 1758 (Linnaeus, 10th ed.) as the beginning of nomenclature, whereas the British used 1766 (12th ed.), thus causing a lack of uniformity.

The need for world-wide agreement was seriously considered at the first International Congress of Zoology (Paris, 1889), but it was not until 1902 that an international code of zoological nomenclature was adopted and published by the congress, following the unanimous recommendation of a commission which had been appointed, consisting of 15 members (later increased to 18) representing ten different nations. The president of the original commission was the French zoologist, R. Blanchard, and the secretary the American, C. W. Stiles. The code was something of a compromise, and power to alter it was restricted to the congress with the commission limited mainly to recommendation and interpretation, but various congresses down to that at Lisbon (1935) made a few amendments, and the powers of the commission were

somewhat increased. Zoologists of all countries supported the code and followed its rules so far as possible, but many cases proved so equivocal that they were submitted to the commission, which began to issue a series of "Opinions" (more than 150 by 1945), most of which were accepted and given the force of law. In special cases, the commission was empowered to make arbitrary decisions, and it began the compilation of an official list of generic names which was to be inviolate. A serious difficulty has been the delay in obtaining decisions because of the infrequency of meetings of the congress.

The basis of the rules is the law of priority: "The name of a genus or species can only be that name under which it was first designated." With the re-examination of literature and the changing concepts of zoological groupings, the rigid application of this law has been difficult and elimination of long current names has often been necessary. However, it has been the spirit of the rules that no name be changed except upon convincing evidence. Personal opinion or preference has been largely outlawed and it has been necessary to disregard inferences as to an author's intention and to make judgment solely on his printed record.

The law of priority is not strictly applied to family names, but they are always formed by adding *idae* to the root of the name of the typical genus, and subfamily names by adding *inae*, as Felidae and Felinae from *Felis*. A subgeneric name is governed by the same rules as those applying to generic names, but when written is enclosed in parentheses after the generic name, *e.g., Felis (Lynx) canadensis*. A proper name following a specific name is that of the authority or first proposer of the specific name; if his name be in parentheses it indicates that the species was originally described under a generic name different from the one now combined with it; *e.g., Psittacus linnaei* (Wagler).

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ZOOLOGY, the study of animals. The science of zoology embraces all conceivable modes of study, not only of individual animals but of entire faunas and of the relations of animals with one another, with plants, and with the nonliving environment. Because of its vast scope, zoology is usually broken up into several subsidiary subjects of which the chief ones are: morphology or anatomy, histology and cytology, embryology, palaeontology, taxonomy or systematics, genetics and evolution, ecology and physiology. As special articles under these names will be found in the encyclopaedia, only a brief survey can be attempted here of the main findings in the various fields of zoology, with special emphasis on morphology and classification. Although animal physiology, strictly speaking, is a branch of zoology, it is usually considered an independent science and will not be treated here.

MORPHOLOGY

The study of zoology undoubtedly had its origin from the observation that there are many different kinds of animals. The more obvious and easily discovered characters that distinguish animals from one another are the external ones: differences in body shape, size and colour, character of the skin and its derivatives as scales, hair and feathers, presence of prominent sense organs, such as eyes and ears, and presence of legs or other appendages. But it soon became clear to zoologists that external appearances alone will not provide understanding of the animal kingdom, thus they were driven to a study of internal structure. Anatomical investigations of this character were carried out at first entirely by dissection of the animal's carcass with knives, scissors and other instruments, a technique that, in skillful hands, can yield an astonishing amount of accurate information but which is necessarily incapable of revealing many structures, either because they are too small to be seen or are otherwise undiscoverable. Progress in anatomical investigation, therefore, had to await the introduction of the microscope (toward the end of the 16th century). The possibility of magnifying an animal at once greatly extended the scope of zoology, since it enabled the structure of very small animals to be investigated and, indeed, revealed the existence of an immense variety of microscopic animals previously unknown because they were too small to be seen with the unaided eye.

Cellular Structure of Animals.—The most important revelation of microscopical study was the discovery, through the efforts of a number of workers toward the end of the 18th century and during the first half of the 19th, that animals (and plants) do not consist of a continuous mass of material, but that their substance is partitioned off by walls and membranes into an immense number of minute units, the cells. The cells of an animal are not all alike, but occur as a number of different kinds with appropriate functions, a condition known as differentiation. Cells also do not in general occur singly; but many of one kind are united in masses or sheets termed tissues. Organs such as the stomach or liver consist of two or more kinds of tissues closely associated. Thus, the body of an animal consists of cells combined to form tissues and organs.

During the last half of the 19th century great progress was made in the study of cells. It was discovered that cells have affinities for dyes similar to those used in dyeing cloth, and that with the aid of such dyes the details of cell structure are made much more visible and apparent for microscopical examination. Because only very thin objects can be studied with the microscope, methods and a machine, the microtome, were devised by which small animals or pieces of larger ones could be sliced into a series of exceedingly thin sections, and these mounted serially on glass plates for microscopical examination. By the application of such methods an understanding was attained of the internal structure of a great variety of animals. That branch of zoology which concerns itself with the kinds of cells that go to make up an animal is termed histology (*q.v.*), and that which studies the fine details of structure within the cells is called cytology (*q.v.*).

The discovery and study of the cellular structure of animals and plants resulted in the last half of the 19th century in a philosophy termed the cell theory. This theory exaggerated the importance of cells and considered them to be the vital units in which were vested all of the phenomena of life. An animal was regarded not as a functioning whole but merely as a collection of cells and its properties merely as the sum of the properties of the cells. Following a wide acceptance, this theory began to be questioned and discarded by the leading thinkers among zoologists, and is being replaced by the organismal conception, which maintains that the cells are simply constituent parts of an animal and that such phenomena as growth, form, reproduction, development, heredity and evolution are clearly manifestations of the animal as a whole, and cannot be understood merely by studying its cells.

Grades of Structure.—All combined methods of studying the structure of animals show that animals exist in several grades of structure ranging from simple to complex. Such arrangements are, of course, more or less artificial but they assist in enabling one to understand the animal kingdom.

In the first place it was soon discovered that animals are divisible into two great groups, those that are made of cells and those that are not. The latter group comprises a host of microscopic animals whose substance is not partitioned into cells, and which are thus regarded simply as consisting of one cell. These one-celled or unicellular animals are known as Protozoa. In reality, they are not equivalent to a single cell of other animals but constitute complete little organisms capable of all the functions that distinguish larger animals. Their bodies may be far more elaborately organized than any of the cells of higher animals and may contain contractile and neuroid fibrils, supporting plates and fibres of a skeletal nature and elaborate food-catching mechanisms. Although sexual processes also occur among the Protozoa, practically all of them can reproduce simply by dividing into two or more parts.

All other animals are composed of cells, although in some cases the cell walls may more or less disappear as the animal matures. These multicellular animals are termed Metazoa. They are not only composed of cells, but their cells are differentiated into a number of different kinds and are associated into tissues and organs for the performance of different functions. A metazoan animal is an individual, a unit whose cells are subordinated to the whole and are not in general capable of an independent existence or of performing all of the necessary functions as is the case with the protozoan cell.

It follows, as a necessary concomitant of the cellular differentiation of the metazoan body, that all such animals must undergo a process of development (*see* EMBRYOLOGY) during which this complication gradually arises. Although there are a number of cases among the Metazoa in which reproduction occurs by division or budding much as in Protozoa, the Metazoa generally reproduce sexually, giving rise to female sex cells or eggs, and male sex cells or sperm. The egg is large, provided with food supplies

in varying amounts and nonmotile. The spermatozoan is relatively very small and slender and provided with a locomotory apparatus for reaching the egg. When the egg is fertilized by a spermatozoan, *i.e.,* fuses with it, it starts upon a process of development during which it divides to make many cells, and these undergo differentiation. However, many Protozoa also produce eggs and sperm and undergo some degree of development so that the contrast between Protozoa and Metazoa is not as great as assumed during the heyday of the cell theory. There are, further, types of colonial Protozoa that approach the metazoan condition.

Among the Metazoa it is customary to set off one group, the sponges or Porifera, from the others because of their lowly grade of organization and many peculiarities of structure. Sponges are little more than loose aggregations of cells covered over by an epithelium. Although the cells of sponges show some degree of differentiation, they are mostly variants of amoeboid types and each can perform a number of different functions. Furthermore, sponges have no mouth or proper digestive cavity; they are permeated by systems of canals through which a continuous water current is maintained. On these grounds sponges are separated as a branch Parazoa from other metazoans which are then called Eumetazoa or Metazoa proper.

The Eumetazoa all have a proper mouth and digestive tube; they present many grades of structural complexity of which the lowest is represented by the group Coelenterata (*q.v.*). The Coelenterata illustrate the structural plan on which the Eumetazoa are based and from which the more complex members can be theoretically derived. The coelenterates are composed essentially of tissues; *i.e.,* they represent a tissue grade of construction. They consist of two epithelia back to back with some sort of cement or connective tissue between. The outer epithelium, the ectoderm, or better, epidermis, has protective, nervous and sensory functions, and the inner epithelium, the entoderm, or better, gastrodermis, forms a primitive digestive tube. Epidermis and gastrodermis meet at the mouth. Both epithelia may give off muscle fibres that lend the animal a considerable degree of motility. It is characteristic of animals of the tissue grade of construction that they are built on the plan of radial symmetry or some variant thereof (*see* MORPHOLOGY). Consequently they may be termed radiate animals or Radiata.

All other Eumetazoa are constructed on the plan of bilateral symmetry, and hence may be collectively termed Bilateria. They show definite differentiation into anterior and posterior ends, and dorsal and ventral surfaces (*see* MORPHOLOGY). Their tissues are also more or less aggregated into organs so that they may be considered to be of the organ-system grade of construction. Between their outer or ectodermal epithelium and inner or entodermal epithelium they have a mass of mesodermal tissue that gives rise to muscles, connective tissues, and reproductive, circulatory and excretory systems (*see* EMBRYOLOGY).

It is customary to group the Bilateria on the basis of the number and kinds of internal cavities. The lowest Bilateria, the Platyhelminthes or flatworms, have the same solid construction as the Coelenterata; *i.e.,* there is only one internal cavity, the digestive cavity. In the flatworms the space between epidermis and digestive epithelium is filled with tissues and organs of mesodermal origin. Bilateria having this kind of solid construction are called acoelomate.

The remaining Bilateria have an extra space between the digestive tube and the body wall, but it appears that this space is not necessarily the same as to embryonic origin in different groups. When this space is formed by the parting of the mesoderm so that it has mesoderm on both sides of it, the space is considered a true coelom. When, however, this space is a remnant of the blastocoel (*see* EMBRYOLOGY) and has mesoderm on only one side or on neither side of it, it is considered a false coelom or *pseudocoelom.* The Bilateria, therefore, exist in acoelomate, pseudocoelomate and coelomate grades.

It is likewise characteristic of all Bilateria, except the Platyhelminthes, that the digestive tube has a rear opening, the anus. The presence of an anus greatly increases the efficiency of the digestive tube, for there is then no mixing of food in various stages of digestion as must be the case where the digestive tube has but one opening, serving for both ingestion of food and ejection of indigestible remnants. Further, in coelomate animals part of the mesoderm attaches to the digestive epithelium, furnishing muscle layers to the latter and conferring motility upon the digestive tube.

A feature seen in three groups of higher Bilateria (Annelida, Arthropoda and Chordata) is the segmentation of the body, *i.e.,* the division of the body along its main axis into a series of equal joints or segments, each of which contains a representative of the various body systems (*see* further, article MORPHOLOGY).

Organ Systems.—As already intimated all of the Bilateria are provided with organ-systems, *i.e.,* associations of organs for the performance of specific functions. The organ-systems of the higher Bilateria are the following: integumentary, muscular, skeletal, nervous, sensory, digestive, excretory, reproductive, circulatory, respiratory and hormonal. These systems appear gradually in the lower Metazoa and attain their full complexity and functional specialization only in the higher ones.

The integumentary system comprises the skin and its derivatives such as cuticle, scales, feathers, hair and armour (exoskeleton). The essential purpose of this system is protection against the external world and against drying out of internal parts.

The muscular system consists primitively of a layer of muscle fibres running in two or more directions situated just beneath the external covering. Such a system is incapable of complicated movements but serves to shorten and extend the animal and to allow it to bend in various directions. In higher animals the muscle fibres aggregate into definite bundles or muscles that permit much more varied and exact movements.

The skeletal system is closely associated with the muscular system, being in fact derived from the same embryonic source, and functions chiefly as a support for the musculature. The skeleton, properly speaking, is an internal structure and is best illustrated in the vertebrates with their internal assemblage of cartilage and bones. Among the invertebrates, skeletal structures such as the shells of molluscs are chiefly external, and, therefore, really belong to the integumentary system. Such exoskeleton also serves for muscle attachment as well as for protection.

The nervous system is a derivative of the surface covering (epidermis) and functions for the correlation of body activities by means of its power of rapid transmission. It consists essentially of nervous tissue aggregated into masses (ganglia) and strands (nerves). It is characteristic of the nervous system of vertebrates that it is dorsal and hollow whereas that of invertebrates is ventral and solid. In the evolution of animals the nervous system gradually shifts from a superficial position immediately under the epidermis to a deeper position, to the inner side of the muscle layer.

The sensory system is that part of the nervous system that responds to external factors and transmits these responses to the central nervous system where appropriate action is initiated. The sensory system consists of a variety of nerve endings and sensory organs designed to be affected by particular external factors such as light, sound waves, odours, temperature, etc. Whereas the essential sensory part is microscopic, numbers of such parts may be aggregated with accessory structures to form conspicuous organs such as the eye, ear, etc.

The digestive system consists in its earliest form, as seen in coelenterates, simply of the inner epithelial tube and has only one opening, the mouth. In the metazoan series, the digestive tube becomes separated from the body wall by the formation of either a pseudocoelomic or a coelomic cavity and at the same time acquires a rear opening, the anus. In coelomate animals part of the mesoderm attaches to the digestive tube, forming muscle layers for the latter which then becomes capable of motility. Various functional regions become differentiated along the digestive tube in different animals, as a crop for storing food, gizzard for grinding hard food, stomach for the main processes of digestion, intestine for absorption, etc.; glands that secrete digestive enzymes or other substances involved in digestion occur either in the wall of the digestive tube or attached to it. Among the vertebrates

the liver and the pancreas are conspicuous glands that embryologically are formed from the lining epithelium of the digestive tube.

The foregoing systems occur in all the Eumetazoa, but the following ones are found only in the Bilateria. The excretory system has the function of regulating the water content of the body and secondarily of removing the useless products of body chemistry, especially nitrogenous products. The system consists primitively of secretory tubules that have either closed inner ends or open at their inner ends into body spaces. At first the tubules obtain their excretory material directly from body spaces but with the increasing size and complexity of the animal they obtain it from the blood and the internal openings then close up. In vertebrates the tubules are aggregated into organs known as kidneys, which extract water and nitrogenous waste products from the blood.

Although sex cells occur in all groups of animals, including some Protozoa, a definite reproductive system with ducts and other differentiated parts is first seen in the lowest Bilateria (flatworms) and is characteristic of the Bilateria in general. Although very simple reproductive systems are seen in many Bilateria, in others the system reaches inexplicable complexity. The complexity is associated with internal fertilization, *i.e.*, the passage of sperm from the male to the female, and seems to indicate that such fertilization is more desirable than the mere shedding of sex cells into the water.

The circulatory system consists of a set of tubes for distributing respiratory gases and food, and collecting waste materials; there is also usually one or more pumping organs to aid the process. Such a system is obviously necessary only to animals of some size and complexity because in small animals physical diffusion is adequate. Hence, the circulatory system is found only in the larger and higher Bilateria and reaches a complex development only in the vertebrates. The circulatory system is filled with a fluid, the blood, that may or may not be red, and that travels in a circuit passing through respiratory organs for the exchange of gases, and close to the excretory organs for the emission of wastes. The red colouring matter found in vertebrate (and some invertebrate) bloods is concerned with the exchange of gases (*see* RESPIRATION).

The respiratory system is concerned with the exchange of respiratory gases and also occurs only in the larger and more complex Bilateria since such exchange takes place by diffusion in smaller forms. Animals obtain energy for their life processes by means of oxidation; therefore, they must continually absorb oxygen or they die. Carbon dioxide is emitted as a result of the oxidation process. A respiratory system is a device for facilitating the absorption of oxygen and the emission of carbon dioxide, and is not itself the seat of the oxidation process. Its essential features are a large exposure of surface to the gases and thin walls to permit easy passage of gases. Hence, a respiratory organ is a greatly folded structure of spongy, feathery or booklike appearance. It may project to the outside and is then known as a gill, or it may project into the interior, forming a lung. Gills get their gases from the surrounding medium, usually water, and lungs get theirs from the air. There are often accessory mechanisms for causing water to flow over the gills or for causing air to pass into and out of the lungs. Such respiratory mechanisms should not be confused with the true process of respiration, which consists of the utilization of oxygen by the body cells.

The hormonal system consists of a number of glands or gland-like bodies that have no ducts and hence secrete their products directly into the blood, for which reason they are also called endocrine glands or glands of internal secretion. They are best known in vertebrates where they include the pituitary body of the brain, the thyroid, parathyroid, the islets of Langerhans in the pancreas, the adrenal glands near the kidneys and the sex glands. The secretions of these glands are necessary for the normal growth and health of the body and for the initiation and maintenance of sexual reproduction. The substances that they secrete are known as hormones. Hormone-secreting structures also occur in invertebrates but are less well-known.

CLASSIFICATION

The knowledge gained through anatomical and microscopical studies, plus the results accumulated in the fields of embryology (*q.v.*) and palaeontology (*q.v.*), has enabled zoologists to classify the animal kingdom. Classifications were of course attempted long before the necessary knowledge was available, but only after 1850 had considerable agreement been reached about the main subdivisions of the animal kingdom. Classification consists essentially of grouping together animals of like structure, in much the same manner as one would separate a mixed lot of grains into wheat, corn, oats, etc. Although seemingly simple in principle, zoological classification is exceedingly difficult in actual practice and depends largely on the personal judgment of zoologists. The usual difficulty consists in deciding when a degree of difference is sufficient to justify the making of a different category. The classification of so-called aberrant forms, *i.e.*, individuals or small groups of animals that do not seem to fit into any of the established groups, also raises great difficulty. As a consequence, no two zoologists or zoological texts agree in all details on the scheme of classification, although a considerable amount of agreement will be found. The branch of zoology that deals especially with classification is termed taxonomy or systematics but so vast is the number of animals (probably approaching 2,000,000) that any one zoologist must limit himself to the taxonomy of a single group.

The Species.—Classification begins by separating animals into different kinds. Thus, anyone can see that the common horse is very much alike throughout the world and that it is different from the cow. This difference is expressed by regarding the entire population of horses as constituting one category, termed the species; the same is done for cows, and for other animals. Although an exact definition of the species concept has given zoologists much trouble, for practical purposes a species may be defined as a population or populations of animals that are alike in the details of their structure within close but variable limits, and that breed together, or can do so.

In the early days of classification when relatively few specimens were available for study, species seemed to be easily distinguishable from each other. But as more and more specimens were collected, and as zoologists began to study actual populations as they exist in nature, it became apparent that the majority of species do not constitute a uniform population, but comprise a number of geographically distributed populations that differ from each other in minor details. Thus, the species in many cases really consists of a few too many geographic races or variants, usually termed varieties or subspecies, many of which were formerly considered distinct species, because of insufficient collecting. It is therefore evident that to determine the content of a species and to distinguish species from each other, extensive collecting over the entire range of distribution is necessary. The interbreeding test should be applied when possible, although it is often obviously impractical. The breeding test is not, however, conclusive since individuals belonging to what taxonomists regard as distinct species do sometimes interbreed in nature.

It is believed by most zoologists (although denied by some), that the geographical variants of a species represent incipient species, and that they will become distinct species whenever they cease to breed together either because of morphological divergence of their copulatory organs or because of behaviouristic divergence.

The Genus.—The next taxonomic category above the species, referred to as the genus, embraces a number of species of sufficiently similar morphology. In short, after the species are defined and delimited they are grouped together according to similarity and each group of similar species constitutes a genus. It is clear that whereas the species has a real existence in nature, the genus is a more or less arbitrary conception. How much species must resemble each other to justify their grouping into one genus, and how much they must differ to justify separating them into different genera are obviously matters of judgment on the part of the taxonomist. As a result, there is a continuous process in taxonomy of transferring species from one genus to another.

The Scientific Name.—Since the days of Carolus Linnaeus, who invented the system, it has become obligatory upon zoologists to combine the generic with the specific name to form the accepted scientific name of the animal. This procedure is termed the binomial system of nomenclature. The generic name is capitalized; the specific name begins with a small letter. The scientific name has to be constructed in Latinized form and hence is understandable throughout the world, whereas common names are confusing and inexact, and vary with language. The scientific name is, therefore, a very useful tool, since each scientific name can designate only one kind of animal; what is meant by that name is apparent to zoologists throughout the world.

Higher Taxonomic Categories.—By using more and more important characters as a basis for deciding resemblance, larger and larger taxonomic divisions can be constructed. The most important ones in common use are family, order, class and phylum. A family is composed of those genera having certain characters in common; an order is made up of families of similar construction, etc. If considered desirable in any particular case, these categories can be subdivided to form subfamilies, suborders, etc., or grouped as superfamilies, etc. Like the scientific name, the names of all taxonomic categories are constructed in Latinized form, usually of Greek and Latin roots. The names of families and subfamilies must be constructed from the name of their principal genus and must end in *idae* and *inae,* respectively. No rules govern the formation of names higher than family although they generally terminate in *a.*

The Phylum.—The highest taxonomic category of all is termed the phylum, which thus constitutes the primary division of the animal kingdom. Each phylum is sharply characterized by a plan of structure in the adult peculiar to it and differing from that of other phyla in such ways that in general phyla are not derivable from each other. However, as all animals are related to each other by descent (*see* EVOLUTION), it is evident that at some time in its past history each phylum must have been derived from some pre-existing phylum, and one of the favourite "arm-chair" occupations of zoologists, especially in the past, was the surveying of available evidence for indications of phyletic relationships, a field of zoology termed phylogeny. The evidence most useful in such phylogenetic speculation is that drawn from embryology (*q.v.*) and palaeontology (*q.v.*). The facts, however, are so scanty that the various schemes of interphyletic relationships that have been advanced must be regarded merely as suggestive. At the present time in the earth's history the different phyla of animals are widely separated from each other in structural plan, and no intermediates between phyla are known except in the case of the phyla Annelida and Arthropoda.

Identification of Animals.—Through his knowledge of the structural characters on which the taxonomic divisions are based, a zoologist when confronted with an unknown animal can usually place it at least to order after a brief examination. However, the determination of the genus and species to which an animal belongs is generally a matter that calls for prolonged study, often with the aid of microscopic examination, because the characters that separate genera and species are usually minute and detailed. In general, only a specialist in the group to which the animal belongs is competent to identify it to genus and species, and identifications should not be attempted by others. The correct identification of an animal is of great importance in zoological research so that zoologists all over the world may know what animal is under discussion. Very often in the history of zoology, heated arguments have arisen over differing research results that in reality were caused by the fact that different species were being used. Experience has shown that results obtained with one species cannot safely be assumed to be applicable to another, even closely related, species. Correct identification is also of great importance in the economic relations of zoology, being the first necessary step in the understanding and control of pests and parasites, and in the encouragement of useful animals.

THE PHYLA OF THE ANIMAL KINGDOM

The question of the division of the animal kingdom into phyla is one of the greatest importance to the zoologist because such division really expresses the state of his knowledge of animal structure, development and relationships. In the beginning of the era of modern zoology, roughly from the times of Linnaeus, the divisions proposed were highly erroneous, being based chiefly on external appearances. As discussed above, a correct knowledge of animal structure is attained only through dissection and microscopical examination. Embryological studies also are of the greatest importance (*see* below). As knowledge from these sources accumulated, the phyletic arrangement was continuously altered by a succession of zoologists, and cannot be said to have attained a stable condition even to this day. The reasons for this are, first that embryological and morphological information is still far from complete, and, second, that opinions differ as to what characters are the most important in defining phyla. Some zoologists tend to lump groups together so as to make a few very inclusive phyla and others tend to separate off various small groups as independent phyla. Consequently any published arrangement of phyla must be understood to represent merely some zoologist's opinion.

The following scheme leans towards the separation of small groups as independent phyla. It is based on the grades of structure discussed above, presence or absence of an anus, kind and number of body spaces, etc.

KINGDOM ANIMALIA

Subkingdom I. Protozoa. Animals consisting of one cell or of colonies of like cells.

Phylum 1. Protozoa.
Class 1. Flagellata
Class 2. Rhizopoda
Class 3. Ciliata
Class 4. Sporozoa

Subkingdom II. Metazoa. Animals composed of unlike cells that may lose their boundaries in the adult state.

Branch A. Mesozoa. Parasitic animals composed of a surface layer of epithelial cells inclosing reproductive cells.

Phylum 2. Mesozoa

Branch B. Parazoa. Animals composed of several kinds of differentiated cells somewhat arranged in tissues; without organ systems or mouth; porous.

Phylum 3. Porifera, the sponges
Class 1. Calcarea
Class 2. Hexactinellida
Class 3. Demospongiae

Branch C. Eumetazoa. Metazoa with cells arranged in tissues; usually also with organ systems; with mouth and digestive tract except when lost by parasitic degeneration; not porous.

Grade I. Radiata. With primary radial symmetry; of the tissue grade of construction.

Phylum 4. Cnidaria or Coelenterata, the coelenterates. Radiata with nematocysts; no ciliated plates.
Class 1. Hydrozoa
Class 2. Scyphozoa
Class 3. Anthozoa

Phylum 5. Ctenophora, the comb jellies. Without nematocysts; with eight rows of ciliated plates.
Class 1. Tentaculata
Class 2. Nuda

Grade II. Bilateria. Eumetazoa with bilateral symmetry or secondary radial symmetry; with organ systems.

Section a. Acoelomata. No space between digestive tube and body wall.

Phylum 6. Platyhelminthes, the flatworms. No anus.
Class 1. Turbellaria
Class 2. Trematoda
Class 3. Cestoda

Phylum 7. Nemertina or Rhynchocoela, the nemertine worms. With anus; with a protrusible proboscis above the digestive system.

Section b. Pseudocoelomata. With pseudocoelom between digestive tract and body wall; usually with anus; body clothed with cuticle.

Phylum 8. Acanthocephala, the spiny-headed worms. Parasitic worms with spiny protrusible anterior end; without mouth or digestive tract.

Phylum 9. Aschelminthes. Without spiny proboscis, or if so, not parasitic; nearly always with mouth and digestive tract.
Class 1. Rotifera, the rotifers
Class 2. Gastrotricha
Class 3. Kinorhyncha or Echinoderida

Class 4. Nematoda, the round worms
Class 5. Nematomorpha or Gordiacea, the gordian worms
Phylum 10. Entoprocta. Anterior end bears circle of ciliated tentacles, inclosing mouth and anus.

Section c. Eucoelomata. With true coelom; with anus and organ systems.

1. With a lophophore, a circular, crescentic, or double spirally coiled ridge bearing ciliated tentacles.
Phylum 11. Phoronida. Wormlike.
Phylum 12. Bryozoa, the moss animals. Colonial with gelatinous, chitinous or calcareous encasements.
Phylum 13. Brachiopoda, the lamp shells. Inclosed in a bivalve shell.

2. Without a lophophore; coelom a schizocoel, formed by a mesodermal split.

a. Body not segmented.
Phylum 14. Mollusca. Visceral mass covered by a body fold, the mantle, that secretes an external shell of one or more pieces; coelom usually reduced.
Class 1. Solenogastres
Class 2. Placophora
Class 3. Gasteropoda
Class 4. Scaphopoda
Class 5. Pelecypoda
Class 6. Cephalopoda
Phylum 15. Sipunculoidea. Wormlike, with eversible proboscis, anus anterior, dorsal.
Phylum 16. Priapuloidea. Similar, anus at posterior end.
Phylum 17. Echiuroidea. Similar, without eversible proboscis.

b. Segmented.
Phylum 18. Annelida, the annelids. Worms, with long jointed bodies, but without jointed appendages.
Class 1. Archiannelida
Class 2. Chaetopoda
Class 3. Hirudinea
Phylum 19. Arthropoda, the arthropods. Mostly not wormlike, body bears jointed appendages.
Class 1. Onychophora
Class 2. Crustacea
Class 3. Arachnida
Class 4. Pentastomida or Linguatulida
Class 5. Pycnogonida or Pantopoda
Class 6. Pauropoda
Class 7. Diplopoda
Class 8. Symphyla
Class 9. Chilopoda
Class 10. Insecta

3. Without a lophophore; coelom an enterocoel, formed by outpouchings of the digestive tube.

a. With secondary, usually pentamerous radial symmetry; with a water-vascular system.
Phylum 20. Echinodermata, the echinoderms.
Class 1. Asteroidea
Class 2. Ophiuroidea
Class 3. Echinoidea
Class 4. Holothuroidea
Class 5. Crinoidea

b. Bilateral symmetry retained throughout life.
Phylum 21. Chaetognatha, the arrow worms. Wormlike, without gill slits or endoskeleton.
Phylum 22. Hemichordata. Wormlike with gill slits.
Phylum 23. Chordata. Not wormlike, adults with gill slits or vertebral column or both.
Subphylum 1. Urochordata or Tunicata.
Subphylum 2. Cephalochordata or Acrania.
Subphylum 3. Vertebrata or Craniata.
Class 1. Agnatha
Class 2. Placodermi
Class 3. Chondrichthyes
Class 4. Osteichthyes
Class 5. Amphibia
Class 6. Reptilia
Class 7. Aves
Class 8. Mammalia

The above omits two groups of very uncertain position, the Tardigrada, or water bears, and the Myzostomida, a group of flat, disc-shaped animals ectoparasitic on echinoderms. These groups seem to be intermediate between Annelida and Arthropoda with closer affinities to the former. The systematic position of the groups Onychophora and Pentastomida is also disputed. For further information about the phyla, special articles in the encyclopaedia should be consulted.

EMBRYOLOGY AND THE HOMOLOGY OF THE GERM LAYERS

Animals in general develop from a single cell, the egg, which, after being stimulated by fusion with a sperm, enters upon a remarkable process of embryonic development in which the definitive characters gradually make their appearance. When this process was studied in many diverse animals, zoologists began to realize that certain similarities obtain throughout the animal kingdom. First the egg undergoes cleavage, dividing up into a ball of many cells. A two-layered condition, the gastrula, follows, in which the embryo consists of an outer epithelium, the ectoderm and an inner epithelium or, in some cases, a solid mass, the entoderm. The manner of origin of the entoderm is varied, but great importance has been attributed by some zoologists, notably Ernst Haeckel, to one particular method, that of invagination, or the bending inward of the outer epithelium. Haeckel, and after him most zoological texts, considered invagination to be the original and primary method and other methods derived and secondary. This proposition is open to grave doubt, but it is probably impractical to ascertain what was the original method of entoderm formation.

Following the establishment of the gastrula stage, the next general step in development is the formation of a tissue between the ectoderm and the entoderm, termed the mesoderm. Here again varied modes of formation of mesoderm are seen in different animal embryos, but most prominence was given in zoological theory to one particular method, the enterocoelous method, in which the mesoderm arises by the out-pushing of pockets from the entoderm. Again the primary nature of the enterocoelous method may be seriously questioned, but the determination of the original mode of mesoderm formation is probably an impossibility.

Ectoderm, entoderm and mesoderm are known as the germ layers, and from them all of the tissues and organs of the adult animal are derived, chiefly by processes of folding and migration. Their role in the production of adult structure is generally much the same throughout the animal kingdom. The ectoderm furnishes the surface covering of the animal (epidermis), and also the nervous system and the nervous part of the sense organs. The entoderm furnishes the lining epithelium (gastrodermis) of the digestive tract and the epithelial cells of various outgrowths of the digestive tract, such as the liver, pancreas and other glands. All the tissues and organs between the epidermis and gastrodermis are of mesodermal origin, *i.e.*, the muscles and connective tissues, the bones and cartilages of the skeleton, and the circulatory, excretory and reproductive systems. In coelomate animals, the mesoderm separates into a somatic part, which furnishes the muscles of the body wall and also the skeleton, and a splanchnic part, which attaches to the viscera and provides their muscular layers. The space between the somatic and splanchnic mesoderm is the coelom.

These facts are certainly very striking and have led to an important zoological theory termed the *homology of the germ layers*. This theory states that development by means of germ layers is fundamental throughout the multicellular animals; that the germ layers were originally (if not now) formed in the same way throughout the Metazoa; that each of them produces the same organs wherever found; and that in short there is complete morphological correspondence between the same germ layers in different animals. Different grades of construction are regarded as representing different stages in germ-layer formation. The coelenterate or tissue-grade corresponds to the gastrula or two-layered stage of development; the acoelomate or flatworm stage corresponds to the stage after the mesoderm has arisen but has not yet divided into somatic and splanchnic layers, etc.

Germ-layer theory prevails in embryological teaching to the present time and certainly constitutes an orderly method of presentation of the subject. The theory has, however, been subject to severe criticism in recent years, and it is not yet clear to what extent it will survive. In regard to early embryonic stages, it must be admitted that the actual modes of formation of the germ layers and the processes of early development are extremely

varied, and it is impossible on the available facts either to affirm or deny some original uniform method of germ-layer formation. There is, however, undoubtedly, a marked similarity in the later developmental stages and the manner of formation of many organs among the Bilateria.

The main criticisms of the germ-layer theory come from the field of experimental embryology (*q.v.*). Transplantation experiments have shown that in early embryonic stages of many animals, pieces of germ layers when transplanted into appropriate sites may be caused to develop into organs that would normally come from some other germ layer. As development proceeds, this is no longer possible, for the fate of embryonic regions becomes more and more fixed and in the case of some animals is fixed at very early stages. These experiments cannot, therefore, be regarded as overthrowing the germ-layer theory. They confirm what observation had shown, namely, that the early stages are labile and do not conform in different animals but that the later stages do show the uniformity of development demanded by the theory. It therefore seems probable that the germ-layer theory in its broader aspects will remain a permanent part of zoological science.

EMBRYOLOGY AND THE THEORY OF RECAPITULATION

The similarity of embryological processes throughout the Bilateria suggests some underlying principle, and this principle is to be found in the phenomenon of evolution (*q.v.*). The resemblance between lower animals and the embryos of higher ones had, however, been noted long before Charles Darwin enunciated the theory of evolution in 1859, especially by J. F. Meckel, 1821, A. E. R. A. Serres, 1842 and Karl Ernst von Baer, 1828. Von Baer formulated his observations on development in four "laws," of which the fourth one states that the young stages of higher animals resemble the young stages of lower ones. Following the publication of Darwin's book, *The Origin of Species,* the concept of evolution as an explanation of the embryonic stages through which higher animals pass was first advanced by Fritz Müller, 1864, and strenuously advocated by Ernst Haeckel, beginning in 1866. Haeckel had a gift for trenchant phrases, and zoology has become thoroughly imbued with his formulations of the relation between evolution and development. Haeckel's generalization is, in effect, that an animal in its development passes through stages representing the ancestors it had during its evolution from lower animals. This doctrine is termed recapitulation or the *biogenetic law,* and was epitomized by Haeckel in such phrases as "ontogeny repeats phylogeny," and "phylogeny is the mechanical cause of ontogeny," etc.

As already noted, the general resemblance of embryonic stages among animals is not to be doubted, and is particularly marked among the members of a given phylum; neither is it to be doubted that evolution, *i.e.,* descent from a common ancestor, is the explanation of this resemblance. However, there has been a great deal of argumentation as to the correctness of Haeckel's theory of recapitulation, *i.e.,* as to whether it is true or not that embryonic stages represent *adult* ancestors. The accumulated facts and arguments indicate that the relation between evolution and embryology does not follow any one rule but is a combination of several different kinds of rules. In some cases development follows ancestral stages up to a very late period, then adds on a new stage that makes the animal different from its ancestors. This type of development most nearly conforms to Haeckel's recapitulation. In many other cases, however, the development diverges from the ancestral pattern at an earlier time, sometimes very early in development. Or, ancestral stages may be omitted at the end or in the middle or even very early in development. The order of development may also be altered so that events may occur in a different order in the descendant than they did in the ancestor. Finally, many embryos exhibit adaptive structures that have no relation to any ancestor but are concerned in embryonic life.

It appears clear enough that Haeckel's formulation was altogether too narrow, and it is probable that no embryonic stage ever represents an exact duplication of an adult ancestor, although very considerable resemblance may obtain in some cases. It is more common for embryonic stages of the descendant to resemble embryonic stages of the ancestor. Phylogeny is not the cause of ontogeny but rather phylogenetic progress, *i.e.,* the evolution of new types, is brought about by deviation from the ancestral pattern during the course of embryonic development.

Ancestral reminiscence during development is then a general zoological principle; commonly this reminiscence concerns the embryonic or larval stages of the ancestor rather than the ancestor itself. Ancestral reminiscence has been of the greatest value in working out relationships especially among the invertebrates. In vertebrates there is an extensive fossil record and fossil findings have given zoologists a fairly complete story of the evolution of the main vertebrate groups. But invertebrates often have no hard parts preservable as fossils and in general palaeontology has been of little value in determining relationships among invertebrates. Hence, embryology is the chief tool for elucidating phylogenetic problems in the invertebrates. It is in fact a truism that a group is not understood in its relations to other invertebrate groups until the embryology of several members has been thoroughly worked out. Many examples could be cited of the solving of the taxonomic position of aberrant forms by means of their embryology. Thus *Sacculina* and related forms are very degenerate parasites of crustaceans, being reduced in the adult state to a nearly structureless sac with rootlike extensions into the host's tissue. It would be impossible to determine the taxonomic position of these parasites by study of their anatomy; but when it is found that their development closely follows that of barnacles, no doubt remains that they are degenerate barnacles.

VARIATION, HEREDITY, AND EVOLUTION

As seen above, hereditary factors play an important role in embryonic development; but as shown by the work in experimental embryology (*q.v.*), environmental influences are also operative. The study of the roles of heredity and environment in the production of the characters of the species and the mechanism of such production constitutes one of the most important and flourishing branches of zoology, generally termed genetics. The end and aim of genetics may be stated to be an understanding of the mechanism of heredity (*q.v.*) under specific environmental conditions, and thereby of evolution (*q.v.*).

Variation.—No two animals, even belonging to the same brood, are alike; although exhibiting a close similarity to their parents and to one another, each will differ from all others to a small extent or sometimes they may vary considerably in one or many respects. Such differences between individuals of the same species or variety is termed variation and the investigation of the nature and causes of these variations and of the manner and the extent to which they are passed on from one generation to the next is the main subject matter of genetics. The inheritance of variations is studied by breeding experiments; variation as it exists in a given population is studied by mathematical methods of the type known as biometrical. Measurements are made of various characters in a large number of individuals of a population and the data so obtained are tabulated to show the number of individuals exhibiting each of certain measurements. Such tabulations can then be graphed and a curve obtained. This curve of variation usually conforms to a definite symmetrical shape, rising to a peak and descending again. Such a normal curve of variation means that most of the individuals of a population fall within certain measurements, as length, for instance, and that especially long or short individuals are few in number. The normal curve of variation implies that the variations it records are due to chance events. Deviation from such a normal curve indicates that some factor is operative to distort the curve, or that the population being studied is not uniform but consists of two or more groups. Such studies of animal populations, termed biometry, are of great value both in pure and in applied science.

Types of Variation.—It is necessary for the geneticist and the systematist to evaluate properly the variations within a

population and to differentiate those associated with age, sex or habitat from hereditary variations that occur by chance without relation to obvious factors. There are in general two sorts of variation: those that do not involve an hereditary alteration, termed phenotypic variation, and those that result from hereditary alteration, termed genotypic.

Phenotypic Variation.—This may concern various stages in the life cycle, seasonal variations in the same individuals, and changes impressed on the individual during its life by environmental conditions. Examples of these may be given. Many animals at birth or hatching bear little resemblance to their parents, and in the past were often regarded as distinct species until the life history of the animal in question was worked out and the juvenile or larval form traced to the adult condition. For instance, the common fresh-water eel, *Anguilla,* passes through a transparent ribbonlike oceanic stage termed *Leptocephalus. Leptocephalus* was considered to be a distinct kind of fish, whose relationship to eels was not suspected, until Johannes Schmidt of Denmark discovered that *Leptocephalus* is a juvenile stage of *Anguilla.* Crawling caterpillars bear no resemblance to the butterflies or moths into which we know they develop. Parasitic worms may have as many as four different juvenile stages in different hosts. As these juveniles bear no or little resemblance to the adults, mere study of them does not suffice to determine to what adults they belong and such information is assembled only by laborious isolation studies and feeding of juveniles to appropriate parasite-free hosts.

The colours and colour patterns of many animals change with age and sexual maturity. The soft down of feathers or hair at birth or hatching gives way first to the juvenile and later to the adult plumage or pelage, differently coloured or patterned. Some plumage or pelage colour changes result from the wearing off of feather or hair tips. Many male animals assume a resplendent nuptial dress during their breeding season and may also develop structural features that are lost again in the off-season, as the horns of mammals, and thickened skin areas termed pearl organs of fishes.

Seasonal changes in colours and shape are of common occurrence. Where several broods are born within a year as in insects, broods produced at different seasons may differ so much as to be originally regarded as distinct species. Many small animals of open waters have summer and winter forms of different shape; commonly the summer form shows increased body surface as compared to volume and the winter form shows the reverse effect. Thus, water-fleas such as *Daphnia* and *Bosmina* tend to develop taller shapes with longer spines in summer, more rounded heads and shorter spines in winter. The factors operative are believed to be quantity of food, and changes in the density and viscosity of the water, requiring new shapes to insure body stability. Seasonal colour changes are well-known in arctic animals, such as the varying hare, ermine, ptarmigan and arctic fox that are white in winter, brownish during the summer. Much seasonal variation is related to temperature. Thus the Himalayan rabbit is white except for black ears, feet and tail. If hair is plucked from the white parts and the animal placed in the cold while the new fur is growing out, this comes out black, not white. Conversely, hair plucked from the black parts grows out white if these parts are kept warm by bandages. It is known that fishes tend to have more vertebrae and more scales along the lateral line in the colder parts of their range. The experiments of Dr. Mordecai Gabriel have shown that if the eggs of the fish *Fundulus* from the same batch are reared at different temperatures, the number of vertebrae formed is greater the lower the temperature. This result probably comes from a slowing down of development by the cold at a critical time.

Members of the same species may show much variation throughout their range as a result of local conditions. This is very true of corals, for instance, since the same species may grow into tall branching shapes in still water, massive rounded shapes in surf. Molluscs also show great variation of shell form in different environments. These variants, termed *ecophenotypes,* were formerly regarded as of taxonomic worth and often very many scientific names were created for what are now known to be merely phenotypic variants of the same species.

In the above examples identity of genetic constitution is assumed. The changes recorded are phenotypic changes of the same genotype, that is, of the same hereditary constitution. Whether a given change is phenotypic or not can, however, be determined only by breeding experiments under varieties of environment.

Genotypic Variation; Mendelian Inheritance.—Genotypic variations are new alterations that are inheritable. Whether a given variation is genotypic or not cannot be determined by mere inspection of the animal but only by painstaking breeding experiments under controlled environmental conditions. Forty years of intensive breeding experiments on various plants and animals have led to the conclusion that hereditary characters are vested in the chromosomes of the nucleus, in the submicroscopic particles termed genes of which these chromosomes are constituted (*see* HEREDITY). It is these genes that are directly transmitted to the offspring in the nuclei of the egg and the sperm whose fusion begins the new individual. The characters that are represented by these genes are inherited, but they do not come to expression unless the environmental conditions are right for their appearance. Among the better known inheritable characteristics of animals transmitted by genes are eye colour, hair colour, hair shape, skin colour, body form and proportions, length of limbs, hands, feet, tail, and various diseases and defects, as well as varying degrees of immunity to disease.

The manner of inheritance of such characters and of genotypic variations in general is that termed Mendelian because it was first formulated by Gregor Mendel, an abbot of Brünn, Austria, in 1865 as a result of his experiments in crossing garden plants in the garden of the monastery. His experiments remained unappreciated until 1900 when they were simultaneously repeated by several biologists. Since that time an enormous amount of work has been done on Mendelian inheritance, for the details of which *see* the articles HEREDITY; VARIATION. A very striking part of the Mendelian work was the elucidation of the mechanism of sex differentiation. It was found that there is a chromosomal difference between the sexes. In some animals two kinds of eggs and in others two kinds of sperm, as to their chromosomal content, are produced, and whether a given fertilization will result in a male or a female offspring is determined at the time of fertilization by whatever chromosomal combination happens to ensue (for complete explanation *see* articles SEX; CYTOLOGY; CHROMOSOME).

Bisexual reproduction is of the greatest importance in increasing the variability within populations. Geneticists are agreed that nearly all genetic factors are located in the chromosomes and that normal individuals of sexually reproducing species have two chromosome sets, one from each parent; *i.e.,* each chromosome occurs in duplicate as a result of the fertilization process. During the formation of the sex cells of an individual the duplicate chromosomes and duplicate genes become segregated in a chance manner into the sex cells, for these have only one chromosome set (*see* CYTOLOGY; CHROMOSOME). Thus an indefinite number of gene combinations is possible. In reference to man with his two sets of 24 chromosomes it is said that exactly the same genic constitution has never appeared in two individuals, except in the case of identical twins that come from one egg.

Heredity and Environment.—Every character of an organism is the product equally of its inheritance and of the environment under which the character develops and matures. Some characters reappear regularly in successive generations because the stimuli necessary for their appearance are always operative in their environment. Often certain temperatures are required for the appearance of both phenotypic and genotypic characters. What is really transmitted is the ability to respond to given environmental factors; but the specific response that occurs in a given case is determined by the hereditary constitution.

For exact studies of environmental effects in the individual's life it is necessary to start with material of identical genetic

constitution. Some of the best information on the heredity-versus-environment question has been accumulated in recent years by the study of identical human twins reared apart from early life. Identical human twins come from the same fertilized egg, hence have the same genic constitution. Data were collected by H. H. Newman of the University of Chicago on 50 pairs of identical twins reared together and 20 pairs reared apart. Twins reared apart were, on the average, no more different in measurable physical characters than those reared together, except for body weight which was found to depend on food, health and amount of physical exercise. A different result ensued when mental differences were studied. The average difference in the I.Q. of twins reared together was 5.3 points and for twins reared apart 8.2 points, an excess of nearly 3 points. The average difference in scholastic achievement for twins reared apart was more than twice as great as for twins reared together, an indication that achievement tests register differences in schooling more accurately than do ability tests. Newman found much evidence that differing environments had resulted in marked personality differences despite identical genetic constitution. These results, although only preliminary, give great encouragement in the direction of human improvement through educational and environmental means.

Inheritance of Acquired Characters.—Since ancient times there has been a general popular belief in the theory that characters acquired during the lifetime of an individual can be inherited, and that thereby an improvement or alteration in a desired direction is possible. This theory is termed Lamarckism because it was expounded particularly by Lamarck in 1815, although not exactly original with him. Lamarckism states that every animal tends to change its structure and habits during its individual existence in such ways that it becomes better fitted for life under the conditions to which it is subjected. If the characters so acquired be transmitted to offspring which in turn become modified in the same direction, there will in time arise a group of individuals differing from the original progenitor and better adapted than it was for the conditions in question. The theory thus particularly seeks to explain the origin of adaptive characters.

Adaptation is certainly an outstanding phenomenon of nature; that environment can alter the structure and habits of animals within their lifetime is also an established fact and comes under the head of phenotypic variation discussed above. The difficulty of the theory centres around the possibility of the inheritance of such environmentally induced alterations. At the present time such inheritance is believed to be impossible; therefore, the theory of the inheritance of acquired characters has been abandoned by practically all biologists.

Mutations.—Inheritable alteration is now believed to be entirely of the nature of mutation, which is another name for genotypic variation. Mutations, in the present sense of the word, are caused by change, probably chemical, in a single gene, or by chromosomal changes such as losses, multiplications, rearrangements of genes, recombinations, etc. Mutations occur in all degrees from those so slight as to be unnoticeable in ordinary genetic work to conspicuous variations. The cause of mutation is not known, although mutations have been induced by the action of x-rays and other radiations on organisms at critical periods in the ripening of their germ cells. It is firmly believed by geneticists that mutations are of chance nature and that they have no direct relation to environmental factors. *See* further, article VARIATION.

Evolution; Natural Selection.—The principle of evolution is the most important contribution of zoology to general science and to civilization. Evolution is the doctrine that all organisms are related to each other through common descent and that the differences that now exist between the many species of animals and plants have arisen through hereditary alteration of pre-existing forms. Evolution is defined by Theodore Dobzhansky as a change in the genetic composition of populations so that dissimilarities develop between the ancestral and the descendant populations. Evolution as a constant process of nature is supported by such innumerable facts that it is unanimously accepted by biologists as a fundamental principle of biological science. The principle of evolutionary change has also been incorporated into almost every field of human thought and endeavour, and everywhere has acted as a clarifying leaven.

It is necessary to distinguish clearly between evolution as a phenomenon of nature and the mechanism by which evolution takes place. Too often there is confusion in the popular mind between these two matters. Evolution is regarded by biologists as an established fact, but the mechanism by which it occurs is still under investigation. Indeed, such investigation is particularly intensive at the present time, nearly 100 years after Darwin published his epoch-making investigations and conclusions.

Although the idea of evolution had been expressed by a long chain of his predecessors, it was first clearly expounded by Darwin in 1859 in his book *The Origin of Species*. Darwin was concerned primarily with finding a mechanism by means of which evolution could occur, and by analogy with selection practised by man in breeding domestic animals, Darwin postulated a selective action of nature. Darwin based his theory of evolution by natural selection on the observed facts of variation and of excessive reproduction in nature. As already noted, every species tends to vary within limits; also, every species tries to reproduce in unlimited numbers so that if unchecked, even slowly-reproducing animals would in a relatively short time populate the earth. As this does not occur, there must be factors limiting the survival of offspring, and these factors consist of competition for food and space, depletion by enemies and parasites, etc. In this struggle for existence it seemed to Darwin that variations, even slight ones, might play a decisive role in preserving some individuals while others perished. Any (genotypic) variation that is at all advantageous will have survival value and the individual possessing it will have more chance to live and to pass on its advantageous variation to its offspring than will individuals lacking such variation. In this way there is an accumulation of variations, and this eventually leads to the establishment of new varieties and species, providing isolation occurs to prevent the wiping out of the new characters by cross-breeding with the old population. By isolation is meant any factor that prevents cross-breeding. Such isolation may consist of physiographical features such as mountains or water courses that form barriers against interbreeding; or it may consist of variations in the sexual apparatus or in sexual behaviour that make mating physically or psychologically impossible.

After the theory of evolution by natural selection had suffered some decline, selection has again come into prominence as a factor in evolution. Acceptable evidence has been found of the actual operation of natural selection in wild populations. Natural selection operating on chance genotypic variations remains the best explanation of adaptation. The modern view of evolution holds that it is the joint product of mutation and selection plus isolating mechanisms (ecological, geographical or sexual) that prevent the new gene patterns from being swamped by interbreeding with the old. In recent years population size has also been shown to be an important factor, and restricted populations appear to be most favourable for progressive evolution. The study of population dynamics is rapidly becoming of increasing interest and importance in the fields of genetics and evolution. (*See* further, EVOLUTION.)

ECOLOGY

What is generally termed natural history or observation of the habits and behaviour of animals in nature has undoubtedly interested man from the dawn of civilization. But toward the end of the 19th century this type of zoological study more or less fell into disrepute as not sufficiently scientific. Zoologists were more or less divided into two camps: those that studied morphology and taxonomy, and those that were experimentalists subjecting animals or their parts to laboratory study. The latter increased rapidly at the expense of the former and neither left much room for natural history in its old form. At the beginning of the 20th century there emerged, however, ecology (also called

bionomics), which has been defined as scientific natural history and which has progressively increased in importance. (*See* ECOLOGY.)

Ecology is the study of animals as they exist in their natural environment. The subject naturally divides itself into two parts: the study of the environment and the study of the animal in its environment.

Environments.—Evidently the complete study of environments is a complicated matter, depending in many cases on the availability of appropriate methods and apparatus. The environment is composed of physical, chemical, geological, geographical and meteorological factors as well as biological factors in the form of other plants and animals and their products. These factors require to be studied not only at any one time but also through daily, seasonal and annual cycles.

Environments are broadly classifiable into marine, fresh-water and terrestrial; each of these of course comprises numerous subsidiary environments. The study of the marine environment has reached the status of a branch of zoology, termed oceanography (*q.v.*). It involves such matters as currents and circulation, depths and bottom contours, types of bottom, temperature at various regions and depths, penetration of light with reference to depth, dissolved gases at various depths, salinity and chemical composition in general, and variations of organic substances or material produced by biological action. Many of these changes need to be followed through daily, seasonal and annual cycles. The animal life of the ocean is divisible into the pelagic forms living free in the water and the benthonic forms inhabiting the bottom. Each of these is again subdivisible on the basis of depth. Thus the pelagic animals fall into epipelagic, inhabiting surface waters to moderate depths, and bathypelagic, or deep water, categories. The ocean bottom is usually divided into the littoral zone (shore to 200 metres), the archibenthal (200 to 1,000 metres), and the abyssal zone or deep bottom.

Brackish water or water of lowered salinity at the mouths of rivers offers special ecological problems. Animals inhabiting such areas must be able to endure great changes of salinity and osmotic pressure. Study of the mechanism of such adjustment may throw light on how marine animals were able to enter fresh waters and establish themselves therein.

Fresh-water habitats are of two general types, standing or lentic waters and running or lotic waters. The former embraces the large lake, small lake, pond, swamp, pool series, and the latter the brook, stream, river series. Here, too, of course there are numerous localized environments as a rapids in a stream. Seasonal changes are of particular importance in the lentic series and many fresh-water animals show marked annual cycles that contrast with the uniformity of existence in the sea.

Terrestrial environments are more varied and present more difficult conditions for animals than do aquatic environments, and vegetation plays a predominant role in them. In fact, the subdivisions of land faunas practically coincide with those of the flora, and the latter in turn depend upon climatic and physiographical features, notably temperature, rainfall and quality of the soil. Land habitats vary from bare areas such as sand dunes, rock outcrops, snowfields and glaciers, the arctic and antarctic circles, and alpine summits, through areas of scant vegetation such as deserts, subalpine zones, high latitudes and treeless areas (grasslands, prairies, plains, steppes), to regions of small trees (thornbush, etc.) and forests. Each terrestrial habitat is of course zoned horizontally into such strata as the air, taller vegetation, shorter vegetation, ground surface and subterranean stratum.

Faunas.—The sum total of the animals inhabiting an area is termed the fauna. The ocean has the richest and most varied fauna, presumably because of the uniformity of conditions therein. The fauna of the ocean is broadly characterized by an inability to withstand extreme changes of conditions, by the lack of protective devices against exposure, such as cysts, by the frequency, especially among pelagic animals, of a delicate, transparent construction, and by the frequent production of free larval stages. Fresh-water animals must be able to withstand much greater ranges of conditions than do marine animals, especially temperature, evaporation, and alterations of acidity and alkalinity. Further, the fresh-water medium has a lower osmotic pressure than that of the body fluids of fresh-water animals, and means must be present to prevent excessive hydration of the body. Fresh-water animals provide against extremes of temperature and drought by protective devices such as encystment or production of hard-shelled eggs or other reproductive bodies, or by habits of hibernation or estivation; free larval stages are in general absent from the reproductive cycle. Air-breathing types are common among fresh-water animals but rare in the ocean. Fresh-water animals also experience greater turbidity and more concentrated organic decay than do the marine fauna, and many are adapted for living in muck practically devoid of oxygen. Conditions encountered by the land fauna are even more difficult, despite the advantage of abundant oxygen. The great danger is that of water loss so that land animals, unless they live in very humid places, must be protected against evaporation; hence the characteristic coverings of scales, hairs, fur, etc., or the hardened exterior as in insects. They must also be adjusted to a wide range of temperature or else have developed a mechanism for maintaining constant body temperature; habits of hibernation and estivation also play a role in temperature adaptation. Lacking the support of water, terrestrial animals must have a generally stronger build than aquatic ones, and they are also capable of efficient types of locomotion depending upon stronger build, such as walking, running, leaping and flight. Although the terrestrial fauna is less rich in species and groups than are aquatic faunas, it displays a much greater variety of associations, many strikingly adapted.

Animal Communities.—The fauna of a restricted area throughout which very similar conditions prevail, such as a meadow or a pond, forms an animal community or association. Such an association usually consists of large numbers of individuals of one or a few species, that form the dominant animals, and small numbers of a considerable number of other species. Many of the animals of an association show striking structural and behaviouristic adaptations to the conditions of the habitat. Very complex relations generally obtain between the members of a community. These are usually in the nature of food relationships, and in general every community contains herbivorous, carnivorous and scavenging animals. In a community each species generally occupies a particular part of the habitat and of the food chain; such a position in the community is termed an ecological niche.

The animals of the same kind of habitat are usually of different species or are even quite different taxonomically in different parts of the world, but they generally show ecological similarity, *i.e.*, structural and behaviouristic resemblance. Such corresponding forms have been termed ecotypes. Thus, the animals of steppes and prairies are generally long-legged, swift-running types, as the bison and pronghorn of the Great Plains of North America, the zebras and various kinds of antelopes of the African plains, and the deer of the Argentine pampas.

Ecological Succession.—The old adage that nothing is permanent except change is peculiarly applicable to ecological study because environments change and with them the flora and fauna also alter. Under ordinary conditions, *i.e.*, in the absence of cataclysms of nature, these changes follow an orderly arrangement, and this is termed ecological succession. Succession is naturally chiefly a phenomenon of fresh-water and land habitats and the littoral zone of the ocean. Thus, ponds fill and become meadow, meadow becomes invaded by shrubs and eventually trees, and finally a forest occupies the site of the original pond. In general all fresh-water and land habitats tend towards a certain floral association that is termed the climax. The climax formation varies in different areas of the earth, primarily in association with rainfall and temperature.

Animal Behaviour.—The reactions and activities of an animal in its environment is termed animal behaviour. This field at first was part of the subject of psychology, and experiments on animal behaviour were carried out chiefly in psychological laboratories. The setups employed in these laboratories were mostly

without relation to the natural habitat of the animal and the object was more or less anthropomorphic—to discover the learning abilities, intelligence and reasoning power of the lower animals, chiefly birds and mammals other than man, and the effect upon these powers of operations on the central nervous system. The animal was frequently set to solve problems that were remote from its normal life. At the same time ecologists were studying the behaviour of animals, chiefly invertebrates and cold-blooded vertebrates, from a different angle, that of subjecting the animal in turn to single factors of its environment such as light, temperature, etc. This procedure usually made use of a gradient tank or box in which the intensity of the factor being investigated was uniformly graded from one end to the other of the apparatus. Animals were placed in the apparatus and the part of the gradient in which the majority of the animals came to rest after random wanderings was considered to represent the intensity of the factor most suitable to the animal, and the one affecting its distribution in nature.

Although valuable results were yielded by both types of inquiry, their artificial nature has gradually become recognized, and there is a decided return at present to studies of the type of the old natural history but more exact, critical and better controlled. Field observations are supplemented by observations in the laboratory in conditions that simulate the natural surroundings, and problems are set that are more in harmony with the animal's anatomical equipment and the conditions of its existence in nature. (*See* ANIMAL BEHAVIOUR.) Studies of mass behaviour and social relations among animals are also receiving increased attention today.

Limiting Factors.—The study of animal behaviour by means of the gradient setup mentioned above showed that a given animal tends to avoid certain intensities of surrounding factors and to seek others. The distribution of a given animal in nature is therefore limited by responses of this type. Thus, an animal that avoids bright light and dryness may be expected to occur in nature in dark humid places as under stones or logs. Such an animal will obviously be limited in its distribution by the availability of this kind of habitat. By these reactions of avoidance animals come to occupy and to remain in certain small niches of a given environment.

Zoological Distribution.—As noted above, animals of similar but geographically separated ecological regions exhibit similarity of appearance and behaviour but are usually taxonomically different. This suggests that the fauna of each part of the world is peculiar to that region and that it might be possible to divide up the world into zoological regions, each with its own set of species. Various attempts of this sort have been made of which the most accepted scheme recognizes the following regions: palaearctic, including Europe, most of Asia, and Africa north of the Sahara; nearctic, comprising North America; neotropical, comprising South and Central America and the West Indies; Ethiopian, Africa south of the Sahara and Madagascar; oriental, southern Asia, Malay Archipelago, and some islands of the East Indies; and Australian, including Australia, New Zealand and the rest of the East Indies. (*See* ZOOLOGICAL GEOGRAPHY.) Each of these areas does in fact have a characteristic fauna. As is well known, the Australian region is characterized by its primitive mammals, such as the duckbill, kangaroo, and other marsupials, and curious birds like the kiwi, emu and cassowary, none of which are found elsewhere. However, many facts of animal distribution are not explained on the basis that each part of the world has its own peculiar constellation of species, for the reason that animals have not necessarily evolved in the region that they now occupy. Although isolation or inability to emigrate because of water or other barriers account for some facts of distribution like the peculiarities of the Australian fauna, emigrations, both recent and in past geological ages, are also an important factor in explaining present distribution. In fact, the distribution of animals constitutes important evidence for the existence of land connections in the past that have later vanished. Emigrations over land bridges later eliminated by geologic change account for the occurrence of closely related animals in distant parts of the earth with no representatives in the intervening area. Such facts can also be explained on the assumption of an originally wide distribution with the wiping out of relatives in intermediate areas through geologic and climatic changes. (*See* further, ZOOLOGICAL GEOGRAPHY.)

Animal Interrelationships.—Study of the relationships between animals constitutes an important part of ecological research. Such relationships within a species vary all the way from the relation of sexual pairs in courtship, mating and rearing of young to studies of populations. Here belongs also competition between the individuals of a species for mates, living and breeding places, and food. Relationships between animals of different species, apart from such general matters as competition for food and space, mostly fall into three categories: relationships of predator and prey, relations of mutual assistance and relations of one-sided benefit. Many animals are provided with protective or defensive devices, such as armour, horns, hoofs, stings, spines, venoms, or exhibit protective behaviour, as hiding, burrowing, rolling up into a ball, or playing dead, as a means of avoiding being captured and eaten by carnivorous animals; conversely, the predator often has special structural devices or exhibits special behaviour enabling it to capture other animals as food, often specific animals. One common mode of avoiding capture is through resemblance to surroundings (protective resemblance) or through resemblance to some other animal that is distasteful (mimicry). Volumes have been written on the questions whether protective resemblance or mimicry actually protect and how they have come about. It now appears quite certain that they do have protective value, and natural selection acting on chance variations is the accepted explanation of their origin.

Associations of animals of different species with mutual benefit is termed mutualism. Many examples of such relationship, often intimate, are known. Thus, ants protect and care for aphids and in return get a sweet fluid secreted by the aphids. Hermit crabs carry anemones on their backs, securing the protection afforded by the stinging bodies of the anemone and furnishing the latter with free transport and better oxygenation. Many such relationships are extremely intimate, in that one partner may live inside the other, as in the case of the termites and their intestinal Protozoa; the former protect the latter and the protozoans digest cellulose for the termites.

Relations of one-sided benefit range all the way from harmless association (commensalism) to parasitism. Small animals may habitually live in or on or near larger ones or accompany them, for protection or to obtain bits of food. Ant-hills and other types of burrows frequently harbour other animals, usually of specific kinds, termed inquilines or guests; these get protection and steal bits of the host's food, but are probably otherwise harmless. Such habits, however, gradually lead to parasitism, a relation in which one animal benefits and the other is harmed. Parasites are divisible into ectoparasites such as lice, mites and ticks, that live on the surface of animal bodies, eating hair, feathers, or bits of skin or sucking blood; and entoparasites that inhabit interior organs, sucking blood or body fluids or devouring cells, or, in case they lack a digestive tract, imbibing nutriment through the surface. Entoparasites include worms of various kinds and protozoans. Parasitism leads to extensive structural changes in the parasite: reduction of sense organs and the nervous system; loss of locomotory organs; reduction and eventual loss of mouth and digestive system; development of clinging organs such as hooks and suckers; excessive development of the reproductive system with production of immense numbers of eggs; and complicated life cycles involving some stage adapted for spreading the parasite.

ECONOMIC ZOOLOGY

This name is applied to the utilization of zoology in the interests of human welfare. The breeding of domestic animals is a great industry that has been extraordinarily successful in producing breeds of sheep, cattle, horses, dogs, poultry, etc., fitted for all conditions and uses. Practiced in the past mainly by empirical methods, animal breeding has in recent years been greatly ad-

vanced by the application of modern genetics. Among recent trends is the practice of artificial insemination by which the semen of fine male horses, cattle, etc., may be shipped considerable distances for the improvement of stock. Fisheries present numerous complex problems falling within the province of the zoologist, such as the study of variations of the catch from season to season, depletions of breeding stock, development of new fishing grounds, and the improvement of pisciculture. Work of this type involves not only fishes but other aquatic food animals such as oysters, shrimp and lobsters.

The damage that animal pests, especially insects, do to crops is tremendous; these ravages can be controlled only by methods laid down by zoologists. The establishment of these methods depends on a full investigation of the life history and habits of the pest, and of all the factors in its surroundings that influence it, such as climatic conditions, alternative sources of food, the efficiency and mode of application of poisons, parasites, and diseases of the pest, and the discovery of animals that prey upon it. Some of the greatest triumphs of economic entomology have been achieved through finding a suitable predator to prey upon a particular insect pest. (*See* ENTOMOLOGY.)

The investigation and control of animal-borne diseases of man such as malaria, yellow fever, etc., is a zoological matter as is also the study of the animal parasites of man, their taxonomic position, life histories and methods of control.

A present important trend in economic zoology concerns conservation which aims towards the preservation of animals beneficial to man and in general towards restoring the balance of nature that has been upset by human activities. Through ignorance and greed man has succeeded in destroying many useful animals and in seriously depleting the stocks of others. The destruction of any one species may have far-reaching effects because of the complicated interrelationships of animals, especially as regards food cycles. These food cycles always involve plants, so that a whole train of evil consequences may result. Thus, elimination of predators such as the mountain lion or birds of prey permits the excessive increase of herbivorous animals that serve as their prey and are normally kept in check by them; and this results in overgrazing of grasslands and forests. Only intensive studies of plant and animal interrelationships can teach man how to avoid wholesale destruction and interference with natural balance that, if continued, will also destroy him.

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(L. H. H.)

ZORILLA, the name of several African carnivorous mammals belonging to the weasel family, the genera *Ictonyx, Poecilictis* and *Poecilogale*. Superficially they resemble skunks, being black with white stripes. (*See* CARNIVORA.) (J. E. HL.)

ZORN, ANDERS (1860–1920), Swedish artist, was born at Mora, in the province of Dalecarlia, Sweden, on Feb. 18, 1860. He began his artistic career as a water-colourist, adopting the style and tastes of Egron Lundgren under whom he studied. He became well-known in Sweden through the exhibition in 1880 of a small girl's head, entitled "Mourning," now in the National Museum, Stockholm. An increasing reputation brought him orders for many portraits and he earned the means to travel. His first trip to Spain greatly advanced his work through contact with vivid colourings in nature and in life. In the three years following he maintained a studio in London and afterwards travelled in eastern Europe and in Algiers. These years saw the best of his water-colours, such as "Our Daily Bread," "Gipsy Forge," "Caique Rower," "Algiers Harbour," "Lapping of the Waves," "En première," "The Fish Market at St. Ives" and "Rositi Mauri." From 1887 to 1893 he lived chiefly in Paris, though making long visits to Sweden in the summer. In these years he took up oil painting. Also he abandoned the realist manner and became primarily an impressionist and colourist. In 1893 he made his first visit to the United States as Swedish commissioner accompanying that country's art exhibit at the Columbian Exposition in Chicago. He made six subsequent trips, and painted portraits of many American millionaires as well as of Cleveland, Taft, Roosevelt, Hanna, Hay and others. After 1896 he began to spend more of his time in Mora, where he loved and encouraged the Dalecarlian peasant life and customs. He died there on Aug. 22, 1920.

As a painter Zorn is an excellent example of the matured impressionistic group. He won renown for his characteristic and picturesque portraits in which, owing to his sensitive study of values, he gives proper play to light and half-tones. In addition to millionaires, international celebrities, and members of royal families, he painted red-cheeked Swedish girls, country peasant women, and old artisans at their work, and some of his best pictures, such as the studies of his mother in "Mona," of the watchmaker "Djos Mats," the smith "Bosl Anders," and the fiddler "Hins Anders," belong in the latter categories. He loved the nude, especially the play of water on or around the body. "Naked," "After Bathing," "En première," "Renaissance," "By Lake Siljan," "Improvised Bath," and "Mother and Daughter" are among the best of these. In later years he turned more and more to Dalecarlian peasant subjects of which should be mentioned "Midsummer Dance," "Dance at Gopsmor," "Vallkulla," "Early Christmas Service" and "Watering the Horses."

Zorn's status as an etcher is still in controversy between those who would rank him among the masters and those who feel he has been over-rated. He learned the art from his fellow-countryman, Axel Haig, in 1882, but did not do important work in the medium until 1889. At his best, especially in the series of etched portraits of Renan, Anatole France, Proust, Rodin and Verlaine in France, of the Scandinavians Strindberg and Carl Larsson, of Grover Cleveland, Henry Marquand and Senator Mason in America, of the old artisans of Mora in "Djos Mats," "An Old Soldier," and "Vicke," and in "Mona" and "The Toast," he shows genius of the highest sort. Of his nudes "Early Morning," "My Model and My Boat," "Edö," "Precipice," "Wet," "Sappho," all enjoyed favour, but he pursued the theme until it became monotonous, and many of his later plates were quite common in conception. Zorn also won fame as a sculptor, one of his most popular pieces in Sweden being the statute of Gustavus Vasa at Mora (1901). The "Faun and Nymph," "Morning Bath" and "Broken Pitcher" also show his high ability in this field.

See T. Hedberg, *Anders Zorn* (1901 and 1910); F. Servaes, *Anders Zorn* (1910); E. Malmberg, *Larsson, Liljefors, Zorn* (1919); K. Asplund, *Anders Zorn: his Life and Work* (1921); *The Etchings of Anders Zorn*, introduction and notes by E. M. Lang (1923); *Anders Zorn* (1925) in Modern Masters of Etching series.

ZORNDORF, a village of Prussia, Germany, in the Oder valley, N.E. of Cüstrin. It is famous as the scene of a battle in which the Prussians under Frederick the Great defeated the Russians under Fermor, on Aug. 25, 1758 (*see* SEVEN YEARS' WAR).

ZOROASTER, the founder of the national religion of the Iranian people from the time of the Achaemenidae to the close of the Sassanian period. The name (Ζωροάστρης) is the corrupt Greek form of the Iranian *Zarathustra* (new Persian, *Zardushi*). Its signification is obscure. Zoroaster was famous in antiquity as the founder of the wisdom of the Magi. His name occurs first in a fragment of Xanthus (29), and in the *Alcibiades* of Plato (i. p. 122), who calls him the son of Oromazdes. Occidental writers sometimes call him a Bactrian, sometimes a Median or

Persian (*cf.* Jackson, *Zoroaster,* 186). According to Pliny (*Nat. Hist.* vii. 15), he laughed on the very day of his birth—a statement found also in the *Zardusht-Nāma*—and lived in the wilderness upon cheese (xi. 97). Plutarch speaks of his intercourse with the deity, and compares him with Lycurgus and Numa (*Numa,* 4). Dio Chrysostom, Plutarch's contemporary, declares that neither Homer nor Hesiod sang of the chariot and horses of Zeus so worthily as Zoroaster, of whom the Persians tell that, out of love to wisdom and righteousness, he withdrew himself from men, and lived in solitude upon a mountain. The mountain was consumed by fire, but Zoroaster escaped uninjured and spoke to the multitude (vol. ii. p. 60). Plutarch, drawing partly on Theopompus, speaks of his religion in his *Isis and Osiris* (cc. 46–47). He gives a faithful sketch of the doctrines, mythology and dualistic system of the Magian Zoroaster.

Agathias remarks (ii. 24), with truth, that it is no longer possible to determine with any certainty when he lived and legislated. "The Persians," he adds, "say that Zoroaster lived under Hystaspes, but do not make it clear whether by this name they mean the father of Darius or another Hystaspes. But, whatever his date, he was their teacher and instructor in the Magian religion, modified their former religious customs, and introduced a variegated and composite belief."

He is nowhere mentioned in the cuneiform inscriptions of the Achaemenidae, although Darius and his successors were Zoroastrians. The Avesta, our principal source for the doctrine of Zoroaster, is comparatively reticent; on the subject of his person and his life with regard to his date it is, naturally enough, absolutely silent. The 13th section, or *Spend Nask,* which was mainly consecrated to the description of his life, has perished; while the biographies founded upon it in the 7th book of the *Dinkard* (9th century A.D.), the *Shāh-Nāma,* and the *Zardusht-Nāma* (13th century) are full of wonders and fabulous histories and miraculous deliverances.

The personality of Zoroaster is historic, but in the later Avesta, and in writings of more recent date, he is presented in a legendary light and endowed with superhuman powers. At his appearing all nature rejoices (*Yasht,* 13, 93); he enters into conflict with the demons and rids the earth of their presence (*Yasht,* 17, 19); Satan approaches him as tempter to make him renounce his faith (*Vendidad,* 19, 6).

The Gāthās alone within the Avesta claim to be the *ipsissima verba* of the prophet, and are expressly called "the Gāthās of the holy Zoroaster" (*Yasna,* 57, 8), his actual expressions in presence of the assembled congregation, the last genuine survivals of the doctrinal discourses with which—as the promulgator of a new religion—he appeared at the court of King Vīshtāspa.

The person of the Zoroaster in these hymns is a mere man, standing always on the solid ground of reality, whose only arms are trust in his God and the protection of his powerful allies. He had to face forms of outward opposition, the unbelief and lukewarmness of adherents, even his own misgivings as to the truth and final victory of his cause. The range of the emotions which find their immediate expression in these hymns is wide and the whole breathes originality, is psychologically accurate and just, so that in the Gāthās we have the beginnings of the Zoroastrian religion. They give no historical account of the life and teaching of their prophet, but are general admonitions, asseverations, solemn prophecies, directed to the faithful or to the princes, and are generally dialogues with God and the arch-angels, whom he repeatedly invokes as witnesses to his veracity with many allusions to personal events which later generations have forgotten. Their extent is limited and their meaning is frequently dubious and obscure.

The Person of the Prophet.—As to his birthplace the testimonies are conflicting. According to the Avesta (*Yasna,* 9, 17), Airyanem Vaējō, on the river Dāitya, the old sacred country of the gods, was the home of Zoroaster. There on the river Dāreja, if the passage (*Vend.,* 19, 4) is correctly interpreted, stood the house of his father; and the *Bundahish* (20, 32 and 24, 15) says expressly that the river Dāreja lay in Airan Vej, on its bank was the dwelling of his father, and that there Zoroaster was born. According to the *Bundahish* (29, 12), Airan Vej was situated in the direction of Atropatēne, and consequently Airyanem Vaējō is generally identified with the district of Arrān on the river Aras (Araxes), close by the north-western frontier of Media. Other traditions make him a native of Rai (Ragha, Ῥάγαι). According to *Yasna,* 19, 18, the *zarathushtrōtema,* or supreme head of the Zoroastrian priesthood lived in Sassanian times, in Ragha. The Arabic writer Shahrastānī endeavours to reconcile the two traditions by the theory that his father lived at Atropatēne, while the mother was from Rai. In his home he is said to have enjoyed the celestial visions and the conversations with the arch-angels and Ormazd mentioned in the Gāthās. There, too, according to *Yasht,* 5, 105, he prayed that he might convert King Vīshtāspa. He then appears to have quitted his native district. On this point the Avesta is wholly silent; an obscure passage (*Vasna,* 53, 9) intimates that he found an ill reception in Rai. Finally, in the person of Vīshtāspa, a prince resident in east Iran, he gained the powerful protector and faithful disciple of the new religion whom he desired—after almost superhuman dangers and difficulties, which the later books depict in lively colours. In the epic legend, Vīshtāspa was king of Bactria; in the later Avesta he became a half-mythical figure, the last in the series of heroes of east Iranian legend. In the Gāthās he appears as a quite historical personage; to his power and good example the prophet is indebted for his success. In *Yasna,* 53, 2, he is spoken of as a pioneer of the doctrine revealed by Ormazd. In the relation between Zoroaster and Vīshtāspa lies the germ of the state church which afterwards became subservient to the dynasty and sought its protection from it.

Among the grandees of the court of Vīshtāspa were two brothers, Frashaoshtra and Jāmāspa, both, according to the later legend, vizirs of Vīshtāspa. Zoroaster's wife, Hvōvi, was the daughter of Frashaoshtra, and the husband of his daughter, Pourucista, was Jāmāspa. The rôle of intermediary was played by the pious queen Hutaosa. Apart from this, the new prophet relies especially upon his own kindred (*hvaētush*). His first disciple, Maidhyōimāongha, was his cousin: his father was, according to the later Avesta, Pourushaspa, his mother Dughdōvā, his great-grandfather Haēcataspa, and the ancestor of the whole family Spitama, for which reason Zarathushtra usually bears this surname. His sons and daughters are repeatedly spoken of. His death is nowhere mentioned in the Avesta; in the *Shāh-Nāma* he is said to have been murdered at the altar by the Turanians in the storming of Balkh.

As to the date of Zoroaster; King Vīshtāspa has no place in any historical chronology, and the Gāthās give no hint on the subject. According to the Arda Vīrāf, 1, 2, Zoroaster taught some 300 years before the invasion of Alexander. Assyrian inscriptions relegate him to a more ancient period. Eduard Meyer (see *Ancient Persia*), conjecturally puts the date of Zoroaster at 1000 B.C., with Duncker (*Geschichte des Altertums,* 4, 78). This may be too high: but, in any case, Zoroaster belongs to a prehistoric era. Probably he belonged to the old school of Median Magi, and appeared first in Media as the prophet of a new faith, but met with sacerdotal opposition, and turned his steps eastward. In the east of Iran the novel creed first acquired a solid footing, and subsequently reacted with success upon the West.

Zoroastrianism.—Zoroaster taught a new religion rooted in the old Iranian—or Aryan—folk-religion, of which we can form some representation by comparison with the religion of the Veda. The Aryan folk-religion was polytheistic. Worship was paid to popular divinities, such as the war-god and dragon-slayer Indra, to natural forces and elements such as fire, but the Aryans also believed in the ruling of moral powers and of an eternal law in nature. On solemn occasions the inspiring drink soma (*haoma*) was consumed by the devout. Numerous coincidences with the Indian religion survive in Zoroastrianism, side by side with astonishing diversities.

In the Avesta the evil spirits are called *daēva* (Modern Persian *dīv*), while the Aryans of India gave the name of *dēva* to their good spirits, the spirits of light. An alternative designation for deity in the *Rig-Veda* is *asura.* In the later hymns of the *Rig-*

Veda and in later India, only *evil* spirits are called *asuras,* while in Iran the corresponding word *ahura* was, and is, the designation of God the Lord. *Ahura* indicates the more sublime and awful divine character, for which man entertains reverence and fear: *daēva* denotes the kind gods of light, the anthropomorphic deities. Zoroaster elevated the conception of the *Ahura,* and he degraded the daivas (*daēvas*) to the rank of malicious powers and devils. In one *Ahura,* he concentrated the whole of the divine character, and conferred upon it the epithet of "the wise" (*mazdāo*). The Wise Lord (*Ahurō Mazdāo*—later *Ormazd*) is the primaeval spiritual being, the All-father, who was existent before ever the world arose. From him that world has emanated, and its course is governed by his foreseeing eye. His guiding spirit is the Holy Spirit, which wills the good: yet it is not free, but restricted, in this temporal epoch, by its antagonist and own twin-brother (*Yasna,* 30, 3), the Evil Spirit (*angrō mainyush, Ahriman*), who in the beginning was banished by the Good Spirit by means of the famous ban contained in *Yasna,* 45, 2, and since then drags out his existence in the darkness of Hell as the principle of ill. In the Gāthās the Good Spirit of Mazda and the Evil Spirit are the two great opposing forces in the world, and Ormazd himself is to a certain extent placed above them both. Later the Holy Spirit is made directly equivalent to Ormazd; and then the great watchword is: "Here Ormazd, there Ahriman!" The very *daēvas* are only the inferior instruments, the corrupted children of Ahriman, from whom come all that is evil in the world. The *daēvas,* attacked by Zoroaster as the enemies of mankind, are still, in the Gāthās, the perfectly definite gods of old popular belief—the idols of the people. Zoroaster regarded them as spurious deities, and their priests and votaries as idolaters and heretics. In the later, developed, system the *daēvas* are the evil spirits in general, and their number has increased to millions. Some have names; and among them the old Aryan divinities emerge here and there, *e.g.,* Indra and Nāonhaitya. With some, of course, such as the god of fire—the connection with the good deity was indissoluble. Other powers of light, such as Mitra the god of day (Iranian *Mithra*), survived in popular belief till the later system incorporated them in the angelic body. The authentic doctrine of the Gāthās had no room either for the cult of Mithra or for that of the Haoma. Beyond the Lord and his Fire, the Gāthās only recognize the archangels and certain ministers of Ormazd, who are personifications of abstract ideas. The essence of Ormazd is Truth and Law (*asha*=Vedic *rta*): this quality he embodies, and its personification (though conceived as sexless) is always his constant companion. The essence of the wicked spirit is falsehood: and falsehood, as the embodiment of the evil principle, is more frequently mentioned in the Gāthās than Ahriman himself.

Zoroaster says that he had received from God a commission to purify religion (*Yasna,* 44, 9) from the grossly sensual elements of *daēva* worship. This self-contained theory of the universe and logical dualistic principle were destined to terminate in monotheism. Later sects sought to rise from it to a higher unity in other ways. Thus the Zarvanites represented Ormazd and Ahriman as twin sons proceeding from the fundamental principle of all—*Zrvana Akarana,* or limitless time.

Ethically, too, the new doctrine stands on a higher plane, and represents, in its moral laws, a superior civilization. It is the religion of the settled grazier and the peasant, while the ruder *daēva*-cult holds its ground among the uncivilized nomadic tribes, who sacrificed the cow, the gift of Ormazd to man, a sacred animal.

The Doctrine of Zoroaster may be summarized as follows:—

At the beginning of things there existed the two spirits who represented good and evil (*Yasna,* 30, 3). Both spirits possess creative power, which manifests itself positively in the one and negatively in the other. Ormazd is light and life, and creates all that is pure and good—in the ethical world of law, order and truth. His antithesis is darkness, filth, death and produces all that is evil in the world. Until then the two spirits had counterbalanced one another. The ultimate triumph of the good spirit is an ethical demand of the religious consciousness and the quintessence of Zoroaster's religion.

The evil spirit with his wicked hosts appears in the Gāthās much less endowed with the attributes of personality and individuality than does Ahura Mazda. Within the world of the good Ormazd is Lord and God alone. In this sense Zoroastrianism is often referred to as the faith of Ormazd or as Mazdaism. Ormazd in his exalted majesty, the ideal figure of an Oriental king, has in conjunction with himself a number of genii—for the most part personifications of ethical ideas. These are his creatures, his instruments, servants and assistants. They are comprehended under the general name of *ameshā spentā* ("immortal holy ones") and are the prototypes of the seven *amshaspands* of a later date. These are—(1) Vohu Manō (εὔνοια), good sense, *i.e.,* the good principle, the idea of the good, the principle that works in man inclining him to what is good; (2) Ashem, afterwards Ashem Vahishtem (Plutarch's ἀλήθεια), the genius of truth and the embodiment of all that is true, good and right, upright law and rule—ideas practically identical for Zoroaster; (3) Khshathrem, afterwards Khshathrem Vairīm (εὐνομία), the power and kingdom of Ormazd, which have subsisted from the first but not in integral completeness, the evil having crept in like tares among the wheat: the time is yet to come when it shall be fully manifested in all its unclouded majesty; (4) Ārmaiti (θοψία), due reverence for the divine, *verecundia,* spoken of as daughter of Ormazd and regarded as having her abode upon the earth; (5) Haurvatāt (πλοῦτος), perfection; (6) Ameretāt, immortality. Other ministering angels are Gēush Urvan ("the genius and defender of animals"), and Sraosha, the genius of obedience.

As soon as the two separate spirits (cf. *Bundahish,* 1, 4) encounter one another, their creative activity and at the same time their permanent conflict begin. The history of this conflict is the history of the world. All creation divides itself into that which is Ahura's and that which is Ahriman's.

In the soul of man is the object of the war. Man is a creation of Ormazd, who therefore has the right to call him to account. But Ormazd created him free in his determinations and in his actions, wherefore he is accessible to the influences of the evil powers. Man takes part in this conflict by all his life and activity in the world. By a true confession of faith, by every good deed, word and thought, by continually keeping pure his body and his soul, he impairs the power of Satan and strengthens the might of goodness, and establishes a claim for reward upon Ormazd; by a false confession, by every evil deed, word and thought and defilement, he increases the evil and renders service to Satan.

The life of man falls into two parts—its earthly portion and that which is lived after death. The lot assigned to him after death is the result and consequence of his life upon earth. On the works of men here below a strict reckoning will be held in heaven (according to later representations, by Rashnu, the genius of justice, and Mithra). All the thoughts, words and deeds of each are entered in the book of life as separate items—all the evil works, etc., as debts. Wicked actions cannot be undone, but in the heavenly account can be counterbalanced by a surplus of good works. Only in this sense can an evil deed be atoned for by a good deed. Of a real remission of sins the old doctrine of Zoroaster knows nothing, whilst the later Zoroastrian Church admits repentance, expiation and remission. After death the soul arrives at the *cinvatō peretu,* or accountant's bridge, over which lies the way to heaven. Here the statement of his life account is made out. If he has a balance of good works in his favour, he passes forthwith into paradise (*Garō demāna*) and the blessed life. If his evil works outweigh his good, he falls finally under the power of Satan, and the pains of hell are his portion for ever. Should the evil and the good be equally balanced, the soul passes into an intermediary stage of existence (the *Hamēstakāns* of the Pahlavi books) and its final lot is not decided until the last judgment. This court of reckoning is called *ākā.* The course of law cannot be turned aside by sacrifice, nor by the grace of God.

In the Gāthās Zoroaster speaks usually in general terms of the divine commands and of good and evil works, of the renunciation of Satan, adoration of Ormazd, purity of soul and body, and care of the cow. Ceremonial worship is hardly mentioned. The Gāthās contain revelations concerning the last things and the future lot, whether bliss or woe, of human souls, promises

for true believers, threatenings for misbelievers, and Zoroaster's firm confidence as to the future triumph of the good.

Zoroaster believed that the calling of a prophet took place precisely when it did with special reason. It was, he held, the final appeal of Ormazd to mankind at large. The fulness of time was near, the kingdom of heaven was at hand. Through the whole of the Gāthās runs the pious hope that the end of the present world is not far distant. He himself hopes, with his followers, to live to see the decisive turn of things, the dawn of the new and better aeon. Ormazd will summon together all his powers for a final decisive struggle and break the power of evil for ever; by his help the faithful will achieve the victory over their detested enemies, the *daēva* worshippers. Thereupon Ormazd will hold a general ordeal. Forthwith begins the one undivided kingdom of God in heaven and on earth. This is called, sometimes the good kingdom, sometimes simply the kingdom. Here the sun will for ever shine, and all the pious and faithful will live a happy life, which no evil power can disturb, in the eternal fellowship of Ormazd and his angels. Every believer will receive as his guerdon the inexhaustible cow and the gracious gifts of the Vohu Manō.

Later Development.—For most of the people Zoroaster's doctrine was too abstract. In the later Avesta are Mithra and popular divinities like the angel of victory, Verethraghna, Anāhita (Anāitis), the goddess of the water, Tishrya (Sirius), and other heavenly bodies, invoked with special preference. The Gāthās know nothing of the belief in the *Fravashi,* or guardian angels of the faithful. *Fravashi* properly means "confession of faith," and when personified comes to be regarded as a protecting spirit.

With the new teaching arose a widely spread priesthood (*āthravanō*) who systematized its doctrines, organized and carried on its worship, and laid down the minutely elaborate laws of the Vendidad for the purifying and keeping clean of soul and body, such as the numerous ablutions, bodily chastisements, love of truth, beneficial works, support of comrades in the faith, alms, chastity, improvement of the land, arboriculture, breeding of cattle, agriculture, protection of useful animals, as the dog, the destruction of noxious animals, and the prohibition either to burn or to bury the dead. These are to be left on the appointed places (*dakhmas*) and exposed to the vultures and wild dogs. In the worship the drink prepared from the *haoma* (Indian *soma*) plant had a prominent place. Worship in the Zoroastrian Church was devoid of pomp; it was independent of temples. Its centre was the holy fire on the altar. The fire altars afterwards developed to fire temples. In the sanctuary of these temples the various sacrifices and high and low masses were celebrated. As offerings meat, milk, show-bread, fruits, flowers and consecrated water were used. The priests were the privileged keepers and teachers of religion. They only performed the sacrifices (Herodotus, i. 132), educated the young clergy, imposed the penances; they in person executed the ceremonies of purification and exercised a spiritual guardianship and pastoral care of the laymen. Every young believer in Mazda, after having been received into the religious community by being girt with the holy lace, chose a spiritual guide (*ratu*).

In eschatology a change took place. The last things and the end of the world are relegated to the close of a long period of time (3,000 years after Zoroaster), when a new Saoshyant is to be born of the seed of the prophet, the dead come to life, and a new incorruptible world begins.

Zoroastrianism was the national religion of Iran, and was professed by Turanians as well. The worship of the Persian gods spread to Armenia and Cappadocia and over the whole of the Near East (Strabo, xv. 3, 14; xi. 8, 4; 14, 76). Of the Zoroastrian Church under the Achaemenides and Aeracides little is known. After the overthrow of the dynasty of the Achaemenides a period of decay set in. Yet the Aeracides and the Indo-Scythian kings as well as the Achaemenides were believers in Mazda. The national restoration of the Sassanides brought new life to the Zoroastrian religion and long-lasting sway to the Church. Protected by this dynasty, the priesthood developed into a completely organized state church, which employed the power of the state in enforcing strict compliance with the religious law-book hitherto enjoined by their unaided efforts only. The head of the Church (Zarathushtrōtema) had his seat at Rai in Media and was the first person in the state next to the king. The formation of sects was at this period not infrequent (*cf.* MANICHAEISM). The Mohammedan invasion (636), with the persecutions of the following centuries, was the death-blow of Zoroastrianism. In Persia itself only a few followers of Zoroaster are now found (in Kerman and Yezd). The PARSEES (*q.v.*) in and around Bombay hold by Zoroaster as their prophet and by the ancient religious usages, but their doctrine is a pure monotheism.

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ZORRILLA, JOSÉ (1817–1893), Spanish poet and dramatist, was born at Valladolid and read law at the University of Toledo, but after a year of idleness there, he fled to Madrid and started a paper which was suppressed by the Government. He then fell into great poverty, but was brought into notice by an elegiac poem, declaimed at Larra's funeral in Feb. 1837. His *Cantos del trovador* (1841), a collection of national legends versified with infinite spirit, secured for the author the place next to Espronceda in popular esteem. National legends also supply the themes of his dramas, though in this department Zorrilla somewhat compromised his reputation for originality by adapting older plays which had fallen out of fashion. For example, in *El Zapatero y el Rey* he recasts *El montañés Juan Pascual* by Juan de la Hoz y Mota; in *Don Juan Tenorio* he adapts from Zamora's *No hay denda que no se pague, y Convidado de piedra,* and from the elder Dumas's *Don Juan de Marana* (which itself derives from *Les âmes du purgatoire* of Prosper Mérimée). But his rearrangements usually contain original elements, and in *Sancho García, El Rey loco,* and *El Alcalde Ronquillo* he apparently owes little to any predecessor. In 1855 he emigrated to Mexico where he was protected by the Emperor Maximilian. He returned in 1866 to find himself a half-forgotten classic. His old fertility was gone, and new standards of taste were coming into fashion. He was always poor, and for some 12 years after 1871 he was in the direst straits. A small pension secured him from actual want in his old age, and the reaction in his favour became an apotheosis. In 1889 he was publicly crowned at Granada as the national laureate.

ZOSIMUS, bishop of Rome from March 18, 417 to Dec. 26, 418, succeeded Innocent I. and was followed by Boniface I. For his attitude in the Pelagian controversy, *see* PELAGIUS. He took a decided part in the protracted dispute in Gaul as to the jurisdiction of the see of Arles over that of Vienne, but without settling the controversy.

ZOSTEROPS, a genus of birds inhabiting various parts of the Old World and especially common in Australia and New Zealand. In New Zealand, the most familiar species (*Z. caerulescens*) is called white-eye or blight-bird, the last an allusion to its clearing the fruit-trees from blight.

ZOUAVE, the name given to certain infantry regiments in the French Army. The corps was first raised in Algeria in 1831 with one and later two battalions, and recruited solely from the Zouaves, a tribe of Berbers, dwelling in the mountains of the Jurjura range (*see* KABYLES). In 1838 a third battalion was raised and the regiment thus formed was commanded by Lamoricière. Shortly afterwards the formation of the *Tirailleurs algériens,* the Turcos, as the corps for natives, changed the enlistment for the Zouave battalions, and they became, as they

now remain, a purely French body. Three regiments were formed in 1852, and a fourth, the Zouaves of the Imperial Guard, in 1854. The Crimean War was the first service which the regiments saw outside Algeria. There are now six regiments, of three battalions each, stationed in North Africa.

The Papal Zouaves were formed in defense of the Papal states by Lamoricière in 1860. After the occupation of Rome by Victor Emmanuel II in 1870, the Papal Zouaves served the government of national defense in France during the Franco-Prussian War, and were disbanded during the siege of Paris.

ZOUTPANSBERG, a district forming part of the Low Veld of the northern Transvaal. It is, for the most part, low-lying undulating country, bounded on the north by the Limpopo river. The principal hills are the Zoutpansberg, which consist of three parallel ranges, which are due to the dislocation of Waterberg rocks with strike faults. Copper is mined at Messina, near the Limpopo, and gold has been found at several places. Owing to its isolation and malaria, the district has been little developed, and the population was regarded as typical "backveld Boers." A railway has been built, linking Messina with the Transvaal system, and with Lourenço Marques. Area 10,698 sq.mi., pop. (1936) 237,414 (7,878 white).

ZUCCARELLI, FRANCESCO (1702–1788), Italian painter, was born at Pitigliano in Tuscany, and studied in Rome under Morandi, and Nelli. He was a foundation member of the Royal Academy and had the patronage of royalty and of many wealthy English collectors, for whom he executed his principal works—generally landscapes with classic ruins and small figures.

ZUCCARO, the name of two Italian painters.

I. Taddeo Zuccaro (1529–1566), one of the most popular painters of the so-called Roman mannerist school, was the son of Ottaviano Zuccaro, an almost unknown painter at St. Angelo in Vado, where he was born in 1529. He was employed by popes Julius III. and Paul IV., by Della Rovere, duke of Urbino, and other patrons. His best frescoes were a historical series painted on the walls of a palace at Caprarola, built for Cardinal Alessandro Farnese, for which Taddeo also designed rich decorations in stucco relief after the style of Giulio Romano and other pupils of Raphael. Nearly all his paintings were in fresco, very large in scale, and often in *chiaroscuro*. He died in Rome in 1566.

II. Federigo Zuccaro (*c.* 1539–1609) was in 1550 placed under his brother Taddeo's charge in Rome, and worked as his assistant; he completed the Caprarola frescoes. Federigo was perhaps the most popular artist of his generation. Probably no other painter has ever produced so many enormous frescoes crowded with figures on the most colossal scale, extravagant in attitude. His first work of this sort was the completion of the painting of the dome of the cathedral at Florence in 1579; the work had been begun by Vasari but left unfinished at his death. Federigo was recalled to Rome by Gregory XIII. to continue in the Pauline chapel of the Vatican the scheme of decoration begun by Michelangelo during his failing years, but he left Italy owing to a quarrel with members of the papal court. He visited Brussels, and there made a series of cartoons for the tapestry-weavers. In 1574 he went to England, where he received commissions to paint the portraits of Queen Elizabeth, Mary, queen of Scots, Sir Nicholas Bacon, Sir Francis Walsingham, Lord High Admiral Howard and others. Federigo was soon recalled to Rome to finish his work on the vault of the Pauline chapel. In 1585 he accepted an offer by Philip II. of Spain to decorate the new Escorial at a yearly salary of 2,000 crowns. He returned to Rome in 1588 and there founded in 1595, under a charter confirmed by Sixtus V., the Academy of St. Luke, of which he was the first president. Its organization suggested to Sir Joshua Reynolds the plan for the English Royal Academy.

He also wrote on art, see *L'Idea de' Pittori, Scultori, ed Architetti* (Turin, 1607), and two volumes (Bologna 1608) describing his visit to Parma and a journey through central Italy. He died at Ancona in 1609.

ZUG, the smallest undivided canton of Switzerland, is centrally situated. Of its 92·6 sq.m., 83·6% are productive, forests covering 20·1 sq. miles. Of the unproductive area, 12·6 sq.m. are covered by lakes, 2·8 by the Aegeri See (wholly within the canton), and the balance by part of the Lake of Zug. The pear-shaped Rossberg mass, with its central summit (Wildspitz, 5,193 ft.) thrusts its pointed end (Zugerberg, 3,261 ft.) north-north-west into the canton. Its steep western flanks fall to the Lake of Zug, the less steep eastern slopes descend to the basin and waters of the Aegeri See. Still eastwards, the land rises to the Hohe Rone mass (4,055 ft.) near its eastern boundary. From Aegeri a gorge carries the river Lorze to the low land at the north end of the Zugerberg, round which it curves to enter the lower end of the Lake of Zug. The Lorze leaves this lake slightly west of its point of entrance and flows north-north-west, over fertile lowlands, to its junction with the river Reuss—the latter stream forming the north-west boundary of the canton. Zug thus holds a strategical position at the entrance to the higher land. Railways connect the capital both with Lucerne and with Zürich, while lines running along the shores of the Lake of Zug join at the Arth-Goldau station of the St. Gotthard railway. (*See* Schwyz.) An electric railway connects Zug and Oberaegeri; $2\frac{3}{4}$ m. distant, on the south-east of the lake, is Morgarten, the site of the great victory of the Confederates over the Habsburgs (1315). In 1941 the population was 36,744; in 1930, 34,395, of whom 32,897 were German-speaking, 1,001 Italian-speaking, and 294 French-speaking, while 29,211 were Catholics, 5,015 Protestants, and 46 Jews. Since 1928 the canton has formed part of the diocese of Basle. All towns are small. Zug (pop. 12,316) is the largest; north of it is Baar, and west-north-west is Cham, which are merely large villages. The canton forms a single administrative district and contains 11 communes. By the Constitution of 1814 the "Landsgemeinde," or primitive democratic assembly, which had existed since 1376, became an electoral body to choose a cantonal council. In 1848 the remaining functions of the Landsgemeinde were abolished.

The 1873–76 Cantonal Constitution was largely replaced by the present one in 1894.

The legislature (*Kantonsrat*) of 78 deputies has one member to every 450 inhabitants, and the seven members of the executive (*Regierungsrat*) are elected directly by popular vote.

The earlier history of the canton is closely linked with that of its capital, Zug (*see* below); subsequently violent disputes about the distribution of the French pensions took place (1728–38). In 1798 its inhabitants opposed the French, and during the period of the Helvetia republic it was one of the districts of the huge canton of the Waldstätten, but became a separate canton again on the fall of the republic (1803). As one of the six Catholic cantons, it joined the Sonderbund (1845) and shared in the war of 1847. In 1848, and again in 1874, it voted against the acceptance of the proposed Federal Constitution.

ZUG, capital of the Swiss canton of that name, a picturesque little town at the N.E. corner of the lake of Zug, and at the foot of the Zugerberg (3,255 ft.), which rises gradually, its lower slopes thickly covered with fruit trees. Pop. (1941) 12,316, mainly German-speaking and Roman Catholic.

The town, first mentioned in 1240, is called an *oppidum* in 1242, and a *castrum* in 1255. In 1273 it was bought by Rudolph of Habsburg from Anna, the heiress of Kyburg. After this it was governed by a bailiff, appointed by the Habsburgs, and a council, and was much favoured by that family. Several country districts (Baar, Menzingen, and Aegeri) had each its own "Landsgemeinde" but were governed by one bailiff, also appointed by the Habsburgs; these were known as the "Aeusser Amt," and were always favourably disposed to the Confederates. On the 27th of June 1352 both the town of Zug and the Aeusser Amt entered the Swiss Confederation; but in September, 1352, Zug had to acknowledge its own lords again, and in 1355 to break off its connection with the league. About 1364 the town and the Aeusser Amt were recovered for the league by the men of Schwyz, and from this time Zug took part as a full member in all the acts of the league. In 1379 the German king Wenceslaus exempted Zug from all external jurisdictions, and in 1389 the Habsburgs renounced their claims, reserving only an annual payment of twenty silver marks, and this came to an end in 1415. In 1385 Zug joined the league of the Swabian cities against Leopold of Habsburg,

and shared in the victory of Sempach. Between 1379 (Walchwil) and 1477 (Cham) Zug had acquired various districts in her own neighbourhood, principally to the north and the west, which were ruled till 1798 by the town alone as subject lands. At the time of the Reformation Zug clung to the old faith and was a member of the "Christliche Vereinigung" of 1529. In 1586 it became a member of the Golden League.

ZUG, LAKE OF, one of the minor Swiss lakes, north of that of Lucerne. It is formed by the Aa, which enters the southern extremity of the lake. The Lorze enters at its northern end, but $1\frac{1}{4}$ m. further W. issues from the lake to pursue its course towards the Reuss. The lake has an area of about 15 sq.m., is about 9 m. long, $2\frac{1}{2}$ m. wide, and has a maximum depth of 650 ft., while its surface is 1,368 ft. above sea-level. Most of the lake is in the canton of Zug, but $3\frac{3}{4}$ sq.m. at the southern end is in Schwyz, while $\frac{3}{4}$ sq.m., to the N. of Immensee is in Lucerne.

ZUHAIR [Zuhair ibn Abī Sulmā Rabī' a ul-Muzanī] (6th century), one of the six great Arabian pre-Islamic poets. Of his life practically nothing is known save that he belonged to a family of poetic power; his stepfather, Aus ibn Hajar, his sister, Khansā, and his son, Ka'b ibn Zuhair, were all poets of eminence. He is said to have lived long, and at the age of one hundred to have met Mohammed. His home was in the land of the Banī Ghatafān. His poems are characterized by their peaceful nature and a sententious moralizing. One of them is contained in the *Moallakāt*.

As a whole his poems have been published by W. Ahlwardt in his *The Diwans of the six Ancient Arabic Poets* (London, 1870); and with the commentary of al-A'lam (died 1083) by Count Landberg in his *Primeurs arabes* (Leiden, 1889). (G. W. T.)

ZUIDER ZEE (Zoi'dur zā), a shallow gulf, penetrating far into the northern Netherlands, communicating with the North Sea but almost cut off from it at low water by the Frisian islands (Texel, etc.) and the sandbanks of the Wadden Zee. It is probable that in the middle ages the coast line to the north of the Zuider Zee was an almost continuous series of dunes, but, before the 14th century the Zuider Zee acquired something of its present form. The greater part of the water-covered area has a depth of less than 15ft. at low water. An area of over 12,000ac. of rich land was reclaimed from Lake Y in the neighbourhood of Amsterdam, at the time of the building of the North Sea ship canal in the middle of the 19th century, by the construction of a sea-dike and locks cutting off Amsterdam from the Zuider Zee. The earliest plans for reclaiming the Zuider Zee date from the 17th century but it was not until 1918 that the sanction of the Netherlands legislature was obtained to the carrying out of a vast scheme of reclamation commenced in 1920. (*See* COAST PROTECTION AND LAND RECLAMATION; HOLLAND.) (N. G. G.)

The Zuider Zee originally covered an area of about 3,570 square kilometres. When drained, there will remain a fresh-water lake covering 1,450 square kilometres. The reclaimed land, divided into four polders by the new lake (to be called Yssel lake), and the mouths of the Amstel and the Yssel, will cover an area of almost 2,112 square kilometres. Of this land, 1,950 sq.km., will consist of exceedingly fertile soil. To render this drainage possible, the Zuider Zee had to be separated from the North sea by a dike, completed in 1932 at a cost of £10½ millions. The dike is 29.3 kilometres long, and six metres high above the water level. The top is only two metres in width. On the inside berm, however, there will be room for a road 17 metres wide, over which a double-track railway will run. The dike will be equipped with 30 discharge sluices, each 10 metres wide and five metres deep. Further, there will be two locks, respectively 10 and 6 metres wide. These sluices and locks will maintain communication between the Yssel lake and the North sea. It is hoped that the northwestern polder, covering an area of 220 sq.km., will be completed at the same time as the dike and that all four polders will be in exploitation by 1958.

ZULA, a small town near the head of Annesley bay on the African coast of the Red sea. Ruins in its vicinity are supposed to mark the site of the ancient emporium of Adulis ('Αδουλῖς, 'Αδουλεί), the port of Aksum (*q.v.*) and chief outlet in the early centuries of the Christian era for the ivory, hides, slaves and other exports of the interior. Cosmas Indicopleustes saw here an inscription of Ptolemy Euergetes (247–222 B.C.); and it is conjectured that the town may have been the Berenice Panchrysus of the Ptolemies.

In 1857 an agreement was entered into by Dejaj Negusye, a chief of Tigré, in revolt against the Negus Theodore of Ethiopia, to cede Zula to the French. Negusye was defeated by Theodore, and the commander of a French cruiser sent to Annesley Bay in 1859 found the country in a state of anarchy. No further steps were taken by France to assert its sovereignty, and Zula, with the neighbouring coast, passed nominally to Egypt in 1866. Zula was the place where the British expedition of 1867–68 against Theodore disembarked. The road made by the British from Zula to Senafé on the Ethiopian plateau is still in use. The authority of Egypt having lapsed, an Italian protectorate over the district of Zula was proclaimed in 1888, and in 1890 it was incorporated in the colony of Eritrea (*q.v.*).

ZULOAGA, IGNACIO (1870–1945), Spanish painter, was born at Eibar in the Basque country on July 26, 1870, the son of the metal-worker and damascener Placido Zuloaga, and grandson of the organizer and director of the royal armoury in Madrid. He was intended for an architect, and to this end was sent to Rome, where he at once followed his strong impulse to become a painter. After six months' work he completed his first picture, which was exhibited at the Paris Salon of 1890. Continuing his studies in Paris, he was strongly influenced by Gauguin and Toulouse-Lautrec. But his true style developed after his return to Spain, when he had studied the work of Velazquez, Zurbaran, El Greco and Goya. His own country was slow in acknowledging the young artist whose strong, decorative, rugged style was the very negation of the aims of such well-known modern Spanish artists as Fortuny, Madrazo and Benlliure. It was in Paris, and then in Brussels and other continental art centres, that Zuloaga was first hailed by the reformers as the regenerator of Spanish national art and as the leader of a school. He is represented in almost every great continental gallery.

Two of his canvases are at the Luxembourg, one at the Brussels Museum ("Avant la Corrida"), and one ("The Poet Don Miguel") at the Vienna Gallery. The Pau Museum owns an interesting portrait of a lady, the Barcelona Municipal Museum the important group "Amies," the Venice Gallery, "Madame Louise"; the Berlin Gallery, "The Topers." Other examples are in the Budapest, Stuttgart, Ghent and Posen galleries and in many important private collections.

A fully illustrated account of the artist and his work, by M. Utrillo, was published in a special number of *Forma* (Barcelona, 1907).

ZULULAND, a region in southeast Africa, forming the northeastern section of the province of Natal in the Union of South Africa. It was incorporated with Natal in Dec. 1897, from which time until the formation of the union it was known as the province of Zululand. It lies between 26° 50′ and 29° 15′ S. and 30° 40′ and 33° E. and is bounded on the southeast by the Indian ocean, on the north and northeast by the Utrecht and Vryheid districts of Natal and by Swaziland. The region has an area of 10,427 sq.mi. including Amatongaland, Zaambauland and Ingwavuma District, territories not part of the former Zulu domains. Population (1936) 362,421 of which 352,437 are natives; 6,159 Europeans; 2,600 Asiatics; and 1,225 coloured. European settlement has been restricted by the prevalence of malaria and of the tsetse fly. For an account of physical features, geology, climate, flora, fauna and general geography *see* under NATAL and SOUTH AFRICA, UNION OF.

Crown reserves of land for native use, although considerably reduced, form about three-fifths of Zululand, 3,882,000 acres having been set aside in 21 districts as the Zululand native trust. Large areas in Zululand have been planted to sugar cane. Completion of the Swazi border railway opened up much country for the cultivation of cotton. The completion of the Empangeni-Nkwaleni railroad should aid in the development of large and fertile areas. The important irrigation scheme at Mkuzi should further facilitate agriculture, as should also a similar project, estimated to cost £250,000, on the Pongola river. Coal deposits, believed to underlie much of the southern sections of Zululand,

have not been fully exploited. (P. W. I.)

History.—At what period the Zulu (one of a number of closely allied septs) first reached the country to which they have given their name is uncertain; they were probably settled in the valley of the White Umfolosi river at the beginning of the 17th century, and they take their name from a chief who flourished about that time. By certain shipwrecked Europeans they were described as very proud and haughty, careful in the preparation of food, very cleanly in person and keeping strict watch over their women. That was in 1756. At the close of the 18th century the Zulu were an unimportant tribe, numbering a few thousands only. At that time the most powerful of the neighbouring tribes was the Umtetwa (mTetwa or Aba-Tetwa), which dwelt in the country northeast of the Tugela. Its ruler was a chief who had had in early life an adventurous career and was known as Dingiswayo (the Wanderer). He divided the young men of his tribe into *impis* (regiments), and the Umtetwa became a formidable military power. In 1805 he was joined by Chaka (Tshaka, born *c.* 1783), the son of the Zulu chief Senzangokona; on the latter's death in 1810 Chaka, through the influence of Dingiswayo, was chosen as ruler of the Ama-Zulu, though not the rightful heir. About 1812 Dingiswayo was captured and put to death by Zwide, chief of the Undwandwe clan.

Chaka and Dingaan.—After Dingiswayo's death the Umtetwa army then placed themselves under Chaka, who not long afterward conquered the Undwandwe. By the incorporation of these tribes Chaka made the Zulu a powerful nation. He strengthened the regimental system adopted by Dingiswayo and perfected the discipline of his army. A new order of battle was adopted—the troops being massed in crescent formation, with a reserve in the shape of a parallelogram ready to strengthen the weakest point. This order of battle was not, however, entirely new to the Bantu and probably Chaka's greatest innovation was the introduction of the stabbing assegai. At the same time the size of the shield was increased, the more completely to cover the body of the warrior. Military kraals were formed for the warriors.

Chaka had but two ways of dealing with the tribes with whom he came in contact; either they received permission to be incorporated in the Zulu nation or they were attacked. In the latter case the only persons spared were young girls and growing lads. About 1820, after the Zulu had conquered Natal, Mosilikatze (properly Umsilikazi), a general in the Zulu army, having incurred Chaka's wrath by keeping back part of the booty taken in an expedition, fled with a large following across the Drakenberg. Mosilikatze was not of the Zulu tribe proper, and he and his followers became known as the Matabele. Chaka's own dominions coincided almost exactly with the limits of Zululand and Natal.

Chaka seems to have first come into contact with Europeans in 1824, when he was visited by F. G. Farewell and a few companions. To them he made a grant of the district of Port Natal. Chaka, who was cured of a wound by the skill of one of Farewell's companions, showed himself friendly to Europeans. He wished to send an embassy to England, but the Cape government turned back his envoy. Again Chaka sent chiefs to Capetown, but before their arrival he had been murdered (Sept. 23, 1828) at a kraal on the Umvote, about 50 miles from Port Natal. Chaka was a victim to a conspiracy by his half-brothers Dingaan and Umthlangana, while a short time afterwards Dingaan murdered Umthlangana and made himself king.

Bloodstained as had been Chaka's rule, that of Dingaan appears to have exceeded it in wanton cruelty. In 1835 Dingaan permitted the British settlers at Port Natal to establish missionary stations in the country in return for a promise made by the settlers not to harbour fugitives from his dominions. In 1836 American missionaries were also allowed to open stations; in Nov. 1837 Dingaan received Pieter Retief, the leader of the first party of Boer immigrants to enter Natal. The story of Retief's mission, the massacre of the Boer leader and the fighting which followed is told in the article NATAL. In the result Dingaan's army was totally defeated on Dec. 16, 1838 ("Dingaan's Day"), by a Boer force under Andries Pretorius. A year later he was overthrown, the Boers in Natal (Jan. 1840) supporting his brother Mpande (usually called Panda) in rebellion against him. Dingaan passed into Swaziland in advance of his retreating forces, and was there murdered, while Panda was crowned king of Zululand by the Boers.

Panda and Cetywayo.—When in 1843 the British succeeded the Boers as masters of Natal they entered into a treaty with Panda, who gave up to the British the country between the upper Tugela and the Buffalo rivers, and also the district of St. Lucia bay (which, however, was not then occupied). Less warlike than Chaka and Dingaan, Panda remained throughout at peace with the government of Natal. Bishop Schreuder, a Norwegian missionary long resident in Zululand, gave Sir Bartle Frere the following estimate of the three brothers who successively reigned over the Zulu:—"Chaka was a really great man, cruel and unscrupulous, but with many great qualities. Dingaan was simply a beast on two legs. Panda was a weaker and less able man, but kindly and really grateful, a very rare quality among Zulus. He used to kill sometimes, but never wantonly or continuously." In 1856 war broke out between two of Panda's sons, Cetywayo and Umbulazi, who were rival claimants for the succession. A battle was fought between them on the banks of the Tugela in Dec. 1856, in which Umbulazi and many of his followers were slain. The government of Natal in 1861 obtained the formal nomination of a successor to Panda; and Cetywayo was appointed. Panda died in Oct. 1872 and Cetywayo succeeded in 1873.

Border disputes with the Transvaal Boers were fairly frequent during Panda's reign. The Boers had obtained from Panda in 1854 a cession of the Utrecht district; in 1860 they tried to get from the king a road to the sea at St. Lucia bay. In 1861 a quarrel arose between Cetywayo and another of his brothers, Umtonga (who had been originally designated by Panda as his successor). Umtonga fled to Utrecht; Cetywayo offered the Boers a strip of land if they would surrender his brother. This they did on condition that Umtonga's life was spared. The Boers got their strip of land and beaconed it off in 1864. When, however, in 1865 Umtonga fled to Natal, Cetywayo declared that he had lost his part of the bargain, for he feared that Umtonga might be used to supplant him. He thereupon caused the boundary beacons to be removed and put forward a claim to certain lands north of the Pongola, ceded by the Swazi to the Lyndenburg Boers in 1855, on the ground that the Swazi were the vassals of the Zulu and had no right to part with any of their territory.

Cetywayo's Rule.—Such was the position when by his father's death Cetywayo (*q.v.*) became absolute ruler of the Zulu. As far as possible he revived the military methods of his uncle Chaka. His rule over his own people was tyrannous. By Bishop Schreuder he was described as "an able man, but for cold, selfish pride, cruelty and untruthfulness worse than any of his predecessors." The tension between Cetywayo and the Transvaal over border disputes continued and when in 1877 Great Britain annexed the Transvaal the disputes were transferred to the new owners of the country. A commission appointed by the lieutenant governor of Natal reported in July 1878, and found almost entirely in favour of the Zulu on the boundary disputes. Sir Bartle Frere, then high commissioner, thought the award "one-sided and unfair to the Boers" (Martineau, *Life of Frere,* ii, xix). Frere, moreover, was convinced that it was necessary in the interests of South Africa that the power of Cetywayo be curtailed. In furtherance of this general plan a British resident was to be accepted. These demands were made to Zulu deputies on Dec. 11, 1878, a definite reply being required by the 31st of that month.

The Zulu War.—Cetywayo returned no answer, and in Jan. 1879 a British force under Gen. Thesiger (Lord Chelmsford) invaded Zululand. Chelmsford had a force of 5,000 Europeans and 8,200 natives; Cetywayo an army of fully 40,000 men. Chelmsford divided his force into three columns—their entry was unopposed—which were to converge on Ulundi, the royal kraal. On Jan. 22 the centre column (1,600 Europeans, 2,500 natives), which had advanced from Rorke's Drift, was encamped near Isandhlwana; on the morning of that day Chelmsford moved out with a small force to support a reconnoitring party. After he had left, the camp, in charge of Col. Durnford, was surprised by a Zulu army nearly 10,000 strong. The British were overwhelmed and

almost every man killed, the casualties being 806 Europeans (more than half belonging to the 24th regiment) and 471 natives. The reconnoitring party returned to find the camp deserted; next day they retreated to Rorke's Drift, which had been the scene of an heroic and successful defense. After the victory at Isandhlwana several impis of the Zulu army had moved to the Drift. The garrison stationed there, under Lieuts. Chard and Bromhead, numbered about 80 men of the 24th regiment, and they had in hospital between 30 and 40 men. Late in the afternoon they were attacked by about 4,000 Zulus. On six occasions the Zulus got within the entrenchments, to be driven back each time at the bayonet's point. At dawn the Zulus withdrew, leaving 350 dead. The British loss was 17 killed and 10 wounded.

In the meantime the right column under Col. Pearson had reached Eshowe from the Tugela; on receipt of the news of Isandhlwana most of the mounted men and the native troops were sent back to Natal, leaving at Eshowe a garrison of 1,300 Europeans and 65 natives. This force was hemmed in by the enemy. The left column under Col. Evelyn Wood, which had advanced from Utrecht, found itself obliged to act on the defensive.

News of Isandhlwana reached England on Feb. 11 and on the same day about 10,000 men were ordered to South Africa. The first troops arrived at Durban on March 17. On the 29th a column under Chelmsford, consisting of 3,400 Europeans and 2,300 natives, marched to the relief of Eshowe, entrenched camps being formed each night. On April 2 the camp was attacked at Ginginhlovo, the Zulu being repulsed. Their loss was estimated at 1,200, while the British had only two killed and 52 wounded. The next day Eshowe was relieved. Wood, who had been given leave to make a diversion in northern Zululand, on March 28 occupied Hlobane (Inhlobane) mountain. The force was, however, compelled to retreat owing to the unexpected appearance of the main Zulu army, which nearly outflanked the British. There were 100 casualties among the 400 Europeans engaged. At midday next day the Zulu army made a desperate attack, lasting over four hours, on Wood's camp at Kambula; the enemy—over 20,000 strong—was driven off, losing fully 1,000 men, while the British casualties were 18 killed and 65 wounded.

By the middle of April nearly all the reinforcements had reached Natal, and Chelmsford reorganized his forces. The 1st division, under Maj. Gen. Crealock, advanced along the coast belt and was destined to act as a support to the 2nd division, under Maj. Gen. Newdigate, which, with Wood's flying column, an independent unit, was to march on Ulundi from Rorke's Drift and Kambula. Owing to difficulties of transport it was June before Newdigate was ready to advance. On the 1st of that month the prince imperial of France (Louis Napoleon), who had been allowed to accompany the British troops, was killed while out with a reconnoitring party. On July 1 Newdigate and Wood had reached the White Umfolosi, in the heart of the enemy's country. On the 4th they crossed the river, the force numbering 4,200 Europeans and 1,000 natives. Within a mile of Ulundi the British force, formed in a hollow square, was attacked by a Zulu army numbering 12,000 to 15,000. The battle ended in a decisive victory for the British, whose losses were about 100, while of the Zulu some 1,500 men were killed (*see* ULUNDI). Sir Garnet Wolseley had been sent out to supersede Chelmsford and reached headquarters on July 7.

Cetywayo's Downfall.—After Ulundi the Zulu army dispersed, most of the leading chiefs tendered their submission, and Cetywayo became a fugitive. On Aug. 27 the king was captured and sent to Capetown. His deposition was formally announced to the Zulu, and Wolseley drew up a new scheme for the government of the country. The Chaka dynasty was deposed and the Zulu country portioned among 11 Zulu chiefs, John Dunn, a white adventurer, and Hlubi, a Basuto chief, who had done good service in the war. A resident was appointed who was to be the channel of communication between the chiefs and the British government. This arrangement was productive of much bloodshed and disturbance, and in 1882 the British government determined to restore Cetywayo to power. In the meantime, however, blood feuds had been engendered between two chiefs of the royal house, Usibepu (Zibebu) and Hamu, and the tribes who supported the ex-king and his family. Cetywayo's party (who became known as Usutus) suffered severely at the hands of the two chiefs. When Cetywayo was restored Usibepu was left in possession of his territory, while Dunn's land and that of the Basuto chief (the country between the Tugela and the Umhalatuzi, *i.e.*, adjoining Natal) was constituted a reserve. Before very long this new arrangement proved as futile as had Wolseley's. A collision soon took place; Usibepu's forces were victorious and, on July 22, 1883, led by a troop of mounted whites, he made a sudden descent upon Cetywayo's kraal at Ulundi, which he destroyed, massacring such of the inmates of both sexes as could not save themselves by flight. The king escaped, though wounded, into the reserve; he died in Feb. 1884.

Cetywayo left a son, Dinizulu, who sought the assistance of some of the Transvaal Boers against Usibepu, who was defeated and driven into the reserve. These Boers, led by Lukas Meyer, claimed as a reward for their services the greater and more valuable part of central Zululand. On May 21 the Boer adventurers had proclaimed Dinizulu king of Zululand; in August following they founded the "New Republic," carved out of Zululand. The British government intervened, and in Dec. 1884 took formal possession of St. Lucia bay, caused the Boers to reduce their territorial demands, and in its truncated form recognized the New Republic—which was in 1888 incorporated in the Transvaal and has since 1903 formed the Vryheid division of Natal. (F. R. C.)

Zululand Annexed.—The British government annexed Zululand in 1887 and placed it under a commissioner responsible to the governor of Natal. In the following year Dinizulu rebelled. After a sharp campaign (June–Aug. 1888), Dinizulu fled into the Transvaal. He surrendered to the British in November; in April 1889 he and two of his uncles were found guilty of high treason and were exiled to St. Helena.

Under the administration of Sir Melmoth Osborn, the commissioner, and his successor Sir Marshal Clarke, and the district magistrates, the Zulu became reconciled to British rule.

At the close of 1897 Zululand, in which Tongaland had been incorporated, was handed over by the imperial government to Natal. In 1898 Dinizulu was allowed to return and was made a "government induna." Officially one of several chiefs he was, in fact, regarded by most of the Zulu as the head of their nation.

In 1905 a poll tax of £1 on all adult males was imposed by the Natal legislature; this tax was the ostensible cause of a revolt in 1906 among the natives of Natal. After a hard campaign the rebellion was crushed by July 1906. In all about 3,500 Zulus were killed and about 3,000 taken prisoners, the majority of them being released in 1907. (*See* further, NATAL: *History.*) Zululand remained, however, in a disturbed condition, and a number of white traders and officials were murdered. In Dec. 1907 the Natal government felt justified in charging Dinizulu with high treason, murder and other crimes. A military force entered Zululand and Dinizulu surrendered without opposition. He was brought to trial in Nov. 1908 and in March 1909 was found guilty of harbouring rebels. The more serious charges against him were not proved. Sentenced to four years' imprisonment, he was released on the establishment of the Union in 1910 by Gen. Botha. Dinizulu was settled on a farm in the Transvaal, where he died in Oct. 1913.

No disturbance of public order occurred from 1907 to 1945. European influence has greatly modified native life, consequent upon opening of the country to cotton and sugar planters. The Zulus, because of their traditions as a dominant military people, have shown reluctance to enter industrial employment, although they have not been disinclined to enter domestic service. Numbers of the male population have been obliged to seek livelihoods off the native reserves, with consequent deterioration of the native communities. Many aspects of the tribal systems, however, continue to be important, including the patriarchical social organization, the system of regulating inheritance of personal property (consisting chiefly of cattle), and regulation of marriage. Considerable pressure for further reduction of the native reserves is exerted by the fact that additional land suitable for sugar plantations under European ownership can be found only in the native reserves where the density is already 33.7 per sq.mi. as compared with 20.7 in the union.

About 80 native chiefs, as provided in the act of annexation of Zulu-

land to Natal, hear native criminal and civil cases, under a supervisory staff of magistrates. A court of appeals has been established. The Natal Code of Native Law, with revisions, has been extended to Zululand. It is also proposed to set up a native Bunga, a consultative and deliberative council, along the lines of that set up in the Transkei.

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ZUMALACÁRREGUI, TOMÁS (1788–1835), Spanish Carlist general, born at Ormaiztegui, Navarre, Dec. 29, 1788. In his youth he served under Gaspar de Jauregui, one of the minor guerrillero leaders. He then entered the army, but was disgraced for his support of Don Carlos.

Appointed commander-in-chief in Navarre by Don Carlos, he escaped from Pamplona on the night of Oct. 29, 1833, and took command the next day in the Val de Araquil of the few hundred ill-armed and dispirited guerrilleros that constituted his whole force. In a few months Zumalacárregui had organized the Carlist forces into a regular army. Whether as a guerrillero leader, or as a general conducting regular war in the mountains, he proved unconquerable. By July 1834, he had made it safe for Don Carlos to join his headquarters. The pretender, bigoted and narrow-minded, was afraid of Zumalacárregui's personal influence with the soldiers, and Zumalacárregui was hampered by the intrigues of the court. Yet by June 1835 he had made the Carlist cause triumphant to the north of the Ebro: had he been allowed to march on Madrid, he might well have put Don Carlos in possession of the capital. He reluctantly obeyed the order to besiege Bilbao, was wounded in the leg on June 14, 1835, attended by Don Carlos's physicians, and died on June 24, 1835—not without suspicion of poison.

ZUMPT, the name of two German classical scholars. KARL GOTTLOB ZUMPT (1792–1849) was born on April 1, 1792 in Berlin, and died at Karlsbad on June 25, 1849. He was professor of Latin literature at Berlin University. His chief work was his *Lateinische Grammatik* (1818). He edited Quintilian's *Institutio oratoria* (1831), Cicero's *Verrines* and *De officiis* (1837), and Curtius. He also published *Annales veterum regnorum et populorum* (3rd ed. 1862), a work in chronology down to A.D. 476, and other antiquarian studies. His nephew, AUGUST WILHELM ZUMPT (1815–1877), was born on Dec. 4, 1815, at Königsberg, and died on April 22, 1877, and was professor in the Friedrich Wilhelm Gymnasium. He is known chiefly in connection with Latin epigraphy, his papers on which (collected in *Commentationes epigraphicae*, 2 vols., 1850–54) brought him into conflict with Mommsen. His works include *Monumentum Ancyranum* (with Franck, 1847) and *De monumento Ancyrano supplendo* (1869); *Studia Romana* (1859); *Das Kriminalrecht der röm. Republik* (1865–69); *Der Kriminalprozess der röm. Republik* (1871); editions of Namatianus (1840), Cicero's *Pro Murena* (1859) and *De lege agraria* (1861). Ihne incorporated materials left by him in the 7th and 8th vols. of his *Römische Geschichte* (1840).

ZUNI, a native town on the Zuni river, an affluent of the Little Colorado, in western New Mexico, sole remnant of a Pueblo population of wholly distinct speech and unknown origin. First seen by Niza in 1539; the then seven Zuni towns were entered by Coronado in 1540 after the storming of Hawikuh, one of the chief of them. A mission was established in 1629; in 1670 Hawikuh was destroyed by the Apache; in 1680, on the outbreak of the Pueblo rebellion, only three towns remained, at one of which, Halonawa, the reconquered Zuni population was concentrated around a mission, now in ruins. About this rose the congested pueblo in tiers up to four and five stories of masonry. The population was 2,252 as of Jan. 1, 1941, the largest resident population of any Pueblo. Like the other pueblos, the Zunis have maintained much of their traditional customs and religion. While their culture is thus closely bound up with soil and seasons, their government is on an elective democratic basis. The Zuni ritual best known to non-Indians is the Shalako dance, a house-blessing ceremony held annually in December.

See M. C. Stevenson, *Bur. Am. Ethn. Rep.*, vol. xxiii. (1904); F. H. Cushing, *idem*, vols. ii., iv., xiii. (1883–96), *Zuñi Folk Tales*, 1901, *Zuñi Breadstuff* (Indian Notes and Monographs, vol. viii., 1920); A. L. Kroeber, *Am. Mus. Nat. Hist. Anthr. Pap.*, vol. xviii. (1917); E. C. Parsons, *Am. Anthr. Ass. Mem.*, vol. iv. (1917).

ZUNZ, LEOPOLD (1794–1886), Jewish scholar, was born at Detmold in 1794, and died in Berlin in 1886. He was the founder of what has been termed the "science of Judaism," the critical investigation of Jewish literature, hymnology and ritual. His *Gottesdienstliche Vorträge der Juden, i.e.*, lays down principles for the investigation of the Rabbinic exegesis (Midrash, *q.v.*) and of the prayer-book of the synagogue.

Zunz's other principal works are *Synagogale Poesie des Mittelalters* (1855); and *Literaturgeschichte der Synagogalen Poesie* (1865, supp. vol. 1867).

ZURBARAN, FRANCISCO DE (1598–?1669), Spanish painter, was born at Fuente de Cantos in Estremadura, and baptized on Nov. 7, 1598. His parents belonged to the agricultural labouring class, but, discovering their son's talent, sent him at the age of 16 to study under a painter called Diego Perez Villanueva; he then worked under Juan de Roélas at Seville. He soon developed an independent realistic style, with solid modelling, and strongly contrasted light and shade, and acquired the name of the "Spanish Caravaggio." A series of "Scenes from the life of St. Peter" and a great altarpiece painted for the cathedral at Seville in 1625 established his reputation and in 1629 he was nominated town painter of Seville. Other important works of the early period are four pictures representing "Scenes from the Life of St. Buenaventura" now in the Louvre, Berlin, and Dresden museums; "the Vision of Alonso Rodriguez" (1630 in the Academy, Madrid) which is, perhaps, his masterpiece; the grand altarpiece representing "the Apotheosis of St. Thomas of Aquinas" (1631, Seville museum); to the year 1629 belong the series of pictures out of the Merced Calzada, representing scenes from the life of S. Pedro Molaxo (Seville Cathedral and Prado Madrid). The paintings in the monastery of Guadelupe were executed ten years later. Through his friendship with Velasquez he was nominated "Painter to the king" in 1638. It was, however, not until 1650, that he moved to the capital where he was commissioned to decorate a room of the palace of Buenretiro with the "Labours of Hercules." Of this series only four panels (now in the Prado) were completed. The date of Zurbaran's death is unknown. He was still alive on Feb. 28, 1664, when he was called upon to value some paintings at Madrid. Other important works of the master are at Seville, Cadiz, Jerez and in the museums of Budapest, London, in the Gardner collection, Boston, and with the Hispanic Society, New York, and elsewhere.

Zurbaran's principal pupils were Martinez de Granadille, Bernabe de Ayala, and the brothers Polanco. In the 19th century Courbet, who, like Zurbaran, was a son of the soil, professed a great admiration for the Spaniard's works in the Louvre and, to some extent, formed his style thereon.

See Narcisso Sentenach y Cabanas, *Painters of the School of Seville* (Eng. trans., 1911); José Cascales y Munoz, *Francesco de Zurbaran* (Madrid, 1911); C. Justi, *Diego Velazquez und sein Jahrhundert* (Bonn, 1903). (I. A. R.)

ZÜRICH, the canton of north-eastern Switzerland and which ranks officially first in the Confederation. Its total area is 667·4 sq.m., of which the high proportion of 90·4% is reckoned as "productive" (forests, 184·9 sq.m., and vineyards 4·6 sq.m., the latter showing a rapid decrease during the 20th century, and now ranking much below Valais [*q.v.*]). Of the rest, 27·8 sq.m. are occupied by lake waters, chiefly part of the Lake of Zürich, but wholly within the canton are the Lakes of Greifen (3¼ sq.m.) and Pfäffikon (1¼ sq.m.). The canton, though not one of the ancient three, joined the Confederation in 1351. Its irregularity of shape arises from its continued growth, up to 1803, by the additions of acquisitions made by the capital. As far back as 1362 the

whole of the lower part of the lake was added, and by the purchase of Winterthur (1467) from the Habsburgs, it reached the Rhine. To-day it extends from its enclave in Baden, on the right bank of the Rhine (above the Thur junction to below the Töss junction) to some 8 m. S.W. of Pfäffikon See. It consists essentially of shallow river valleys draining Rhinewards and separated from one another by north-west to south-east ridges. The most important valley is that of the Linth, which expands into the Lake of Zürich and is continued as the Limmat; the ridge to the east is low and then successively eastwards are the valley of the river Aa-Glatt, which flows through the Greifen See; a higher ridge separating it from the more gorge-like Töss valley, and finally the highest ridge along the east boundary separating the Töss from the Toggenburg (*q.v.*). On the last ridge, Hornli reaches 3,727 feet. West of the Lake of Zürich is the strikingly parallel valley of the Sihl, bounded farther west by the Albis range, with Albishorn (3,012 ft.) as its highest point. All the valleys are occupied by railway lines and the Limmat (Zürich to Baden) carried the first line opened (1847) in Switzerland. From the town of Zürich standard lines and mountain railways radiate in all directions; of the latter, one (south-west) is for Uetliberg (2,864 ft.) the north buttress of the Albis range and one (north-east) is for Zürichberg (2,285 ft.), on the ridge between the Limmat and the Glatt. Pop. (1941) 671,714.

In 1930 the population was 617,706, of whom 585,501 were German-speaking, 17,192 Italian-speaking, 9,350 French-speaking, and 1,716 Romansch-speaking, while there were 458,307 Protestants, 141,568 Catholics and 6,081 Jews. The capital of the canton is Zürich (pop. 1941, 333,829), but Winterthur (59,192) is the only other considerable town. Uster (10,588), east of Greifen See, is an industrial town, while Thalwil (7,943), Horgen (9,358) and Wädenswil (9,501), all on the western shore of the Lake of Zürich, are of note as industrial centres. Though the land is highly cultivated, yet the canton is essentially a great manufacturing area, especially of machinery and railway rolling-stock. Silk weaving and cotton weaving are widely spread, and the products of the former industry have a large foreign market. The canton is divided into 11 administrative districts containing 186 communes. In 1869 the cantonal Constitution was revised, and no material changes have been made since. There is an executive (*Regierungsrat*) of seven members and a legislature (*Kantonsrat*) of 180 deputies (distributed among the electoral circles on a population basis, which varies from census to census). Each body holds office for four years and is elected by a method making use of the principle of proportional representation. The compulsory referendum exists, and all laws and all financial decisions involving a total sum over 250,000 frcs., or an annual sum of 20,000 frcs., must be submitted to a popular vote. Any 5,000 voters can employ the "initiative" to force the government to submit to the people any legislative or constitutional matter. Both members of the Federal *Ständerat* and the 28 members of the Federal *Nationalrat* are elected simultaneously by a popular vote and hold office for three years. (*See* SWITZERLAND.) (W. E. WH.)

ZÜRICH, the capital of the Swiss canton of the same name (Fr. *Zurich;* Ital. *Zurigo;* Lat. *Turicum*). It is the most populous, the most important, and on the whole the finest town in Switzerland, and till 1848 was practically the capital of the Swiss Confederation. In 1941, after an extension of boundaries (1934), its population was 333,829. In 1930 it was 249,820, and with its suburbs 309,541. Of the city's population 160,621 were Protestants, 75,291 Roman Catholics and 5,742 Jews, while 230,209 were German-speaking, 6,633 French-speaking, 8,850 Italian-speaking, and 1,082 Romansch-speaking.

Zürich is built on both banks of the Limmat as it issues from the lake of Zürich, and also of its tributary, the Sihl. That portion of the town which lies on the right bank of the Limmat is called the "Grosse Stadt" and that on the left bank the "Kleine Stadt." Till 1893 the central portion of the town on either bank of the Limmat formed the "city" and ruled the outlying communes or townships that had sprung up around it. But at that time the eleven outer districts (including Aussersihl, the workmen's quarter on the left bank of the Sihl) were incorporated with the town. Much land has been rescued from the lake, and is the site of fine quays, stately public buildings, such as the Civic Theatre and the Concert Hall, and splendid private villas. The older quarters are still crowded; but the newer quarters which stretch up the slope of the Zürichberg (above the right bank of the Limmat) have broad streets and fine buildings.

There were numerous pile dwellings on the sides of the lake and Zürich was a pre-Roman settlement, probably an "oppidum." About the middle of the first century A.D. a Roman "castellum" and customs station existed on the Lindenhof.

Of the old buildings the finest and most important is the Gross Münster (or Propstei), on the right bank of the Limmat. This was originally the church of the king's tenants, and in one of the chapels the bodies of Felix, Regula and Exuperantius, the patron saints of the city, were buried. The present building was erected at two periods (*c.* 1090–1150 and *c.* 1225–1300), the high altar having been consecrated in 1278. The towers were first raised above the roof at the end of the 15th century and took their present form in 1779. The chapter consisted of twenty-four secular canons; it was reorganized at the Reformation (1526), and suppressed in 1832. On the site of the canons' houses stands a girls' school (opened 1853), but the fine Romanesque cloisters (12th and 13th centuries) still remain. There is a curious figure of Charlemagne in a niche on one of the towers; to him is attributed the founding or reform of the chapter. On the left bank of the Limmat stands the other great church of Zürich, the Frau Münster (or Abtei), founded for nuns in 853, by Louis the German. The high altar was consecrated in 1170; but the greater part of the buildings are of the 13th and 14th centuries.

Of the other old churches may be mentioned St. Peter's, the oldest parish church, though the present buildings date in part from the 13th century only (much altered in the early 18th century), and formerly the meeting-place of the citizens; the Dominican church or Predigerkirche (13th century), in the choir of which the cantonal library was stored after 1873; the church of the Austin friars (14th century), now used by the Old Catholics, and the Wasserkirche. The last-named church is on the site of a pagan holy place, where the patron saints of the city were martyred; after 1631 it housed the Town Library. In 1916 the various libraries were united into a central library of some 700,000 books, 12,000 mss. including letters of Zwingli, of Bullinger and his friend Lady Jane Grey, of Schiller, etc. This is near the Predigerkirche which is now the repository of the archives of Zürich. The building itself was erected from 1479 to 1484, and near it is a statue of Zwingli, erected in 1885. The existing town hall dates from 1698, while the gild houses were mostly rebuilt in the 18th century. One of the most magnificent of the newer buildings is the Swiss National Museum, which was opened in 1898, and contains a wonderful collection of Swiss antiquities of all periods and art treasures of all kinds.

The town is noted for its numerous clubs and societies, and is the intellectual capital of German-speaking Switzerland. The University of Zürich (*see* below) ordinarily has students of many nations and is housed in new buildings with several outlying institutes. It was opened in 1833, no doubt as a successor to the ancient chapter school at the Gross Münster, said to date back to Charlemagne's time, and hence called the Carolinum, which was reorganized at the Reformation and suppressed in 1832. The Federal Polytechnic school, opened in 1855, is one of the best known institutions of its type and had more than 2,000 students in 1941. Near it is the observatory (1,542 ft.). There are excellent primary and secondary schools and many institutions for special branches of education, *e.g.,* music, silk-weaving, etc. The Pestalozzium, with educational exhibits and Pestalozzi's study, occupies a new building near the Urania bridge.

The position of Zürich as a meeting-point of international trade gives it a cosmopolitan character. Cotton spinning, furniture-making, the manufacture of machinery, the electrical industry and the silk industry are leading activities. The silk-weaving industry flourished in Zürich in the 12th and 13th centuries, but disappeared about 1420; it was revived by the Protestant exiles from Locarno (1555) and by the Huguenot refugees from France (1682 and 1685). Zürich is the banking centre of Switzerland.

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History.—The earliest inhabitants of the future site of Zürich were the lake dwellers. Later, the Helvetii (a Celtic tribe) had a settlement on the Lindenhof, where the Romans established a custom station. The Romans called it Turicum. The district was later occupied by the Alamanni.

The beginnings of the mediaeval town of Zürich date from the 9th and 10th centuries. In the 13th century Zürich was already an important imperial city; in the 16th century she became the centre of the Swiss Reformation and in modern times, though she lost the dominion over the country-side, she remained the capital of the canton and developed as a commercial, industrial intellectual and educational centre of the first importance.

Three stages in the constitutional development of the town may be distinguished. First comes the city's fight for freedom from foreign powers. The burghers were originally under the rule of a *Reichsvogt*, the representative of the emperor (who had a castle on the Lindenhof), but they obeyed also the orders of the abbess of the Fraumünster, a Benedictine convent (endowed in 853 by the Emperor Louis the Pious) which had acquired extensive rights and privileges over the people who had settled round about it. When the council of the abbess, which was composed of the noblemen and rich merchants of the town, became the trusted representation of the townspeople, power actually passed from the abbey to the town (13th century). The *Reichsvogtei*, which had been in the hands of the most powerful dynasty in the country, was in the same period entrusted to some nobleman of the town and was later (1400) bought off altogether from the emperor. Thus the city had acquired independence.

The second stage is characterized by the struggle for admittance of the craft guilds to a share with the patricians in the government of the town. Naturally, in the age of industrial development and of democratic tendencies in the towns, the guilds tried to secure for themselves a share in the city's councils. They found a leader in Rudolf Brun, a nobleman, who after being elected burgomaster introduced a new constitution (1336) which divided the functions of government between the patricians (the *Constafel*) and the representatives of the 13 guilds. The *Constafel* still retained a privileged position; the head of the *Constafel* was to be the burgomaster, and in the Little Council the *Constafel* members alone were invested with the functions of government.

In 1393, however, power passed from the Little Council into the hands of the Great Council (about 200 members) and the guild members got the majority on the Little Council with a title to have the burgomaster chosen out of their own ranks. From the 13th to the 15th century Zürich fought for the possession of a considerable dominion—the Zürich country district (which later became the canton). For a long time the town hesitated between a pro-Habsburg and a pro-Swiss policy. Brun had induced his followers to join in the Swiss League, which was then (1353) only beginning to develop. When, by purchase or right of succession, Zürich had become the ruler of the adjoining lake district, she came in conflict with the territorial aspirations of Schwyz. The "Old Zürich War" (1436–50) broke out between Zürich and all the other members of the Swiss League; Zürich, however, had the assistance of Austria, the old enemy of the League. The war ended with the defeat of Zürich who gave up the Austrian alliance. The authority of the Swiss League was much strengthened. In 1467 Zürich enlarged her dominion by acquiring from the Habsburgs the town of Winterthur. Zürich gained the military leadership in the League under her great burgomaster Hans Waldmann, who led the Swiss to victory in the Burgundian war at Morat (1476). He also fought with the gild masters against the *Constafel* party. A true adventurer by nature, he was a great reformer, did much to strengthen the administration of the town against the Church and the country districts, and helped to make Zürich a great commercial centre.

Another great figure, but of an entirely opposite character, was Huldreich Zwingli (*q.v.*), the leader in the Swiss Reformation. He obtained quite an exceptional influence over the decisions of the council. Zürich was later to become the capital of a reformed Swiss League and for the realization of this aim he renewed the fight against the conservative Forest districts of the Swiss League. This war ended again with defeat for Zürich and it deprived the whole Evangelical party in Switzerland for nearly two centuries of its preponderant position.

The fight of the country districts for the grant of equal political rights with the burghers of the ruling class marks the third stage in the history of Zürich. Originally the people in the country had retained a number of political privileges, which had been confirmed by the town herself and in the Reformation period were even enlarged. In the 17th and 18th centuries, however, there was a tendency to limit the privileges of burghership to the actual holders. The reserved rights of the country population were disregarded, the administration centralized, the country ruled solely by deputies from the town. The Great Council came to be mainly chosen by a small committee of members actually sitting in the Council and each gild had the right to fill by itself the seats becoming vacant by decease of its members. Trade was a privilege of the burghers alone. A country man was not allowed to have a business of his own; he could only work in the pay of a burgher as his employee. Some particular crafts were altogether reserved to the townspeople; an attempt was even made to deprive the town of Winterthur of its flourishing silk trade.

Occasional opposition from the country folk was severely punished. In 1794 some inhabitants of Stäfa (a rich village on the lake) claimed the restoration of their old privileges (Stäfner articles), but it was not until 1798, when the Helvetic Republic was founded, that political and economical liberty was extended to the country districts. In 1803 certain privileges of the town were restored by giving the town proportionally a much larger representation in the new council than the country. Under the cantonal constitution of 1814 matters became even worse, for the town with about 10,000 inhabitants had 130 representatives in the Great Council, while the country districts with about 200,000 inhabitants had only 82. Reaction lasted till 1830, when a great popular meeting at Uster proposed a radical reform to abolish inequality between town and country. The democratic reform was accepted by the majority of the voters. The following period has rightly been called the "Regeneration Period"; administration was completely reorganized, the school-system reformed and crowned by the establishment of a cantonal university. The last great change in the cantonal constitution occurred in 1867–69, when the rights of the legislative council were reduced in favour of a more truly democratic system. The cantonal Government was to be elected by the people, the power of parliament was reduced by the people's privilege of referendum (*i.e.* the right to accept or reject bills proposed by parliament) and initiative (*i.e.* the right to propose bills of its own).

A particular task fell yet on the city proper: the assimilation of the new population which—owing to the rapid development of the town—had by far outgrown the number of the old privileged class and had partly settled in the outlying districts. The town began to open her schools to the newcomers and then facilitated the entrance into burghership. The work was crowned by the incorporation into the town of 11 outlying districts in 1893. A further expansion of 1934 in which a number of other suburbs were incorporated brought the city's area to within the size of some of the biggest European cities.

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(M. St.)

Zürich University (*see* UNIVERSITIES) was founded in 1833. Its buildings are nearly all new, with modern equipment, among the most outstanding being its central university library, and its clinics for diseases of the eye, ear and throat. The language of the university is German, and there are faculties of evangelical theology, law and political sciences, medicine and dentistry, veterinary medicine, science and letters. It has made important developments in bacteriology and hygiene, and in the study of living oriental languages and in the thought and history of Islam. Though during World War I and immediately afterwards its numbers fluctuated considerably, its usual attendance is about 1,600 regular students and 700 non-matriculated. In 1919 it received 1,274,052 fr. for the Julius Claus Foundation for social anthropology racial hygiene. (A. L. Wi.)

ZÜRICH, LAKE OF, a Swiss lake, extending south-east of the town of Zürich. Its basin was formed by glacial erosion and it shows interesting phases of damming by moraines. The river Linth flows into it and the Limmat out of it. Its area is about 34 sq.m., extreme length 25 m., greatest breadth 2½ m., greatest depth 469 ft., surface 1,342 ft. above sea level. The greater portion is in the canton of Zürich, but 8¾ sq.m. S.E. is in Schwyz, and 4 sq.m. N.E. in St. Gall. The great dam of masonry, carrying the railway line and motor road from Rapperswil to Pfäffikon, cuts off the extreme eastern part of the lake and is passed only by small boats; steamers do not go beyond the dam, as the part beyond is shallow. West of this dam is the island of Ufenau, where in 1523 Ulrich von Hutten took refuge and died. Zürich stands at the north end of the lake. On the west shore are Thalwil, Horgen, Wädenswil, Richterswil, Pfäffikon, and Lachen. On the opposite shore are Meilen (near which the first lake dwellings were discovered in 1853–54), Stäfa, and Rapperswil, the castle of which shelters a Polish museum. Schmerikon and Uznach are near the eastern end.

ZUTPHEN or ZUTFEN, a town in the province of Gelderland, Holland, on the right bank of the Ysel at the influx of the Berkel, and a junction station 18 mi. N.N.E. of Arnhem by rail. Pop. (1940) 21,490. In the middle ages it was the seat of a line of counts, which became extinct in the 12th century. Having been fortified, the town stood several sieges, specially during the wars of freedom waged by the Dutch, the most celebrated fight under its walls being the one in September 1586 when Sir Philip Sidney was mortally wounded. Taken by the Spaniards in 1587, Zutphen was recovered by Maurice, prince of Orange, in 1591, and except for two short periods, one in 1672 and the other during the French Revolutionary Wars, it then remained a part of the United Netherlands. German troops occupied it in World War II.

The most important building is the *Groote Kerk* of St. Walpurgis, which dates from the 12th century and contains monuments of the former counts of Zutphen, and other objects of interest. The chapter-house contains a pre-Reformation library which includes some valuable mss. and *incunabula*. There are some remains of the old town walls. The place has an active trade, especially in grain and in the timber floated down from the Black forest by the Rhine and the Ysel; the industries include tanning, weaving, and oil and paper manufactures. About 3 mi. to the north of Zutphen is the agricultural colony of Nederlandsch-Mettray, founded by a private benefactor for the education of poor friendless boys in 1851. At 3 mi. distance, in the picturesque "Achterhoek," are the mediaeval castles of Ruurloo and Vorden.

ZUTUHIL, an Indian tribe inhabiting the territory south of Lake Atitlan in Guatemala. Their tongue, one of the "metropolitan" Maya dialects, is spoken to-day in Atitlan, San Pedro la Laguna, San Lucas Tolimán, and San Antonio Suchitepéquez. They number about 14,000.

The part the Zutuhil played in the wars with the Quiché and Cakchiquel is described in the annals of those tribes, which make it clear that the Zutuhil were only slightly less powerful than these enemy neighbours, and they appear never to have been completely subdued. The Zutuhil capital was picturesquely located above Lake Atitlan. Near by stood a strongly fortified position, reduced by the Spaniards under Pedro de Alvarado in 1525 only with the greatest difficulty. To-day the Zutuhil work, often under a system of peonage, on the big coffee estates. Their costumes, of local cotton covered with embroidery, are noted for their brilliant colours.

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ZWEIBRÜCKEN, a town of Germany, in the Bavarian Palatinate, on the Schwarzbach, and on the railway between Germersheim and Saarbrücken. Pop. (1939) 33,430.

Zweibrücken ("two bridges") is the Latin *Bipontinum;* it appears in early documents also as *Geminus Pons,* and was called by the French *Deux-Ponts*. The independent territory was at first a countship, half of which Count Eberhard sold in 1385 to the count palatine of the Rhine, holding the other half as his feudatory. Louis (d. 1489) founded the line of the dukes of Zweibrücken which became extinct in 1731, when the duchy passed to the Birkenfeld branch. At the peace of Lunéville Zweibrücken was ceded to France; on its reunion with Germany in 1814 the greater part of the territory was given to Bavaria, the remainder to Oldenburg and Prussia. Zweibrücken was known to scholars for its early editions of the Greek and Latin classics. Its war factories were bombed in World War II.

ZWICKAU, a town of Germany, in the *Land* of Saxony, situated on the left bank of the Zwickauer Mulde, 41 mi. S. of Leipzig and 20 mi. S.W. of Chemnitz on the main line of railway Dresden-Hof and at the junction of several other lines. Pop. (1939) 85,484.

Zwickau is of Slavonic origin, and is mentioned in 1118 as a trading place. Zwickau was an imperial possession, but was pledged to Henry the Illustrious, margrave of Meissen. It passed to the electors of Saxony, as successors of the margraves of Meissen. The discovery of silver in the Schneeberg in 1470 brought it much wealth. The Anabaptist movement of 1525 began at Zwickau under the inspiration of the "Zwickau prophets." Robert Schumann (*q.v.*) was born here.

Among the nine churches, the Gothic church of St. Mary (1451–1536 and restored 1885–91) is remarkable. Other noteworthy buildings are the town-hall of 1581, with the municipal archives, including documents dating back to the 13th century and an autograph ms. of the works of Hans Sachs, and the late Gothic *Gewandhaus* (cloth merchants' hall), built 1522–24 and now in part converted into a theatre. The manufactures of Zwickau include spinning and weaving, machinery, chemicals, porcelain, paper, glass, dyestuffs, wire goods, aluminum, lacquer, embroidery, stockings and curtains. The adjacent coalfield has only been actively worked since 1823, during which time the population has increased more than tenfold.

ZWINGLI, HULDREICH (1484–1531), Swiss reformer, was born on Jan. 1, 1484, at Wildhaus in the Toggenburg valley, St. Gall, Switzerland. He came of a free peasant stock, his father being *amtmann* of the village; his mother, Margaret Meili, was the sister of the abbot of Fischingen in Thurgau. His uncle, Bartholomew Zwingli, afterwards *dekan* or *superintendent* of Wesen, had been elected parish priest of Wildhaus. He went to school at Wesen, then at Basle, and finally at Berne, where his master, Heinrich Wölflin, inspired him with an enthusiasm for the classics. In 1500 he was sent to the university of Vienna to study philosophy. He then returned to Basle, where he graduated in the university and taught classics in the school of St. Martin's church. At twenty-two Zwingli was ordained by the bishop of Constance and elected parish priest of Glarus. The ten years which Zwingli spent at Glarus laid the foundations of his work as a reformer. He there began the study of Greek that he might "learn the teaching of Christ from the original sources," and gave some attention to Hebrew. He read also the older Church Fathers and his skill in

the classics led his friends to hail him as "the undoubted Cicero of our age." He entered into correspondence with Erasmus, and received a somewhat chilling patronage; whilst the brilliant humanist, Pico della Mirandola (1463–94), taught him to criticize Catholic doctrine. His first publications, which appeared as rhymed allegories, were political rather than religious; they were directed against the Swiss practice of hiring out mercenaries in the European wars. In 1521 he prevailed upon the authorities of the canton of Zürich to renounce the practice altogether. Especially did he oppose alliances with France; but the French party in Glarus was strong, and it retaliated so fiercely that in 1516 Zwingli was glad to accept the post of people's priest at Einsiedeln. He dated his arrival at evangelical truth from the three years (1516–19) which he spent in this place. There he studied the New Testament in the editions of Erasmus and began to found his preaching on "the Gospel," which he declared to be simple and easy to understand.

Reform Propaganda.—Zwingli began to preach "the Gospel" in 1516, but a contemporary says that he did it so cunningly (*listiglich*) that none could suspect his drift. He began his work without saying much about corruptions in the Roman Church, and it was his political denunciation of the fratricidal wars into which the pope, not less than others, was drawing his fellow-countrymen, that first led to rupture with the papal see. Three visits which he had paid to Italy as army chaplain opened his eyes to the worldly character of the papal rule, and he began to attack at Einsiedeln the superstitions which attended the great pilgrimages made to that place. Zwingli denounced the publication of plenary indulgence to all visitors to the shrine. When in August 1518 the Franciscan monk Bernardin Samson appeared in Switzerland with a commission to sell indulgences, Zwingli persuaded the council to forbid his entrance into Zürich.

Zwingli now became (1518) people's priest at the Great Minster of Zürich. In the beginning of 1519 he began a series of discourses on St. Matthew's Gospel, the Acts of the Apostles, and the Pauline epistles; and with these it may be said that the Reformation was fairly begun in Zürich. His correspondence of this year shows him jealous of the growing influence of Luther. He claimed to have discovered the Gospel before ever Luther was heard of in Switzerland. Towards the end of September he fell ill with the plague; his illness sobered his spirit and brought into his message a deeper note than that merely moral and common-sense one with which, as a polite humanist, he had hitherto been content. He began to preach against fasting, saint worship and the celibacy of priests. People were found eating flesh in Lent, and the bishop of Constance accused them before the council of Zürich. Zwingli was heard in their defence and the accusation was abandoned. His first Reformation tract, April 1522, dealt with this subject: *Von Erkiesen und Fryheit der Spysen.* The matter of the celibacy of the clergy was more serious. Zwingli had joined in an address to the bishop of Constance calling on him no longer to endure the scandal of harlotry, but to allow the priests to marry wives, or, at least, to wink at their marriages. Pope Adrian VI. interfered and asked the Zürichers to abandon Zwingli, but the reformer persuaded the council to allow a public disputation (1523), when he produced sixty-seven theses and vindicated his position so strongly that the council decided to uphold their preacher and to separate the canton from the bishopric of Constance. Thus legal sanction was given in Zürich to the Reformation. In 1522 Zwingli produced his first considerable writing, the *Architeles,* "the beginning and the end," in which he sought by a single blow to win his spiritual freedom from the control of the bishops, and in a sermon of that year he contended that only the Holy Spirit is requisite to make the Word intelligible, and that there is no need of Church, council, or pope in the matter.

Victory of Reform.—There was a strong opposition to the Reformation, especially in the five Forest Cantons: Lucerne, Zug, Schwyz, Uri and Unterwalden; and the Zürichers felt it necessary to form a league in its defence. They were especially anxious to gain Berne, and Zwingli challenged the Romanists to a public disputation in that city. The pleadings began on Jan. 2, 1523 and lasted nineteen days. Zwingli and his companions undertook to defend the following propositions:—

(1) That the Holy Christian Church, of which Christ is the only Head, is born of the Word of God, abides therein, and does not listen to the voice of a stranger; (2) that this Church imposes no laws on the conscience of people without the sanction of the Word of God, and that the laws of the Church are binding only in so far as they agree with the Word; (3) that Christ alone is our righteousness and our salvation, and that to trust to any other merit or satisfaction is to deny Him; (4) that it cannot be proved from the Holy Scripture that the body and blood of Christ are corporeally present in the bread and in the wine of the Lord's Supper; (5) that the mass, in which Christ is offered to God the Father for the sins of the living and of the dead, is contrary to Scripture and a gross affront to the sacrifice and death of the Saviour; (6) that we should not pray to dead mediators and intercessors, but to Jesus Christ alone; (7) that there is no trace of purgatory in Scripture; (8) that to set up pictures and to adore them is also contrary to Scripture, and that images and pictures ought to be destroyed where there is danger of giving them adoration; (9) that marriage is lawful to all, to the clergy as well as to the laity; (10) that shameful living is more disgraceful among the clergy than among the laity.

The result of the discussion was that Berne was won over to the side of the reformer. He had maintained that the congregation, and not the hierarchy, was the representative of the Church; and he sought to reorganize the Swiss constitution on the principles of representative democracy so as to reduce the disproportionate voting power of the Forest Cantons.

On April 2, 1524 the marriage of Zwingli with Anna Reinhard was publicly celebrated in the cathedral. In August of that year Zwingli printed a pamphlet in which he set forth his views of the Eucharist. They proved the occasion of a conflict with Luther which was never settled, but more attention was attracted by Zwingli's denunciation of the worship of images and of the Roman doctrine of the mass. These points were discussed at a fresh congress where about 900 persons were present, and where Vadian (Joachim von Watt, the reformer of St. Gall) presided. It was decided that images are forbidden by Scripture and that the mass is not a sacrifice. Images were removed from the churches, and many ceremonies and festivals were abolished. Zürich was threatened with exclusion from the union, and she began to make preparations for war.

Divergence from Luther.—At this point the controversy between Luther and Zwingli became more serious. In March 1525 Zwingli brought out his *Commentary on the True and False Religion.* He declined to accept Luther's teaching that Christ's words of institution required the belief that the real flesh and blood of Christ co-exist in and with the natural elements. He declared that Luther was in a fog, and that Christ had proclaimed that by faith alone could His presence be received in a feast which He designed to be commemorative and symbolical. The landgrave of Hesse brought the two Reformers together in vain at Marburg in October 1529, and the whole Protestant movement broke into two camps. At home the long-felt strain between opposing cantons led at last to civil war. In February 1531 Zwingli himself urged the Evangelical Swiss to attack the Five Cantons, and on Oct. 10 there was fought at Kappel a battle, disastrous to the Protestant cause and fatal to its leader. Zwingli, who as chaplain was carrying the banner, was struck to the ground, and was later despatched in cold blood. His corpse was quartered by the public hangman, and burnt with dung by the soldiers. A great boulder, roughly squared, standing a little way off the road, marks the place where Zwingli fell. It is inscribed, " 'They may kill the body but not the soul': so spoke on this spot Ulrich Zwingli, who for truth and the freedom of the Christian Church died a hero's death, Oct. 11, 1531."

Zwingli's theological views are expressed succinctly in the sixty-seven theses published at Zürich in 1523, and at greater length in the *First Helvetic Confession,* compiled in 1536 by a number of his disciples[1]. They contain the elements of Reformed as distinguished from Lutheran doctrine. As opposed to Luther, Zwingli insisted more firmly on the supreme authority of Scripture, and broke more thoroughly and radically with the mediaeval Church. Luther was content with changes in one or two fundamental doctrines; Zwingli aimed at a reformation of government

[1] P. Schaff, *Creeds of the Evangelical Protestant Churches,* p. 211.

and discipline as well as of theology. Zwingli held that there should be no government in the Church separate from the civil government which ruled the commonwealth. All rules and regulations about the public worship, doctrines and discipline of the Church were made in Zwingli's time, and with his consent, by the council of Zürich, the supreme civil authority in the State. This was the ground of his quarrel with the Swiss Anabaptists, for the main idea in the minds of these greatly maligned men was the modern thought of a free Church in a free State. Like all the Reformers, he was strictly Augustinian in theology, but he dwelt chiefly on the positive side of predestination—the election to salvation—and he insisted upon the salvation of infants and of the pious heathen. His most distinctive doctrine is perhaps his theory of the sacrament, which involved him and his followers in a long and, on Luther's part, an acrimonious dispute. He held that the Eucharist was not the *repetition* of the sacrifice of Christ, but the faithful *remembrance* that that sacrifice had been made once for all. His theological opinions were set aside in Switzerland for the somewhat profounder views of Calvin. The publication of the Zürich Consensus (*Consensus Tigurinus*) in 1549 marks the adherence of the Swiss to Calvinist theology.

Zwingli's most important writings are—*Von Erkiesen und Fryheit der Spysen* (April 1522); *De Canone Missae Epichiresis* (September 1523); *Commentarius de Vera et Falsa Religione* (1525); *Vom Touf, vom Wiedertouf, und vom Kindertouf* (1525); *Ein klare Unterrichtung vom Nachtmal Christi* (1526); *De Providentia Dei* (1530); and *Christianae Fidei Expositio* (1531). For a full bibliography *see* G. Finsler, *Zwingli-Bibliographie* (Zürich, 1897).

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S. M. Jackson's book gives a chapter on Zwingli's Theology by Prof. F. H. Foster, and also full details of further information on the subject, together with a list of modern English translations of Zwingli's works.

ZWITTERION. In chemistry, a molecule containing both acidic and basic groups may be expected to neutralize itself with the production of an internal salt or, as it is commonly called, a zwitterion (from the German *Zwitter,* hybrid or hermaphrodite, plus *ion*). Thus glycine (*q.v.*) may be expected not to have the amino-acid structure I, with the acidic carboxyl group COOH and the basic amino group NH_2, but rather the zwitterionic structure II. In general amino acids

$$\underset{\text{I}}{H_2N.CH_2.COOH} \qquad \underset{\text{II}}{H_3\overset{+}{N}.CH_2.COO^-}$$

and proteins (*q.v.*) at their isoelectric points, as well as betaines (*q.v.*), exist largely if not entirely in the form of zwitterions.

ZWOLLE, the capital of the province of Overysel, Holland, on the Zwarte Water, and a junction station 24½ mi. N.E. of Harderwyk. Pop. (1939), 42,136. It is the centre of the whole northern and eastern canal systems, and by means of the short canal, the Willemsvaart, which joins the Zwarte Water and the Ysel, has regular steamboat communication with Kampen and Amsterdam.

Three miles from Zwolle on the Agnietenberg, once stood the Augustinian convent in which Thomas à Kempis spent the greatest part of his life. Zwolle has a considerable trade by river, a large fish market and the most important cattle market in Holland after Rotterdam.

ZYGADENUS, a genus of plants of the lily family (Liliaceae, *q.v.*), containing about 12 species, all North American except one found in Siberia. They are smooth perennial herbs, springing mostly from coated bulbs, with erect stems, usually ½ ft. to 4 ft. high, very narrow leaves and conspicuous flowers in terminal clusters. Some 10 species occur in the United States and Canada. The smooth zygadene (*Z. elegans*), with greenish flowers, is found from New Brunswick to Alaska and southward to New Mexico. The poisonous zygadene or death camas (*Z. venenosus*) with yellow flowers, occurs in the northwestern and Pacific states.

ZYGOPHYLLACEAE, a family of dicotyledonous plants, 26 genera and about 225 species being recognized. The various genera and species are characteristic of the drier parts of both temperate and tropical regions in both hemispheres, and include herbs, shrubs and trees. Large genera are *Fagonia,* in the Mediterranean region with about 40 species, southern North America and Chile, and *Zygophyllum* with 80 species in the drier parts of Asia, Africa and Australia. *Guiacum* of tropical America produces the very hard wood known as lignum vitae, the resin of which is also used in the practice of medicine. The South American species of *Bulnesia* also yield a very hard wood. For a consideration of the genera *see* A. Engler, "Zygophyllaceae," in Engler and Prantl, *Die Natürlichen Pflanzenfamilien,* ed. 2, vol. 19a, pp. 144–184, fig. 70–87 (1931). (E. D. Mᴇ.)

ZYGOTE, the biological term for the fertilized egg or ovum. (*See* Fertilization; Embryology.)

END OF VOLUME TWENTY-THREE

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